Predicting momentum

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Abstract

We construct a momentum spread ratio (MSR) and test its ability to predict various types of momentum. As a potential proxy for investor underreaction, we find that it negatively predicts momentum, industry momentum, and residual momentum, both in-sample and out-of-sample. Adjusting for the common risk factors, such as the Fama-French three factors, our result remains. Moreover, to minimize the influence of cross-sectional variation in stock returns when constructing MSR, we also build a residual-level MSR. We find that it can also predict these risk-adjusted momentum returns, implying that momentum might indeed arise from behavioral bias. The different predictability before and after 1993 shows that the market has largely corrected such behavioral bias because of the massive attention to momentum. These results survive size and liquidity controls.

JEL classification code: G12, G14, G17

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I. Introduction

During the past three decades, return momentum, initially documented by Jegadeesh and Titman (1993), remains one of the most challenging anomalies to be explained by risk-based explanations. The cross-sectional stock return predictability based on past returns seriously challenges the efficient Efficient Markets Hypothesis (EMH) proposed by Eugene Fama. Numerous papers have been dedicated to explaining this unique phenomenon, yet no unified explanation has been found. At the center of the argument is whether momentum arises from behavioral bias, such as investor underreaction, or the cross-sectional variations in common risk factors.

From a risk-based perspective, Lewellen (2002) argues that momentum also exists in well-diversified size and B/M portfolios, disputing the claims that momentum arises simply from the firm or industry-specific returns and that the covariance among stocks, not the underreaction, explains momentum in the portfolios. He also claims that the pervasive feature of momentum in portfolios suggests that macroeconomic factors must be responsible for the size and B/M momentum.

Liu and Zhang (2008) find that recent winners have temporarily higher MP loadings than losers. The growth rate of industrial production is a priced risk factor. Thus, they claim that this macroeconomic-related risk factor explains over half of the momentum profits.

Avramov et al. (2013) explore the effect of financial distress on the profitability of anomaly-based trading strategies. They find that the profitability of return momentum, earnings momentum, credit risk, dispersion, idiosyncratic volatility, and capital investment anomalies derive exclusively from periods of financial distress. Furthermore, none of these strategies is profitable during periods around credit rating downgrades are excluded from the sample.

Motived by the findings that past returns can predict future realized betas, Kelly et al. (2021) explore the question of how much of the momentum premium can be explained by conditional risk exposures. Using IPCA, they show that the previous failure of the conditional factor model to explain momentum is due to model misspecification, and they find that the variation in stock's conditional risk premia is strongly linked to momentum through time-varying factor exposures.

Compared to risk-based explanations, more evidence is in favor of behavioral explanations. Vayanos and Woolley (2013) suspect that momentum arises when investors react to recent fund performance. Momentum arises if fund flows exhibit inertia because rational prices do not fully adjust to reflect future flows. Reversal arises because flows push prices away from fundamental values. By proposing a theoretical model, they show that institutional fund flows cause momentum.

Blitz et al. (2021) document a residual momentum that earns risk-adjusted profits about twice as large as those associated with the total return momentum and is less concentrated in the extremes of the cross-sectional of stocks. Therefore, their result seems inconsistent with the risk-based explanation of momentum.

Medhat and Schmeling (2022) find that momentum and short-term reversal could coexist by sorting stocks on the previous month's return and share turnover. It survives transaction costs and is pervasive among the largest and most liquid stocks. They find that a risk-based explanation cannot explain their findings, and they suggest that some traders underappreciating the information conveyed by prices might be the cause.

Besides the study of cross-sectional determinants of momentum, time-series prediction is also one aspect of the momentum-related literature. Inspired by the momentum crashes in late 2008, Wang and Xu (2015) find that market volatility has significant power to predict momentum payoffs, which survive the market state and business cycle variables. Compared to other studies that primarily focus on the cross-sectional property of momentum, they mainly study the time-series feature of momentum. They claim that this finding presents a severe challenge to the existing explanations of momentum, both risk-based and behavioral.

Perhaps the most related work to ours is Huang (2019), which claims that the momentum gap can negatively predict the expected momentum profit. However, Guo (2019) find no similar result in his study. In the unreported analysis, we agree with Guo (2019) and find no robust result.

Pervasive at both the stock and portfolio level, momentum remains probably one of the most significant anomalies so far. Regarding the direction of the momentum-related study, most studies focus on the cross-sectional determinants of momentum, while time-series predictors of momentum have received less attention. After decades of exploration, researchers who advocate risk-based explanations argue that momentum could be attributed to some unknown macroeconomic factors or the misspecification of the current unconditional linear factor models. On the contrary, the behavioral explanation suggests that momentum is too strong to be explained by common risk factors because after controlling for common risk factors, such as the Fama-French three-factor, the cross-sectional differences in risk fail to explain momentum profits.

In sum, the controversy around momentum remains. Both risk-based and behavioral explanations fail to provide dominant empirical evidence over one another. Perhaps researchers have to concede that

momentum arises not only from cross-sectional variation in common risk factors but also partially from behavioral bias.

We now discuss how behavioral bias contributes to the momentum profit from a time-series perspective. If the market learns from certain behavioral biases and investors exploit such arbitrage opportunities, we will eventually see that the variation in common risk factors can fully explain momentum. Therefore, under such assumptions, we expect risk-adjusted momentum profit to attenuate over time since abundant literature on momentum has already drawn tremendous attention to academics and the financial market. Examining the momentum strategy performance before and after 1994, the year after Jegadeesh and Titman (1993) get published, we notice that return momentum after 1994 is no longer as significant as it was before 1994, while the risk-adjusted return is still significant after 1994. If the model misspecification can be ignored, this finding indicates that variation in common risk factors still fails to explain momentum.

Therefore, to test if the potential behavioral bias contributes to the momentum profit and if arbitrage activities affect the profitability of the momentum strategy, we try to construct a momentum spread ratio(MSR) to capture the crowdedness in momentum arbitrage activity and the level of investor underreaction. Our results show that stock-level MSR can significantly predict various types of momentum, such as return momentum, industry momentum, and residual momentum. We even get more significant results by controlling for common risk factors, such as Fama-French three factors. The fact that stock-level MSR can predict various types of momentum confirms that there are at least some commonalities in those momentum strategies, given that they are all based on past return information.

We believe the answer to why MSR can adequately measure investor arbitrage activity is straightforward. First, we assume investors solely act on past return information. If the investor underreaction story is true, investors will take positions once they observe the prior t-month winners and losers. The momentum gap, which we define as the difference of the formation-period recent i-month returns between winners and losers, will therefore widen in the next month because investors put more weight on past winners and less on past losers. Such a positive reinforcement process will continue until the momentum gap becomes too wide to be backed up by firm fundamentals. Hence, it appears that the narrow the momentum gap is, the greater profit is left for investors. Therefore, controlling for all other factors, the momentum gap seems to be a good indicator of the next-period momentum profit. However, we argue that this might not be the case.

On the one hand, the momentum gap potentially contains information about the crowdedness of trading and some other information that might be irrelevant to the momentum profit. Many other factors can explain the variation of the momentum gap, such as market return in a month. On the other hand, the momentum gap is also dependent on past return information. Investors would probably not take positions if the previous momentum gap seems too wide. Therefore, if a large market return causes a wide momentum gap in the last month, investors would have difficulty convincing themselves that such a wide momentum gap represents a high level of arbitrage activity. In other words, the momentum gap alone can not represent the willingness of investors to take positions on previous winners and losers. Therefore, noticing that there is some time-varying dependence of the momentum gap on previous return information, we argue that a momentum spread ratio (MSR) can adequately measure the willingness of investors to take positions on past return information.

As we show above, if investors are well-informed about how to arbitrage from past return information, they will immediately take a position on past winners and losers. However, such investing behavior must be based on the belief that arbitrage opportunities have not been fully exploited. In other words, if a firm in month $t-2$ is in a winner portfolio, we check if it is already a winner at month $t-(i+1)$, where $i>=1$. If this probability is high, we conclude that the arbitrage opportunity remains. However, since a high beta stock tends to outperform the market when the market performs well, such probability would be useless for evaluating the arbitrage opportunity. Therefore, we consider constructing a ratio to measure such probability:

$$MSR_{t-2}^{i}=\frac{pseudomomspread_{t-(1+i)}^{t-2}}{momspread_{t-12}^{t-2}}, \tag{1}$$

Our logic on MSR is that it can measure the arbitrage opportunity while controlling for the market performance. If we assume that the past $t-12$ to $t-2$ winners and losers are always winners and losers from month $t-12$ to $t-2$, we have a $pseudomomspread_{t-(1+i)}^{t-2}$ for these winners and losers, which represents the return spread of fake winners and losers from month $t-(1+i)$ to $t-2$. When the market performs well in the past 12 months, we expect $momspread_{t-12}^{t-2}$ and $momspread_{t-i}^{t-2}$ to be both relatively high. Thus, such a ratio construction, on the one hand, naturally controls for market performance. On the other hand, this ratio can, to some extent, measure investor underreaction and arbitrage activity. For example, if the winner for the past $t-12$ to $t-(1+i)$ still beats the market in month $t-i$, we tend to believe investors act relatively slow to the firm-specific news. That is to say, as long as the momentum strategy is still profitable in the following month, we believe the investor underreaction contributes to the momentum profit. Therefore, if a narrow momentum spread from months

$t-12$ to $t-2$ arises from a wide pseudo-momentum spread for the most recent i months, we believe arbitrage activities during this period are high, and investor underreaction is low. Eventually, the momentum profit in month t will be low. Therefore, we expect our MSR constructed at the end of month $t-2$ negatively predict momentum profit in month t.

Before using MSR to predict momentum, we try to gather some time-varying features of momentum. First, we raise the question of if the winner for the past month $t-12$ to $t-2$ returns is still the winner even before the portfolio formation period, which is before month $t-12$. By answering this question, we can know precisely when momentum starts. If the investor underreaction is pervasive, we expect momentum to start even before month $t-12$. Our result indicates that the two subsamples, one before 1994 and the other after 1994, seem to be two different regimes, and momentum forms much earlier in the first subsample than in the second.

Second, we try to price momentum with k-month common risk factors. We conduct such experiments mainly because momentum could arise if stock prices react to common risk factors with some delay (Jegadeesh and Titman 1995). Again, our pricing result shows that the two subsamples are remarkably different. The risk-adjusted momentum profit seems much more significant and persistent in the first subsample than in the second.

Since we argue that MSR can proxy for arbitrage activities and investor underreaction, we also use MSR to predict industry momentum and residual momentum. Our results show that stock-level MSR can predict these three types of momentum, especially controlling for the common risk factors. Even though the predictive power is different, this finding indicates some commonality among the three momentums.

In sum, section II studies the question of when momentum starts, section III examines the result of using *k*-month factors to price the momentum profit, section IV presents the result of using MSR to predict various types of anomalies, section V discusses the robustness, and section VI concludes.

II. When does momentum start

1.1. Data

Our sample consists of all the common stocks listed on the NYSE/AMEX/NASDAQ. All stock prices and returns are from CRSP, and all accounting information is from COMPUSTAT. We use NYSE breakpoints and value-weighted returns when constructing the momentum decile portfolios. Our sample period is from 1966 to 2021. We obtain monthly MKT, SMB, HML, RMW, CMA, and UMD factors data

from Kenneth French's Website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french). To construct these six factors in benchmark models for a given return horizon *k*, for example, the SMB factor returns are formed as $f_{t,k}^{SMB} = \prod_{k=1}^{K}(1 + f_{t-k+K}^{S}) - \prod_{k=1}^{K}(1 + f_{t-k+K}^{B})$, where f_{t-k+K}^{S} is defined as the small portfolio in a $2x3$ bivariate sort portfolio, which is $\frac{1}{3} * (Small\ Value + Small\ Neutral + Small\ Growth)$, and f_{t-k+K}^{B} is defined as the big portfolio in $2x3$ bivariate sort portfolio, which is $\frac{1}{3} * (Big\ Value + Big\ Neutral + Big\ Growth)$. The monthly MKT, SMB, HML, RMW, CMA, and UMD factors are all are constructed using the six value-weighted portfolios(all two-by-three sorts) formed respectively on size, book-to-market, profitability, investment, and past-return.

1.2 Momentum constructions

To construct momentum portfolios, we strictly follow French's method (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french). At the beginning of each month t, we use the NYSE breakpoint to cut stocks into deciles based on their prior 11-month returns from month $t-12$ $to\ t-2$. Note that we skip month $t-1$. All stocks are value-weighted within each portfolio and are rebalanced at the beginning of month $t+1$.

We start with the Fama-French (1997) 49-industry classifications to construct industry momentum portfolios. After we exclude financial-related industries, we have 45 industries in total. At the beginning of each month *t*, we cut industries into nine portfolios (9*5=45), each consisting of five industries. Our sorting is based on their prior 6-month value-weighted returns from month $t-6$ to $t-1$. Following Moskowitz and Grinblatt (1999), we do not skip month $t-1$. The return of each portfolio is calculated as the equal-weighted return of the five industries within the portfolio. The portfolios are rebalanced at the beginning of month $t+1$.

To construct residual momentum portfolios, we cut all stocks into deciles at the beginning of each month t based on their prior 11-month residual returns from month $t-12$ to $t-2$. These residuals are standardized by scaling them over their standard deviations over the same period. Regressing stock excess return on the Fama-French (1993) three factors, we estimate residual returns each month for all stocks over the past 36 months from month $t-36$ to month $t-1$. We require these stocks have 36 observations in the past 36 months. The portfolios are rebalanced at the beginning of month $t+1$.

1.3 Historical momentum strategy performance

[Insert Table 1]

Table 1 documents the historical performance of three types of momentum strategy: momentum, industry momentum, and residual momentum. From 1966 to 2021, the momentum strategy, on average, generates a significant 1.12% return per month. Before 1994, the momentum profit is much more substantial. It delivers an average 1.71% monthly return with a t-value above 5. However, compared with the performance of the momentum strategy before 1993, the profit of raw momentum declines dramatically after 1994, generating only an insignificant 0.65% monthly return. Seemingly the profitability of the momentum strategy seems no longer profitable after 1993.

Besides conventional return momentum, we find similar evidence in industry and residual momentum. Both industry and residual momentums are significant before 1994, while they both lose their statistical significance after 1994. Those three major momentum strategies all show that the strategies based on past return information all attenuate after 1994, which does not seem to be a coincidence. The horizon of the two sub-samples is 28 and 27 years, respectively. Therefore, the comparison between the two sub-sample is statistically meaningful.

Additionally, we also report the statistics for the risk-adjusted return (alpha) of each momentum. E.g., the MOM_alpha is defined as the intercept term of regressing momentum on the Fama-French three factors: MKT, SMB, and HML. The MOM_alpha* is defined as the intercept term of regressing momentum on the Fama-French five factors: MKT, SMB, HML, CMA, and RMW. Besides momentum alpha, we also report industry momentum alpha and residual alpha. The evidence from alphas is similar for momentum but not for industry momentum and residual momentum. Compared to the subsample before 1994, t-values of both FF3 alpha and FF5 alphas go down. FF5 alpha appears much less significant than FF3 alpha, suggesting that FF5 is better at explaining cross-sectional variation in momentum. For industry and residual momentum, alphas do not seem to change much before and after 1994, while t-values of alphas drop significantly compared to the raw industry and residual momentum. If we ignore the model misspecification issue and assume that the alpha captures the potential behavioral bias, industry and residual momentum seem less influenced by investor underreaction.

Panel B reports the result for size quintiles. We see that the momentum profit, in general, decreases in size. In the whole sample period and the first sample period, the t-value of the momentum strategy weakens when the size of the portfolio increases. However, the later sample period after 1994 shows the momentum profit for size quintiles is no longer significantly profitable other than the first size quintile portfolio. The alphas of size quintiles provide mixed evidence, however, not all t-values of size quintiles drop in the second subsample, especially for the last two size quintiles. This finding is intriguing because,

again, if we assume that alpha captures the potential behavioral bias, the bigger firms appear to be less vulnerable to investor underreaction. Overall, the FF3 and FF5 factor models fail to explain every size quintile.

In sum, many pieces of literature attribute momentum to investor underreaction. If the investors are rational in the long run and evolve with the market, we expect any anomalies associated with a behavioral bias to attenuate over time. Table 1 provides such evidence, albeit not perfect. Three momentum strategies all present a somewhat decrease in t-values after 1994, especially alphas. Similar evidence can also be found in size quintiles. Literature has documented that after the publication of anomaly-finding papers, some of the anomalies would eventually disappear or become less significant than before. Therefore, we suspect that momentum might be another example of investors learning from the publication, correcting behavioral bias, and eventually driving the anomaly-related profit out.

1.4. When does the winner become the winner?

[Insert Table 2]

When does the winner become the winner? We raise this question because if the investor underreaction story is true, we expect the information to spread slowly, meaning winners are more likely to be winners even before the portfolio formation period. In other words, if investors underreact to firm-specific news, the momentum

profit would likely be preserved for the next month since no investors take a position on winner or loser stocks this month. Therefore, if we look backward, a winner stock is more likely to be a winner if the investor underreaction is severe. More importantly, if the market and investor correct certain behavioral biases, we expect behavioral-related anomalies to attenuate over time, especially after the critical publication on related topics. For example, if the publication of JT 1993 indeed provides investors insight into how the momentum profit forms, we expect this effect to be less prominent after 1994.

Furthermore, if slow information spreading speed suggests a more persistent investor underreaction, the expected return of the winner portfolio will be higher in the next period. On the contrary, if information spreads quickly, all investors will react quickly to the signal that the winner portfolio could provide a higher expected return than the lower portfolio. Hence, smart investors would act quickly and put more weight on the current winner portfolio, driving the expected return of the winner portfolio down for the next period.

Table 2 reports the result that if past month $t-12$ to $t-2$ winners are also winners before the month $t-12$. Specifically, we try to calculate the return spread of the decile momentum portfolio backward. At the beginning of each month t, we form 10 portfolios based on their cumulative returns from month $t-12$ to $t-2$. We define the top decile portfolio as the winner portfolio and the bottom decile as the loser portfolio. From month $t-36$ to $t-2$, we assume winners in month $t-2$ are also winners for the past 36 months and losers in month $t-2$ are losers for the past 36 months, and we calculate their return spread in each previous month.

For the whole sample period, the winners of prior $t-12$ to $t-2$ returns are already winners even in months $t-19$. The comparison between the two subsample periods is quite interesting. In the first sample period, it stops becoming significant before month $t-20$. For the later sample period, which is from 1994 to 2021, the winners are no longer winners before month $t-15$. Therefore, the 5-month difference between the two subsamples implies that the information spreads at a different speed. In addition, besides checking the return spread before the starting point of the portfolio formation, we also pay attention to the return spread within the portfolio formation period. The *t*-stats in the later sample period are also lower than those in the earlier. Again, this finding is in line with the evidence before the portfolio formation period.

In sum, we argue that if investor underreaction is persistent, the winner of past $t-12$ to $t-2$ monthly returns is more likely to be the winner before month $t-12$. The difference in the two subsamples is probably due to the publication of Jegadeesh and Titman (1993), which helps investors realize that momentum arises from certain behavioral biases rather than cross-sectional variation in common risk factors. Indeed, the cross-sectional variation in risk factors may have difficulty explaining the difference in the two subsamples because no evidence suggests the consistent time-varying property for the common risk factors, such as the Fama-French three factors.

[Insert Table 3]

Besides the result of the univariate sort on the previous cumulative return, we also report the result of the bivariate sort on cumulative return and size in Table 3. The winner-loser return spread for size quintiles in the whole sample period is still statistically significant when the lag is around 18 months. Compared to the last two size quintiles, the first three size quintiles seem to have the strongest persistence of the winner being the winner and the loser being the loser because their *t*-values are nearly all more significant than those of the last two size quintiles. The same conclusion is more evident in the first sub-sample period when the biggest size quintile loses its statistical significance after lag 16, and the first size quintile remains significant until lag 21. The second sub-sample period shows significant differences compared to

the first subsample period. All size quintiles do not exhibit any statistically significant return spread when the lag is longer than 14, and small-size portfolios no longer have stronger persistence of the winner being the winner and the loser being the loser than big-size portfolios. The sharp comparison between the two subsamples provides additional evidence that the two subsample periods are quite two different regimes. Even though we show in Table 1 that momentum exists in every size quintile, it seems momentum is more pervasive in those stocks that are likely to have the persistence that winners are winners and losers are losers and that those firms tend to have smaller market values.

In sum, the findings from Table 3 have several implications. First, before 1994, small-size firms contribute the majority of the momentum profit, which confirms the findings of Hong et al. (2000), which claim that momentum profit decreases in size. Second, after 1994, such persistence largely disappears in all quintiles, indicating that potential investor underreaction has largely diminished.

III. Pricing Momentum with *k*-month compounded returns.

If the story that the investor underreaction goes away after the investors realize that it is a behavior bias, the pricing of momentum profit must also be different between the two subsamples. Therefore, we now study to what extent cross-sectional variation in common risk factors can explain momentum profit between two subsamples. Inspired by the finding of Jegadeesh and Titman (1995), which states that momentum profits can arise from the delayed reaction of stock price to the common risk factors, we examine if the *k*-month compounded return can explain the cross-section variation in momentum profit. Also, since Kelly et al. (2021) claim that their version of the conditional factor model can explain a large fraction of momentum profit, we believe our *k*-month compounded returns, to some extent, can also carry the time-varying information about the common risk factors. To construct the *k*-month cumulative factor return, we calculate our factor $f_{k,t}^{TMB}$ as overlapping cumulative *k*-month returns as:

$$f_{k,t}^{TMB} = \prod_{k=1}^{K}\left(1 + f_{t-k+K}^{TOP}\right) - \prod_{k=1}^{K}\left(1 + f_{t-k+K}^{BOT}\right), \quad (2)$$

Next, we consider evaluating the following cross-sectional regression of the Fama-French three-factor model but with the *k*-month cumulative factor return.

$$MOM_t = \alpha + \beta_1 * MKT_{k,t} + \beta_2 * SMB_{k,t} + \beta_3 * HML_{k,t} + \varepsilon_t \quad (3)$$

[Insert Table 4]

Since we argue that the decrease in behavioral bias could largely explain the difference in momentum profits between the two subsamples, we also expect that the *k*-month risk factors can capture the cross-

sectional variation of the momentum profits between the two subsamples differently. For example, regressing momentum return of month *t* on *k*-month compounded the Fama-French three factors, we find that when using longer than 6-month compounded return, the momentum return in the whole sample period is marginally priced. Panels A and B of Table 4 report the pricing result using the *k*-month Fama-French three factors and the Fama-French five factors, respectively.

Even though the t-stat of the intercept term slowly decreases as we increase the *k*, we still manage to price the raw momentum. Most importantly, consistent with our expectations, the common risk factor could barely explain the cross-sectional variation in momentum before 1994. Even if we increase the *k* to 12 months, the t-stat of the intercept term is still 3.71 in the first subsample. On the contrary, the sample after 1994 shows a significant improvement in the pricing result. The *k*-month common risk factors can capture the variation when *k* reaches 3. The result from the Fama-French five factors model largely resembles that of the Fama-French three factors model. In the sample period from 1966 to 1993, the t-values of the intercept term remain around 3.53 even after using 12-month compounded returns, suggesting that variation in the Fama-French five factors is far from explaining the cross-sectional variation in momentum. However, the result significantly changes after 1994. The t-stat of the intercept term is only 1.44 even when *k* equals 1, and it never reaches 1 after *k* is bigger than 3.

In sum, the common risk factors have different pricing abilities in the two sub-samples. Even though we allow momentum to be correlated with the lagged common risk factors, the FF3 and FF5 factor models still cannot explain momentum in the first sample period. On the other hand, our finding in the later sample period suggests that momentum can partially be priced but only with some past return information. If one claims that the alpha captures some part of momentum that is related to behavioral bias, our result shows that this effect may have largely been mitigated after 1994.

IV. time-series predictability of momentum profit

1. 1 Construction of Stock-level MSR

[Insert Table 5]

If part of the momentum profit is due to investor underreaction, informed investors would immediately take a position based on signals as soon as they realize momentum profit can be exploited by correcting such behavioral bias. Therefore, after the publication of Jegadeesh and Titman (1993), we believe the investors would quickly realize that they can make a profit by putting more weight on the previous winners and less on the losers at the end of the month $t-1$. Hence, investors would expect a significant positive return at the end of month *t*. However, like the Ponzi scheme, the last investor who enters this

game would end up losing every penny because there will be no one to further invest in the previous winner. Thus, if investors believe momentum arises from behavioral bias and can be corrected by investment activities eventually, the best strategy for them is to take a position earlier than before. Accordingly, positions on previous winners and losers would keep growing until the expected momentum profit in month *t* becomes zero because the investor underreaction has been corrected. In other words, since the window that momentum strategy needs to be based on is from the month $t-12$ to $t-2$, a smart investor need not take a position until the end of month $t-1$. For example, compared to a normal momentum trader who takes a position at the end of month $t-1$ based on prior 11-month returns, a smart investor would probably long a stock that is a winner based on prior 9-month returns at the end of month $t-3$. Thus, the return of month $t-2$ would be pushed higher than it should be because of the existence of first movers. Eventually, the underreaction is corrected by adding more weight on earlier winners and less weight on the earlier losers, and the expected momentum profit in month *t* would be exploited in the earlier stage. That is to say, a part of momentum profit is now absorbed between month $t-(1+i)$ and month $t-2$, where $i \geq 1$. Therefore, if momentum profit is due to investor underreaction, some later cumulative return would potentially predict a negative momentum profit. Most importantly, we argue that the value of the cumulative return spread is not important. What really matters is how much of the earlier profit compared to the total momentum profit has been exploited by smart investors.

To capture this effect, we define $Momentum\ spread\ ratio$ in month *t* in equation (1), where $i \geq 1$. The $momspread_{t-12}^{t-2}$ stands for the return spread of the 0.9 and 0.1 percentile of the past month $t-12$ to $t-2$ cumulative returns. Next, we define the winner stocks as stocks whose past month $t-12$ to $t-2$ cumulative returns are above 0.9 percentile and loser stocks as stocks whose past month $t-12$ to $t-2$ cumulative returns are below 0.1 percentile. Then the $pseudomomspread_{t-(1+i)}^{t-2}$ is the month $t-(1+i)$ to $t-2$ return spread of the value-weighted cumulative return as if these stocks, whose are winner stocks and loser stocks in month $t-2$ based on prior 11-month return, are also winners and losers from month $t-i$ to $t-2$. The MSR at the end of month $t-2$ is the ratio of $pseudomomspread_{t-i}^{t-2}$ over $momspread_{t-12}^{t-2}$. As explained in the introduction, we argue that this ratio can reasonably measure the profit taken by the investors who exploit the arbitrage opportunity spawned by behavioral bias. Also, we can get the MSR from the decomposition of momentum spread:

$$\begin{aligned} momspread_{t-12}^{t-2} &= \log\left(R_{t-12,t-2}^{c,top}\right) - \log\left(R_{t-12,t-2}^{c,bot}\right) \\ &= \log\left(R_{t-i,t-2}^{c,top}\right) - \log\left(R_{t-i,t-2}^{c,bot}\right) + \log\left(R_{t-12,t-i+1}^{c,top}\right) - \log\left(R_{t-12,t-i+1}^{c,bot}\right), \end{aligned} \tag{4}$$

$$1 = \frac{\log\left(R^{c,top}_{t-i,t-2}\right) - \log\left(R^{c,bot}_{t-i,t-2}\right)}{\log\left(R^{c,top}_{t-12,t-2}\right) - \log\left(R^{c,bot}_{t-12,t-2}\right)} + \frac{\log\left(R^{c,top}_{t-12,t-i+1}\right) - \log\left(R^{c,bot}_{t-12,t-i+1}\right)}{\log\left(R^{c,top}_{t-12,t-2}\right) - \log\left(R^{c,bot}_{t-12,t-2}\right)}, \quad (5)$$

$$1 = \frac{pseudomomspread^{t-2}_{t-(1+i)}}{momspread^{t-2}_{t-12}} + \frac{signal_{t-i+1}}{momspread^{t-2}_{t-12}}, \quad (6)$$

where we substitute the term $\log\left(R^{c,top}_{t-12,t-2}\right) - \log\left(R^{c,bot}_{t-12,t-2}\right)$ with $momspread^{t-2}_{t-12}$, term $\log\left(R^{c,top}_{t-i,t-2}\right) - \log\left(R^{c,bot}_{t-i,t-2}\right)$ with $pseudomomspread^{t-2}_{t-i}$, and term $\log\left(R^{c,top}_{t-12,t-i+1}\right) - \log\left(R^{c,bot}_{t-12,t-i+1}\right)$ with $signal_{t-i+1}$.

If we assume that the investors are aware of the level of investor underreaction in month $t-(i+1)$ and can observe the $signal_{t-i+1}$, then the $pseudomomspread^{t-2}_{t-i}$ would decrease because investors in month $t-(i+1)$ already put more weight on the winners and less on the losers. Consequently, the $momspread^{t-2}_{t-12}$ also decreases because $momspread^{t-2}_{t-12}$is the sum of $pseudomomspread^{t-(i+1)}_{t-12}$and $pseudomomspread^{t-2}_{t-i}$. Since $momspread^{t-2}_{t-12}$ is always larger than $pseudomomspread^{t-2}_{t-i}$, such a decline both in the nominator and denominator would cause a decrease in the ratio, which is essentially MSR^{i}_{t-2}. If the investor underreaction story is true and if the $Momentum\ spread\ ratio\ (MSR)$ is high for the period from month $t-i$ to $t-2$, we conjecture that a large fraction of momentum profit is already taken by smart investors who act before month $t-2$. If not, the momentum profits would largely remain at the beginning of month *t*. Hence, we expect the MSR negatively predicts the momentum profit when the market can correct investor underreaction.

[Insert Table 6]

As the previous literature suggests, we also include some macroeconomic variables to test if macro-factors can help predict momentum profits. Inspired by Cooper et al. (2014), we incorporate the market return for the past three years. In addition, we include the unemployment rate in month $t-1$, the standard deviation of market return over the past 24 months, and the standard deviation of the unemployment rate over the past 24 months. Specifically, we consider estimating the following time-series prediction for each month *t*:

$$MOM_t = \alpha + \beta_1 * MSR^{i}_{t-2} + \beta_2 * LagUR_t + \beta_3 * LagMKTSD_t + \beta_4 * LagURSD_t + \beta_5 * LagMKTRET_t + \varepsilon_t. \quad (7)$$

Here we emphasize the MOM_t is not the return spread of the decile portfolio sorted on prior $t-12$ to $t-2$ returns. Instead, we obtain the momentum factor directly from French's data library. Compared to the return spread of the decile portfolio, the momentum factor is constructed based on independent sort by two size and three prior (2-12) return groups. We adopt the NYSE size breakpoint and use the 30th and 70th NYSE percentiles to cut prior (2-12) returns.

Table 6 delivers the predictive results. Before 1994, when probably fewer investors have information about if momentum exists and what drives it, the stock-level MSR almost predicts nothing. After 1994, the coefficient of MSR turns significantly negative, which confirms our conjecture that there are indeed smart investors who already take advantage of the arbitrage opportunity spawned by investor underreaction. If we increase the window from 1 to 11, we also see that the predictive power of the MSR declines. This result is expected because the more months we include, the less information is left for the investors, and hence less momentum profit MSR can predict. Additionally, the comparison of $Adj.R^2$ between two subsamples suggests the year 1994 is indeed a critical time point. The $Adj.R^2$ after 1994 is always above 2, while it never reaches 1 before 1994. Therefore, the differences in $Adj.R^2$ also shows that the ability of the stock-level MSR to predict momentum is notably different in the two subsamples.

For the macroeconomic variables, we find that for the majority of the prediction scenarios, the standard deviation of the past 24-month unemployment rate negatively predicts the momentum profit, and the past 36-month positively predict the momentum profit. While we are not sure if any other studies have similar findings on the standard deviation of the past 24-month unemployment rate, The predictive ability of the past 36-month market return is in line with Cooper et al. (2014).

In sum, the finding from Table 6 confirms our conjecture that the stock-level MSR can indeed negatively predict momentum profit in month *t*. Furthermore, the comparison between the two subsamples provides compelling evidence that momentum indeed may arise from behavioral bias, and potential arbitrage activities can mitigate this bias.

1.2. Predicting risk-adjusted momentum

[Insert Table 7]

Since there is evidence that common risk factors can capture some variation in cross-sectional momentum profit, we next use the risk-adjusted return to examine our result in Table 6. Table 7 reports the results of using stock-level MSR to predict risk-adjusted momentum profit for both the Fama-French three and five

factors. To calculate risk-adjusted momentum, we first regress momentum profit on contemporaneous Fama-French three factors (FF3): MKT, SMB, and HML from:

$$R_t = a + bMKT_t + cSMB_t + dHML_t + \varepsilon_t. \quad (8)$$

For risk-adjusted momentum under the Fama-French five factors (FF5), we estimate the following regression:

$$R_t = a + bMKT_t + cSMB_t + dHML_t + eCMA_t + fRMW_t + \varepsilon_t. \quad (9)$$

We define the risk-adjusted momentum as the sum of the intercept and error terms estimated in month *t*. We again report our results for three sample periods: 1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively. Controlling for FF3 and FF5 factors, we find that MSR presents even stronger power in forecasting momentum profit. Compared to Table 6, the Panel A of Table 7 shows that in the whole sample period, the predictive power of MSR is always higher than that of Table 6, while the coefficient of the MSR remains the same. In the two subsamples, we find similar evidence to the whole sample. While the MSR can still forecast momentum after 1994, it fails to predict momentum profit significantly before 1994. The adjusted R-squared between two subsample periods also provides extra evidence: before 1994, the $Adj.R^2$ barely reaches 1. On the contrary, $Adj.R^2$ after 1994 never drops below 2, even when *i* is 11. Additionally, the $Adj.R^2$ in Panel A of Table 7 in most scenarios is also always higher than that of Table 6, especially after 1994. Switching to the Fama-French five factors, we find that the result for the whole sample period largely remains. However, the predictive ability of MSR seems less effective under the FF5 model than FF3. The stock-level MSR seems to be struggling with forecasting risk-adjusted momentum after *i* reaches 4. Interestingly, after controlling for FF5 factors, we find that the stock-level MSR is also able to predict risk-adjusted momentum in the first subsample period. We tend to attribute this finding to model misspecification because while the predictive power of the MSR increases significantly from Panel B to Panel A, the intercept term in Panel B of Table 7, especially for the first subsample, is always larger than that of Panel A.

In sum, according to the evidence from Panels A and B of Table 7, we claim that our stock-level MSR can significantly predict risk-adjusted momentum profit. Moreover, the adjusted R-squared largely remains the same as that of Table 6, which suggests that the stock-level MSR can indeed predict a critical part of momentum that is not associated with risk. This finding provides compelling evidence that momentum is unlikely solely caused by the cross-sectional variation in common risk factors.

2. Predicting industry momentum

Besides using stock-level MSR to predict conventional momentum, we construct two types of MSR to predict industry momentum. First, we construct industry-level MSR to predict industry momentum. The differences between industry-level and stock-level MSR are: 1) industry-level MSR are constructed based on industry portfolio. We use Fama-French (1997) 49 industry classifications. Excluding financial industries, we have 45 industries. 2) we use the 90^{th} and 10^{th} percentile to calculate momentum spread on stock-level MSR, while we use the 88^{th} and 12^{th} percentile to calculate the industry momentum spread; thus, we can make sure at least five industries are in the top or decile portfolio. We expect that the industry-level MSR is less effective in predicting industry momentum than stock-level MSR because we conjecture that investor underreaction is less pervasive among portfolios.

[Insert Table 8]

As shown in Table 8, the MSR on the industry level does not show any predictive power in forecasting the industry momentum profit for all sample periods. If we use the Fama-French three factors to adjust the industry momentum, our result in Panel B of Table 8 shows no significant difference. However, the results are different if we use the stock-level MSR to predict risk-adjusted industry momentum. Panel C in Table 8 shows that when *i* ranges from 2 to 3, the stock-level MSR can predict industry momentum in the second subsample period. This finding has several implications. First, it seems MSR constructed at the portfolio level loses its forecasting power compared to the stock-level MSR. Second, industry momentum could potentially arise from the stock-level momentum since we can use the stock-level MSR to predict industry momentum, albeit less conspicuous than the results from Tables 6 and 7. Third, the stock-level MSR shows similar evidence as in Tables 6 and 7, and it can predict industry momentum only in the second subsample. Finally, the same patterns we find in Tables 6 to 8 show that the capability of stock-level MSR predicting momentum is unified: even if momentum is more prominent before 1994, the stock-level MSR does not show strong predictive power. The weak performance of momentum after 1994, however, can be predicted by our stock-level MSR, suggesting that the stock-level MSR indeed could be a proxy for investor underreaction. In sum, our findings suggest that the stock-level MSR is less effective in predicting the industry momentum than raw momentum.

3. Predicting residual momentum

[Insert Table 9]

Next, we use stock-level MSR to predict residual momentum. According to Panel A of Table 9, we find MSR fails to show any significant predictive power in the whole sample and first subsample. In the

second subsample, 1994 to 2021, the MSR predicts residual momentum only when *i* is equal to 1. In general, the stock-level MSR seems terrible at predicting residual momentum.

The risk-adjusted residual momentum shows striking differences compared to the raw residual momentum. The stock-level MSR can predict risk-adjusted momentum for the whole sample period, first subsample, and second subsample period, while it can only significantly predict unadjusted momentum and industry momentum in the second subsample period. Specifically, in Panel B of Table 9, the stock-level MSR in the first subsample can significantly predict the risk-adjusted residual momentum when *i* ranges from 2 to 7, except for 4. This interesting contrast has a critical implication that risk-adjusted residual momentum could essentially be a behavioral part of the raw momentum, which is in line with Blitz et al. (2011).

In sum, we use different types of MSR to predict three types of momentum and their risk-adjusted returns. Because these momentum strategies are constructed based on different predictors, we expect these MSRs to have a different capability to predict these momentum profits. Though the stock-level MSR can predict raw momentum, we find that it is better at predicting risk-adjusted momentums. Also, the stock-level MSR seems to work better in the second subsample, which is quite interesting because all momentum profits in the second subsample are much less profitable than in the first subsample period. The industry-level MSR, by contrast, is built at the industry level. Such a measure is less effective in predicting industry momentum because portfolios may suffer less from investor underreaction, which also provides additional evidence that behavioral bias might largely exist at the stock level. The result from residual momentum further indicates that our stock-level MSR can predict part of momentum that is not associated with the risk. Therefore, we argue that there are at least some commonalities among these three types of momentum, and part of them is very likely to arise from the same behavioral bias.

4. Predicting momentum with residual-level MSR

So far, we have shown that our stock-level MSR can predict three types of momentum, especially their risk-adjusted returns. However, one may argue that stock-level MSR does not explicitly relate to investor underreaction and arbitrage activities as the momentum spread also can arise from pure cross-sectional variation in common risk factors. To solve this problem, we further decompose stock-level MSR into two parts: one is a risk-related component, and the other is a residual-related component. To construct residual-related MSR, we strictly follow the procedure for constructing residual momentum. Specifically, we define residual-related MSR as:

$$Residual\_MSR_{t-2}^{i} = \frac{pseudoresidual\_momspread_{t-(1+i)}^{t-2}}{residual\_momspread_{t-12}^{t-2}}, \quad (10)$$

where $residual\_momspread_{t-12}^{t-2}$ is the return spread between top and bottom deciles based on prior 11-month residual returns from month t -12 to t -2 scaled by their standard deviation over the same period. Term $pseudoresidual\_momspread_{t-(1+i)}^{t-2}$ is the month $t-(1+i)$ to $t-2$ return spread of the value-weighted cumulative residual return as if these stocks, who are winner stocks and loser stocks in month $t-2$, are always winners and losers from month $t-i$ to $t-2$. Except for the definition of the residual momentum, all other settings remain exactly the same as before.

[Insert Table 10]

Table 10 deliver the predictive result. While Panel A and B both adopt the 90th and 10th percentile to cut the NYSE stocks, Panel C shows the result using the 75th and 25th percentile. Even though we conduct previous experiments based on the 90th and10th percentile, we emphasize the importance of adopting the 75th and 25th percentile here because the residuals are estimated from time-series regression and thus are more vulnerable to model specification and measurement errors. Compared to the result from Panel C, results from Panel A and B are less impressive: only a few residual-level MSRs can marginally predict momentum and risk-adjusted momentum. However, if we change the 90th and 10th percentile to the 75th and 25th percentile, we find that the residual-level MSR can strongly predict the risk-adjusted momentum when *i* ranges from 2 to 4. Again, this finding is consistent with our previous table results, especially Table 7. The commonality between stock-level and residual-level MSR shows that the predictability of momentum does not likely arise from the cross-sectional variation in common risk factors, even though we still lack direct evidence linking investor underreaction to momentum profitability.

5. Out-of-sample prediction

So far, we have demonstrated that stock-level MSR can predict various types of momentum. In this section, we further discuss the out-of-sample prediction performance of stock-level MSR. To measure the out-of-sample performance of the model, we adopt the out-of-sample R-squared from Campbell and Thompson (2007):

$$R_{oos}^{2} = 1 - \frac{\sum(y_t - \hat{y}_t)^2}{\sum(y_t - \bar{y}_{train})^2}, \quad (10)$$

where y_t is the future momentum factor return, which we obtain from the French's data library. $\hat{y}_t$ is the predicted value of the model, and $\bar{y}_{train}$ is the historical average return of the training sample.

[Insert Table 11]

Table 11 delivers the result of the out-sample prediction of stock-level MSR. Panel A and B report the result whose training window is 120 and 240 months, respectively. Also, in each panel, we report the prediction on a monthly and a yearly basis. The model we use to train the sample is the same as equation (7). In Panel A, the model fails to beat the benchmark model, which is the historical mean of the momentum factor, in the whole sample period. However, the comparison between the two subsamples shows an intriguing result. In Table 6, the MSR does a better job predicting the in-sample momentum factor in the second subsample, and the in-sample R-squared is also much higher in the second subsample. Returning to the out-of-sample prediction, we find the situation reverses. The out-of-sample prediction in the second sample is much worse than in the first subsample, both for monthly prediction and annual prediction. This finding has an important implication. Based on the finding from Table 1 to Table 4, we conclude that because the behavioral component of momentum gradually attenuates, the risk component becomes dominant after 1994. Therefore, the out-of-sample performance of MSR after 1994 becomes highly unpredictable because the increasingly dominant component of momentum arises from cross-sectional variation in common risk factors. Since we argue that MSR can be a potential proxy for arbitrage activity and investor underreaction and that we suspect investor underreaction has largely relieved after 1994, we should observe such a reverse. In Panel B, where we change the training window from 120 months to 240 months, all out-of-sample predictions become much better compared to Panel A. However, such a reverse still exists for the monthly prediction. The R^2_{oos} in the first subsample are all positive, meaning the model outperforms the historical average of the momentum factor. In the second subsample, the out-of-sample prediction significantly improves, especially for the annual prediction.

In sum, the model beats the historical average of momentum before 1994 while failing to do so after 1994. This out-of-sample prediction again implies that the behavioral component of momentum largely attenuates over time.

V. Limits to arbitrage

Next, we discuss whether the prediction of MSR is pervasive among different portfolios based on size and liquidity. We emphasize the importance of this issue because, on the one hand, previous studies, such as Hong et al. (2000), have shown that the profitability of momentum strategies can be affected by other firm characteristics, such as size and analyst coverage. Their finding is particularly important because it implies that certain stocks have slower news diffusion and thus can enjoy greater momentum returns, providing compelling evidence that momentum might arise from investor underreaction. On the other

hand, since we focus on the potential capability that the MSR can proxy for arbitrage activity and investor underreaction, we wonder if its forecasting power is among all portfolios regardless of the investor underreaction. If that is the case, then previous studies may have the wrong conclusion because MSR has the same predictive power among all portfolios.

[Insert Table 12]

Table 12 documents the result of using MSR to predict momentum sorted on previous size and illiquidity (Amihud 2002). The result shows that there is no significant difference across the two different measures of arbitrage proxy, even though there is some pattern in each panel. In Panel A, the comparison of the two subsamples again resembles the previous result. The stock-level MSR seems to be struggling to predict momentum before 1993, especially for medium to large-size firms. However, such a pattern disappears after 1993. MSR can predict all momentum portfolios sorted on size when *i* is less than 4. Moving to Panel B, we find a similar result.

In sum, we document no significant difference in using MSR to predict risk-adjusted momentum sorted on size and illiquidity. In contrast to previous studies that claim momentum positively correlates to investor underreaction proxies such as size, we argue that this pattern largely mitigates after 1994.

V. Robustness check, arbitrager's activity, and crowdedness of trading

When constructing stock-level MSR, we define the denominator momentum spread as the difference between the 90th and 10th percentiles of the distribution of cumulative stock returns from month $t-12$ to $t-2$. Since the nominator pseudo-momentum spread is also based on the 90th minus 10th percentiles momentum spread, we expect the predictive ability of MSR is, to some extent, sensitive to the percentile we choose. That is to say, the closer the two percentiles get, we expect the less predictive ability remains. Hence, if we change the 90th and 10th percentiles to 75th and 25th percentile, we expect our result would largely retain, albeit weaker than before.

[Insert Table 13]

As shown in Table 13, we find our conclusion largely remains the same except for the first subsample. Other than the first subsample, the new MSR result highly correlates with the original MSR and shows no significant difference in predicting raw momentum. The notable difference, however, is that the predictive ability becomes less significant for the whole sample period and the second subsample period while more significant for the first subsample period. Specifically, for the whole sample period, the new MSR loses its predictive power after *i* reaches 3, whereas, in Table 6, the original MSR manages to predict raw

momentum until *i* reaches 7. Furthermore, we observe that the stock-level MSR can predict momentum for the first subsample, and the *t*-stats are very close to those of the second subsample.

This reverse in the predictive power in two subsamples could reveal a unique feature of momentum. On the one hand, among maybe hundreds of anomalies, momentum is the most robust evidence against the efficient market hypothesis (EMH) because past returns can predict future returns, even controlling for the common risk factors. On the other hand, momentum might be the only anomaly in which the arbitrage activity amplifies the signal. For example, if an investor trade on size strategy, in the next period, the small-size firm tends to earn a higher expected return than the large firm. Such investing activity will only diminish the signal because, in the next period, the small size firm will become bigger. However, if arbitragers trade on past return information, the momentum spread will only widen in the next period. Accordingly, the new arbitragers will further bet on a stronger signal in the next period until momentum crashes because the extra return diverges too much from the firm's fundamental value. If the market is unaware of the momentum strategy for both subsample periods, we expect MSR to remain the same no matter what percentile we choose. However, if the market does know about the arbitrage opportunity for the momentum strategy in a particular subsample, the MSR based on different percentiles will have different predictive power for momentum. Also, according to Table 5, given that the means of MSR are almost the same for the two subsamples, we can directly compare the predictive results between different percentile cuts and the two subsamples. That is to say, to achieve the same predictive power, 75^{th} and 25^{th} percentiles are much better than 90^{th} and 10^{th} percentiles in the first subsample.

In contrast, in the second subsample, the 90^{th} and 10^{th} percentiles are more efficient than 75^{th} and 25^{th} percentiles. Even though we have no conclusive evidence to explain this finding, we tend to attribute this result to the increasing arbitrage activities after 1994. As mentioned above, the momentum spread will keep widening as arbitrage activities increase, so the momentum profit will likely arise from the more extreme percentile portfolio. However, this argument cannot explain why 90^{th} and 10^{th} percentiles are terrible at predicting momentum compared to 75^{th} and 25^{th} percentiles in the first subsample. Perhaps future studies can answer this question.

In sum, we find no significant changes in our results by replacing the 90th and 10th percentiles with the 75th and 25th percentiles. Although there is some decrease in statistical significance overall, we argue that such decreases are expected and could be reasonably explained. Furthermore, compared to the 75^{th} and 25^{th} percentiles, the 90^{th} and 10^{th} percentiles are more efficient at predicting various types of momentum except for the first subsample.

VI. Conclusion

Based on the observations that three types of momentum anomalies all attenuate after 1994, we suspect a significant fraction of the momentum profit has been exploited. Since the risk-adjusted momentum is still significant after 1994, we argue that the diminished part of momentum is likely to be associated with behavioral bias. Thus, the momentum profit after 1994 should be more sensitive to arbitrage activities than it was before. Though several potential explanations try to explain why behavioral bias is the cause of momentum, the time-series predictability of momentum has not yet been thoroughly studied. If the behavioral bias story is true, we wonder if the market learns from such arbitrage opportunities. Therefore, we try to construct a proxy that can measure how much behavioral-related momentum profit has already been exploited before the final construction of momentum at the end of month $t-1$.

Motivated by this idea, we propose a ratio measure called momentum spread ratio (MSR) and use it to predict various momentum. Surprisingly, we find it can significantly predict various types of momentums and is much better at forecasting risk-adjusted momentums. This finding is interesting because momentum profit largely weakens after 1994, but MSR can still forecast momentum. In contrast, even though momentum profit is much stronger before 1994, we find less conspicuous evidence. This critical comparison implies that the diminished part of momentum, which could potentially arise from behavioral bias, is likely to have been exploited by the market. The same story that many anomalies gradually attenuate over time, especially after the initial discovery of these anomalies, has also been confirmed by much other literature. Hence, we believe momentum is probably another example.

Also, since we construct the stock-level MSR based on the raw return spread, one may argue that the predictability may arise from the risk part of the cross-sectional stock returns, not necessarily from the behaviroal part. To control for this effect, we also build a residual-level MSR and test its ability to predict momentum. Again, we find that it can negatively predict risk-ajdusted momentum returns.

In sum, by constructing MSR, we provide compelling evidence that a significant fraction of momentum can be predicted, and this part is independent of the risk compensation. Such a prediction is strongly in favor of the behavioral explanation.

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Table 1

Momentum strategy performance

In Panel A, at the beginning of each month *t*, we form 10 portfolios based on their cumulative returns from months $t-12$ to $t-2$. We define the top decile portfolio as the winner portfolio and the bottom decile as the loser portfolio. The MOM is then calculated as the return spread between the winner and loser portfolios. The MOM_alpha is defined as the intercept term of regressing momentum on Fama-French three factors: MKT, SMB, and HML. The MOM_alpha* is defined as the intercept term of regressing momentum on Fama-French five factors: MKT, SMB, HML, CMA, and RMW.

Additionally, we report industry momentum (IM) and residual momentum (RM) and their alphas, respectively. In Panel B, we report the momentum profit by size quintile and their corresponding alphas. ME1 to ME5 are five momentum portfolios sorted on previous one-month market values. Both Panel A and Panel B present the summary statistics for the whole sample period, 1966 to 2021, the first subsample period, 1966 to 1993, and the second subsample period, 1994 to 2021.

Panel A. Average monthly return of various types of momentum

zMOM	MOM_alpha	MOM_alpha*	IM	IM_alpha	IM_alpha*	RM	RM_alpha	RM_alpha*
				1966-2021				
1.12	1.22	0.97	0.74	0.62	0.40	0.57	0.22	0.15
[4.21]	[4.55]	[3.52]	[3.10]	[2.63]	[1.65]	[3.72]	[1.44]	[0.95]
				1966-1993				
1.71	1.41	1.20	0.77	0.42	0.39	0.80	0.21	0.13
[5.69]	[4.65]	[3.67]	[2.59]	[1.43]	[1.22]	[3.98]	[0.99]	[0.57]
				1994-2021				
0.65	1.02	0.64	0.72	0.83	0.44	0.33	0.21	0.17
[1.38]	[2.37]	[1.44]	[1.91]	[2.28]	[1.18]	[1.44]	[0.91]	[0.71]

Panel B. Average monthly return of size quintiles

ME1	ME2	ME3	ME4	ME5
		1966-2021		
1.21	1.00	0.81	0.72	0.54
[6.48]	[5.02]	[3.77]	[3.05]	[2.29]
		1966-1993		
1.59	1.46	1.31	0.95	0.74
[7.79]	[6.85]	[5.45]	[3.70]	[2.52]
		1994-2021		
0.82	0.54	0.31	0.49	0.35
[2.65]	[1.62]	[0.88]	[1.25]	[0.94]
ME1_alpha	ME2_alpha	ME3_alpha	ME4_alpha	ME5_alpha
		1966-2021		
1.08	0.88	0.73	0.74	0.53
[6.22]	[4.72]	[3.63]	[3.40]	[2.42]
		1966-1993		
1.23	1.05	0.92	0.58	0.36
[6.08]	[4.90]	[3.77]	[2.24]	[1.22]
		1994-2021		
1.01	0.73	0.54	0.84	0.64
[3.47]	[2.31]	[1.62]	[2.32]	[1.87]
ME1_alpha*	ME2_alpha*	ME3_alpha*	ME4_alpha*	ME5_alpha*
		1966-2021		
0.89	0.72	0.53	0.54	0.39
[5.01]	[3.79]	[2.57]	[2.43]	[1.71]
		1966-1993		
1.09	0.83	0.68	0.33	0.21
[5.01]	[3.61]	[2.63]	[1.21]	[0.65]
		1994-2021		
0.77	0.55	0.26	0.61	0.43
[2.56]	[1.66]	[0.76]	[1.64]	[1.21]

Table 2

When does the winner become the winner

At the beginning of each month *t*, we form 10 portfolios based on their cumulative returns from month $t-12$ to $t-2$. We define the top decile portfolio as the winner portfolio and the bottom decile as the loser portfolio. From month $t-36$ to $t-2$, we assume winners at month $t-2$ are also winners for the past 36 months and losers at month $t-2$ are losers for the past 36 months, and we calculate their return spread in each previous month. We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

Lag	1966-2021		1966-1993		1994-2021	
2	10.61	[37.34]	10.09	[33.69]	11.24	[22.73]
3	10.16	[36.90]	9.49	[32.81]	10.91	[22.78]
4	9.92	[38.99]	9.20	[34.04]	10.72	[24.32]
5	9.95	[39.57]	9.25	[34.23]	10.74	[24.70]
6	10.05	[43.58]	9.30	[36.70]	10.87	[27.50]
7	9.92	[44.98]	9.18	[38.28]	10.71	[28.20]
8	9.91	[45.64]	9.18	[38.69]	10.72	[28.69]
9	10.06	[44.77]	9.23	[40.63]	10.95	[27.52]
10	10.07	[44.56]	9.27	[41.26]	10.93	[27.06]
11	10.25	[47.15]	9.46	[43.24]	11.07	[28.64]
12	10.68	[44.40]	9.95	[42.82]	11.45	[26.23]
13	0.83	[4.17]	0.80	[3.63]	0.85	[2.44]
14	1.07	[5.09]	1.31	[5.85]	0.82	[2.18]
15	1.06	[5.13]	1.40	[6.28]	0.72	[1.96]
16	0.86	[4.10]	1.30	[5.66]	0.42	[1.13]
17	0.66	[3.18]	0.88	[3.64]	0.45	[1.26]
18	0.65	[3.29]	0.93	[4.17]	0.37	[1.06]
19	0.45	[2.25]	0.74	[3.26]	0.15	[0.43]
20	0.36	[1.84]	0.65	[2.78]	0.07	[0.22]
21	0.30	[1.56]	0.44	[1.86]	0.11	[0.35]
22	0.05	[0.28]	0.21	[0.89]	-0.14	[-0.51]
23	0.06	[0.35]	0.13	[0.56]	-0.01	[-0.05]
24	-0.13	[-0.72]	-0.05	[-0.22]	-0.23	[-0.80]
25	-0.41	[-2.34]	-0.45	[-2.00]	-0.32	[-1.13]
26	-0.30	[-1.71]	-0.42	[-1.80]	-0.15	[-0.52]
27	-0.30	[-1.68]	-0.30	[-1.30]	-0.26	[-0.88]
28	-0.24	[-1.37]	-0.11	[-0.48]	-0.34	[-1.20]
29	-0.29	[-1.57]	-0.14	[-0.60]	-0.47	[-1.46]
30	-0.28	[-1.52]	-0.16	[-0.73]	-0.38	[-1.21]
31	-0.33	[-1.86]	-0.20	[-0.88]	-0.50	[-1.69]
32	-0.30	[-1.71]	-0.12	[-0.56]	-0.50	[-1.71]
33	-0.32	[-1.77]	-0.16	[-0.69]	-0.56	[-1.83]
34	-0.32	[-1.78]	-0.21	[-0.93]	-0.60	[-1.92]
35	-0.25	[-1.37]	-0.18	[-0.78]	-0.46	[-1.49]
36	-0.23	[-1.26]	-0.13	[-0.55]	-0.44	[-1.39]

Table 3

Size quintile: When does the winner become the winner?

At the beginning of each month *t*, we form 10 portfolios based on their cumulative returns from month $t-12$ to $t-2$, and five portfolios based on their $t-1$ market value. We define the top decile portfolio as the winner portfolio and the bottom decile as the loser portfolio. From month $t-36$ to $t-2$, we assume winners at month $t-2$ are also winners for the past 36 months and losers at month $t-2$ are losers for the past 36 months, and we calculate their return spread for five size portfolios in each previous month. We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

	1966-2021					1966-1993					1994-2021				
Lag	ME1	ME2	ME3	ME4	ME5	ME1	ME2	ME3	ME4	ME5	ME1	ME2	ME3	ME4	ME5
2	6.84	6.02	5.54	5.15	4.57	6.48	5.58	5.11	4.83	4.09	7.19	6.46	5.97	5.46	5.05
	[46.12]	[36.36]	[31.58]	[28.42]	[21.73]	[48.05]	[36.70]	[30.84]	[25.89]	[17.30]	[27.31]	[22.05]	[19.35]	[17.60]	[14.56]
3	6.35	5.77	5.37	4.81	4.52	5.80	5.24	4.82	4.32	4.06	6.90	6.31	5.92	5.31	4.98
	[43.23]	[36.34]	[31.49]	[26.81]	[22.85]	[43.68]	[34.40]	[29.89]	[23.53]	[19.35]	[26.58]	[22.80]	[19.83]	[17.27]	[14.89]
4	6.23	5.61	5.21	4.65	4.19	5.66	5.09	4.70	4.16	3.64	6.81	6.14	5.72	5.14	4.75
	[43.73]	[37.45]	[31.68]	[26.72]	[22.89]	[44.02]	[35.31]	[29.95]	[23.39]	[18.16]	[27.03]	[23.53]	[19.88]	[17.25]	[15.59]
5	6.29	5.66	5.15	4.70	4.12	5.72	5.10	4.60	4.24	3.68	6.87	6.22	5.71	5.16	4.58
	[46.86]	[39.21]	[33.49]	[28.87]	[24.77]	[46.53]	[36.64]	[30.87]	[24.65]	[19.65]	[29.13]	[24.84]	[21.35]	[18.73]	[16.67]
6	6.28	5.67	5.14	4.71	3.94	5.69	5.08	4.60	4.25	3.52	6.88	6.28	5.68	5.17	4.37
	[48.98]	[40.94]	[35.28]	[30.34]	[24.82]	[49.11]	[39.16]	[32.11]	[25.65]	[19.38]	[30.46]	[25.92]	[22.56]	[19.77]	[16.82]
7	6.28	5.66	5.14	4.76	3.90	5.68	5.03	4.59	4.26	3.52	6.89	6.31	5.70	5.27	4.29
	[52.24]	[42.23]	[35.86]	[30.95]	[25.16]	[53.23]	[40.06]	[32.34]	[25.48]	[20.77]	[32.50]	[27.00]	[23.04]	[20.50]	[16.51]
8	6.31	5.61	5.12	4.69	3.92	5.74	5.05	4.58	4.20	3.52	6.88	6.19	5.68	5.21	4.32
	[52.15]	[42.67]	[37.02]	[30.81]	[25.83]	[55.60]	[41.25]	[33.72]	[25.38]	[20.68]	[31.81]	[26.81]	[23.71]	[20.41]	[17.22]
9	6.30	5.60	5.10	4.69	3.92	5.71	4.99	4.57	4.24	3.51	6.92	6.21	5.65	5.16	4.34
	[53.25]	[42.12]	[37.12]	[32.16]	[26.43]	[54.92]	[40.85]	[34.00]	[27.03]	[22.17]	[32.98]	[26.60]	[23.69]	[21.00]	[17.30]
10	6.31	5.56	5.03	4.67	3.81	5.70	5.06	4.57	4.24	3.45	6.93	6.06	5.49	5.10	4.18
	[55.75]	[42.77]	[38.11]	[32.78]	[27.10]	[56.56]	[42.71]	[35.82]	[28.20]	[23.24]	[34.78]	[26.29]	[23.81]	[21.10]	[17.45]
11	6.38	5.62	5.07	4.60	3.82	5.80	5.16	4.65	4.24	3.57	6.97	6.10	5.51	4.98	4.09
	[58.80]	[47.07]	[39.75]	[34.71]	[29.37]	[57.03]	[44.81]	[37.30]	[28.79]	[24.35]	[37.02]	[29.21]	[24.72]	[22.53]	[18.89]
12	6.81	5.79	5.25	4.75	3.90	6.45	5.45	4.99	4.46	3.53	7.18	6.13	5.52	5.05	4.29
	[61.77]	[48.09]	[40.90]	[36.17]	[31.42]	[58.02]	[46.28]	[39.13]	[30.93]	[24.59]	[37.64]	[29.07]	[24.54]	[22.87]	[21.18]

13	0.07	0.37	0.32	0.30	0.22		0.02	0.45	0.29	0.19	0.11		0.12	0.29	0.34	0.42	0.33
	[0.60]	[2.75]	[2.40]	[2.10]	[1.75]		[0.18]	[3.38]	[2.24]	[1.20]	[0.74]		[0.60]	[1.22]	[1.47]	[1.72]	[1.66]
14	0.49	0.65	0.55	0.47	0.33		0.66	0.93	0.68	0.44	0.27		0.31	0.35	0.40	0.49	0.40
	[4.10]	[4.86]	[4.17]	[3.35]	[2.60]		[5.47]	[7.06]	[5.20]	[2.91]	[1.76]		[1.47]	[1.52]	[1.76]	[2.08]	[1.93]
15	0.47	0.57	0.54	0.52	0.40		0.71	0.88	0.64	0.56	0.35		0.22	0.24	0.43	0.47	0.46
	[3.93]	[4.21]	[3.97]	[3.70]	[3.18]		[6.14]	[6.73]	[4.66]	[3.77]	[2.43]		[1.04]	[1.01]	[1.82]	[1.97]	[2.17]
16	0.35	0.55	0.46	0.47	0.39		0.53	0.82	0.62	0.52	0.36		0.16	0.27	0.30	0.41	0.42
	[2.94]	[4.02]	[3.43]	[3.62]	[3.17]		[4.34]	[5.93]	[4.39]	[3.67]	[2.47]		[0.78]	[1.14]	[1.28]	[1.88]	[2.10]
17	0.22	0.43	0.40	0.35	0.29		0.43	0.64	0.52	0.42	0.26		0.00	0.21	0.27	0.28	0.32
	[1.85]	[3.08]	[2.95]	[2.50]	[2.33]		[3.62]	[4.76]	[3.61]	[2.79]	[1.73]		[0.00]	[0.83]	[1.18]	[1.17]	[1.60]
18	0.18	0.34	0.32	0.34	0.25		0.38	0.54	0.47	0.41	0.21		-0.04	0.12	0.17	0.25	0.30
	[1.52]	[2.51]	[2.45]	[2.50]	[2.13]		[3.12]	[3.98]	[3.34]	[2.82]	[1.46]		[-0.18]	[0.53]	[0.73]	[1.11]	[1.55]
19	0.09	0.33	0.26	0.24	0.22		0.27	0.55	0.45	0.33	0.21		-0.10	0.09	0.07	0.14	0.23
	[0.75]	[2.40]	[1.96]	[1.70]	[1.85]		[2.30]	[4.24]	[3.17]	[2.29]	[1.48]		[-0.49]	[0.36]	[0.29]	[0.57]	[1.18]
20	0.05	0.29	0.25	0.18	0.28		0.21	0.48	0.35	0.27	0.25		-0.11	0.09	0.15	0.08	0.31
	[0.46]	[2.19]	[1.92]	[1.29]	[2.28]		[1.73]	[3.69]	[2.54]	[1.91]	[1.64]		[-0.53]	[0.38]	[0.65]	[0.32]	[1.61]
21	0.06	0.26	0.21	0.13	0.31		0.18	0.41	0.28	0.15	0.24		-0.07	0.10	0.14	0.12	0.38
	[0.50]	[2.00]	[1.60]	[1.00]	[2.51]		[1.61]	[3.16]	[1.90]	[1.05]	[1.56]		[-0.36]	[0.43]	[0.63]	[0.50]	[1.97]
22	0.00	0.16	0.23	0.11	0.16		0.10	0.33	0.25	0.09	0.00		-0.11	-0.02	0.20	0.14	0.34
	[-0.01]	[1.24]	[1.74]	[0.89]	[1.31]		[0.90]	[2.61]	[1.74]	[0.65]	[-0.03]		[-0.55]	[-0.10]	[0.91]	[0.63]	[1.79]
23	-0.07	0.12	0.11	-0.04	0.19		-0.04	0.19	0.10	-0.12	0.04		-0.11	0.05	0.13	0.05	0.36
	[-0.69]	[1.00]	[0.89]	[-0.29]	[1.68]		[-0.36]	[1.46]	[0.72]	[-0.82]	[0.26]		[-0.58]	[0.25]	[0.58]	[0.24]	[2.03]
24	-0.12	0.08	0.04	-0.06	0.14		-0.12	0.14	0.03	-0.10	0.03		-0.11	0.01	0.06	-0.01	0.26
	[-1.08]	[0.60]	[0.32]	[-0.42]	[1.15]		[-1.08]	[1.06]	[0.19]	[-0.67]	[0.19]		[-0.58]	[0.04]	[0.26]	[-0.03]	[1.37]
25	-0.18	-0.02	0.03	-0.03	-0.01		-0.27	-0.02	-0.12	-0.17	-0.17		-0.07	-0.03	0.19	0.12	0.17
	[-1.68]	[-0.17]	[0.22]	[-0.25]	[-0.07]		[-2.47]	[-0.12]	[-0.85]	[-1.23]	[-1.10]		[-0.40]	[-0.13]	[0.87]	[0.59]	[0.95]
26	-0.03	0.02	0.05	0.06	0.12		-0.13	-0.02	-0.09	-0.13	0.01		0.09	0.08	0.20	0.27	0.25
	[-0.26]	[0.19]	[0.39]	[0.47]	[1.00]		[-1.19]	[-0.18]	[-0.61]	[-0.94]	[0.04]		[0.51]	[0.35]	[0.90]	[1.27]	[1.33]
27	-0.01	0.07	0.03	0.12	0.02		-0.09	0.08	-0.11	-0.02	-0.10		0.07	0.06	0.18	0.28	0.14
	[-0.12]	[0.56]	[0.21]	[0.93]	[0.13]		[-0.83]	[0.63]	[-0.80]	[-0.15]	[-0.63]		[0.39]	[0.26]	[0.82]	[1.21]	[0.75]
28	-0.03	0.05	0.00	0.06	0.04		-0.02	0.00	-0.06	-0.07	-0.05		-0.04	0.10	0.06	0.21	0.14
	[-0.30]	[0.41]	[-0.02]	[0.51]	[0.34]		[-0.22]	[0.01]	[-0.42]	[-0.55]	[-0.36]		[-0.21]	[0.49]	[0.28]	[0.99]	[0.81]

29	-0.02	0.02	0.01	0.13	-0.01	-0.07	0.02	-0.05	-0.02	-0.06	0.05	0.02	0.08	0.30	0.05
	[-0.15]	[0.18]	[0.07]	[1.03]	[-0.06]	[-0.67]	[0.18]	[-0.37]	[-0.18]	[-0.39]	[0.26]	[0.09]	[0.35]	[1.36]	[0.30]
30	-0.04	0.02	-0.01	0.05	-0.06	-0.06	0.04	-0.04	-0.02	-0.17	-0.02	0.00	0.03	0.13	0.05
	[-0.39]	[0.18]	[-0.05]	[0.42]	[-0.55]	[-0.52]	[0.29]	[-0.28]	[-0.15]	[-1.10]	[-0.13]	[0.02]	[0.13]	[0.60]	[0.25]
31	-0.09	0.02	0.03	0.04	-0.18	-0.09	0.04	-0.06	-0.05	-0.26	-0.09	0.00	0.12	0.14	-0.09
	[-0.84]	[0.21]	[0.20]	[0.32]	[-1.49]	[-0.84]	[0.34]	[-0.44]	[-0.34]	[-1.68]	[-0.46]	[0.01]	[0.57]	[0.65]	[-0.47]
32	-0.02	0.00	0.00	0.01	-0.11	0.06	0.01	-0.01	0.06	-0.12	-0.12	-0.01	0.01	-0.05	-0.10
	[-0.22]	[-0.02]	[0.00]	[0.06]	[-0.97]	[0.57]	[0.05]	[-0.05]	[0.47]	[-0.76]	[-0.64]	[-0.06]	[0.03]	[-0.25]	[-0.61]
33	-0.01	-0.06	-0.04	0.06	-0.05	0.02	-0.07	-0.09	0.04	-0.05	-0.05	-0.04	0.01	0.08	-0.04
	[-0.14]	[-0.50]	[-0.34]	[0.46]	[-0.42]	[0.19]	[-0.57]	[-0.64]	[0.28]	[-0.35]	[-0.28]	[-0.21]	[0.04]	[0.36]	[-0.25]
34	-0.05	-0.08	-0.01	0.06	-0.15	-0.04	-0.05	-0.02	-0.01	-0.13	-0.06	-0.11	0.00	0.15	-0.18
	[-0.46]	[-0.70]	[-0.08]	[0.52]	[-1.28]	[-0.32]	[-0.42]	[-0.16]	[-0.08]	[-0.83]	[-0.34]	[-0.56]	[0.01]	[0.70]	[-0.98]
35	-0.05	-0.03	0.02	0.05	-0.19	-0.02	-0.07	-0.03	0.01	-0.24	-0.08	0.01	0.08	0.09	-0.13
	[-0.49]	[-0.27]	[0.20]	[0.39]	[-1.60]	[-0.21]	[-0.54]	[-0.21]	[0.05]	[-1.54]	[-0.45]	[0.06]	[0.42]	[0.44]	[-0.73]
36	-0.02	0.06	-0.07	0.03	-0.11	0.03	0.01	-0.06	0.04	-0.10	-0.07	0.11	-0.08	0.02	-0.11
	[-0.16]	[0.55]	[-0.57]	[0.25]	[-0.92]	[0.33]	[0.12]	[-0.44]	[0.29]	[-0.67]	[-0.41]	[0.60]	[-0.38]	[0.09]	[-0.63]

Table 4

Pricing momentum with *k*-month common risk factors

We estimate cross-sectional regression of the Fama-French three-factor model in Panel A and the Fama-French five-factor model in Panel B based on *k*-month cumulative factor returns. To construct MKT, SMB, HML, UMD, CMA, and RMW factors in benchmark models for a given return horizon *k*, we use $2x3$ bivariate sort portfolio. For example, the SMB factor returns are formed as $f_{t,k}^{SMB} = \prod_{k=1}^{K}(1 + f_{t-k+K}^{S}) - \prod_{k=1}^{K}(1 + f_{t-k+K}^{B})$, where f_{t-k+K}^{S} is defined as the small portfolio in a $2x3$ bivariate sort portfolio, which is $\frac{1}{3} * (Small\ Value + Small\ Neutral + Small\ Growth)$, and f_{t-k+K}^{B} is defined as the big portfolio in $2x3$ bivariate sort portfolio, which is $\frac{1}{3} * (Big\ Value + Big\ Neutral + Big\ Growth)$. The monthly MKT, SMB, HML, RMW, CMA, and UMD factors are all are constructed using the six value-weighted portfolios(all two-by-three sorts) formed respectively on size, book-to-market, profitability, investment, and past-return. We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

Panel A. Fama and French three factors

	1966-2021					1966-1993					1994-2021				
k	Intercept	Mkt	SMB	HML	Adj.R	Intercept	Mkt	SMB	HML	Adj.R	Intercept	Mkt	SMB	HML	Adj.R
1	0.01	-0.40	-0.11	-0.65	10.80	0.01	-0.03	-0.29	-0.30	3.70	0.01	-0.69	-0.03	-0.78	18.72
	[4.66]	[-6.42]	[-1.23]	[-7.22]		[4.79]	[-0.42]	[-2.81]	[-2.55]		[2.37]	[-6.97]	[-0.18]	[-5.99]	
2	0.01	-0.24	0.01	-0.29	5.93	0.01	-0.08	-0.09	-0.18	2.00	0.01	-0.35	0.04	-0.33	8.70
	[4.49]	[-5.33]	[0.21]	[-4.74]		[4.82]	[-1.53]	[-1.19]	[-2.37]		[2.19]	[-4.78]	[0.39]	[-3.50]	
3	0.01	-0.09	0.00	-0.18	2.18	0.01	-0.05	-0.05	-0.12	0.90	0.01	-0.10	0.01	-0.22	2.48
	[3.93]	[-2.44]	[-0.07]	[-3.79]		[4.66]	[-1.07]	[-0.82]	[-2.04]		[1.48]	[-1.67]	[0.09]	[-2.99]	
4	0.01	-0.05	0.01	-0.09	0.51	0.01	-0.04	0.00	-0.10	0.26	0.01	-0.06	0.01	-0.09	0.06
	[3.50]	[-1.64]	[0.29]	[-2.19]		[4.43]	[-0.96]	[0.00]	[-1.93]		[1.29]	[-1.13]	[0.07]	[-1.42]	
5	0.01	-0.04	0.01	-0.08	0.51	0.01	-0.03	0.01	-0.09	0.38	0.01	-0.05	-0.01	-0.08	0.10
	[3.47]	[-1.38]	[0.29]	[-2.36]		[4.36]	[-0.73]	[0.22]	[-2.07]		[1.28]	[-1.01]	[-0.11]	[-1.52]	
6	0.01	-0.03	-0.01	-0.06	0.24	0.01	0.00	-0.01	-0.08	0.28	0.01	-0.06	-0.03	-0.05	0.13
	[3.42]	[-1.16]	[-0.16]	[-1.91]		[4.25]	[-0.05]	[-0.22]	[-1.89]		[1.45]	[-1.30]	[-0.54]	[-1.04]	
7	0.01	-0.03	0.01	-0.04	-0.01	0.02	-0.01	-0.01	-0.07	0.19	0.01	-0.04	0.01	-0.03	-0.49
	[3.30]	[-1.13]	[0.25]	[-1.47]		[4.41]	[-0.39]	[-0.39]	[-1.86]		[1.27]	[-0.97]	[0.21]	[-0.71]	
8	0.01	-0.01	-0.01	-0.02	-0.26	0.01	-0.01	-0.02	-0.05	-0.04	0.01	-0.02	-0.02	-0.01	-0.73
	[3.08]	[-0.60]	[-0.46]	[-0.76]		[4.26]	[-0.35]	[-0.58]	[-1.55]		[1.09]	[-0.48]	[-0.46]	[-0.18]	
9	0.01	0.00	-0.02	-0.01	-0.35	0.01	0.00	-0.03	-0.03	-0.28	0.00	0.00	-0.01	-0.01	-0.88
	[2.82]	[-0.01]	[-0.60]	[-0.51]		[3.96]	[0.18]	[-1.00]	[-0.99]		[0.84]	[0.01]	[-0.30]	[-0.25]	

10	0.01	0.01	-0.01	0.00	-0.40		0.01	0.00	-0.01	-0.02	-0.68		0.00	0.02	-0.02	0.00	-0.81
	[2.56]	[0.33]	[-0.46]	[-0.19]			[3.66]	[0.03]	[-0.51]	[-0.66]			[0.59]	[0.51]	[-0.40]	[-0.14]	
11	0.01	0.01	-0.01	0.00	-0.41		0.01	0.01	-0.02	-0.02	-0.62		0.00	0.01	-0.01	0.00	-0.86
	[2.50]	[0.34]	[-0.39]	[-0.18]			[3.56]	[0.29]	[-0.65]	[-0.66]			[0.60]	[0.39]	[-0.27]	[-0.11]	
12	0.01	0.01	-0.02	0.00	-0.30		0.01	0.00	-0.01	-0.03	-0.52		0.00	0.03	-0.03	0.00	-0.51
	[2.40]	[0.67]	[-0.80]	[-0.23]			[3.71]	[-0.20]	[-0.53]	[-0.98]			[0.34]	[1.01]	[-0.76]	[-0.08]	

Panel B. Fama and French five factors

	1966-2021						
k	Intercept	Mkt	SMB	HML	RMW	CMA	Adj.R
1	0.01	-0.33	-0.01	-0.88	0.39	0.48	12.24
	[3.66]	[-5.04]	[-0.15]	[-7.23]	[3.05]	[2.55]	
2	0.01	-0.22	0.06	-0.37	0.19	0.19	6.42
	[3.53]	[-4.50]	[0.87]	[-4.44]	[2.14]	[1.41]	
3	0.01	-0.08	0.00	-0.21	0.04	0.06	1.96
	[3.40]	[-2.09]	[0.07]	[-3.12]	[0.52]	[0.56]	
4	0.01	-0.05	0.03	-0.09	0.08	0.00	0.50
	[2.84]	[-1.43]	[0.63]	[-1.61]	[1.38]	[0.04]	
5	0.01	-0.04	0.02	-0.09	0.07	0.01	0.49
	[2.72]	[-1.14]	[0.60]	[-1.83]	[1.34]	[0.17]	
6	0.01	-0.03	0.00	-0.05	0.06	-0.03	0.26
	[2.83]	[-1.11]	[0.12]	[-1.11]	[1.25]	[-0.45]	
7	0.01	-0.03	0.01	-0.01	0.03	-0.10	0.17
	[3.13]	[-1.39]	[0.41]	[-0.14]	[0.72]	[-1.42]	
8	0.01	-0.02	-0.01	0.02	0.02	-0.09	-0.08
	[3.01]	[-0.93]	[-0.29]	[0.42]	[0.50]	[-1.52]	
9	0.01	-0.01	-0.01	0.02	0.00	-0.09	-0.29
	[2.93]	[-0.41]	[-0.52]	[0.62]	[-0.04]	[-1.50]	
10	0.01	0.00	-0.01	0.04	-0.02	-0.10	-0.18
	[3.01]	[-0.23]	[-0.47]	[1.15]	[-0.60]	[-1.87]	
11	0.01	0.00	-0.01	0.03	-0.03	-0.08	-0.31
	[2.92]	[-0.15]	[-0.45]	[0.99]	[-0.77]	[-1.58]	
12	0.01	0.00	-0.02	0.04	-0.02	-0.10	0.13
	[3.01]	[0.02]	[-0.74]	[1.35]	[-0.60]	[-2.22]	

	1966-1993						
k	Intercept	Mkt	SMB	HML	RMW	CMA	Adj.R
1	0.01	-0.01	-0.24	-0.29	0.40	0.23	3.93
	[3.88]	[-0.11]	[-2.20]	[-1.64]	[1.65]	[0.89]	

2	0.01	-0.08	-0.07	-0.16	0.13	0.05	1.60
	[3.99]	[-1.44]	[-0.94]	[-1.44]	[0.79]	[0.27]	
3	0.01	-0.05	-0.05	-0.13	0.01	0.03	0.33
	[3.95]	[-1.00]	[-0.74]	[-1.54]	[0.06]	[0.20]	
4	0.01	-0.04	0.01	-0.10	0.07	0.05	-0.20
	[3.32]	[-0.88]	[0.19]	[-1.37]	[0.62]	[0.43]	
5	0.01	-0.03	0.02	-0.08	0.06	0.02	-0.10
	[3.19]	[-0.73]	[0.37]	[-1.29]	[0.60]	[0.17]	
6	0.02	-0.01	-0.02	-0.04	0.00	-0.09	0.06
	[3.56]	[-0.22]	[-0.43]	[-0.63]	[-0.05]	[-1.00]	
7	0.02	-0.02	-0.03	0.00	-0.01	-0.16	1.04
	[3.87]	[-0.67]	[-0.81]	[0.07]	[-0.09]	[-1.96]	
8	0.02	-0.02	-0.04	0.01	-0.01	-0.16	0.97
	[3.76]	[-0.61]	[-1.02]	[0.31]	[-0.15]	[-2.09]	
9	0.02	0.00	-0.05	0.02	-0.05	-0.16	0.75
	[3.87]	[0.03]	[-1.61]	[0.54]	[-0.76]	[-2.29]	
10	0.02	0.00	-0.03	0.03	-0.05	-0.15	0.36
	[3.58]	[-0.07]	[-1.14]	[0.79]	[-0.69]	[-2.29]	
11	0.02	0.01	-0.04	0.03	-0.05	-0.14	0.52
	[3.52]	[0.27]	[-1.28]	[0.83]	[-0.71]	[-2.35]	
12	0.02	0.00	-0.03	0.03	-0.03	-0.14	1.08
	[3.53]	[-0.22]	[-1.13]	[0.86]	[-0.47]	[-2.56]	

	1994-2021						
k	Intercept	Mkt	SMB	HML	RMW	CMA	Adj.R
1	0.01	-0.55	0.15	-1.10	0.54	0.41	20.32
	[1.44]	[-4.97]	[0.94]	[-6.08]	[2.66]	[1.48]	
2	0.01	-0.28	0.14	-0.47	0.27	0.20	9.28
	[1.27]	[-3.39]	[1.13]	[-3.64]	[1.84]	[0.96]	
3	0.00	-0.07	0.06	-0.28	0.14	0.05	2.30
	[0.85]	[-0.98]	[0.55]	[-2.60]	[1.14]	[0.27]	
4	0.00	-0.03	0.07	-0.12	0.16	-0.05	0.13

	[0.60]	[-0.48]	[0.78]	[-1.24]	[1.46]	[-0.30]	
5	0.00	-0.02	0.03	-0.12	0.12	0.01	-0.09
	[0.53]	[-0.32]	[0.39]	[-1.47]	[1.17]	[0.10]	
6	0.01	-0.04	-0.01	-0.07	0.06	0.01	-0.35
	[0.85]	[-0.75]	[-0.20]	[-0.96]	[0.65]	[0.05]	
7	0.01	-0.03	0.03	-0.02	0.04	-0.06	-0.96
	[0.92]	[-0.69]	[0.48]	[-0.31]	[0.44]	[-0.52]	
8	0.01	-0.02	-0.02	0.00	0.01	-0.04	-1.31
	[0.89]	[-0.43]	[-0.27]	[0.06]	[0.10]	[-0.36]	
9	0.01	0.00	-0.01	0.00	0.01	-0.04	-1.45
	[0.70]	[-0.05]	[-0.10]	[0.04]	[0.12]	[-0.39]	
10	0.01	0.00	-0.01	0.02	-0.02	-0.06	-1.30
	[0.80]	[0.08]	[-0.27]	[0.42]	[-0.30]	[-0.59]	
11	0.01	-0.01	-0.02	0.02	-0.05	-0.02	-1.30
	[0.95]	[-0.13]	[-0.43]	[0.44]	[-0.77]	[-0.25]	
12	0.01	0.02	-0.03	0.02	-0.02	-0.05	-1.00
	[0.65]	[0.43]	[-0.58]	[0.47]	[-0.36]	[-0.58]	

Table 5

Summary statistics of MSR

We report the mean, standard deviation, and skewness of MSR for three sample periods. We define $Momentum\ spread\ ratio$ at month t as:

$$MSR_{t-2}^{i} = \frac{pseudomomspread_{t-(1+i)}^{t-2}}{momspread_{t-12}^{t-2}},$$

where $i \geq 1$. The $momspread_{t-12}^{t-2}$ stands for the return spread of the 0.9 and 0.1 percentile of past month $t-12$ to $t-2$ cumulative returns. Next, we construct the winner portfolios whose past month $t-12$ to $t-2$ cumulative returns are above 0.9 and loser portfolios whose past month $t-12$ to $t-2$ cumulative returns are below 0.1. Then the $pseudomomspread_{t-(1+i)}^{t-2}$ is the month $t-(1+i)$ to $t-2$ return spread of the value-weighted cumulative return as if these stocks, whose are in the winner or loser portfolios at month $t-2$, are always winners and losers from month $t-i$ to $t-2$. The MSR at the beginning of month t is the ratio of $pseudomomspread_{t-i}^{t-2}$ over $momspread_{t-12}^{t-2}$. We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

i	Mean	SD	Skewness	Kurtosis	Mean	SD	Skewness	Kurtosis	Mean	SD	Skewness	Kurtosis
1	0.13	0.10	0.37	8.27	0.13	0.08	-0.11	4.81	0.13	0.11	0.52	8.27
2	0.25	0.13	-0.23	7.71	0.25	0.11	-0.30	6.45	0.25	0.15	-0.21	7.41
3	0.37	0.15	-0.18	6.33	0.37	0.13	-0.09	3.95	0.37	0.17	-0.24	6.62
4	0.49	0.16	-0.39	5.95	0.49	0.14	-0.05	2.57	0.49	0.18	-0.55	6.74
5	0.61	0.17	-1.22	12.13	0.61	0.15	-0.24	2.62	0.61	0.19	-1.63	14.62
6	0.73	0.18	-2.95	36.54	0.73	0.15	-0.32	2.74	0.73	0.20	-3.92	43.37
7	0.86	0.16	-0.70	5.22	0.86	0.15	-0.31	3.01	0.85	0.17	-0.96	6.42
8	0.99	0.15	-0.43	4.29	0.99	0.14	-0.09	3.76	0.99	0.15	-0.69	4.64
9	1.12	0.14	-0.25	5.57	1.12	0.13	0.29	4.60	1.12	0.15	-0.65	6.18
10	1.26	0.12	0.31	5.99	1.26	0.11	0.31	4.31	1.27	0.13	0.26	6.34
11	1.41	0.09	0.42	3.20	1.41	0.08	0.33	2.95	1.42	0.10	0.45	3.20

Table 6

Predicting momentum using stock-level MSR

In every month *t*, we regress monthly momentum profit on MSR constructed at the end of month $t-2$, past month unemployment rate, past 24-month market volatility, past 24-month unemployment rate, and past 36-month market return. We define MSR in month $t-2$ as:

$$MSR_{t-2}^{i} = \frac{pseudomomspread_{t-(1+i)}^{t-2}}{momspread_{t-12}^{t-2}},$$

where $i \geq 1$. The $momspread_{t-12}^{t-2}$ stands for the return spread of the 0.9 and 0.1 percentile of past month $t-12$ to $t-2$ cumulative returns. Next, we construct the winner portfolios whose past month $t-12$ to $t-2$ cumulative returns are above 0.9 and loser portfolios whose past month $t-12$ to $t-2$ cumulative returns are below 0.1. Then the $pseudomomspread_{t-(1+i)}^{t-2}$ is the month $t-(1+i)$ to $t-2$ return spread of the value-weighted cumulative return as if these stocks, whose are in the winner or loser portfolios at month $t-2$, are always winners and losers from month $t-i$ to $t-2$. The MSR at the end of month $t-2$ is the ratio of $pseudomomspread_{t-i}^{t-2}$ over $momspread_{t-12}^{t-2}$. We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

	1966-2021		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.01	[1.59]	0.02	[1.39]	0.01	[0.48]
MSR	-0.06	[-3.37]	-0.03	[-1.34]	-0.07	[-3.08]
lagur	0.00	[-0.14]	0.00	[1.56]	0.00	[-0.15]
lagmktsd	0.02	[0.16]	-0.17	[-0.84]	0.11	[0.51]
lagursd	-0.01	[-2.23]	-0.02	[-1.87]	-0.01	[-1.74]
lagmkt36	0.01	[1.92]	-0.01	[-1.51]	0.02	[2.56]
Adj.R	2.50		0.70		4.53	
2						
Intercept	0.02	[2.15]	0.02	[1.81]	0.01	[0.85]
MSR	-0.05	[-3.96]	-0.04	[-2.21]	-0.06	[-3.29]
lagur	0.00	[-0.14]	0.00	[1.62]	0.00	[-0.14]
lagmktsd	0.02	[0.14]	-0.17	[-0.82]	0.11	[0.49]
lagursd	-0.01	[-2.42]	-0.02	[-2.04]	-0.01	[-1.89]
lagmkt36	0.01	[1.95]	-0.01	[-1.60]	0.02	[2.61]
Adj.R	3.13		1.63		4.92	

3						
Intercept	0.02	[1.94]	0.02	[1.82]	0.01	[0.74]
MSR	-0.03	[-2.76]	-0.03	[-1.84]	-0.04	[-2.21]
lagur	0.00	[-0.17]	0.00	[1.60]	0.00	[-0.18]
lagmktsd	0.02	[0.10]	-0.18	[-0.87]	0.11	[0.47]
lagursd	-0.01	[-2.30]	-0.02	[-2.01]	-0.01	[-1.78]
lagmkt36	0.01	[1.96]	-0.01	[-1.59]	0.02	[2.58]
Adj.R	1.95		1.18		3.23	
4						
Intercept	0.02	[1.87]	0.02	[1.18]	0.02	[1.07]
MSR	-0.02	[-2.31]	-0.01	[-0.55]	-0.04	[-2.48]
lagur	0.00	[-0.21]	0.00	[1.52]	0.00	[-0.23]
lagmktsd	0.01	[0.09]	-0.18	[-0.87]	0.10	[0.42]
lagursd	-0.01	[-2.20]	-0.02	[-1.77]	-0.01	[-1.77]
lagmkt36	0.01	[2.00]	-0.01	[-1.43]	0.02	[2.62]
Adj.R	1.62		0.24		3.59	
5						
Intercept	0.02	[1.81]	0.02	[1.33]	0.02	[1.02]
MSR	-0.02	[-2.05]	-0.01	[-0.81]	-0.03	[-2.07]
lagur	0.00	[-0.23]	0.00	[1.52]	0.00	[-0.27]
lagmktsd	0.01	[0.09]	-0.18	[-0.86]	0.09	[0.41]
lagursd	-0.01	[-2.14]	-0.02	[-1.82]	-0.01	[-1.68]
lagmkt36	0.01	[2.01]	-0.01	[-1.46]	0.02	[2.60]
Adj.R	1.45		0.35		3.05	
6						
Intercept	0.03	[2.27]	0.02	[1.60]	0.02	[1.38]
MSR	-0.02	[-2.61]	-0.02	[-1.21]	-0.03	[-2.49]
lagur	0.00	[-0.28]	0.00	[1.53]	0.00	[-0.31]
lagmktsd	0.01	[0.06]	-0.18	[-0.87]	0.08	[0.37]
lagursd	-0.01	[-2.20]	-0.02	[-1.89]	-0.01	[-1.71]
lagmkt36	0.01	[2.00]	-0.01	[-1.52]	0.02	[2.63]
Adj.R	1.84		0.60		3.60	

7						
Intercept	0.03	[2.11]	0.02	[1.38]	0.03	[1.53]
MSR	-0.02	[-2.20]	-0.01	[-0.91]	-0.04	[-2.26]
lagur	0.00	[-0.25]	0.00	[1.52]	0.00	[-0.30]
lagmktsd	0.01	[0.06]	-0.18	[-0.88]	0.09	[0.39]
lagursd	-0.01	[-2.12]	-0.02	[-1.82]	-0.01	[-1.68]
lagmkt36	0.01	[2.00]	-0.01	[-1.47]	0.02	[2.61]
Adj.R	1.54		0.40		3.29	
8						
Intercept	0.03	[1.83]	0.02	[1.02]	0.03	[1.39]
MSR	-0.02	[-1.77]	-0.01	[-0.50]	-0.03	[-1.91]
lagur	0.00	[-0.21]	0.00	[1.49]	0.00	[-0.22]
lagmktsd	0.01	[0.08]	-0.18	[-0.89]	0.10	[0.45]
lagursd	-0.01	[-2.02]	-0.01	[-1.74]	-0.01	[-1.60]
lagmkt36	0.01	[1.97]	-0.01	[-1.41]	0.02	[2.56]
Adj.R	1.29		0.23		2.87	
9						
Intercept	0.03	[1.94]	0.01	[0.33]	0.05	[1.89]
MSR	-0.02	[-1.87]	0.00	[0.25]	-0.04	[-2.39]
lagur	0.00	[-0.22]	0.00	[1.50]	0.00	[-0.24]
lagmktsd	0.01	[0.09]	-0.18	[-0.86]	0.11	[0.47]
lagursd	-0.01	[-1.96]	-0.01	[-1.68]	-0.01	[-1.58]
lagmkt36	0.01	[1.96]	-0.01	[-1.35]	0.02	[2.54]
Adj.R	1.34		0.17		3.47	
10						
Intercept	0.01	[0.68]	0.00	[-0.18]	0.02	[0.64]
MSR	-0.01	[-0.45]	0.01	[0.67]	-0.02	[-0.84]
lagur	0.00	[-0.14]	0.00	[1.54]	0.00	[-0.23]
lagmktsd	0.02	[0.13]	-0.18	[-0.84]	0.11	[0.48]
lagursd	-0.01	[-1.86]	-0.01	[-1.70]	-0.01	[-1.42]
lagmkt36	0.01	[2.01]	-0.01	[-1.37]	0.02	[2.51]
Adj.R	0.85		0.29		2.01	

11						
Intercept	-0.03	[-0.95]	-0.02	[-0.66]	-0.04	[-1.05]
MSR	0.02	[1.20]	0.02	[1.03]	0.03	[1.03]
lagur	0.00	[0.01]	0.00	[1.63]	0.00	[-0.08]
lagmktsd	0.01	[0.09]	-0.18	[-0.88]	0.09	[0.41]
lagursd	-0.01	[-1.87]	-0.02	[-1.80]	-0.01	[-1.36]
lagmkt36	0.01	[2.00]	-0.01	[-1.47]	0.02	[2.53]
Adj.R	1.04		0.48		2.11	

Table 7

Predicting risk-adjusted momentum using stock-level MSR

Panel A. Fama-French three factors

In every month *t*, we regress monthly risk-adjusted momentum profit on MSR constructed at the end of month $t-2$, past month unemployment rate, past 24-month market volatility, past 24-month unemployment rate, and past 36-month market return. We define MSR at month $t-2$ as:

$$MSR_{t-2}^{i} = \frac{pseudomomspread_{t-(1+i)}^{t-2}}{momspread_{t-12}^{t-2}},$$

where $i \geq 1$. The $momspread_{t-12}^{t-2}$ stands for the return spread of the 0.9 and 0.1 percentile of past month $t-12$ to $t-2$ cumulative returns. Next, we construct the winner portfolios whose past month $t-12$ to $t-2$ cumulative returns are above 0.9 and loser portfolios whose past month $t-12$ to $t-2$ cumulative returns are below 0.1. Then the $pseudomomspread_{t-(1+i)}^{t-2}$ is the month $t-(1+i)$ to $t-2$ return spread of the value-weighted cumulative return as if these stocks, whose are in the winner or loser portfolios at month $t-2$, are always winners and losers from month $t-i$ to $t-2$. The MSR at the end of month $t-2$ is the ratio of $pseudomomspread_{t-i}^{t-2}$ over $momspread_{t-12}^{t-2}$. We define the risk-adjusted momentum as the intercept term (a) plus the error term (ε_t) that are estimated from:

$$R_t = a + bMKT_t + cSMB_t + dHML_t + \varepsilon_t,$$

and

$$R_t = a + bMKT_t + cSMB_t + dHML_t + eCMA_t + fRMW_t + \varepsilon_t,$$

We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

	1966-2021		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.01	[1.35]	0.01	[1.19]	0.00	[-0.04]
MSR	-0.06	[-3.58]	-0.03	[-1.43]	-0.07	[-3.24]
lagur	0.00	[0.05]	0.00	[1.59]	0.00	[0.38]
lagmktsd	0.00	[-0.01]	-0.21	[-1.01]	0.12	[0.51]
lagursd	0.00	[-1.32]	-0.01	[-1.73]	0.00	[-1.04]
lagmkt36	0.01	[1.61]	-0.01	[-1.76]	0.02	[2.84]
Adj.R	1.89		0.86		4.59	

2						
Intercept	0.02	[2.07]	0.02	[1.69]	0.01	[0.47]
MSR	-0.05	[-4.52]	-0.04	[-2.48]	-0.06	[-3.79]
lagur	0.00	[0.04]	0.00	[1.66]	0.00	[0.42]
lagmktsd	-0.01	[-0.04]	-0.20	[-1.00]	0.11	[0.46]
lagursd	-0.01	[-1.58]	-0.02	[-1.94]	-0.01	[-1.26]
lagmkt36	0.01	[1.64]	-0.01	[-1.87]	0.02	[2.93]
Adj.R	2.99		2.09		5.80	
3						
Intercept	0.02	[2.05]	0.02	[1.75]	0.01	[0.64]
MSR	-0.04	[-3.53]	-0.03	[-2.12]	-0.05	[-3.19]
lagur	0.00	[0.00]	0.00	[1.64]	0.00	[0.38]
lagmktsd	-0.01	[-0.09]	-0.21	[-1.05]	0.10	[0.44]
lagursd	-0.01	[-1.52]	-0.02	[-1.92]	-0.01	[-1.25]
lagmkt36	0.01	[1.65]	-0.01	[-1.87]	0.02	[2.92]
Adj.R	1.84		1.59		4.49	
4						
Intercept	0.02	[1.89]	0.02	[1.27]	0.01	[0.83]
MSR	-0.03	[-2.79]	-0.01	[-1.05]	-0.04	[-2.98]
lagur	0.00	[-0.05]	0.00	[1.56]	0.00	[0.31]
lagmktsd	-0.01	[-0.10]	-0.21	[-1.04]	0.09	[0.38]
lagursd	0.00	[-1.36]	-0.01	[-1.72]	0.00	[-1.14]
lagmkt36	0.01	[1.69]	-0.01	[-1.73]	0.02	[2.94]
Adj.R	1.16		0.57		4.09	
5						
Intercept	0.02	[1.79]	0.02	[1.49]	0.01	[0.74]
MSR	-0.02	[-2.40]	-0.02	[-1.36]	-0.03	[-2.40]
lagur	0.00	[-0.06]	0.00	[1.57]	0.00	[0.25]
lagmktsd	-0.01	[-0.09]	-0.21	[-1.04]	0.09	[0.40]
lagursd	0.00	[-1.28]	-0.01	[-1.77]	0.00	[-1.02]
lagmkt36	0.01	[1.70]	-0.01	[-1.77]	0.02	[2.90]
Adj.R	0.85		0.80		3.09	

6						
Intercept	0.02	[2.08]	0.03	[1.88]	0.02	[0.90]
MSR	-0.02	[-2.68]	-0.02	[-1.86]	-0.03	[-2.44]
lagur	0.00	[-0.10]	0.00	[1.58]	0.00	[0.23]
lagmktsd	-0.02	[-0.12]	-0.21	[-1.05]	0.09	[0.38]
lagursd	0.00	[-1.29]	-0.02	[-1.87]	0.00	[-0.98]
lagmkt36	0.01	[1.70]	-0.01	[-1.86]	0.02	[2.90]
Adj.R	1.06		1.29		3.16	
7						
Intercept	0.03	[2.08]	0.03	[1.68]	0.02	[1.16]
MSR	-0.02	[-2.41]	-0.02	[-1.52]	-0.04	[-2.28]
lagur	0.00	[-0.08]	0.00	[1.56]	0.00	[0.22]
lagmktsd	-0.02	[-0.12]	-0.22	[-1.07]	0.09	[0.40]
lagursd	0.00	[-1.23]	-0.01	[-1.76]	0.00	[-0.96]
lagmkt36	0.01	[1.69]	-0.01	[-1.79]	0.02	[2.88]
Adj.R	0.86		0.93		2.91	
8						
Intercept	0.03	[1.80]	0.02	[1.23]	0.02	[1.06]
MSR	-0.02	[-1.95]	-0.01	[-0.93]	-0.03	[-1.93]
lagur	0.00	[-0.03]	0.00	[1.51]	0.00	[0.29]
lagmktsd	-0.01	[-0.10]	-0.22	[-1.08]	0.11	[0.47]
lagursd	0.00	[-1.12]	-0.01	[-1.63]	0.00	[-0.88]
lagmkt36	0.01	[1.67]	-0.01	[-1.69]	0.02	[2.82]
Adj.R	0.56		0.50		2.42	
9						
Intercept	0.03	[1.91]	0.01	[0.69]	0.04	[1.61]
MSR	-0.02	[-2.01]	0.00	[-0.32]	-0.04	[-2.44]
lagur	0.00	[-0.04]	0.00	[1.50]	0.00	[0.26]
lagmktsd	-0.01	[-0.09]	-0.22	[-1.06]	0.12	[0.50]
lagursd	0.00	[-1.04]	-0.01	[-1.55]	0.00	[-0.85]
lagmkt36	0.01	[1.65]	-0.01	[-1.63]	0.02	[2.79]
Adj.R	0.60		0.26		3.16	

10						
Intercept	0.01	[0.45]	0.00	[0.02]	0.01	[0.19]
MSR	0.00	[-0.34]	0.01	[0.35]	-0.01	[-0.63]
lagur	0.00	[0.05]	0.00	[1.54]	0.00	[0.28]
lagmktsd	-0.01	[-0.04]	-0.21	[-1.03]	0.13	[0.53]
lagursd	0.00	[-0.94]	-0.01	[-1.54]	0.00	[-0.68]
lagmkt36	0.01	[1.71]	-0.01	[-1.62]	0.02	[2.77]
Adj.R	0.01		0.27		1.33	
11						
Intercept	-0.05	[-1.80]	-0.03	[-0.88]	-0.07	[-1.75]
MSR	0.04	[1.98]	0.03	[1.19]	0.04	[1.58]
lagur	0.00	[0.27]	0.00	[1.68]	0.00	[0.49]
lagmktsd	-0.02	[-0.12]	-0.22	[-1.07]	0.09	[0.38]
lagursd	0.00	[-0.96]	-0.01	[-1.67]	0.00	[-0.63]
lagmkt36	0.01	[1.69]	-0.01	[-1.73]	0.02	[2.83]
Adj.R	0.58		0.66		2.02	

Panel B. Fama-French five factors

	1966-2021		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.01	[1.39]	0.01	[1.25]	0.01	[0.39]
MSR	-0.03	[-2.91]	-0.01	[-0.86]	-0.05	[-2.96]
lagur	0.00	[-0.15]	0.00	[1.53]	0.00	[-0.20]
lagmktsd	0.02	[0.15]	-0.18	[-0.89]	0.12	[0.54]
lagursd	-0.01	[-2.17]	-0.01	[-1.77]	-0.01	[-1.77]
lagmkt36	0.01	[1.95]	-0.01	[-1.47]	0.02	[2.60]
Adj.R	2.08		0.38		4.34	
2						
Intercept	0.02	[1.76]	0.02	[2.01]	0.01	[0.41]
MSR	-0.03	[-3.23]	-0.03	[-2.71]	-0.03	[-2.31]
lagur	0.00	[-0.11]	0.00	[1.64]	0.00	[-0.12]
lagmktsd	0.01	[0.08]	-0.21	[-1.02]	0.11	[0.51]
lagursd	-0.01	[-2.27]	-0.02	[-2.02]	-0.01	[-1.73]
lagmkt36	0.01	[1.98]	-0.01	[-1.69]	0.02	[2.63]
Adj.R	2.36		2.36		3.36	
3						
Intercept	0.02	[1.79]	0.03	[2.25]	0.01	[0.41]
MSR	-0.02	[-2.68]	-0.03	[-2.78]	-0.02	[-1.73]
lagur	0.00	[-0.13]	0.00	[1.68]	0.00	[-0.14]
lagmktsd	0.01	[0.08]	-0.21	[-1.03]	0.11	[0.49]
lagursd	-0.01	[-2.23]	-0.02	[-2.13]	-0.01	[-1.66]
lagmkt36	0.01	[1.97]	-0.01	[-1.79]	0.02	[2.61]
Adj.R	1.89		2.48		2.68	
4						
Intercept	0.02	[1.60]	0.02	[1.85]	0.01	[0.49]
MSR	-0.01	[-1.97]	-0.02	[-1.75]	-0.02	[-1.59]
lagur	0.00	[-0.16]	0.00	[1.60]	0.00	[-0.17]
lagmktsd	0.01	[0.08]	-0.20	[-0.98]	0.11	[0.48]
lagursd	-0.01	[-2.12]	-0.02	[-1.98]	-0.01	[-1.62]

lagmkt36	0.01	[1.99]	-0.01	[-1.64]	0.02	[2.62]
Adj.R	1.40		1.09		2.54	
5						
Intercept	0.02	[1.65]	0.03	[2.04]	0.01	[0.56]
MSR	-0.01	[-1.87]	-0.02	[-1.95]	-0.01	[-1.42]
lagur	0.00	[-0.20]	0.00	[1.58]	0.00	[-0.22]
lagmktsd	0.01	[0.09]	-0.21	[-1.01]	0.11	[0.48]
lagursd	-0.01	[-2.10]	-0.02	[-1.99]	-0.01	[-1.59]
lagmkt36	0.01	[2.01]	-0.01	[-1.69]	0.02	[2.62]
Adj.R	1.34		1.31		2.39	
6						
Intercept	0.03	[2.22]	0.03	[2.24]	0.02	[1.16]
MSR	-0.02	[-2.56]	-0.02	[-2.14]	-0.02	[-2.17]
lagur	0.00	[-0.26]	0.00	[1.58]	0.00	[-0.25]
lagmktsd	0.01	[0.08]	-0.22	[-1.07]	0.12	[0.53]
lagursd	-0.01	[-2.17]	-0.02	[-1.98]	-0.01	[-1.71]
lagmkt36	0.01	[2.02]	-0.01	[-1.73]	0.02	[2.73]
Adj.R	1.80		1.54		3.18	
7						
Intercept	0.02	[1.70]	0.03	[1.96]	0.02	[0.87]
MSR	-0.01	[-1.69]	-0.02	[-1.69]	-0.02	[-1.47]
lagur	0.00	[-0.22]	0.00	[1.55]	0.00	[-0.25]
lagmktsd	0.02	[0.11]	-0.22	[-1.04]	0.12	[0.54]
lagursd	-0.01	[-2.03]	-0.02	[-1.87]	-0.01	[-1.58]
lagmkt36	0.01	[2.03]	-0.01	[-1.63]	0.02	[2.66]
Adj.R	1.25		1.02		2.44	
8						
Intercept	0.02	[1.37]	0.03	[1.43]	0.02	[0.90]
MSR	-0.01	[-1.23]	-0.01	[-1.00]	-0.02	[-1.34]
lagur	0.00	[-0.20]	0.00	[1.49]	0.00	[-0.25]
lagmktsd	0.02	[0.13]	-0.21	[-0.99]	0.13	[0.57]
lagursd	-0.01	[-1.95]	-0.01	[-1.76]	-0.01	[-1.54]

lagmkt36	0.01	[2.03]	-0.01	[-1.50]	0.02	[2.65]
Adj.R	1.05		0.45		2.32	
9						
Intercept	0.01	[0.82]	0.01	[0.36]	0.03	[1.06]
MSR	-0.01	[-0.57]	0.00	[0.24]	-0.02	[-1.41]
lagur	0.00	[-0.16]	0.00	[1.50]	0.00	[-0.27]
lagmktsd	0.02	[0.15]	-0.17	[-0.83]	0.14	[0.63]
lagursd	-0.01	[-1.88]	-0.01	[-1.68]	-0.01	[-1.52]
lagmkt36	0.01	[2.03]	-0.01	[-1.34]	0.02	[2.68]
Adj.R	0.87		0.17		2.38	
10						
Intercept	-0.01	[-0.71]	0.01	[0.24]	-0.02	[-0.76]
MSR	0.01	[1.09]	0.00	[0.26]	0.01	[0.74]
lagur	0.00	[-0.03]	0.00	[1.50]	0.00	[-0.15]
lagmktsd	0.02	[0.10]	-0.17	[-0.83]	0.08	[0.36]
lagursd	-0.01	[-1.79]	-0.01	[-1.69]	-0.01	[-1.28]
lagmkt36	0.01	[1.96]	-0.01	[-1.36]	0.02	[2.36]
Adj.R	1.00		0.17		1.96	
11						
Intercept	-0.07	[-2.48]	-0.01	[-0.34]	-0.12	[-2.76]
MSR	0.04	[2.81]	0.01	[0.73]	0.07	[2.82]
lagur	0.00	[0.07]	0.00	[1.55]	0.00	[-0.05]
lagmktsd	-0.02	[-0.16]	-0.16	[-0.77]	-0.07	[-0.31]
lagursd	-0.01	[-1.61]	-0.01	[-1.75]	0.00	[-0.78]
lagmkt36	0.01	[1.80]	-0.01	[-1.38]	0.02	[2.00]
Adj.R	2.00		0.31		4.11	

Table 8

Predicting industry momentum using industry-level MSR

In every month *t*, we regress monthly industry momentum profit on industry-level MSR constructed at the end of month $t-1$, past month unemployment rate, past 24-month market volatility, past 24-month unemployment rate, and past 36-month market return. We define MSR at month $t-1$ as:

$$MSR_{t-1}^{i} = \frac{pseudomomspread_{t-i}^{t-1}}{momspread_{t-6}^{t-1}},$$

where $i \geq 1$. The $momspread_{t-6}^{t-1}$ stands for the return spread of the 0.9 and 0.1 percentile of past month $t-6$ to $t-1$ cumulative industry portfolio returns. Next, we construct the winner portfolios whose past month $t-12$ to $t-2$ cumulative returns are above 0.9 and loser portfolios whose past month $t-6$ to $t-1$ cumulative returns are below 0.1. Then the$pseudomomspread_{t-i}^{t-1}$ is the month $t-i$ to $t-1$ return spread of the value-weighted cumulative return as if industry portfolios, whose are in the winner or loser portfolios at month $t-1$, are always winners and losers from month $t-i$ to $t-1$. The MSR at the end of month $t-1$ is the ratio of $pseudomomspread_{t-i}^{t-1}$ over $momspread_{t-6}^{t-1}$. We define the risk-adjusted momentum as the intercept term (a) plus the error term (ε_t) that are estimated from:

$$R_t = a + bMKT_t + cSMB_t + dHML_t + \varepsilon_t.$$

We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

Panel A. Predicting industry momentum using industry-level MSR

	1966-2021		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.02	[1.65]	0.03	[1.53]	0.01	[0.66]
MSR	0.00	[-0.33]	0.01	[0.43]	-0.01	[-0.74]
lagur	0.00	[-0.96]	0.00	[0.12]	0.00	[-0.78]
lagmktsd	-0.25	[-1.11]	-0.50	[-1.49]	-0.07	[-0.24]
lagursd	0.01	[0.89]	-0.01	[-0.91]	0.01	[1.29]
lagmkt36	0.01	[1.21]	-0.01	[-0.58]	0.02	[1.59]
Adj.R	0.07		0.55		0.19	
2						
Intercept	0.03	[1.96]	0.04	[1.51]	0.03	[1.17]
MSR	-0.01	[-1.14]	0.00	[0.29]	-0.03	[-1.72]
lagur	0.00	[-0.99]	0.00	[0.09]	0.00	[-0.84]

lagmktsd	-0.26	[-1.17]	-0.50	[-1.50]	-0.11	[-0.34]
lagursd	0.01	[0.91]	-0.01	[-0.90]	0.01	[1.37]
lagmkt36	0.01	[1.18]	-0.01	[-0.58]	0.02	[1.59]
Adj.R	0.26		0.52		0.94	
3						
Intercept	0.03	[1.79]	0.04	[1.55]	0.02	[0.91]
MSR	-0.01	[-0.76]	0.00	[-0.03]	-0.01	[-1.03]
lagur	0.00	[-0.95]	0.00	[0.11]	0.00	[-0.73]
lagmktsd	-0.25	[-1.14]	-0.50	[-1.50]	-0.09	[-0.30]
lagursd	0.01	[0.87]	-0.01	[-0.93]	0.01	[1.27]
lagmkt36	0.01	[1.21]	-0.01	[-0.60]	0.02	[1.65]
Adj.R	0.14		0.49		0.35	
4						
Intercept	0.02	[1.05]	0.03	[1.07]	0.01	[0.48]
MSR	0.00	[0.43]	0.01	[0.80]	0.00	[-0.16]
lagur	0.00	[-0.93]	0.00	[0.07]	0.00	[-0.73]
lagmktsd	-0.23	[-1.06]	-0.50	[-1.52]	-0.07	[-0.22]
lagursd	0.01	[0.88]	-0.01	[-0.81]	0.01	[1.25]
lagmkt36	0.01	[1.22]	-0.01	[-0.55]	0.02	[1.62]
Adj.R	0.08		0.72		0.02	
5						
Intercept	0.03	[1.78]	0.01	[0.41]	0.04	[1.56]
MSR	-0.01	[-0.97]	0.02	[1.18]	-0.02	[-1.85]
lagur	0.00	[-0.88]	0.00	[0.15]	0.00	[-0.75]
lagmktsd	-0.26	[-1.19]	-0.50	[-1.50]	-0.11	[-0.34]
lagursd	0.01	[0.94]	-0.01	[-0.78]	0.01	[1.40]
lagmkt36	0.01	[1.34]	0.00	[-0.36]	0.02	[1.70]
Adj.R	0.25		0.87		1.08	
6						
Intercept	0.03	[1.32]	0.01	[0.28]	0.03	[1.01]
MSR	0.00	[-0.51]	0.01	[0.81]	-0.01	[-0.94]
lagur	0.00	[-0.86]	0.00	[0.32]	0.00	[-0.77]

lagmktsd	-0.26	[-1.17]	-0.49	[-1.50]	-0.08	[-0.25]
lagursd	0.01	[0.94]	-0.01	[-0.91]	0.01	[1.34]
lagmkt36	0.01	[1.41]	0.00	[-0.40]	0.02	[1.66]
Adj.R	0.16		0.57		0.29	

Panel B. Predicting risk-adjusted industry momentum using industry-level MSR

	1966-2021		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.02	[1.34]	0.02	[0.84]	0.01	[0.35]
MSR	0.00	[-0.30]	0.01	[0.46]	-0.01	[-0.71]
lagur	0.00	[-0.69]	0.00	[0.66]	0.00	[-0.06]
lagmktsd	-0.25	[-1.16]	-0.45	[-1.40]	-0.21	[-0.60]
lagursd	0.01	[1.30]	-0.01	[-0.87]	0.01	[1.38]
lagmkt36	0.01	[0.87]	-0.01	[-0.94]	0.02	[1.80]
Adj.R	-0.19		-0.02		0.49	
2						
Intercept	0.02	[1.65]	0.02	[0.86]	0.02	[0.91]
MSR	-0.01	[-1.15]	0.00	[0.28]	-0.03	[-1.76]
lagur	0.00	[-0.71]	0.00	[0.63]	0.00	[-0.09]
lagmktsd	-0.26	[-1.23]	-0.45	[-1.40]	-0.26	[-0.75]
lagursd	0.01	[1.33]	-0.01	[-0.87]	0.01	[1.48]
lagmkt36	0.01	[0.85]	-0.01	[-0.94]	0.02	[1.79]
Adj.R	0.01		-0.06		1.39	
3						
Intercept	0.02	[1.56]	0.02	[0.92]	0.02	[0.75]
MSR	-0.01	[-0.87]	0.00	[-0.04]	-0.02	[-1.25]
lagur	0.00	[-0.68]	0.00	[0.64]	0.00	[0.01]
lagmktsd	-0.26	[-1.21]	-0.45	[-1.41]	-0.25	[-0.72]
lagursd	0.01	[1.28]	-0.01	[-0.89]	0.01	[1.38]
lagmkt36	0.01	[0.88]	-0.01	[-0.97]	0.02	[1.86]
Adj.R	-0.08		-0.09		0.86	
4						
Intercept	0.01	[0.81]	0.01	[0.39]	0.01	[0.30]
MSR	0.00	[0.38]	0.01	[0.97]	0.00	[-0.31]
lagur	0.00	[-0.65]	0.00	[0.59]	0.00	[0.00]
lagmktsd	-0.24	[-1.12]	-0.46	[-1.43]	-0.22	[-0.61]
lagursd	0.01	[1.29]	-0.01	[-0.75]	0.01	[1.36]

lagmkt36	0.01	[0.89]	-0.01	[-0.91]	0.02	[1.83]
Adj.R	-0.18		0.25		0.35	
5						
Intercept	0.02	[1.25]	-0.01	[-0.29]	0.03	[1.12]
MSR	-0.01	[-0.56]	0.02	[1.47]	-0.02	[-1.51]
lagur	0.00	[-0.60]	0.00	[0.66]	0.00	[0.01]
lagmktsd	-0.26	[-1.22]	-0.45	[-1.41]	-0.27	[-0.77]
lagursd	0.01	[1.33]	-0.01	[-0.71]	0.01	[1.47]
lagmkt36	0.01	[1.00]	-0.01	[-0.72]	0.02	[1.88]
Adj.R	-0.11		0.61		1.11	
6						
Intercept	0.02	[0.77]	-0.01	[-0.31]	0.02	[0.62]
MSR	0.00	[-0.06]	0.02	[1.03]	-0.01	[-0.70]
lagur	0.00	[-0.56]	0.00	[0.84]	0.00	[-0.02]
lagmktsd	-0.26	[-1.19]	-0.45	[-1.41]	-0.23	[-0.66]
lagursd	0.01	[1.30]	-0.01	[-0.87]	0.01	[1.41]
lagmkt36	0.01	[1.04]	-0.01	[-0.80]	0.02	[1.85]
Adj.R	-0.15		0.20		0.48	

Panel C. Predicting risk-adjusted industry momentum using stock-level MSR

	1966-2021		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.01	[0.78]	0.00	[0.19]	0.00	[0.23]
MSR	0.02	[0.86]	0.04	[1.56]	-0.01	[-0.23]
lagur	0.00	[-0.60]	0.00	[0.79]	0.00	[-0.02]
lagmktsd	-0.24	[-1.13]	-0.41	[-1.29]	-0.20	[-0.57]
lagursd	0.01	[1.35]	-0.01	[-0.80]	0.01	[1.32]
lagmkt36	0.01	[0.92]	-0.01	[-0.84]	0.02	[1.82]
Adj.R	-0.09		0.77		0.33	
2						
Intercept	0.03	[1.74]	0.01	[0.53]	0.03	[1.43]
MSR	-0.02	[-1.16]	0.01	[0.49]	-0.06	[-2.28]
lagur	0.00	[-0.76]	0.00	[0.69]	0.00	[-0.14]
lagmktsd	-0.26	[-1.21]	-0.43	[-1.35]	-0.22	[-0.65]
lagursd	0.01	[1.17]	-0.01	[-0.84]	0.01	[1.13]
lagmkt36	0.01	[0.81]	-0.01	[-0.89]	0.02	[1.80]
Adj.R	0.01		-0.01		2.12	
3						
Intercept	0.03	[1.86]	0.02	[0.69]	0.05	[1.72]
MSR	-0.02	[-1.33]	0.00	[0.01]	-0.06	[-2.27]
lagur	0.00	[-0.76]	0.00	[0.67]	0.00	[-0.10]
lagmktsd	-0.27	[-1.23]	-0.45	[-1.40]	-0.23	[-0.67]
lagursd	0.01	[1.09]	-0.01	[-0.89]	0.01	[1.00]
lagmkt36	0.01	[0.80]	-0.01	[-0.95]	0.02	[1.80]
Adj.R	0.08		-0.09		2.10	
4						
Intercept	0.02	[0.83]	0.00	[0.10]	0.04	[1.15]
MSR	0.00	[-0.09]	0.02	[0.71]	-0.04	[-1.32]
lagur	0.00	[-0.68]	0.00	[0.71]	0.00	[-0.07]
lagmktsd	-0.25	[-1.15]	-0.43	[-1.33]	-0.22	[-0.64]
lagursd	0.01	[1.28]	-0.01	[-0.80]	0.01	[1.24]

lagmkt36	0.01	[0.88]	-0.01	[-0.88]	0.02	[1.86]
Adj.R	-0.21		0.09		0.92	
5						
Intercept	0.01	[0.32]	-0.02	[-0.53]	0.04	[0.92]
MSR	0.01	[0.33]	0.03	[1.27]	-0.03	[-0.98]
lagur	0.00	[-0.64]	0.00	[0.77]	0.00	[-0.06]
lagmktsd	-0.25	[-1.14]	-0.44	[-1.36]	-0.21	[-0.60]
lagursd	0.01	[1.31]	-0.01	[-0.79]	0.01	[1.32]
lagmkt36	0.01	[0.88]	-0.01	[-0.90]	0.02	[1.85]
Adj.R	-0.19		0.48		0.65	
6						
Intercept	-0.05	[-1.19]	-0.07	[-1.22]	-0.06	[-0.85]
MSR	0.05	[1.64]	0.06	[1.68]	0.04	[0.93]
lagur	0.00	[-0.53]	0.00	[0.83]	0.00	[0.11]
lagmktsd	-0.25	[-1.16]	-0.44	[-1.37]	-0.21	[-0.61]
lagursd	0.01	[1.25]	-0.01	[-1.02]	0.01	[1.32]
lagmkt36	0.01	[0.85]	-0.01	[-1.11]	0.02	[1.86]
Adj.R	0.23		0.90		0.62	

Table 9

Predicting residual momentum using stock-level MSR

In every month t, we regress monthly momentum and risk-adjusted momentum profit on residual-level MSR constructed at the end of month $t-2$, past month unemployment rate, past 24-month market volatility, past 24-month unemployment rate, and past 36-month market return. We define MSR at month $t-2$ as:

$$Residual\_MSR_{t-2}^{i} = \frac{pseudoresidual\_momspread_{t-(1+i)}^{t-2}}{residual\_momspread_{t-12}^{t-2}},$$

where $i \geq 1$. The $residual\_momspread_{t-12}^{t-2}$ is the return spread between top and bottom deciles based on prior 11-month residual returns from month t -12 to t -2 scaled by their standard deviation over the same period, and $pseudoresidual\_momspread_{t-(1+i)}^{t-2}$ is the month $t-(1+i)$ to $t-2$ return spread of the value-weighted cumulative residual return as if these stocks, whose are winner stocks and loser stocks in month $t-2$, are always winners and losers from month $t-i$ to $t-2$. The residual-level MSR at the end of month t-2 is the ratio of$pseudoresidual_momspread_{t-(1+i)}^{t-2}$ over $residual\_momspread_{t-12}^{t-2}$. We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

We define the risk-adjusted momentum as the intercept term (a) plus the error term (ε_t) that are estimated from:

$$R_t = a + bMKT_t + cSMB_t + dHML_t + \varepsilon_t.$$

We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

Panel A. Predicting residual momentum using stock-level MSR

	1966-2021		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.00	[-0.26]	-0.01	[-0.47]	-0.01	[-0.55]
MSR	-0.02	[-1.16]	0.02	[0.70]	-0.04	[-2.13]
lagur	0.00	[-0.01]	0.00	[1.95]	0.00	[-0.58]
lagmktsd	0.11	[0.78]	-0.04	[-0.16]	0.22	[1.19]
lagursd	0.00	[0.86]	-0.01	[-1.53]	0.01	[1.68]
lagmkt36	0.01	[1.73]	-0.02	[-1.82]	0.02	[2.94]
Adj.R	0.21		0.41		3.70	

2						
Intercept	0.00	[-0.30]	-0.01	[-0.42]	-0.01	[-0.49]
MSR	-0.01	[-0.67]	0.01	[0.42]	-0.02	[-1.49]
lagur	0.00	[-0.01]	0.00	[1.95]	0.00	[-0.61]
lagmktsd	0.11	[0.77]	-0.04	[-0.15]	0.22	[1.16]
lagursd	0.00	[0.89]	-0.01	[-1.56]	0.01	[1.73]
lagmkt36	0.01	[1.76]	-0.02	[-1.85]	0.02	[2.95]
Adj.R	0.06		0.30		3.00	
3						
Intercept	0.00	[-0.10]	0.00	[-0.04]	-0.01	[-0.39]
MSR	-0.01	[-0.85]	-0.01	[-0.38]	-0.02	[-1.27]
lagur	0.00	[-0.04]	0.00	[1.91]	0.00	[-0.62]
lagmktsd	0.11	[0.76]	-0.05	[-0.19]	0.22	[1.16]
lagursd	0.00	[0.88]	-0.02	[-1.66]	0.01	[1.71]
lagmkt36	0.01	[1.75]	-0.02	[-1.94]	0.02	[2.95]
Adj.R	0.10		0.29		2.81	
4						
Intercept	0.00	[0.40]	0.01	[0.63]	0.00	[-0.09]
MSR	-0.02	[-1.52]	-0.02	[-1.43]	-0.02	[-1.50]
lagur	0.00	[-0.16]	0.00	[1.82]	0.00	[-0.70]
lagmktsd	0.10	[0.72]	-0.06	[-0.27]	0.21	[1.13]
lagursd	0.00	[0.91]	-0.02	[-1.83]	0.01	[1.79]
lagmkt36	0.01	[1.77]	-0.02	[-2.08]	0.02	[2.99]
Adj.R	0.37		0.96		3.01	
5						
Intercept	0.00	[0.36]	0.03	[1.35]	-0.01	[-0.50]
MSR	-0.01	[-1.26]	-0.04	[-2.42]	-0.01	[-0.59]
lagur	0.00	[-0.15]	0.00	[1.71]	0.00	[-0.61]
lagmktsd	0.10	[0.73]	-0.08	[-0.34]	0.21	[1.14]
lagursd	0.00	[0.92]	-0.02	[-1.97]	0.01	[1.74]
lagmkt36	0.01	[1.77]	-0.02	[-2.23]	0.02	[2.92]
Adj.R	0.25		2.26		2.42	

6						
Intercept	0.00	[-0.06]	0.03	[1.32]	-0.01	[-0.86]
MSR	-0.01	[-0.56]	-0.03	[-2.21]	0.00	[0.07]
lagur	0.00	[-0.04]	0.00	[1.74]	0.00	[-0.51]
lagmktsd	0.11	[0.76]	-0.08	[-0.33]	0.22	[1.16]
lagursd	0.00	[0.92]	-0.02	[-1.93]	0.01	[1.70]
lagmkt36	0.01	[1.77]	-0.02	[-2.22]	0.02	[2.88]
Adj.R	0.04		1.93		2.32	
7						
Intercept	0.00	[0.09]	0.02	[1.03]	-0.01	[-0.52]
MSR	-0.01	[-0.62]	-0.03	[-1.66]	0.00	[-0.22]
lagur	0.00	[-0.06]	0.00	[1.77]	0.00	[-0.56]
lagmktsd	0.11	[0.75]	-0.07	[-0.31]	0.22	[1.15]
lagursd	0.00	[0.93]	-0.02	[-1.80]	0.01	[1.72]
lagmkt36	0.01	[1.77]	-0.02	[-2.11]	0.02	[2.90]
Adj.R	0.05		1.20		2.33	
8						
Intercept	0.00	[-0.04]	0.03	[1.02]	-0.02	[-0.79]
MSR	0.00	[-0.38]	-0.03	[-1.52]	0.00	[0.21]
lagur	0.00	[-0.01]	0.00	[1.76]	0.00	[-0.50]
lagmktsd	0.11	[0.77]	-0.08	[-0.32]	0.22	[1.16]
lagursd	0.00	[0.92]	-0.02	[-1.72]	0.01	[1.68]
lagmkt36	0.01	[1.77]	-0.02	[-2.04]	0.02	[2.87]
Adj.R	0.01		1.04		2.33	
9						
Intercept	0.00	[-0.02]	0.01	[0.40]	-0.01	[-0.43]
MSR	0.00	[-0.35]	-0.01	[-0.68]	0.00	[-0.16]
lagur	0.00	[0.01]	0.00	[1.85]	0.00	[-0.54]
lagmktsd	0.11	[0.77]	-0.05	[-0.23]	0.22	[1.16]
lagursd	0.00	[0.92]	-0.02	[-1.63]	0.01	[1.71]
lagmkt36	0.01	[1.77]	-0.02	[-1.95]	0.02	[2.89]
Adj.R	0.00		0.40		2.33	

10						
Intercept	-0.01	[-0.59]	-0.01	[-0.21]	-0.02	[-0.89]
MSR	0.00	[0.35]	0.00	[0.09]	0.01	[0.45]
lagur	0.00	[0.08]	0.00	[1.93]	0.00	[-0.51]
lagmktsd	0.11	[0.79]	-0.04	[-0.16]	0.22	[1.16]
lagursd	0.00	[0.91]	-0.02	[-1.63]	0.01	[1.72]
lagmkt36	0.01	[1.77]	-0.02	[-1.91]	0.02	[2.88]
Adj.R	0.00		0.24		2.38	
11						
Intercept	-0.04	[-1.49]	-0.05	[-1.31]	-0.06	[-1.73]
MSR	0.02	[1.36]	0.04	[1.31]	0.04	[1.46]
lagur	0.00	[0.06]	0.00	[2.01]	0.00	[-0.54]
lagmktsd	0.10	[0.71]	-0.05	[-0.23]	0.20	[1.06]
lagursd	0.00	[1.02]	-0.02	[-1.76]	0.01	[1.94]
lagmkt36	0.01	[1.77]	-0.02	[-2.05]	0.02	[2.97]
Adj.R	0.29		0.84		2.97	

Panel B. Predicting risk-adjusted residual momentum using stock-level MSR

	1966-2021		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.01	[1.22]	0.02	[1.33]	0.00	[-0.21]
MSR	-0.05	[-3.28]	-0.03	[-1.24]	-0.07	[-3.05]
lagur	0.00	[0.33]	0.00	[0.94]	0.00	[0.66]
lagmktsd	-0.02	[-0.12]	-0.31	[-1.43]	0.11	[0.47]
lagursd	-0.01	[-1.46]	-0.01	[-1.10]	-0.01	[-1.16]
lagmkt36	0.01	[1.25]	-0.01	[-1.68]	0.02	[2.73]
Adj.R	1.83		0.68		4.45	
2						
Intercept	0.02	[2.07]	0.03	[1.98]	0.01	[0.38]
MSR	-0.05	[-4.43]	-0.05	[-2.60]	-0.06	[-3.70]
lagur	0.00	[0.13]	0.00	[0.85]	0.00	[0.56]
lagmktsd	-0.03	[-0.20]	-0.33	[-1.52]	0.10	[0.42]
lagursd	-0.01	[-1.44]	-0.01	[-1.29]	-0.01	[-1.09]
lagmkt36	0.01	[1.28]	-0.01	[-1.84]	0.02	[2.84]
Adj.R	3.22		2.47		5.87	
3						
Intercept	0.02	[2.07]	0.04	[2.10]	0.01	[0.54]
MSR	-0.04	[-3.57]	-0.04	[-2.42]	-0.05	[-3.11]
lagur	0.00	[0.13]	0.00	[0.83]	0.00	[0.53]
lagmktsd	-0.03	[-0.23]	-0.34	[-1.59]	0.10	[0.40]
lagursd	-0.01	[-1.46]	-0.01	[-1.30]	-0.01	[-1.12]
lagmkt36	0.01	[1.28]	-0.01	[-1.87]	0.02	[2.83]
Adj.R	2.14		2.18		4.58	
4						
Intercept	0.02	[1.92]	0.03	[1.77]	0.01	[0.72]
MSR	-0.03	[-2.86]	-0.03	[-1.63]	-0.04	[-2.84]
lagur	0.00	[0.09]	0.00	[0.84]	0.00	[0.42]
lagmktsd	-0.04	[-0.24]	-0.33	[-1.53]	0.09	[0.36]
lagursd	-0.01	[-1.34]	-0.01	[-1.20]	-0.01	[-0.96]

lagmkt36	0.01	[1.35]	-0.01	[-1.76]	0.02	[2.86]
Adj.R	1.42		1.08		4.05	
5						
Intercept	0.02	[1.84]	0.04	[2.06]	0.01	[0.62]
MSR	-0.03	[-2.51]	-0.03	[-2.01]	-0.03	[-2.28]
lagur	0.00	[0.09]	0.00	[0.78]	0.00	[0.41]
lagmktsd	-0.03	[-0.23]	-0.34	[-1.56]	0.09	[0.37]
lagursd	-0.01	[-1.31]	-0.01	[-1.24]	-0.01	[-0.95]
lagmkt36	0.01	[1.36]	-0.01	[-1.81]	0.02	[2.81]
Adj.R	1.11		1.55		3.08	
6						
Intercept	0.03	[2.09]	0.05	[2.52]	0.01	[0.72]
MSR	-0.03	[-2.72]	-0.04	[-2.61]	-0.03	[-2.23]
lagur	0.00	[0.05]	0.00	[0.74]	0.00	[0.40]
lagmktsd	-0.04	[-0.26]	-0.35	[-1.62]	0.09	[0.36]
lagursd	-0.01	[-1.30]	-0.01	[-1.33]	-0.01	[-0.94]
lagmkt36	0.01	[1.36]	-0.01	[-1.93]	0.02	[2.80]
Adj.R	1.29		2.49		3.02	
7						
Intercept	0.03	[2.14]	0.05	[2.37]	0.02	[0.96]
MSR	-0.03	[-2.53]	-0.03	[-2.30]	-0.03	[-2.05]
lagur	0.00	[0.05]	0.00	[0.75]	0.00	[0.36]
lagmktsd	-0.04	[-0.26]	-0.35	[-1.62]	0.09	[0.38]
lagursd	-0.01	[-1.25]	-0.01	[-1.20]	-0.01	[-0.90]
lagmkt36	0.01	[1.36]	-0.01	[-1.84]	0.02	[2.79]
Adj.R	1.13		1.99		2.75	
8						
Intercept	0.03	[1.78]	0.04	[1.77]	0.02	[0.84]
MSR	-0.02	[-1.97]	-0.02	[-1.47]	-0.03	[-1.68]
lagur	0.00	[0.18]	0.00	[0.80]	0.00	[0.47]
lagmktsd	-0.03	[-0.21]	-0.34	[-1.56]	0.11	[0.45]
lagursd	-0.01	[-1.24]	-0.01	[-1.04]	-0.01	[-0.94]

lagmkt36	0.01	[1.34]	-0.01	[-1.68]	0.02	[2.73]
Adj.R	0.72		0.90		2.28	
9						
Intercept	0.03	[1.83]	0.03	[1.17]	0.04	[1.34]
MSR	-0.02	[-1.97]	-0.01	[-0.73]	-0.04	[-2.17]
lagur	0.00	[0.25]	0.00	[0.89]	0.00	[0.50]
lagmktsd	-0.03	[-0.19]	-0.32	[-1.47]	0.11	[0.48]
lagursd	-0.01	[-1.26]	-0.01	[-0.96]	-0.01	[-0.99]
lagmkt36	0.01	[1.31]	-0.01	[-1.60]	0.02	[2.70]
Adj.R	0.72		0.33		2.92	
10						
Intercept	0.01	[0.29]	0.01	[0.32]	0.00	[-0.09]
MSR	0.00	[-0.21]	0.00	[0.18]	-0.01	[-0.39]
lagur	0.00	[0.47]	0.00	[0.98]	0.00	[0.67]
lagmktsd	-0.02	[-0.12]	-0.30	[-1.40]	0.12	[0.49]
lagursd	-0.01	[-1.32]	-0.01	[-0.97]	-0.01	[-1.10]
lagmkt36	0.01	[1.35]	-0.01	[-1.55]	0.02	[2.64]
Adj.R	0.09		0.15		1.36	
11						
Intercept	-0.05	[-1.81]	-0.04	[-1.02]	-0.08	[-1.73]
MSR	0.04	[1.99]	0.04	[1.52]	0.04	[1.51]
lagur	0.00	[0.50]	0.00	[1.06]	0.00	[0.71]
lagmktsd	-0.03	[-0.22]	-0.32	[-1.49]	0.09	[0.35]
lagursd	-0.01	[-1.16]	-0.01	[-1.12]	-0.01	[-0.82]
lagmkt36	0.01	[1.35]	-0.01	[-1.72]	0.02	[2.73]
Adj.R	0.73		0.95		2.10	

Table 10

Out-of-sample prediction

This table reports the out-of-sample R-squared for the model:

$$MOM_t = \alpha + \beta_1 * MSR_{t-2}^{i} + \beta_2 * LagUR_t + \beta_3 * LagMKTSD_t + \beta_4 * LagURSD_t + \beta_5 * LagMKTRET_t + \varepsilon_t.$$

The training window is 120 and 240 months, respectively, and we forecast the momentum both for the future month *t* (monthly prediction), and future month *t* to $t + 11$ (annual prediciton). To train the model, in every month *t*, we regress monthly momentum profit on MSR constructed at the end of month $t - 2$, past month unemployment rate, past 24-month market volatility, past 24-month unemployment rate, and past 36-month market return. We define MSR in month $t - 2$ as:

$$MSR_{t-2}^{i} = \frac{pseudomomspread_{t-(1+i)}^{t-2}}{momspread_{t-12}^{t-2}},$$

where $i \geq 1$. The $momspread_{t-12}^{t-2}$ stands for the return spread of the 0.9 and 0.1 percentile of past month $t - 12$ to $t - 2$ cumulative returns. Next, we construct the winner portfolios whose past month $t - 12$ to $t - 2$ cumulative returns are above 0.9 and loser portfolios whose past month $t - 12$ to $t - 2$ cumulative returns are below 0.1. Then the $pseudomomspread_{t-(1+i)}^{t-2}$ is the month $t - (1 + i)$ to $t - 2$ return spread of the value-weighted cumulative return as if these stocks, whose are in the winner or loser portfolios at month $t - 2$, are always winners and losers from month $t - i$ to $t - 2$. The MSR at the end of month $t - 2$ is the ratio of $pseudomomspread_{t-i}^{t-2}$ over $momspread_{t-12}^{t-2}$. We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

Panel A. Training window=120 months

	Monthly Prediction			Annual Prediction		
i	1966-2021	1966-1993	1994-2021	1966-2021	1966-1993	1994-2021
1	-0.07	0.01	-0.17	-0.32	-0.05	-0.34
2	-0.07	0.02	-0.19	-0.35	-0.09	-0.49
3	-0.09	0.00	-0.16	-0.36	-0.12	-0.37
4	-0.10	-0.02	-0.18	-0.38	-0.15	-0.44
5	-0.09	-0.02	-0.18	-0.36	-0.16	-0.42
6	-0.08	-0.01	-0.12	-0.36	-0.14	-0.27
7	-0.08	-0.01	-0.09	-0.35	-0.16	-0.22
8	-0.08	0.00	-0.07	-0.30	-0.09	-0.13

9	-0.09	0.00	-0.04	-0.27	-0.04	-0.07
10	-0.10	0.00	-0.05	-0.32	-0.05	-0.13
11	-0.11	0.01	-0.19	-0.45	-0.04	-0.58

Panel B. Training window=240 months

	Monthly Prediction			Annual Prediction		
i	1966-2021	1966-1993	1994-2021	1966-2021	1966-1993	1994-2021
1	-0.03	0.03	-0.15	-0.17	-0.06	-0.11
2	-0.02	0.01	-0.08	-0.18	-0.09	-0.10
3	-0.03	0.04	-0.08	-0.17	-0.05	-0.08
4	-0.03	0.04	-0.07	-0.16	-0.05	-0.09
5	-0.02	0.04	-0.07	-0.16	-0.06	-0.07
6	-0.02	0.04	-0.06	-0.17	-0.07	-0.05
7	-0.02	0.04	-0.04	-0.17	-0.07	-0.04
8	-0.02	0.04	-0.05	-0.16	-0.07	-0.03
9	-0.03	0.05	-0.03	-0.14	-0.03	0.00
10	-0.04	0.05	-0.05	-0.16	-0.03	-0.01
11	-0.03	0.06	-0.09	-0.16	-0.01	-0.08

Table 11

Predicting momentum with residual-level MSR

In every month *t*, we regress monthly risk-adjusted momentum profit on MSR constructed at the end of month $t-2$, past month unemployment rate, past 24-month market volatility, past 24-month unemployment rate, and past 36-month market return. We define MSR at month $t-2$ as:

$$MSR_{t-2}^{i} = \frac{pseudomomspread_{t-(1+i)}^{t-2}}{momspread_{t-12}^{t-2}},$$

where $i \geq 1$. The $momspread_{t-12}^{t-2}$ stands for the return spread of the 0.9 and 0.1 percentile of past month $t-12$ to $t-2$ cumulative returns. Next, we construct the winner portfolios whose past month $t-12$ to $t-2$ cumulative returns are above 0.9 and loser portfolios whose past month $t-12$ to $t-2$ cumulative returns are below 0.1. Then the $pseudomomspread_{t-(1+i)}^{t-2}$ is the month $t-(1+i)$ to $t-2$ return spread of the value-weighted cumulative return as if these stocks, whose are in the winner or loser portfolios at month $t-2$, are always winners and losers from month $t-i$ to $t-2$. The MSR at the end of month $t-2$ is the ratio of $pseudomomspread_{t-i}^{t-2}$ over $momspread_{t-12}^{t-2}$. We define the risk-adjusted momentum as the intercept term (a) plus the error term (ε_t) that are estimated from:

$$R_t = a + bMKT_t + cSMB_t + dHML_t + \varepsilon_t,$$

Panel A. Predicting momentum using residual-level MSR

	1966-201		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.01	[1.34]	0.03	[2.19]	0.00	[0.18]
MSR	-0.95	[-1.91]	-0.76	[-1.29]	-1.36	[-1.74]
lagur	0.00	[-0.37]	0.00	[0.32]	0.00	[-0.33]
lagmktsd	0.07	[0.42]	-0.30	[-1.36]	0.25	[1.03]
lagursd	-0.01	[-1.80]	-0.01	[-0.88]	-0.01	[-1.62]
lagmkt36	0.01	[1.86]	-0.01	[-1.78]	0.02	[2.74]
Adj.R	1.31		1.33		2.69	
2						
Intercept	0.01	[1.52]	0.03	[2.03]	0.01	[0.60]
MSR	-0.67	[-1.93]	-0.12	[-0.28]	-1.32	[-2.42]
lagur	0.00	[-0.45]	0.00	[0.22]	0.00	[-0.55]

lagmktsd	0.09	[0.54]	-0.30	[-1.37]	0.36	[1.45]
lagursd	-0.01	[-1.76]	-0.01	[-0.92]	-0.01	[-1.68]
lagmkt36	0.01	[1.90]	-0.01	[-1.75]	0.02	[2.89]
Adj.R	1.32		0.75		3.51	
3						
Intercept	0.02	[1.76]	0.04	[2.60]	0.01	[0.41]
MSR	-0.60	[-2.15]	-0.83	[-2.27]	-0.63	[-1.45]
lagur	0.00	[-0.62]	0.00	[0.51]	0.00	[-0.53]
lagmktsd	0.11	[0.67]	-0.28	[-1.27]	0.29	[1.11]
lagursd	-0.01	[-1.62]	-0.01	[-0.83]	-0.01	[-1.45]
lagmkt36	0.01	[1.91]	-0.01	[-1.86]	0.02	[2.71]
Adj.R	1.46		2.57		2.42	
4						
Intercept	0.02	[1.50]	0.04	[2.56]	0.00	[0.17]
MSR	-0.32	[-1.55]	-0.67	[-2.03]	-0.27	[-0.94]
lagur	0.00	[-0.58]	0.00	[0.56]	0.00	[-0.42]
lagmktsd	0.08	[0.47]	-0.27	[-1.25]	0.21	[0.84]
lagursd	-0.01	[-1.53]	-0.01	[-0.84]	-0.01	[-1.34]
lagmkt36	0.01	[1.83]	-0.01	[-1.88]	0.02	[2.60]
Adj.R	1.10		2.20		2.06	
5						
Intercept	0.01	[1.00]	0.04	[2.60]	0.00	[-0.24]
MSR	-0.06	[-0.42]	-0.64	[-2.05]	0.02	[0.10]
lagur	0.00	[-0.39]	0.00	[0.65]	0.00	[-0.16]
lagmktsd	0.02	[0.14]	-0.26	[-1.18]	0.10	[0.42]
lagursd	-0.01	[-1.63]	-0.01	[-0.86]	-0.01	[-1.38]
lagmkt36	0.01	[1.72]	-0.02	[-1.94]	0.02	[2.48]
Adj.R	0.73		2.23		1.80	
6						
Intercept	0.02	[1.57]	0.04	[2.45]	0.01	[0.38]
MSR	-0.29	[-1.50]	-0.52	[-1.63]	-0.32	[-1.09]
lagur	0.00	[-0.52]	0.00	[0.67]	0.00	[-0.47]

lagmktsd	0.10	[0.58]	-0.26	[-1.17]	0.28	[1.01]
lagursd	-0.01	[-1.74]	-0.01	[-0.92]	-0.01	[-1.53]
lagmkt36	0.01	[1.81]	-0.02	[-1.91]	0.02	[2.63]
Adj.R	1.10		1.69		2.15	
7						
Intercept	0.02	[1.48]	0.04	[2.19]	0.01	[0.44]
MSR	-0.24	[-1.27]	-0.26	[-0.82]	-0.31	[-1.11]
lagur	0.00	[-0.50]	0.00	[0.37]	0.00	[-0.48]
lagmktsd	0.09	[0.55]	-0.28	[-1.24]	0.30	[1.05]
lagursd	-0.01	[-1.74]	-0.01	[-0.80]	-0.01	[-1.57]
lagmkt36	0.01	[1.75]	-0.01	[-1.84]	0.02	[2.61]
Adj.R	0.97		0.94		2.16	
8						
Intercept	0.01	[0.96]	0.03	[1.97]	0.00	[-0.07]
MSR	-0.07	[-0.41]	-0.15	[-0.48]	-0.05	[-0.18]
lagur	0.00	[-0.36]	0.00	[0.34]	0.00	[-0.23]
lagmktsd	0.04	[0.21]	-0.28	[-1.23]	0.14	[0.49]
lagursd	-0.01	[-1.72]	-0.01	[-0.87]	-0.01	[-1.39]
lagmkt36	0.01	[1.73]	-0.01	[-1.76]	0.02	[2.51]
Adj.R	0.76		0.77		1.81	
9						
Intercept	0.01	[0.94]	0.04	[1.99]	0.00	[-0.14]
MSR	-0.07	[-0.40]	-0.19	[-0.63]	-0.02	[-0.06]
lagur	0.00	[-0.35]	0.00	[0.41]	0.00	[-0.20]
lagmktsd	0.04	[0.21]	-0.26	[-1.15]	0.12	[0.41]
lagursd	-0.01	[-1.72]	-0.01	[-0.88]	-0.01	[-1.36]
lagmkt36	0.01	[1.74]	-0.01	[-1.76]	0.02	[2.50]
Adj.R	0.77		0.82		1.80	
10						
Intercept	0.01	[1.08]	0.04	[2.23]	0.00	[-0.13]
MSR	-0.10	[-0.64]	-0.32	[-1.12]	-0.02	[-0.07]
lagur	0.00	[-0.37]	0.00	[0.55]	0.00	[-0.20]

lagmktsd	0.06	[0.33]	-0.23	[-1.00]	0.12	[0.41]
lagursd	-0.01	[-1.74]	-0.01	[-0.77]	-0.01	[-1.36]
lagmkt36	0.01	[1.74]	-0.01	[-1.80]	0.02	[2.50]
Adj.R	0.81		1.14		1.80	
11						
Intercept	0.01	[0.50]	0.04	[1.92]	-0.01	[-0.71]
MSR	0.04	[0.26]	-0.15	[-0.56]	0.19	[0.83]
lagur	0.00	[-0.24]	0.00	[0.36]	0.00	[0.06]
lagmktsd	-0.02	[-0.11]	-0.26	[-1.13]	-0.07	[-0.23]
lagursd	-0.01	[-1.70]	-0.01	[-0.79]	-0.01	[-1.11]
lagmkt36	0.01	[1.75]	-0.01	[-1.73]	0.02	[2.50]
Adj.R	0.77		0.78		2.00	

Panel B. Predicting risk-adjusted momentum using residual-level MSR

	1966-201		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.01	[0.99]	0.02	[1.61]	0.00	[-0.33]
MSR	-0.72	[-1.53]	-0.47	[-0.82]	-1.61	[-2.05]
lagur	0.00	[-0.22]	0.00	[0.59]	0.00	[0.08]
lagmktsd	0.02	[0.15]	-0.31	[-1.45]	0.31	[1.22]
lagursd	0.00	[-0.87]	-0.01	[-0.90]	0.00	[-0.97]
lagmkt36	0.01	[1.62]	-0.01	[-1.89]	0.02	[3.07]
Adj.R	0.31		0.91		2.59	
2						
Intercept	0.01	[1.09]	0.02	[1.61]	0.00	[-0.04]
MSR	-0.44	[-1.33]	-0.05	[-0.12]	-1.23	[-2.25]
lagur	0.00	[-0.30]	0.00	[0.41]	0.00	[-0.12]
lagmktsd	0.03	[0.22]	-0.32	[-1.49]	0.40	[1.49]
lagursd	0.00	[-0.81]	-0.01	[-0.81]	0.00	[-0.96]
lagmkt36	0.01	[1.57]	-0.02	[-1.97]	0.03	[3.13]
Adj.R	0.17		0.72		2.86	
3						
Intercept	0.01	[1.46]	0.03	[2.15]	0.00	[-0.01]
MSR	-0.53	[-1.97]	-0.78	[-2.18]	-0.76	[-1.77]
lagur	0.00	[-0.47]	0.00	[0.76]	0.00	[-0.20]
lagmktsd	0.07	[0.44]	-0.29	[-1.38]	0.37	[1.35]
lagursd	0.00	[-0.70]	-0.01	[-0.77]	0.00	[-0.76]
lagmkt36	0.01	[1.63]	-0.02	[-2.08]	0.02	[3.02]
Adj.R	0.52		2.43		2.23	
4						
Intercept	0.01	[1.26]	0.03	[2.20]	0.00	[-0.25]
MSR	-0.28	[-1.47]	-0.64	[-2.00]	-0.37	[-1.32]
lagur	0.00	[-0.47]	0.00	[0.72]	0.00	[-0.08]
lagmktsd	0.04	[0.29]	-0.29	[-1.37]	0.29	[1.07]
lagursd	0.00	[-0.60]	-0.01	[-0.70]	0.00	[-0.61]

lagmkt36	0.01	[1.55]	-0.02	[-2.10]	0.02	[2.92]
Adj.R	0.23		2.14		1.77	
5						
Intercept	0.01	[0.74]	0.04	[2.24]	-0.01	[-0.71]
MSR	-0.04	[-0.29]	-0.62	[-2.02]	-0.02	[-0.12]
lagur	0.00	[-0.27]	0.00	[0.83]	0.00	[0.27]
lagmktsd	-0.01	[-0.06]	-0.28	[-1.30]	0.14	[0.54]
lagursd	0.00	[-0.72]	-0.01	[-0.74]	0.00	[-0.65]
lagmkt36	0.01	[1.44]	-0.02	[-2.17]	0.02	[2.76]
Adj.R	-0.11		2.18		1.20	
6						
Intercept	0.01	[1.30]	0.03	[2.08]	0.00	[0.18]
MSR	-0.24	[-1.32]	-0.46	[-1.46]	-0.50	[-1.72]
lagur	0.00	[-0.42]	0.00	[0.75]	0.00	[-0.26]
lagmktsd	0.06	[0.37]	-0.28	[-1.31]	0.44	[1.46]
lagursd	0.00	[-0.78]	-0.01	[-0.74]	0.00	[-0.95]
lagmkt36	0.01	[1.51]	-0.02	[-2.13]	0.02	[2.99]
Adj.R	0.16		1.47		2.18	
7						
Intercept	0.01	[1.15]	0.03	[1.76]	0.00	[0.26]
MSR	-0.18	[-1.04]	-0.23	[-0.74]	-0.47	[-1.70]
lagur	0.00	[-0.36]	0.00	[0.59]	0.00	[-0.28]
lagmktsd	0.05	[0.30]	-0.29	[-1.34]	0.47	[1.50]
lagursd	0.00	[-0.81]	-0.01	[-0.76]	0.00	[-1.02]
lagmkt36	0.01	[1.48]	-0.02	[-2.02]	0.02	[2.95]
Adj.R	0.05		0.89		2.15	
8						
Intercept	0.01	[0.76]	0.03	[1.72]	0.00	[-0.12]
MSR	-0.05	[-0.33]	-0.15	[-0.48]	-0.24	[-0.92]
lagur	0.00	[-0.30]	0.00	[0.42]	0.00	[-0.04]
lagmktsd	0.01	[0.04]	-0.30	[-1.36]	0.32	[1.01]
lagursd	0.00	[-0.74]	-0.01	[-0.64]	0.00	[-0.83]

lagmkt36	0.01	[1.40]	-0.02	[-2.02]	0.02	[2.84]
Adj.R	-0.14		0.77		1.48	
9						
Intercept	0.01	[0.74]	0.03	[1.75]	0.00	[-0.27]
MSR	-0.05	[-0.35]	-0.21	[-0.73]	-0.15	[-0.62]
lagur	0.00	[-0.27]	0.00	[0.58]	0.00	[0.06]
lagmktsd	0.01	[0.04]	-0.28	[-1.24]	0.26	[0.81]
lagursd	0.00	[-0.77]	-0.01	[-0.70]	0.00	[-0.77]
lagmkt36	0.01	[1.44]	-0.02	[-2.01]	0.02	[2.80]
Adj.R	-0.10		0.87		1.32	
10						
Intercept	0.01	[0.83]	0.04	[1.97]	0.00	[-0.27]
MSR	-0.07	[-0.49]	-0.34	[-1.20]	-0.14	[-0.57]
lagur	0.00	[-0.28]	0.00	[0.74]	0.00	[0.09]
lagmktsd	0.02	[0.12]	-0.24	[-1.08]	0.26	[0.78]
lagursd	0.00	[-0.79]	-0.01	[-0.62]	0.00	[-0.78]
lagmkt36	0.01	[1.44]	-0.02	[-2.03]	0.02	[2.79]
Adj.R	-0.08		1.20		1.30	
11						
Intercept	0.00	[0.30]	0.03	[1.76]	-0.02	[-0.97]
MSR	0.05	[0.36]	-0.20	[-0.78]	0.13	[0.57]
lagur	0.00	[-0.18]	0.00	[0.56]	0.00	[0.49]
lagmktsd	-0.05	[-0.29]	-0.27	[-1.17]	-0.02	[-0.06]
lagursd	0.00	[-0.73]	-0.01	[-0.59]	0.00	[-0.46]
lagmkt36	0.01	[1.42]	-0.02	[-1.99]	0.02	[2.76]
Adj.R	-0.11		0.89		1.30	

Panel C. Predicting risk-adjusted momentum using residual-level MSR based on 25th and 75th percentile

	1966-201		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.01	[0.98]	0.02	[1.60]	-0.01	[-0.46]
MSR	-0.50	[-1.76]	-0.32	[-0.89]	-1.05	[-2.31]
lagur	0.00	[-0.24]	0.00	[0.61]	0.00	[0.09]
lagmktsd	0.03	[0.20]	-0.31	[-1.44]	0.32	[1.29]
lagursd	0.00	[-0.83]	-0.01	[-0.93]	0.00	[-0.90]
lagmkt36	0.01	[1.64]	-0.01	[-1.91]	0.03	[3.13]
Adj.R	0.43		0.96		2.96	
2						
Intercept	0.01	[1.28]	0.03	[1.75]	0.00	[-0.10]
MSR	-0.45	[-2.19]	-0.23	[-0.89]	-0.99	[-2.99]
lagur	0.00	[-0.34]	0.00	[0.52]	0.00	[-0.13]
lagmktsd	0.07	[0.46]	-0.31	[-1.43]	0.48	[1.83]
lagursd	0.00	[-0.88]	-0.01	[-0.84]	0.00	[-1.11]
lagmkt36	0.01	[1.69]	-0.02	[-1.99]	0.03	[3.35]
Adj.R	0.67		1.01		4.11	
3						
Intercept	0.02	[1.68]	0.04	[2.35]	0.00	[0.03]
MSR	-0.47	[-2.74]	-0.75	[-3.29]	-0.65	[-2.33]
lagur	0.00	[-0.48]	0.00	[1.03]	0.00	[-0.26]
lagmktsd	0.11	[0.71]	-0.28	[-1.31]	0.47	[1.68]
lagursd	0.00	[-0.92]	-0.01	[-0.98]	0.00	[-1.06]
lagmkt36	0.01	[1.79]	-0.02	[-2.12]	0.03	[3.20]
Adj.R	1.11		4.57		2.98	
4						
Intercept	0.02	[1.97]	0.04	[2.48]	0.01	[0.45]
MSR	-0.45	[-3.06]	-0.67	[-3.15]	-0.71	[-2.99]
lagur	0.00	[-0.63]	0.00	[1.08]	0.00	[-0.59]
lagmktsd	0.14	[0.89]	-0.27	[-1.29]	0.61	[2.13]
lagursd	0.00	[-0.85]	-0.01	[-0.98]	0.00	[-1.09]

lagmkt36	0.01	[1.83]	-0.02	[-2.19]	0.03	[3.36]
Adj.R	1.39		4.25		4.11	
5						
Intercept	0.01	[1.42]	0.04	[2.43]	0.00	[-0.08]
MSR	-0.22	[-1.77]	-0.57	[-2.80]	-0.29	[-1.58]
lagur	0.00	[-0.47]	0.00	[1.18]	0.00	[-0.19]
lagmktsd	0.07	[0.45]	-0.27	[-1.29]	0.36	[1.29]
lagursd	0.00	[-0.76]	-0.01	[-1.00]	0.00	[-0.81]
lagmkt36	0.01	[1.63]	-0.02	[-2.20]	0.02	[2.99]
Adj.R	0.39		3.54		2.02	
6						
Intercept	0.02	[1.64]	0.04	[2.26]	0.01	[0.50]
MSR	-0.25	[-2.04]	-0.41	[-1.99]	-0.48	[-2.46]
lagur	0.00	[-0.47]	0.00	[0.99]	0.00	[-0.54]
lagmktsd	0.10	[0.66]	-0.28	[-1.33]	0.59	[1.96]
lagursd	0.00	[-0.91]	-0.01	[-0.88]	-0.01	[-1.20]
lagmkt36	0.01	[1.62]	-0.02	[-2.14]	0.03	[3.12]
Adj.R	0.55		2.14		3.19	
7						
Intercept	0.02	[1.50]	0.04	[2.11]	0.01	[0.52]
MSR	-0.20	[-1.71]	-0.34	[-1.57]	-0.42	[-2.29]
lagur	0.00	[-0.42]	0.00	[0.96]	0.00	[-0.53]
lagmktsd	0.09	[0.58]	-0.28	[-1.29]	0.59	[1.90]
lagursd	0.00	[-0.90]	-0.01	[-0.87]	-0.01	[-1.19]
lagmkt36	0.01	[1.55]	-0.02	[-2.09]	0.02	[3.00]
Adj.R	0.36		1.59		2.92	
8						
Intercept	0.01	[1.08]	0.04	[2.09]	0.00	[0.07]
MSR	-0.10	[-0.87]	-0.29	[-1.30]	-0.23	[-1.31]
lagur	0.00	[-0.36]	0.00	[0.79]	0.00	[-0.21]
lagmktsd	0.05	[0.28]	-0.27	[-1.26]	0.41	[1.27]
lagursd	0.00	[-0.80]	-0.01	[-0.71]	0.00	[-0.94]

lagmkt36	0.01	[1.44]	-0.02	[-2.08]	0.02	[2.86]
Adj.R	-0.03		1.32		1.76	
9						
Intercept	0.01	[1.29]	0.04	[2.26]	0.00	[0.18]
MSR	-0.13	[-1.27]	-0.38	[-1.73]	-0.24	[-1.41]
lagur	0.00	[-0.38]	0.00	[1.05]	0.00	[-0.27]
lagmktsd	0.08	[0.48]	-0.24	[-1.08]	0.45	[1.36]
lagursd	0.00	[-0.87]	-0.01	[-0.75]	0.00	[-0.99]
lagmkt36	0.01	[1.49]	-0.02	[-2.05]	0.02	[2.82]
Adj.R	0.15		1.78		1.86	
10						
Intercept	0.01	[1.21]	0.05	[2.63]	0.00	[-0.01]
MSR	-0.11	[-1.12]	-0.51	[-2.39]	-0.17	[-1.02]
lagur	0.00	[-0.34]	0.00	[1.31]	0.00	[-0.12]
lagmktsd	0.07	[0.44]	-0.19	[-0.85]	0.38	[1.10]
lagursd	0.00	[-0.87]	0.00	[-0.55]	0.00	[-0.93]
lagmkt36	0.01	[1.47]	-0.02	[-2.03]	0.02	[2.78]
Adj.R	0.09		2.78		1.54	
11						
Intercept	0.01	[0.70]	0.05	[2.57]	-0.01	[-0.71]
MSR	-0.03	[-0.28]	-0.48	[-2.18]	0.02	[0.16]
lagur	0.00	[-0.25]	0.00	[1.19]	0.00	[0.34]
lagmktsd	0.01	[0.04]	-0.17	[-0.74]	0.08	[0.24]
lagursd	0.00	[-0.78]	0.00	[-0.29]	0.00	[-0.57]
lagmkt36	0.01	[1.42]	-0.01	[-1.95]	0.02	[2.77]
Adj.R	-0.12		2.44		1.20	[1.20]

Table 12. Limits-to-arbitrage

We strictly follow Amihud (2002) to construct the illiquidity measure, Illiq, as the ratio of absolute daily stock return to daily dollar trading volume, averaged over the prior six months. The stock must have at least 50 daily observations to be included in the portfolio. At the beginning of each month *t*, we sort stocks into two 25 (5*5) portfolios based on size and Illiq. Monthly quintile returns are calculated for the current month *t*, and portfolios are rebalanced at the beginning of month $t+1$. T-values are reported in the brackets for the first 5 columns, and two sample z-test is reported in the bracket for the last column. We use Fama-French three-factor to adjust the momentum return for all portfolios and We adopt NYSE breakpoints to cut all the portfolios.

Panel A. Predicting momentum by size quintiles using stock-level MSR

	1966-2021											
i	ME1		ME2		ME3		ME4		ME5		ME5-1	
1	-0.04	[-2.08]	-0.07	[-3.71]	-0.06	[-2.96]	-0.05	[-2.22]	-0.07	[-3.10]	0.03	[0.23]
2	-0.05	[-3.97]	-0.07	[-4.91]	-0.07	[-4.15]	-0.06	[-3.62]	-0.06	[-3.27]	0.00	[0.03]
3	-0.04	[-3.29]	-0.04	[-3.35]	-0.04	[-2.94]	-0.04	[-2.77]	-0.04	[-2.76]	0.00	[0.03]
4	-0.03	[-2.33]	-0.04	[-3.02]	-0.03	[-2.30]	-0.03	[-2.24]	-0.03	[-1.96]	0.00	[0.02]
5	-0.02	[-1.85]	-0.03	[-2.43]	-0.02	[-1.87]	-0.03	[-1.85]	-0.03	[-2.01]	0.01	[0.07]
6	-0.02	[-2.22]	-0.03	[-2.44]	-0.03	[-2.13]	-0.03	[-2.29]	-0.03	[-2.36]	0.01	[0.07]
7	-0.03	[-2.42]	-0.03	[-2.25]	-0.03	[-1.87]	-0.03	[-2.13]	-0.03	[-2.06]	0.00	[0.02]
8	-0.03	[-2.28]	-0.03	[-2.07]	-0.02	[-1.63]	-0.03	[-1.80]	-0.02	[-1.21]	-0.01	[-0.07]
9	-0.03	[-2.06]	-0.03	[-1.88]	-0.02	[-1.45]	-0.03	[-1.59]	-0.03	[-1.46]	0.00	[-0.02]
10	0.00	[0.01]	-0.01	[-0.31]	0.00	[-0.18]	-0.01	[-0.42]	0.00	[-0.17]	0.00	[0.02]
11	0.05	[2.64]	0.05	[2.17]	0.03	[1.16]	0.04	[1.64]	0.05	[1.74]	0.01	[0.05]
	1966-1993											
i	ME1		ME2		ME3		ME4		ME5		ME5-1	
1	0.00	[-0.14]	-0.03	[-1.30]	-0.04	[-1.20]	-0.02	[-0.71]	-0.05	[-1.20]	0.04	[0.21]
2	-0.04	[-2.29]	-0.06	[-2.97]	-0.05	[-2.10]	-0.04	[-1.90]	-0.05	[-1.77]	0.01	[0.04]
3	-0.04	[-2.28]	-0.04	[-2.42]	-0.02	[-1.26]	-0.03	[-1.65]	-0.04	[-1.57]	0.00	[0.01]
4	-0.02	[-1.22]	-0.02	[-1.43]	-0.01	[-0.52]	-0.01	[-0.60]	-0.02	[-0.79]	0.00	[0.00]
5	-0.01	[-0.95]	-0.02	[-1.23]	0.00	[-0.23]	-0.02	[-0.95]	-0.03	[-1.26]	0.01	[0.09]
6	-0.02	[-1.76]	-0.03	[-1.74]	-0.01	[-0.68]	-0.03	[-1.85]	-0.04	[-1.68]	0.01	[0.08]
7	-0.02	[-1.57]	-0.02	[-1.37]	-0.01	[-0.33]	-0.03	[-1.44]	-0.03	[-1.46]	0.01	[0.06]
8	-0.01	[-0.85]	-0.01	[-0.87]	0.00	[-0.02]	-0.03	[-1.29]	-0.02	[-0.80]	0.01	[0.04]
9	-0.01	[-0.50]	0.00	[-0.29]	0.01	[0.52]	-0.02	[-0.85]	-0.01	[-0.21]	0.00	[-0.02]

10	0.00	[-0.03]	0.00	[0.06]	0.01	[0.55]	-0.01	[-0.56]	0.02	[0.82]	-0.02	[-0.14]
11	0.01	[0.23]	0.01	[0.37]	0.01	[0.35]	0.01	[0.30]	0.07	[1.85]	-0.06	[-0.33]
	1994-2021											
i	ME1		ME2		ME3		ME4		ME5		ME5-1	
1	-0.06	[-2.11]	-0.10	[-3.39]	-0.08	[-2.60]	-0.07	[-2.01]	-0.09	[-2.88]	0.03	[0.19]
2	-0.06	[-3.16]	-0.08	[-3.96]	-0.08	[-3.54]	-0.07	[-3.01]	-0.07	[-2.94]	0.01	[0.04]
3	-0.05	[-2.60]	-0.05	[-2.76]	-0.06	[-2.88]	-0.06	[-2.49]	-0.06	[-2.75]	0.01	[0.08]
4	-0.04	[-2.18]	-0.05	[-2.98]	-0.05	[-2.70]	-0.05	[-2.55]	-0.04	[-2.19]	0.01	[0.05]
5	-0.03	[-1.92]	-0.04	[-2.51]	-0.05	[-2.51]	-0.04	[-1.98]	-0.04	[-1.95]	0.01	[0.05]
6	-0.03	[-1.98]	-0.04	[-2.29]	-0.04	[-2.56]	-0.04	[-2.04]	-0.04	[-2.05]	0.01	[0.05]
7	-0.04	[-2.21]	-0.04	[-2.20]	-0.05	[-2.41]	-0.05	[-1.99]	-0.04	[-1.71]	0.00	[-0.02]
8	-0.05	[-2.32]	-0.04	[-2.07]	-0.05	[-2.08]	-0.04	[-1.57]	-0.02	[-1.04]	-0.02	[-0.14]
9	-0.05	[-2.55]	-0.05	[-2.29]	-0.05	[-2.28]	-0.04	[-1.70]	-0.04	[-1.74]	-0.01	[-0.06]
10	-0.01	[-0.30]	-0.01	[-0.44]	-0.02	[-0.61]	-0.01	[-0.36]	-0.02	[-0.66]	0.01	[0.07]
11	0.08	[2.61]	0.08	[2.30]	0.05	[1.32]	0.06	[1.52]	0.03	[0.78]	0.05	[0.27]

Panel B. Predicting momentum by liquidity quintiles using stock-level MSR

	1966-2021											
i	ILLIQ1		ILLIQ2		ILLIQ3		ILLIQ4		ILLIQ5		ILLIQ 5-1	
1	-0.08	[-3.18]	-0.07	[-2.87]	-0.08	[-3.37]	-0.07	[-3.57]	-0.03	[-1.79]	-0.04	[-0.33]
2	-0.08	[-4.25]	-0.08	[-4.60]	-0.08	[-4.77]	-0.08	[-5.42]	-0.04	[-3.28]	-0.03	[-0.27]
3	-0.06	[-3.61]	-0.06	[-3.59]	-0.05	[-3.31]	-0.05	[-4.06]	-0.04	[-3.13]	-0.02	[-0.18]
4	-0.04	[-2.68]	-0.04	[-2.86]	-0.03	[-2.29]	-0.04	[-3.08]	-0.02	[-1.95]	-0.02	[-0.17]
5	-0.03	[-2.16]	-0.03	[-2.22]	-0.02	[-1.65]	-0.03	[-2.40]	-0.02	[-1.42]	-0.02	[-0.15]
6	-0.03	[-2.34]	-0.03	[-1.97]	-0.03	[-1.95]	-0.03	[-2.56]	-0.02	[-1.79]	-0.01	[-0.14]
7	-0.04	[-2.39]	-0.03	[-2.00]	-0.03	[-1.84]	-0.03	[-2.39]	-0.02	[-1.96]	-0.01	[-0.13]
8	-0.03	[-1.46]	-0.03	[-1.77]	-0.02	[-1.55]	-0.03	[-1.88]	-0.03	[-1.99]	0.00	[0.00]
9	-0.03	[-1.84]	-0.03	[-1.38]	-0.03	[-1.50]	-0.03	[-1.70]	-0.02	[-1.59]	-0.01	[-0.10]
10	-0.01	[-0.69]	0.00	[-0.17]	0.00	[-0.01]	-0.01	[-0.61]	-0.01	[-0.33]	-0.01	[-0.07]
11	0.03	[1.11]	0.04	[1.57]	0.04	[1.80]	0.04	[1.78]	0.03	[1.61]	0.00	[-0.02]
	1966-1993											
i	ILLIQ1		ILLIQ2		ILLIQ3		ILLIQ4		ILLIQ5		ILLIQ 5-1	
1	-0.04	[-1.01]	-0.08	[-2.15]	-0.06	[-1.74]	-0.05	[-1.63]	-0.02	[-0.98]	-0.01	[-0.09]
2	-0.05	[-1.77]	-0.07	[-2.97]	-0.07	[-3.06]	-0.07	[-3.22]	-0.05	[-2.72]	0.00	[0.00]
3	-0.04	[-1.64]	-0.05	[-2.32]	-0.04	[-2.07]	-0.04	[-2.21]	-0.03	[-2.17]	-0.01	[-0.05]
4	-0.02	[-0.97]	-0.02	[-1.12]	-0.02	[-1.10]	-0.02	[-0.91]	-0.02	[-1.13]	-0.01	[-0.04]
5	-0.03	[-1.43]	-0.03	[-1.59]	-0.01	[-0.74]	-0.02	[-0.91]	-0.01	[-0.73]	-0.02	[-0.17]
6	-0.04	[-1.81]	-0.04	[-1.89]	-0.02	[-1.21]	-0.03	[-1.65]	-0.02	[-1.27]	-0.02	[-0.18]
7	-0.04	[-1.61]	-0.03	[-1.30]	-0.02	[-1.04]	-0.02	[-0.99]	-0.01	[-0.86]	-0.02	[-0.19]
8	-0.02	[-1.02]	-0.03	[-1.23]	-0.02	[-1.08]	-0.01	[-0.50]	-0.01	[-0.51]	-0.02	[-0.13]
9	0.00	[-0.15]	0.00	[-0.21]	-0.01	[-0.67]	0.00	[0.13]	0.00	[0.10]	-0.01	[-0.04]
10	0.02	[0.71]	0.01	[0.29]	0.00	[-0.13]	0.00	[-0.05]	0.00	[-0.22]	0.03	[0.18]
11	0.07	[1.85]	0.03	[0.82]	0.03	[0.83]	0.02	[0.70]	0.00	[-0.01]	0.07	[0.44]
	1994-2021											
i	ILLIQ1		ILLIQ2		ILLIQ3		ILLIQ4		ILLIQ5		ILLIQ5-1	
1	-0.10	[-3.11]	-0.07	[-2.12]	-0.09	[-2.95]	-0.08	[-3.03]	-0.04	[-1.45]	-0.06	[-0.38]
2	-0.10	[-4.20]	-0.09	[-3.58]	-0.09	[-3.84]	-0.09	[-4.29]	-0.04	[-2.20]	-0.06	[-0.41]
3	-0.08	[-3.75]	-0.07	[-3.13]	-0.06	[-2.93]	-0.07	[-3.53]	-0.04	[-2.48]	-0.04	[-0.28]

4	-0.06	[-3.06]	-0.07	[-3.02]	-0.05	[-2.42]	-0.06	[-3.18]	-0.03	[-1.79]	-0.03	[-0.26]
5	-0.04	[-2.19]	-0.04	[-2.09]	-0.04	[-2.00]	-0.04	[-2.45]	-0.02	[-1.50]	-0.02	[-0.15]
6	-0.04	[-2.19]	-0.03	[-1.62]	-0.04	[-2.07]	-0.04	[-2.21]	-0.03	[-1.66]	-0.02	[-0.13]
7	-0.06	[-2.36]	-0.05	[-1.90]	-0.05	[-1.99]	-0.05	[-2.37]	-0.04	[-2.02]	-0.02	[-0.12]
8	-0.04	[-1.54]	-0.04	[-1.48]	-0.04	[-1.48]	-0.04	[-1.96]	-0.04	[-2.12]	0.00	[0.03]
9	-0.07	[-2.57]	-0.05	[-1.73]	-0.05	[-1.80]	-0.05	[-2.35]	-0.05	[-2.25]	-0.02	[-0.14]
10	-0.04	[-1.43]	-0.01	[-0.45]	0.00	[-0.17]	-0.02	[-0.80]	-0.01	[-0.45]	-0.03	[-0.20]
11	0.00	[0.11]	0.06	[1.33]	0.06	[1.62]	0.05	[1.40]	0.05	[1.61]	-0.05	[-0.26]

Table 13

Robustness Check

Panel A. Predicting momentum using stock-level MSR based on 25th and 75th percentile

In every month *t*, we regress monthly momentum profit on MSR constructed at the end of month $t-2$, past month unemployment rate, past 24-month market volatility, past 24-month unemployment rate, and past 36-month market return. We define MSR in month $t-2$ as:

$$MSR_{t-2}^{i} = \frac{pseudomomspread_{t-(1+i)}^{t-2}}{momspread_{t-12}^{t-2}},$$

where $i \geq 1$. The $momspread_{t-12}^{t-2}$ stands for the return spread of the 75th and 25th percentile of the past month $t-12$ to $t-2$ cumulative returns. Next, we construct the winner portfolios whose past month $t-12$ to $t-2$ cumulative returns are above 0.9 and loser portfolios whose past month $t-12$ to $t-2$ cumulative returns are below 0.1. Then the $pseudomomspread_{t-(1+i)}^{t-2}$ is the month $t-(1+i)$ to $t-2$ return spread of the value-weighted cumulative return as if these stocks, whose are in the winner or loser portfolios at month $t-2$, are always winners and losers from month $t-i$ to $t-2$. The MSR at the end of month $t-2$ is the ratio of $pseudomomspread_{t-i}^{t-2}$ over $momspread_{t-12}^{t-2}$. We report our results for three different sample periods:1966 to 2021, 1966 to 1993, and 1994 to 2021, respectively.

	1966-2021		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.01	[1.39]	0.01	[1.25]	0.01	[0.39]
MSR	-0.03	[-2.91]	-0.01	[-0.86]	-0.05	[-2.96]
lagur	0.00	[-0.15]	0.00	[1.53]	0.00	[-0.20]
lagmktsd	0.02	[0.15]	-0.18	[-0.89]	0.12	[0.54]
lagursd	-0.01	[-2.17]	-0.01	[-1.77]	-0.01	[-1.77]
lagmkt36	0.01	[1.95]	-0.01	[-1.47]	0.02	[2.60]
Adj.R	2.08		0.38		4.34	
2						
Intercept	0.02	[1.76]	0.02	[2.01]	0.01	[0.41]
MSR	-0.03	[-3.23]	-0.03	[-2.71]	-0.03	[-2.31]
lagur	0.00	[-0.11]	0.00	[1.64]	0.00	[-0.12]
lagmktsd	0.01	[0.08]	-0.21	[-1.02]	0.11	[0.51]
lagursd	-0.01	[-2.27]	-0.02	[-2.02]	-0.01	[-1.73]
lagmkt36	0.01	[1.98]	-0.01	[-1.69]	0.02	[2.63]

Adj.R	2.36		2.36		3.36	
3						
Intercept	0.02	[1.79]	0.03	[2.25]	0.01	[0.41]
MSR	-0.02	[-2.68]	-0.03	[-2.78]	-0.02	[-1.73]
lagur	0.00	[-0.13]	0.00	[1.68]	0.00	[-0.14]
lagmktsd	0.01	[0.08]	-0.21	[-1.03]	0.11	[0.49]
lagursd	-0.01	[-2.23]	-0.02	[-2.13]	-0.01	[-1.66]
lagmkt36	0.01	[1.97]	-0.01	[-1.79]	0.02	[2.61]
Adj.R	1.89		2.48		2.68	
4						
Intercept	0.02	[1.60]	0.02	[1.85]	0.01	[0.49]
MSR	-0.01	[-1.97]	-0.02	[-1.75]	-0.02	[-1.59]
lagur	0.00	[-0.16]	0.00	[1.60]	0.00	[-0.17]
lagmktsd	0.01	[0.08]	-0.20	[-0.98]	0.11	[0.48]
lagursd	-0.01	[-2.12]	-0.02	[-1.98]	-0.01	[-1.62]
lagmkt36	0.01	[1.99]	-0.01	[-1.64]	0.02	[2.62]
Adj.R	1.40		1.09		2.54	
5						
Intercept	0.02	[1.65]	0.03	[2.04]	0.01	[0.56]
MSR	-0.01	[-1.87]	-0.02	[-1.95]	-0.01	[-1.42]
lagur	0.00	[-0.20]	0.00	[1.58]	0.00	[-0.22]
lagmktsd	0.01	[0.09]	-0.21	[-1.01]	0.11	[0.48]
lagursd	-0.01	[-2.10]	-0.02	[-1.99]	-0.01	[-1.59]
lagmkt36	0.01	[2.01]	-0.01	[-1.69]	0.02	[2.62]
Adj.R	1.34		1.31		2.39	
6						
Intercept	0.03	[2.22]	0.03	[2.24]	0.02	[1.16]
MSR	-0.02	[-2.56]	-0.02	[-2.14]	-0.02	[-2.17]
lagur	0.00	[-0.26]	0.00	[1.58]	0.00	[-0.25]
lagmktsd	0.01	[0.08]	-0.22	[-1.07]	0.12	[0.53]
lagursd	-0.01	[-2.17]	-0.02	[-1.98]	-0.01	[-1.71]
lagmkt36	0.01	[2.02]	-0.01	[-1.73]	0.02	[2.73]

Adj.R	1.80		1.54		3.18	
7						
Intercept	0.02	[1.70]	0.03	[1.96]	0.02	[0.87]
MSR	-0.01	[-1.69]	-0.02	[-1.69]	-0.02	[-1.47]
lagur	0.00	[-0.22]	0.00	[1.55]	0.00	[-0.25]
lagmktsd	0.02	[0.11]	-0.22	[-1.04]	0.12	[0.54]
lagursd	-0.01	[-2.03]	-0.02	[-1.87]	-0.01	[-1.58]
lagmkt36	0.01	[2.03]	-0.01	[-1.63]	0.02	[2.66]
Adj.R	1.25		1.02		2.44	
8						
Intercept	0.02	[1.37]	0.03	[1.43]	0.02	[0.90]
MSR	-0.01	[-1.23]	-0.01	[-1.00]	-0.02	[-1.34]
lagur	0.00	[-0.20]	0.00	[1.49]	0.00	[-0.25]
lagmktsd	0.02	[0.13]	-0.21	[-0.99]	0.13	[0.57]
lagursd	-0.01	[-1.95]	-0.01	[-1.76]	-0.01	[-1.54]
lagmkt36	0.01	[2.03]	-0.01	[-1.50]	0.02	[2.65]
Adj.R	1.05		0.45		2.32	
9						
Intercept	0.01	[0.82]	0.01	[0.36]	0.03	[1.06]
MSR	-0.01	[-0.57]	0.00	[0.24]	-0.02	[-1.41]
lagur	0.00	[-0.16]	0.00	[1.50]	0.00	[-0.27]
lagmktsd	0.02	[0.15]	-0.17	[-0.83]	0.14	[0.63]
lagursd	-0.01	[-1.88]	-0.01	[-1.68]	-0.01	[-1.52]
lagmkt36	0.01	[2.03]	-0.01	[-1.34]	0.02	[2.68]
Adj.R	0.87		0.17		2.38	
10						
Intercept	-0.01	[-0.71]	0.01	[0.24]	-0.02	[-0.76]
MSR	0.01	[1.09]	0.00	[0.26]	0.01	[0.74]
lagur	0.00	[-0.03]	0.00	[1.50]	0.00	[-0.15]
lagmktsd	0.02	[0.10]	-0.17	[-0.83]	0.08	[0.36]
lagursd	-0.01	[-1.79]	-0.01	[-1.69]	-0.01	[-1.28]
lagmkt36	0.01	[1.96]	-0.01	[-1.36]	0.02	[2.36]

Adj.R	1.00		0.17		1.96	
11						
Intercept	-0.07	[-2.48]	-0.01	[-0.34]	-0.12	[-2.76]
MSR	0.04	[2.81]	0.01	[0.73]	0.07	[2.82]
lagur	0.00	[0.07]	0.00	[1.55]	0.00	[-0.05]
lagmktsd	-0.02	[-0.16]	-0.16	[-0.77]	-0.07	[-0.31]
lagursd	-0.01	[-1.61]	-0.01	[-1.75]	0.00	[-0.78]
lagmkt36	0.01	[1.80]	-0.01	[-1.38]	0.02	[2.00]
Adj.R	2.00		0.31		4.11	

Panel B. Predicting risk-adjusted momentum using stock-level MSR based on 25th and 75th percentile

	1966-2021		1966-1993		1994-2021	
i=1	Estimate	t value	Estimate	t value	Estimate	t value
Intercept	0.01	[1.16]	0.01	[1.04]	0.00	[-0.12]
MSR	-0.04	[-3.18]	-0.01	[-0.94]	-0.05	[-3.25]
lagur	0.00	[0.04]	0.00	[1.56]	0.00	[0.33]
lagmktsd	0.00	[-0.03]	-0.22	[-1.07]	0.13	[0.56]
lagursd	0.00	[-1.28]	-0.01	[-1.63]	0.00	[-1.09]
lagmkt36	0.01	[1.64]	-0.01	[-1.72]	0.02	[2.90]
Adj.R	1.50		0.50		4.62	
2						
Intercept	0.01	[1.67]	0.02	[1.84]	0.00	[0.02]
MSR	-0.03	[-3.79]	-0.03	[-2.84]	-0.04	[-2.89]
lagur	0.00	[0.08]	0.00	[1.67]	0.00	[0.44]
lagmktsd	-0.01	[-0.10]	-0.24	[-1.21]	0.12	[0.51]
lagursd	0.00	[-1.42]	-0.02	[-1.89]	0.00	[-1.12]
lagmkt36	0.01	[1.67]	-0.01	[-1.95]	0.02	[2.97]
Adj.R	2.12		2.66		3.92	
3						
Intercept	0.02	[1.86]	0.03	[2.15]	0.00	[0.22]
MSR	-0.03	[-3.48]	-0.03	[-3.01]	-0.03	[-2.70]
lagur	0.00	[0.06]	0.00	[1.72]	0.00	[0.44]
lagmktsd	-0.02	[-0.12]	-0.25	[-1.23]	0.11	[0.48]
lagursd	0.00	[-1.43]	-0.02	[-2.02]	0.00	[-1.12]
lagmkt36	0.01	[1.65]	-0.02	[-2.07]	0.02	[2.98]
Adj.R	1.79		2.95		3.58	
4						
Intercept	0.02	[1.69]	0.02	[1.87]	0.00	[0.32]
MSR	-0.02	[-2.66]	-0.02	[-2.15]	-0.02	[-2.36]
lagur	0.00	[0.01]	0.00	[1.66]	0.00	[0.38]
lagmktsd	-0.02	[-0.11]	-0.24	[-1.18]	0.11	[0.46]
lagursd	0.00	[-1.30]	-0.02	[-1.90]	0.00	[-1.04]

lagmkt36	0.01	[1.68]	-0.01	[-1.95]	0.02	[2.97]
Adj.R	1.05		1.63		3.03	
5						
Intercept	0.02	[1.75]	0.03	[2.13]	0.01	[0.36]
MSR	-0.02	[-2.43]	-0.02	[-2.38]	-0.02	[-1.97]
lagur	0.00	[-0.04]	0.00	[1.63]	0.00	[0.31]
lagmktsd	-0.01	[-0.10]	-0.25	[-1.22]	0.11	[0.48]
lagursd	0.00	[-1.26]	-0.02	[-1.90]	0.00	[-0.97]
lagmkt36	0.01	[1.70]	-0.02	[-2.00]	0.02	[2.95]
Adj.R	0.88		1.94		2.48	
6						
Intercept	0.02	[2.29]	0.04	[2.45]	0.02	[0.91]
MSR	-0.02	[-2.99]	-0.02	[-2.69]	-0.03	[-2.52]
lagur	0.00	[-0.10]	0.00	[1.63]	0.00	[0.28]
lagmktsd	-0.02	[-0.11]	-0.26	[-1.31]	0.12	[0.53]
lagursd	0.00	[-1.30]	-0.02	[-1.91]	0.00	[-1.05]
lagmkt36	0.01	[1.72]	-0.02	[-2.07]	0.02	[3.06]
Adj.R	1.33		2.41		3.27	
7						
Intercept	0.02	[1.94]	0.04	[2.22]	0.02	[0.80]
MSR	-0.02	[-2.30]	-0.02	[-2.25]	-0.02	[-1.96]
lagur	0.00	[-0.07]	0.00	[1.59]	0.00	[0.25]
lagmktsd	-0.01	[-0.07]	-0.26	[-1.28]	0.14	[0.57]
lagursd	0.00	[-1.18]	-0.01	[-1.79]	0.00	[-0.94]
lagmkt36	0.01	[1.73]	-0.01	[-1.97]	0.02	[3.00]
Adj.R	0.78		1.77		2.46	
8						
Intercept	0.02	[1.66]	0.03	[1.60]	0.02	[0.93]
MSR	-0.01	[-1.81]	-0.01	[-1.39]	-0.02	[-1.86]
lagur	0.00	[-0.05]	0.00	[1.52]	0.00	[0.24]
lagmktsd	-0.01	[-0.05]	-0.25	[-1.21]	0.15	[0.64]
lagursd	0.00	[-1.08]	-0.01	[-1.63]	0.00	[-0.91]

lagmkt36	0.01	[1.73]	-0.01	[-1.79]	0.02	[2.99]
Adj.R	0.48		0.82		2.34	
9						
Intercept	0.02	[1.19]	0.01	[0.60]	0.03	[1.31]
MSR	-0.01	[-1.18]	0.00	[-0.20]	-0.03	[-2.09]
lagur	0.00	[-0.03]	0.00	[1.51]	0.00	[0.18]
lagmktsd	0.00	[-0.02]	-0.22	[-1.06]	0.18	[0.75]
lagursd	0.00	[-0.99]	-0.01	[-1.54]	0.00	[-0.88]
lagmkt36	0.01	[1.74]	-0.01	[-1.63]	0.02	[3.05]
Adj.R	0.20		0.24		2.64	
10						
Intercept	-0.01	[-0.41]	0.01	[0.47]	-0.02	[-0.52]
MSR	0.01	[0.62]	0.00	[-0.12]	0.00	[0.17]
lagur	0.00	[0.12]	0.00	[1.51]	0.00	[0.31]
lagmktsd	-0.01	[-0.06]	-0.22	[-1.05]	0.12	[0.49]
lagursd	0.00	[-0.89]	-0.01	[-1.54]	0.00	[-0.63]
lagmkt36	0.01	[1.68]	-0.01	[-1.62]	0.02	[2.70]
Adj.R	0.04		0.23		1.20	
11						
Intercept	-0.07	[-2.59]	-0.01	[-0.35]	-0.12	[-2.79]
MSR	0.04	[2.83]	0.01	[0.65]	0.07	[2.68]
lagur	0.00	[0.26]	0.00	[1.57]	0.00	[0.55]
lagmktsd	-0.05	[-0.33]	-0.20	[-0.96]	-0.09	[-0.37]
lagursd	0.00	[-0.68]	-0.01	[-1.59]	0.00	[-0.04]
lagmkt36	0.01	[1.49]	-0.01	[-1.63]	0.02	[2.27]
Adj.R	1.18		0.36		3.54	