Broad-Market Return Persistence & Momentum Profits

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EXTENDED ABSTRACT

Momentum profits are shown to be driven by the broad-market persistence of returns between the formation period and the holding period, which is measured as the slope coefficient of the regression of the cross-section returns in the holding period on the cross-section returns in the formation period. Broad-market persistence offers an understanding on momentum profits from a market-wide perspective that goes beyond the stock-specific continuation of extreme winners and losers as proposed in Jegadeesh and Titman (1993) and Grundy and Martin (2001). The proposed framework provides an alternative explanation to the inability of widely accepted asset pricing models in explaining momentum ptofits.

1. INTRODUCTION

The abnormal returns on momentum-based portfolio trading strategies – buying stocks with high returns ("winners") and selling stocks with low returns ("losers") over the preceding three to twelve months – remain a serious challenge to the standard risk-return paradigm that is widely accepted by finance academics. Despite the large volume of work on this issue, the sources of momentum profit, even at a general level, are still under considerable dispute as argued in Jegadeesh and Titman (1993, 2001, 2002) among others. With respect to the recent debate in the literature, the present paper attempts to address two important issues: whether there is a role for the cross-section of expected returns in explaining the momentum profit, and whether the source of momentum profit is a market-wide phenomenon or stock-specific feature.

In this paper, we characterize momentum profits as multiplicative interactions of dispersion and persistence in the cross-section of stock returns. The persistence in the cross-section of returns, or ***broad-market persistence*** hereafter, signifies how the cross-section of returns comoves when referenced against the same cross-section in the past. Specifically, broad-market persistence is defined as the expected common persistence in the cross-section of stock returns at any period, which is measured as the slope coefficient of the regression of cross-section returns in the holding period on the cross-section returns in the formation period. Unlike the traditional approach that studies the comovement in asset returns with the specification of economic structure of common fundamental factors, this paper circumvents the specification problem and focuses on a particular perspective of the cross-section returns – their comovement in relation to the ***entire*** cross-section of past returns.

Broad-market persistence is shown to project the nontrivial selection returns of the Winner-Minus-Loser (WML) portfolio from the formation period to the holding period, which in turn shows as momentum profit. Therefore, it can be argued that the only concern for an investor who adopts the momentum strategy is the degree to which past returns are extrapolated into the holding period on a broad-market level. That is, with a higher common persistence – and thus a stronger comovement among the stock returns – we have higher momentum profits, and vice versa. Our empirical findings demonstrate that the interaction between broad-market persistence and the selection of winners and losers explains 95% of the time-series movement of momentum profits. By controlling for this interaction, abnormal momentum profits are found to be at a level of 1.2% per annum, in contrast to the evidence of over 10% that has been found in most of the previous studies.

The possibility that momentum is related to the degree of broad-market persistence in returns contrasts with the conventional view that is expressed in papers such as those by Jegadeesh and Titman (1993) and Grundy and Martin (2001), that momentum profits mainly result from persistence in the stock returns of extreme winners and losers. Rather than focusing on return continuation of a stock-specific nature, we argue that it is the common continuation of returns in the entire market that characterizes the phenomenon of momentum returns. Empirically, the broad-market persistence in returns is found to be about 0.07 on average, and is statistically significant over the period of one to six months after portfolio formation. Consequently, this generally positive broad-market persistence gives rise to the positive momentum profits that are observed.

The mechanism that is proposed here shares with the emphasis of Conrad and Kaul (1998) on the importance of cross-section selection. Conrad and Kaul (1998) have argued that the cross-sectional dispersion of expected returns is the major determinant of momentum profits, and have shown that the momentum strategy is consistent with buying stocks with higher expected returns and selling stocks with lower expected returns. Our mechanism is similar to Conrad and Kaul (1998) yet different in two important ways. First, the selection in Conrad and Kaul (1998) is based on the unconditional expected returns of individual stocks, whereas the selection here is conditionally based on the total returns in the formation period, which include both the expected and stock-specific components. Second, instead of separating the cross-section and time-series perspectives of the returns in an additive form, as in Conrad and Kaul (1998), the proposed mechanism separates the two perspectives in a multiplicative form that takes into account their interaction. That is, we show that the momentum profit is determined by both the broad-market intertemporal continuation of returns and the cross-section selection instead of either source alone.

To the extent that momentum profits can be attributed to broad-market persistence in returns, this paper suggests that the profit of a momentum strategy is an aggregate/systematic phenomenon rather than a stock-specific/idiosyncratic characteristic. This view is consistent with the findings of Lewellen (2002), who shows that collections of well-diversified portfolios are also capable of producing significant momentum profits. He attributes momentum profits to the excess covariance among the cross-section of returns, where excess covariance refers to the comovement among the cross-section of returns that is caused by nonstandard and unknown features of the return generating process that goes beyond standard risk-return paradigms. We show that such excess covariance in momentum profits can be characterized with a very simple form of return comovement – the common level of the extrapolation of past returns across the broad market.

2. BROAD-MARKET PERSISTENCE IN RETURNS

2.1. Equity Selection, Broad-Market Persistence, and Momentum

Instead of modeling the cross-section of stock returns as in standard asset pricing models, we focus on the total returns and their time-series evolution at the broad-market level. That is, we examine the sources of momentum profits through an investigation of stock selection that is based on past total returns and the persistence of the cross-section of total returns over time.

To fix the notation, denote the month *t* total return of stock *i* in the formation period and the holding period as $r_{i,t}^{form}$ and $r_{i,t}^{post}$, respectively. We assume that the time t cross-sectional distributions of these returns are normal, with the respective mean and variance of $(\overline{\mu}_t^{form}, \sigma_{r_t^{form}}^2)$ and $(\overline{\mu}_t^{post}, \sigma_{r_t^{post}}^2)$. Note that these are ***conditional*** distributions that are based on the information at time *t*. Denote the slope coefficient of the cross-section population regression between the holding period return and the formation period return as γ_t. It will be shown in Proposition 2 that γ_t reflects a common level of cross-section persistence, i.e., the expected persistence of any randomly selected stock in the market at time t, which is what we refer to as broad-market persistence. Broad-market persistence can therefore be viewed as an "average" cross-section serial correlation coefficient (i.e., a commonality in return persistence) that summarizes the degree to which the cross-section of past returns is extrapolated into the future. Furthermore, γ_t will be shown to play an essential role in the projection of the formation period returns of selection into the holding period.

It should be obvious that, given the stock selection mechanism, the conditional mean of the formation period return will be different from the unconditional mean. When there is a potential persistence between individual stock returns in the formation period and in the holding period, the selection return on the Winner-Minus-Loser (WML) portfolio in the formation period thus implies a selection return in the holding period. The following proposition presents a formal description of this mechanism.

Proposition 1: Assume that (1) there is a linear relationship that relates the holding period returns ($r_{i,t}^{post}$) and the formation period returns ($r_{i,t}^{form}$) through the broad-market persistence parameter that is the same across all individual stocks; and (2) there is negligible cross-serial correlation between the stock returns in the sense that the law of large numbers continues to hold, so that the portfolio return reflects only the cross-section persistence. The expected return of the WML portfolio in the holding period given the formation period returns (denoted as π_t^{BMP}) is the multiplicative product of   and the formation period returns (denoted as $r_{WML,t}^{form}$). That is, $\pi_t^{BMP} = \gamma_t \times r_{WML,t}^{form}$.

The assumptions of this proposition are admittedly simplistic. Essentially we have assumed that the cross-section of returns comoves in the holding period and extrapolates the past returns in a linear fashion. There is no known theoretical foundation for such type of comovement, as cross-section returns may comove in other ways, such as those that are described by a common-factor structure like the Fama-French three-factor model. This proposition thus serves more as a motivation than as a general theoretical statement on stock returns. However, we will show that the proposition holds well empirically in later sections.

2.2. Decomposition of Broad-Market Persistence

In general, standard asset pricing models imply that stock returns can be decomposed into a systematic component and a stock-specific component. We follow this tradition and delineate our discussion based on this separation to further cast light on the meaning of broad-market persistence. Assume that the return generating process of stock *i* over the formation period and the holding period is

$$r_{i,t}^k = \mu_{i,t}^k + \varepsilon_{i,t}^k, \qquad \text{(RGP)}$$

where $\mu_{i,t}^k \sim N(\overline{\mu}_t^k, \sigma_{\mu_t^k}^2)$ and $\varepsilon_{i,t}^k \sim N(0, \sigma_{\varepsilon_t^k}^2)$ denote the systematic and idiosyncratic component of the stock return in period *k*, *k* = '*form*' or '*post*'.

An implication of this separation is that the common level of cross-section persistence, or broad-market persistence, can be written as:

$$\gamma_t = \gamma_t^{sys} + \gamma_t^{ido},$$

where γ_t^{sys} is the regression coefficient that is obtained when the cross-section of the systematic components of the holding period returns ($\mu_{i,t}^{post}$) are regressed on the formation period returns ($r_{i,t}^{form}$), and γ_t^{ido} is the regression coefficient that is obtained when the cross-section of idiosyncratic components of the holding period returns ($\varepsilon_{i,t}^{post}$) are regressed on $r_{i,t}^{form}$. This separation follows from a simple algebraic principle, and suggests that continuation or persistence at a broad-market level comes through both time-varying expected returns and stock-specific components.

As has been mentioned, Proposition 1 does not specify how the persistence between the holding period returns and the formation period returns arises. In addition, we have assumed that cross-serial correlations among stock returns to be negligible. However, Lo and MacKinlay (1990) have argued that such cross-serial correlation is an important part of asset pricing regularities, and could be an important source of momentum profits as proposed by Lewellen (2002). We will now go over two cases to illustrate these issues and their implications for the proposed broad-market persistence mechanism.

Case A: No Cross-Serial Correlation in Returns

In this first case, the $\varepsilon_{i,t}^{k}$ in (RGP) are assumed to be independent of $\mu_{i,t}^{k}$, and are independent across all stocks. We further assume that for stock *i* at any time *t*, the systematic component of the holding period returns and the formation period returns are related through the following in cross-section:

$$E_t^{form}(\mu_{i,t}^{post} - \overline{\mu}_t^{post}) = \rho_t^{sys}(\mu_{i,t}^{form} - \overline{\mu}_t^{form}),$$

where ρ_t^{sys} is the (conditional) cross-section correlation coefficient for time *t*. Similarly, we assume that the stock-specific components are related in the holding period and the formation period through

$$E_t^{form}(\varepsilon_{i,t}^{post}) = \rho_t^{ido}\varepsilon_{i,t}^{form},$$

where ρ_t^{ido} is the (conditional) cross-section correlation coefficient at time *t*.

The following proposition gives the population correlation coefficient of the total returns when the cross-section of the holding period returns are regressed on the cross-section of the formation period returns.

Proposition 2: The slope coefficient of the cross-section population regression between the holding period returns and the formation period returns is given by

$$\gamma_t = \frac{\rho_t^{sys}\sigma^2_{\mu_t^{form}} + \rho_t^{ido}\sigma^2_{\varepsilon_t^{form}}}{\sigma^2_{r_t^{form}}},$$

where $\sigma^2_{\mu_t^{form}}$ and $\sigma^2_{\varepsilon_t^{form}}$ denote the cross-section variance of expected returns and the stock-specific components in the formation period, respectively, and ρ_t^{sys} and ρ_t^{ido} denote the cross-section persistence of the systematic and idiosyncratic components in individual stock returns between the holding period and the formation period at time *t*.

It is obvious that γ_t can be decomposed into $\gamma_t^{sys} = \rho_t^{sys}\sigma^2_{\mu_t^{form}} \big/ \sigma^2_{r_t^{form}}$ and $\gamma_t^{ido} = \rho_t^{ido}\sigma^2_{\varepsilon_t^{form}} \big/ \sigma^2_{r_t^{form}}$ following Proposition 2, and that therefore the return persistence at a broad-market level comes through common persistence in the systematic and the idiosyncratic components of individual stock returns. The extent to which these two components drive broad-market persistence is determined by their respective cross-section variability. As a result, Proposition 1 and Proposition 2 together imply that the total momentum profit that is driven by broad-market persistence at time *t* can be decomposed into a systematic component (denoted as $\pi_t^{sys,BMP}$) and an idiosyncratic component (denoted as $\pi_t^{ido,BMP}$), i.e.,

$$\pi_t^{BMP} = \gamma_t \times r_{WML,t}^{form} = \gamma_t^{sys} r_{WML,t}^{form} + \gamma_t^{ido} r_{WML,t}^{form} = \pi_t^{sys,BMP} + \pi_t^{ido,BMP}.$$

Case B: Cross-Serial Correlation in Returns

We now turn to comment on the case in which there are cross-serial correlations in the stock-specific components of returns. Such cross-serial correlations may be generated for microeconomic reasons that are not captured by the systematic risks. The existence of cross-serial correlations may affect the validity of Proposition 1, as it could possibly invalidate the law of large numbers that we used to obtain the proposition.

In general, we conjecture that the law of large numbers in Proposition 1 will continue to hold when the cross-section of stocks is diverse enough, and in particular when the cross-serial correlation is largely independent of the winner/loser status during the formation period. That is, given a sufficiently large number of stocks in the cross-section sample, there should be sufficient randomness in the individual stocks of the winner/loser portfolio that attenuates the cross-serial correlation that is caused by other independent rationales. As a result, the law of large numbers will continue to hold as we have near non-correlation in the cross-section returns. See White (2001) for the extent to which we can weaken the mathematical assumptions without invalidating the law of large numbers.

Clearly, we cannot exclude *a priori* the theoretical possibility that cross-serial correlations among stock returns are not canceled out, and lead to nontrivial expected returns upon aggregation. In such cases, we would probably find abnormal profit even in excess of the profits that arise from the mechanism that is based on broad-market persistence as proposed, which is similar to the arguments of Lewellen (2002) that cross-serial correlations among stock returns could cause a profit in excess of the expected return from a standard asset pricing model.

Given this caveat, it should be noted that the separation in the broad-market persistence measure, $\gamma_t = \gamma_t^{sys} + \gamma_t^{ido}$, will continue to hold even in the presence of the cross-serial correlation of an unknown form. That is, although Proposition 2 may not necessarily hold in the given form when there are cross-serial correlations among stock returns, we can still decompose γ_t into a systematic component and an idiosyncratic component by taking into account such cross-serial correlations in addition to the comovement of expected returns and stock-specific components over time. As there are potentially many different forms of cross-serial correlation, we will not list them in detail here. It suffices to say that Proposition 2 will serve as our benchmark in explaining momentum profits without invoking the argument of cross-serial correlation.

3. DATA, MOMENTUM AND BROAD-MARKET PERSISTENCE

This study uses NYSE-AMEX individual stocks from the Center for Research in Security Prices (CRSP) monthly return file. Our sample starts in January 1965 and ends in December 1999, which corresponds to the sample period that is used in Jegadeesh and Titman (2001). The momentum trading strategy selects stocks that are based on return realizations during the past J months, and holds the stocks for the following K months. We focus on the six-month/six-month strategy (i.e., $J = K = 6$), which has been found to be the most profitable and inexplicable. Specifically, at the beginning of each month t, stocks are ranked into deciles, which are based on the returns during the six-month formation period (i.e., $t - 7$ through $t - 2$). Based on their rankings, ten equally weighted decile portfolios are formed. The top decile (P10) and the bottom decile (P1) portfolios are equally weighted portfolios of the ten percent of the stocks with the highest and lowest returns over the previous six months, respectively. The momentum strategy longs the winner portfolio (P10) and shorts the loser (P1), and holds this Winner-Minus-Loser (WML) portfolio for the following six months (t through $t + 5$).

Unlike Jegadeesh and Titman (2001), we do not rollover and rebalance the momentum portfolio. Instead, we split the six-month holding period into six separate months to demonstrate the different nature of the momentum profits for these different months. Throughout the following, the formation period returns at time t denote the average monthly returns for the WML portfolio over the six-month period, which is from month $t - 7$ to month $t - 2$, and the holding period returns at time t denote the average monthly returns for the WML portfolio (ranked in the formation period) over the six-month period from month t through month $t + 5$. For our sample, the average monthly return for the WML portfolio in the formation period is a huge 14.97% per month, in contrast to the same figure for the holding period of 1.01% per month.

The broad-market persistence measure γ_t is estimated with the regression of the cross-section of the holding returns on the cross-section of the formation-period returns. To minimize the impact of stock-specific components that are known to cause the errors-in-variable problem in estimating the broad-market persistence measure, we use returns from 50 equally weighted portfolios (ranked according to the performance in the formation period) in the cross-section regressions. The time-series correspondence of the γ_t (estimated using six-month average monthly returns) and the ratio of the holding period return to the corresponding formation period return (also using the six-month average monthly returns) throughout the sample is shown in Figure 1. According to Proposition 1, barring statistical problems, these two measures will be of the same magnitude at any time t. Indeed, Figure 1 shows that they track each other very closely, with only minor differences at times.

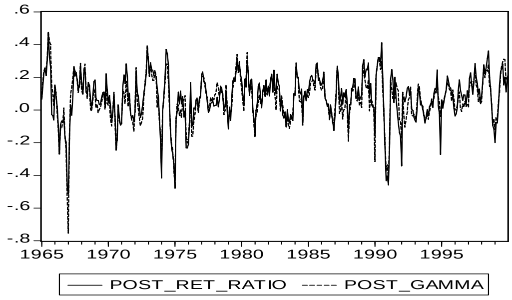

Figure 1. Ratio of the average monthly $r_{WML,t}^{post}$ to the average monthly $r_{WML,t}^{form}$ (solid line) and the estimated γ_t (dashed line).

Table 1 documents the correspondence of the observed momentum profit (π_t), the broad-market persistence based returns for the WML portfolio (π_t^{BMP}) for the average monthly profit from t to t + 5. The broad-market persistence based returns are generated according to Proposition 1 as the product of the broad-market persistence measure γ_t and the formation period WML returns at time t. The averages of π_t and π_t^{BMP} are reported in the first two rows of Table 1, and it can be seen that π_t^{BMP} has a mean that is quite close to π_t for the six-month holding period: the broad-market persistence based momentum payoff is about 0.91% per month, as compared with the 1.01% per month payoff of the observed momentum profits.

Table 1.

	6-month average
Observed WML profits, π_t	0.0101 (0.0018)
Broad-market persistence based WML profit, π_t^{BMP}	0.0091 (0.0019)
Broad-market persistence, γ_t	0.0664 (0.0127)
Std. dev. of π_t	0.0221
Std. dev. of γ_t	0.1519

The broad-market persistence γ_t is on average about 0.07, and is statistically significant, as is shown in the third row of Table 1. The last two rows of Table 1, however, highlight the risk that is associated with the momentum profits – both those that are observed and those that are broad-market persistence based. The average observed momentum profits over six months has a standard deviation of over 2%, which suggests that the payoff is highly volatile and far from risk free. Similarly, the broad-market persistence of the six-month average return has a standard deviation of 0.15, which suggests that the common persistence across stocks is also highly volatile.

Table 2 reports the results of the observed momentum profits regressed on the broad-market persistence based momentum returns that were generated according to Proposition 1. If the observed momentum profits are solely dependant on the broad-market persistence, we would expect to see a high R^2 with the intercept and the slope coefficient being close to zero and one, respectively. Indeed, for the six-month average of the holding period, we see that the R^2 hovers around 95%, which suggests the broad-market persistence based returns explain the observed momentum profits well. Furthermore, the intercept is quite small and the slope coefficient is close to unity.

Table 2. $\pi_t = \beta_0 + \beta_1 \pi_t^{BMP} + \varepsilon_t$

	6-month average
Intercept	0.0016 (0.0004)
Slope	0.9381 (0.0126)
Adj. R^2	0.9478
Difference	0.0008 (0.0004)

The last row of Table 2 reports the average "tracking error" of the broad-market persistence based momentum returns, which is defined as $\pi_t - \pi_t^{BMP}$. The t-statistics of this average can thus be viewed as a direct test of the joint hypothesis that the intercept equals zero and the slope equals one in the above regressions. The difference is only 8 basis points for the average returns over the six-month holding period, which represents a tracking error of less than 1% per annum, despite the marginal statistical significance. Therefore, the results in Table 2 appear to support Proposition 1 that momentum profits arise mainly as an interaction between the broad-market persistence and the winner-loser selection returns.

As has been mentioned in the introduction, the possibility that momentum is related to broad-market persistence in returns contrasts with the conventional view that such a profit is primarily a result of persistence in winners and losers only. To further elaborate on this point, we have also generated a winner-loser persistence based momentum return (denoted as π_t^{WLP}) along the lines of Proposition 1. Specifically, π_t^{WLP} is the multiplicative product of the return on the WML portfolio in the formation period ($r_{WML,t}^{form}$) and the common persistence measure of the extreme winners and losers (denoted as γ_t^{WL}) which is estimated by the cross-section regression of the holding period returns on the formation period returns using the sub-sample of the winner and loser portfolios.

The relative ability of π_t^{WLP} to explain the observed momentum return π_t is first examined, and the results are reported in Panel A of Table 3. As in the case of π_t^{BMP}, we find that π_t^{WLP} is in general closely associated with π_t in the sense that we observe a high R^2 for the six-month average of the holding period, and the intercept is insignificant and the slope coefficient is close to unity. We may not, however, conclude that the observed momentum return is simply a result of persistence in the winners and losers. Intuitively, the broad-market persistence γ_t represents the common level of persistence of the entire market, which is more informative than the common persistence in winners and losers only. Thus, we further investigate the relationship between these two measures by the time series regression of γ_t^{WL} on γ_t.

Table 3.

Panel A: $\pi_t = \beta_0 + \beta_1 \pi_t^{WLP} + \varepsilon_t$

	6-month average
Intercept	0.0002 (0.0004)
Slope	1.0425 (0.0184)
Adj. R^2	0.9810
Difference	0.0006 (0.0003)

Panel B: $\gamma_t^{WL} = \beta_0' + \beta_1' \gamma_t + \varepsilon_t'$

	6-month average
Intercept	0.0089 (0.0029)
Slope	0.8820 (0.0171)
Adj. R^2	0.9443
Difference	0.0011 (0.0030)

From the results in Panel B of Table 3, we can see that these two persistence measures track each other closely across the months with a fairly high R^2. In addition, the difference between these two measures is on average insignificant, as is shown in the last row of Panel B. Based on these results, we may conclude that these two persistence measures are statistically equivalent, and γ_t could explain the momentum profits just as good as γ_t^{WL}. With γ_t being estimated using the entire cross-section of returns, this provides a strong case that an important source of momentum profits is indeed a market-wide or aggregate feature instead of persistence in the individual returns of winners and losers only. If the source of momentum profits only comes from the partial sample of winners and losers, then it is more than likely that broad-market persistence γ_t cannot explain momentum at all – the persistence in returns of the other 80% of stocks in the market will be different if the momentum profit only depends on winners and losers.

4. CONCLUSIONS

In this paper, we examine the sources of momentum profit in terms of the broad-market persistence in returns, which represents an interaction of the cross-section source and the time-series source. The momentum profit is shown to be a product of this broad-market persistence and the selection return at the formation period. The selection return at the formation period is a conditionally known quantity, and therefore is not the essential information in momentum profits. Instead of the highly idiosyncratic stock-specific persistence, we emphasize the common broad-market nature of the persistence that drives momentum profits. This persistence, although significantly positive in mean (with an average magnitude of 0.07), has a standard deviation of 0.15. The momentum profits that arise from the selection are therefore far from risk-free.

While we have proposed a framework that momentum profits could be explained by the broad-market persistence in returns, we need to further investigate the sources of such persistence. Our discussions in Section 2 suggest that broad-market persistence in returns can arise from two sources: the persistence of the risk premium (systematic) component and the persistence of the stock-specific (idiosyncratic) component of returns. In further work, we will investigate these issues using typical risk-based models such as that of Fama and French (1993). Preliminary results have shown that a ***nontrivial common level*** of stock-specific continuation is required as an extra to generate the observed level of broad-market persistence. However, our results also imply that for behavioral models to explain momentum profit, they need to model stock-specific continuations to empirically match the time-variance of the common level of persistence across the broad market.

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