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On the interaction between momentum effect and size effect

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ABSTRACT

This paper uses a sample of firms listed in the NYSE, AMEX, and NASDAQ between January 1963 and December 2012 to analyze the interaction between size effect and momentum effect in cross-sectional stock returns. Furthermore, this paper focuses on the evolution of this interaction through different market states. I report a significant shift in stock returns structure during the rising markets of the 1990s and the 2000s. First, momentum has absorbed the size effect. Second, the momentum effect has become stronger in larger, not smaller, firms. These patterns are indicative of a strong interaction between the two effects. Conceivably, in up markets, firms grow fast, and thus, the size and momentum effects stem from a common economic phenomenon: growth. The findings are robust to variations in the length of the formation period and to the use of residual return (instead of total return) to rank stocks.

1. Introduction

Fama and French (1993, 1996) added two factors to CAPM to reflect a portfolio's exposure to a size factor (small minus big) and a market-to-book factor (high minus low). They introduced their well-known three-factor model and showed that it successfully explains cross-sectional variations in stock returns. Carhart (1997) showed that the sensitivity to a momentum factor (long prior winners and short prior losers) is priced separately from the sensitivity to the three factors of Fama and French's model. Thus, he introduced the four-factor model. This study examines the *interaction* between size and momentum effects and the evolution of this interaction through different market states.

Intuitively, positive momentum (rising stock price) implies increase in size (market value = stock price x number of shares outstanding) and vice versa. Therefore, the two effects stem from a common underlying economic phenomenon: growth in the firm's market value. Two implications of this hypothesis are tested in this paper. First, the interaction of the two effects is a function of market state. In up markets, growing firms simultaneously exhibit positive momentum and gain market value. Hence, the momentum effect should strengthen and the size effect should diminish in bullish markets[1]. Second, in bullish markets, smaller companies ride the momentum wave and grow in size. Therefore, we anticipate finding that the momentum effect is more prominent in *larger* firms, not smaller ones, as indicated by previous research.

The paper uses a sample of firms listed in major exchanges, namely NYSE, AMEX, and NASDAQ, between Jan 1963 and Dec 2012. Two formal methodologies are applied to test the hypotheses of this paper. First, I use the one-pass and two-pass approach of Fama and French (1992) to create factor-sorted portfolios (formed on size and momentum) to observe the behavior of average monthly returns across factor spectrums. Second, I use Fama and MacBeth's (1973) cross-sectional regressions to evaluate the determinants of stock returns.

When momentum and size are considered *jointly*, the size effect fades away in the full sample (1963–2012) and the momentum effect becomes stronger in *larger* firms. These findings contrast sharply with extant literature. Therefore, I re-run the analysis over several subsamples. The most significant results emerge when the sample is split into two subsamples: 1963–1993 and 1994–2012[2]. In the first subsample, consistency with the literature is restored; both size and momentum are priced separately (as in Carhart (1997)), and the momentum effect is stronger in *smaller* firms (as in Rouwenhorst (1998) and Fama and French (2008)). In the second subsample, inconsistency with literature is strengthened. I conclude that the discrepancy found in the full sample extends only to the more recent 1994–2012 subsample, which includes periods of unprecedented growth rates in stock

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[1] The size factor in Fama and French (1996) is constructed as small minus big, indicating that large caps generate *lower* returns. The momentum factor in Carhart (1997) is constructed as high minus low, indicating that firms with positive prior returns (i.e., growing firms) generate *higher* return.

[2] Other subsamples during 1963–1993 were also tested, but the results did not indicate major shifts in the momentum and size effects.

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returns[3]. Thus, the relative strength of size and momentum varies by market conditions.

Specifically, the size effect virtually disappears, whereas the momentum effect strengthens in the 1994–2012 period. This finding supports previous work that documented a weakening size effect since its discovery in the early 1980s (see Schwert (2003), Horowitz, Loughran, and Savin (2000) and Van Dijk (2011)). Furthermore, it provides additional evidence that the momentum premium is pro-cyclical and that the size premium is contra-cyclical (as in Chordia and Shivakumar (2002) and Stivers and Sun (2010)). Similarly, Cooper, Gutierrez, and Hameed (2004) posit that momentum profits are stronger in bullish markets, and Sagi and Seasholes (2007) show that higher growth options in up markets lead to higher return autocorrelations, resulting in higher momentum profits in up markets.

As such, my work supplies out-of-sample evidence that supports the validity of these arguments. However, this paper digs deeper into the interrelation between the size and momentum effects. I show that the momentum effect not only strengthens in growth periods but also subsumes the size effect, which virtually disappears. Accordingly, this indicates not only a fading size effect and a strengthening momentum effect during up markets (as in Chordia and Shivakumar (2002) and Stivers and Sun (2010)) but also implies a strong interaction between the two effects. Similarly, my findings suggest a refinement of the argument made by Schwert (2003) and Horowitz et al. (2000). They argue that the size effect has been fading since its discovery. My results indicate that the size effect fades during strong up markets, leaving the ground for momentum to drive stock prices.

I also find that the momentum effect is more pronounced in larger firms, not smaller ones. This is new to the momentum literature. Several authors have looked at the interaction between the size and momentum effects and reported inconclusive findings. Rouwenhorst (1998) finds that the momentum effect is more pronounced for *small* cap stocks. Hong, Lim, and Stein (2000) find that equally weighted monthly momentum profits sorted against size deciles produce a *humped pattern*. Fama and French (2008) report a *humped pattern* in equally weighted portfolios. However, in value-weighted portfolios, they document a higher momentum effect in *smaller* size quantiles. My work indicates that the momentum effect is stronger in *smaller* firms during normal growth periods. However, in high growth periods, the momentum effect is stronger in *larger* firms. This is consistent with the growth hypothesis presented in this paper.[4] My findings are robust to various momentum strategies (3/6, 6/6, 10/6, and 24/6). Furthermore, in a later robustness check, I use the Blitz, Huij, and Martens (2011a, 2011b) residual return to form size-momentum portfolios. The results with residual return momentum are generally consistent with Blitz et al. (2011a, 2011b) propositions and do not alter the overall conclusions of this paper.

The rest of the paper is organized as follows: Section 2 focuses on the relevant literature and highlights the paper's motivation. Section 3 describes the data and methodology. Section 4 supplies a detailed discussion of the results. Finally, Section 5 concludes the paper with a summary of the results and discussion.

2. Literature review and paper motivation

Fama and French (2004) state that the most serious problem of the three-factor model is the momentum effect of Jegadeesh and Titman (1993), which attacks the core assumptions of capital asset pricing models (Fama, 1998). The earlier research on the momentum effect focused on providing empirical evidence of its existence using descriptive data analysis. Jegadeesh and Titman (1993) compare the performance of an equally weighted portfolio of past winners to the performance of a portfolio of past losers and report an excess return of approximately 0.95% per month. Carhart (1997) shows that the sensitivity to the momentum factor is priced separately from sensitivity to the three factors of Fama and French's model and suggests a four-factor model. Jegadeesh and Titman (2001) show that their 1993 results are not an artifact of data snooping and that momentum trading continues in the 1990s. Several authors conducted research using the momentum strategy of Jegadeesh and Titman (1993) and confirm the existence of the momentum effect[5].

Different theoretical explanations have been proposed for the cross-sectional momentum effect. The most prominent explanations are behavioral explanations and risk-based explanations[6]. Behavioral explanations rely on psychological determinants of investors' decision-making process, such as overconfidence on private information and underreaction to market signals (Daniel, Hirshleifer, and Subrahmanyam, 1998), conservatism and slow updates of one's beliefs (Barberis, Shleifer, & Vishny, 1998), and gradual diffusion of information (Hong & Stein, 1999). Risk-based explanations state that momentum return is a compensation for bearing higher risks. Chordia and Shivakumar (2002) find that momentum profit is attributed to bearing higher macroeconomic risk, but Griffin, Ji, and Martin (2003) show no relation between macroeconomic risks and momentum returns. More recently, Blitz et al. (2011a, 2011b) suggested that variation in total momentum return is larger than variation in residual momentum return. Specifically, total momentum return is highly positive during expansions and highly negative during recessions, whereas residual momentum generates a more stable pattern of return (positive during expansions and recessions but lower in recessions). Furthermore, they show that residual momentum is almost size neutral, whereas total momentum is not.

An important strand of the momentum literature — to which this paper belongs — looks at the relation between the momentum effect and size effect. Carhart (1997) ~~work~~ indicates that momentum and size are priced separately. He includes a momentum factor constructed as the difference in return between the high and low lagged return portfolios. He finds that this factor captures the cross-sectional return patterns in a manner suggestive of a risk factor that is not captured by the three-factor model of Fama and French. Rouwenhorst (1998) finds that the momentum effect is more pronounced for small cap stocks in European stock markets.

Hong et al. (2000) use equally weighted portfolios of NYSE/AMEX stocks and find that the momentum effect is stronger for the 30% of stocks with the lowest market value. Furthermore, they find that the momentum effect is virtually zero in the 30% of stocks with the highest market value. Nonetheless, they show that momentum profits plotted against size deciles produce a humped-shaped curve. Fama and French (2008) analyzed several anomalies including momentum. They use both equally weighted and value-weighted portfolios. In value-weighted portfolios, they find that momentum sorts produce a strong positive spread in returns (high momentum minus low momentum) that decreases systematically from the small to the large ends of the size sorts. Specifically, for micro-, small-, and big-size groups, the

[3] See the next section for details.

[4] Additionally, the momentum literature has tended to focus on either a 6/6 strategy (Jegadeesh & Titman, 2001) or an 11/1 strategy (Fama & French, 2008). To explore different momentum horizons, I examine 3/6, 6/6, 10/6, and 24/6 strategies. This serves as testing different momentum horizons, but it also serves an additional purpose: if the momentum effect is associated with "growth", we anticipate that longer horizons of momentum subsume shorter-horizon momentum. This is because firms grow in the longer and intermediate horizons (short-term surges in stock prices do not necessarily imply sustainable growth). A secondary finding of this paper points in that direction.

[5] Hong et al. (2000), Lee and Swaminathan (2001), Chordia and Shivakumar (2002), and Griffin, Ji, and Martin (2002) reported monthly momentum returns of 0.53%, 1.05%, 1.51%, and 0.58%, respectively. Rouwenhorst (1998, 1999) documents the momentum effect in European and emerging stock markets. Richards (1997) and Chan, Hameed, and Tong (2000) investigated momentum strategies at the country level and reported monthly returns of 0.57% and 0.46%, respectively.

[6] Some have argued that the returns from momentum strategies are the product of data mining biases. This concern was addressed by Jegadeesh and Titman (2001) who showed evidence that momentum profits documented in Jegadeesh and Titman (1993) continued in the 1990s.