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REVIEW OF OVERREACTION AND UNDERREACTION IN STOCK MARKETS

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Abstract

This study evaluates the validity of market efficiency hypothesis based on the findings of extant literature that deals with stock returns. Market efficiency hypothesis posits that it is not possible to beat the market using past trading data. Thus, predictability of returns using past trading data challenges the idea of market efficiency. I present a review of studies that document long term return reversals and short-to-medium term continuation in returns, which contradicts to expectations of market efficiency hypothesis. The reversal effect is generally attributed to overreaction of investors while the momentum effect is attributed to underreaction of investors. The "overreaction" and "underreaction" phenomena constitute examples of possible violations of market efficiency since these ideas assert that investors are likely to make profits either by "buying past losers and selling past winners (contrarian strategies)" in the long run, or by "buying past winners and selling past losers (momentum or relative strength strategies)" in the short run, respectively. Finally, I summarize the leading behavioral models that explain overreaction and underreaction phenomena.

Keywords: Market efficiency, overreaction, underreaction, momentum, contrarian strategy

INTRODUCTION

This study presents a review of literature that documents long-term return reversals and short-to-medium term continuation in returns and evaluates the validity of market efficiency hypothesis based on the empirical findings of related literature. The idea of market efficiency is one of the cornerstones in the area of financial research. The statement: "prices already reflect all readily available information in an efficient market" implies that it is not possible to beat the

market using past trading data. Thus, predictability of returns using past trading data challenges the idea of market efficiency. A group of empirical studies document that the worst stock return performers (losers) tend to outperform the prior period's best return performers (winners) in the long run and this reversal effect is attributed to overreaction of investors. Another group of studies show that winners tend to stay as winners and losers tend to stay as losers in the short run. The so-called momentum effect is attributed to underreaction. The "overreaction" and "underreaction" phenomena constitute examples of possible violations of market efficiency since these ideas assert that we can make profits either by "buying losers and selling winners (contrarian strategies)" in the long run, or by "buying winners and selling losers (momentum or relative strength strategies)" in the short run, respectively.

The remainder of this paper is organized as follows. Sections 2 and 3 review the methodology and findings of the leading studies on overreaction and underreaction, respectively. Section 4 introduces the behavioral models that that explain over and underreaction phenomena. Section 5 summarizes the main findings and concludes the study.

STUDIES ON LONG-TERM RETURN REVERSAL AND OVERREACTION

In 1985, DeBondt and Thaler presented evidence that stocks have significant price reversals over long holding period horizons. They hypothesize that this finding can be attributed to overreaction of investors such that investors tend to overweight recent performance, while they underweight longer-term information in their decisions. In testing the predictive power of the overreaction hypothesis, they do not use the standard event study methodology. They argue that forming event portfolios and testing whether portfolio return relative to CAPM is equal to zero or not is not appropriate since it is not possible to understand whether any departure from zero implies semi-strong form inefficiency or misspecification of CAPM or mis-estimation of alphas/ betas or weak form inefficiency. In order to overcome this ambiguity, they form winner and loser portfolios based on past excess returns and take the association between systematic nonzero residual return behavior of before and after-portfolio formation months into account.

The test procedure utilized by DeBondt and Thaler (1985) is important since many studies follow their methodology in testing overreaction idea and some other studies argue that the procedure leads to biased results. They use CRSP data of NYSE common stock returns between January-1926 and December-1982. Market index is the equally weighted arithmetic average return on all CRSP listed securities. Starting in Jan-1930, the first step is to estimate the monthly residual returns for the next 72 months for each stock. They repeat this procedure 16 times for each of non-overlapping three-year intervals (Jan-1933, Jan-1936, etc.) Second, they form winner and loser portfolios based on the ranked cumulative excess returns of stocks,

starting in Dec-1932 (the portfolio formation date, t=0) and covering 36 months prior to the portfolio formation date. The best and worst performing 35 stocks (or 50 stocks) are considered in forming winner and loser portfolios. They repeat this 16 times for each of non-overlapping three-year intervals (Dec-1935, Dec-1938, etc.). Thus, they fix 16 portfolio formation dates in this step. Third, the 36 months following the portfolio formation date constitutes the "evaluation period" and cumulative average residual returns (CAR) are computed for the next 36 months, for both winner and loser portfolios in each of the 16 non-overlapping 3-year periods. (Starting in January 1933 and up to December 1980). Finally, using these CAR values they calculate the average CAR values for both winner ($ACAR_{w,t}$)and loser ($ACAR_{L,t}$)portfolios and each month between the first month (t=1) and the 36^{th} month. The overreaction hypothesis predicts ACAR for loser portfolios to be greater than ACAR for winner portfolios. They then calculate t-statistics for the 36 post-formation months.

They find that loser portfolios outperform the market by an average of 19.6%, 36 months after the portfolio formation consistent with the overreaction hypothesis. Winner portfolios earn 5% less than the market, which implies a 24.6% difference between the returns of extreme portfolios. Thus, the overreaction effect is asymmetric in favor of loser portfolios. Moreover, as the CAR values during the formation period get larger, subsequent price reversals also get larger. Their results indicate that overreaction is different from seasonality in stock prices. The difference in ACAR values for 3-year formation period exceeds those of 2 and 1-year formation periods, although they are affected by the same seasonality. The finding of significantly higher CAPM betas for winner portfolios implies that the loser portfolios are less risky in addition to their higher performance. However, they cannot provide plausible explanation for the large positive excess returns of the loser portfolio in January. The cumulative average residuals shows that January effect on the loser portfolio continues as late as five Januaries. They also observe a decline in the value of loser portfolio between October and December, which leads the authors to consider tax-loss selling hypothesis. However they find puzzling results on this issue.

Bernstein (1985) discusses the main findings and implications of DeBondt and Thaler (1985) article. He questions the long-term persistence of contrarian strategy abnormal returns and argues that investors should eliminate such profits in a short time. Another consideration is the implication of the findings on market inefficiency. He comments that the market may be inefficient in longer run in incorporating information but short run efficiency is observed in incorporating new information. He argues that this may explain why contrarian strategies pay off. Moreover, the long run inefficiencies are likely to disappear if all investors develop the

necessary psychological attitudes and accept the true investment horizons as their investment horizon.

In a follow-up paper in 1987, Debondt and Thaler provide additional evidence in favor of overreaction hypothesis. They concentrate on the unresolved findings of their previous study: (i) the seasonality in the price correction (January effect) and (ii) the asymmetry in the correction for loser and winner portfolios. The study also describes the characteristics of the firms in extreme portfolios. They use data from CRSP monthly return tape covering the period 1926 to 1982. Portfolios including 50 more extreme winners and 50 more extreme losers are formed based on cumulative excess returns over five year successive formation periods. They calculate average and cumulative average excess returns for rank portfolios and the results imply a seasonal component consistent with their previous study. They also calculate Spearman rank correlations between relevant pairs of average return performances for the entire formation period and different sub-periods. The results present excess returns for losers particularly in January, which is negatively related to formation period performance. January excess returns are also detected for winner portfolios and a negative correlation between winner January excess returns and returns for the prior December is observed. The authors suspect that the exceptional January returns of long-term winners and losers may reflect a tax-loss selling pressure for losers and a capital gains tax “lock-in” effect for winners. However they admit that the study still fall in short of providing a satisfactory explanation regarding the observed seasonality in excess returns. They also show that winner-loser effect is a separate effect from that of size effect, which is still observed when the losing firm effect is removed. Similarly, the winner loser effect cannot be attributed to changes in risk. They find that the arbitrage portfolio beta is not sufficient to explain the average annual return documented for the test period. Thus the main point of the study is in line with the 1985 study such that mean reversion in stock prices is the evidence of overreaction and they further show that the documented excess returns cannot just be attributed to size effect, changes in beta or tax effects.

Findings of Zarowin (1989) contradict to the “overreaction to earnings hypothesis” of DeBondt and Thaler (1987). Zarowin (1989) utilizes a trading rule based on firms that have experienced extremely good and bad earnings years. In particular, he forms portfolios to examine whether we observe overreaction to good or bad extreme earnings. He examines the 36-month subsequent stock returns to extreme earnings years for the poorest earners versus the best earners. The dataset for the study is obtained from CRSP monthly return file and Compustat annual industrial file over the period 1971 to 1981. Earnings utilized in the study are defined as earnings before extraordinary items and discounted operations. The earnings performance is obtained by dividing the changes in earnings from last year to this year by the

standard deviation of the firm's earning changes over the five previous years. Rankings and winner-loser portfolio formation are based on this earnings performance measure.

Zarowin (1989) documents that prior period losers are likely to outperform prior period winners over the subsequent 36-month period. However when he matches poor earners with good earners of equal size, the performance differences among poor and good earners disappear. Similarly, comparison of poor (or good) earners of disparate sizes reveals that small firms outperform large firms and smaller winners outperform larger losers. He argues that the observed overreaction phenomenon can be attributable to size effect and not to investor overreaction of earnings, since loser firms are typically smaller than winners.

Motivated by the findings of his 1989 study, Zarowin (1990) reexamines DeBondt and Thaler's stock market overreaction evidence, controlling for size differences of winner and loser portfolios. In particular, using the data previously utilized in DeBondt and Thaler (1985), he forms winner and loser portfolios based on 17 non-overlapping three-year formation periods. The winners and losers are defined as the top and bottom quintiles of firms ranked by CARs (rather than 35 or 50 most extreme firms in DeBondt and Thaler). The coefficients obtained from regressions of portfolio excess returns against a loser-winner dummy variable confirm original findings of DeBondt and Thaler in that losers outperform winners by a statistically significant amount over evaluation period. The cumulative return difference is smaller and he attributes this to inclusion of less extreme firms due to using quintiles in ranking. Results also reveal strong January effect consistent with DeBondt and Thaler. He also supports DeBondt Thaler (1987) in that differences in risk between winners and losers do not provide a plausible explanation for the findings of reversal.

The analysis of winners and losers suggests that losers tend to be smaller than winners. Zarowin (1990) conducts two tests. The first test matches subsamples of equal size winners and losers and all discrepancies other than January effect disappeared as a result. This leads him to refer to tax loss-selling phenomenon as a plausible explanation rather than overreaction. For the second test, he identifies periods where winners are smaller than losers and where losers are smaller than winners and perform separate analyses on these sub-periods. The idea is that we would expect no difference in returns to the overreaction investment strategy in these sub-periods if overreaction idea may account for the results. On the other hand, we would expect losers to outperform winners when losers are smaller and winners to outperform losers when winners are smaller. The results support the second explanation. In particular when losers are smaller, they outperform winners by a significant 26,7 percent over the 3-year evaluation period and when winners are smaller, they outperform losers. He concludes that results of DeBondt

and Thaler are just another manifestation of the size-effect and the tendency of losers to be smaller sized firms compared to winners explains why losers tend to outperform winners.

DeBondt and Thaler (1990) question whether the behavioral biases that lead to overreaction idea applies to security market analysts in making the periodic forecast about company earnings. They test whether there is a tendency to make extreme forecasts over the predictive value of the information available to the forecaster. Forecasted changes in earnings per share (EPS) for one and two-year time horizons are considered. They regress the actual change in earnings on forecasted change and consider two null hypotheses. The first one is "the forecasted changes are too extreme so actual changes are less than predicted" and the second one is "the estimated coefficient of the forecasted change for the two year forecasts is less than that of one year forecasts". The estimated coefficient for the forecasted change is less than one indicating that the forecasted change in earnings has to be scaled down to match with the actual change. In particular, the study suggests that the forecasts are "too optimistic, too extreme and even more extreme for two year forecasts than for single year predictions". They argue that these findings are consistent with "generalized overreaction". This term indicates that it is not clear to what information analysts are overreacting. However, they also point out two potential alternative interpretations: the first one is "errors in variables" problem indicating that a downward bias may be observed if the measure of forecasted changes in earnings contains an error. The second one is the possibility that the forecasts may be stale and they state that this possibility cannot be completely ruled out. However, they also argue that a large bias is unlikely to be produced by these errors. They also try to explain the underlying reason under the documented generalized overreaction and consider a measure of market valuation (MV/BV) and earnings trend as the possible variable; however the variables could not explain the variation in forecast errors.

Abarbanell and Bernard (1992) also examine the behavior of security analysts. They present conflicting results with that of DeBondt and Thaler (1990). They state that "extreme analysts forecasts" documented by Debondt and Thaler cannot be linked to stock price overreactions. In particular Abarbanell and Bernard try to determine to what extent the analyst's response to earnings may explain the anomalous delayed stock price responses to earnings. Their empirical findings are based on earnings per share and corresponding Value Line forecasts as well as stock price data gathered for 178 firms for the period 1976 to 1986. They select their working sample in such a way that introduces some survivorship bias but they argue that it does not have significant importance while interpreting results since survivorship bias has little or no effect on post earnings announcement drift. They argue that the analyst's forecasts exhibit certain properties of the naïve seasonal random walk forecast model. This explains their

empirical findings that the form of underreaction to recent earnings exhibits a seasonal random walk model. Finally, they also note that the documented underreaction may only be partially rooted in inefficiencies of analysts' forecasts and others should be considered as well to provide a full understanding.

Conrad and Kaul (1993) present evidence that disproves the overreaction idea using a sample of NYSE firms over the 1926-1988 period. They use the Debondt and Thaler (1985) methodology in forming winner and loser portfolios and calculate the long-term performance of these portfolios using both Debondt and Thaler (1985) cumulative return method and the alternative holding period method. The holding period method can be summarized as follows: they first calculate the holding period return of each security in the winner and loser portfolios and portfolio holding period returns are obtained by simply taking average of individual security returns. In calculating the holding period market return, they average the holding period returns of each NYSE security for each holding period instead of simply compounding monthly NYSE equally weighted market return. The average abnormal holding period return is then computed by taking the average of difference between individual holding period return and the market-holding period return for all securities. They show that the first method (using cumulative residual returns) produces upwardly biased results due to cumulating. They argue that the process of cumulation not only cumulates true returns but also cumulates the upward bias in single period returns induced by measurement errors such as bid ask effect. They show that using the alternative method of holding period returns eliminates the non-January returns of the long-term contrarian strategies. This implies that there is no evidence of market overreaction in non-January periods. On the other hand, losers outperform winners using both cumulative residual returns and holding period returns. They accept this January effect and argue that the January returns to long-term contrarian strategies cannot be attributed to overreaction.

The study by Loughran and Ritter (1996) re-test the findings of the Conrad and Kaul (1993) study and report contradictory results. In particular, they find that the test period returns differ very little based on whether calculation is done through cumulative return method or the holding period method. They use monthly returns, price and market value data from CRSP for NYSE and Amex firms. They form portfolios over the period 1928 to 1985. Their findings also suggest that the predictive ability of price is found to be low by cross-sectional regressions. They explain that the differences between findings of these two studies can be attributed to differences in statistical methodology. They criticize the statistical significance in the context of long-term reversals. They state that Conrad and Kaul (1993) has overstated the importance of price in explaining cross-sectional returns as a result of the pooled cross-section time series regression utilized in the study. The contemporaneous correlations of residuals of stocks are

ignored leading to misstatement of the t statistic and survivorship bias in the criticized study. Loughran and Ritter also present support for the January effect and restricting the analysis to January they conclude that the phenomenon of aggregate market reversion occurs entirely in January.

Lo and MacKinley (1990) present evidence that short horizon contrarian strategies yield abnormal returns using weekly portfolio returns (in contrast to longer horizon returns utilized in previous studies). They argue that distinguishing between short and long run horizons is important since weekly fluctuations exhibit differences compared to movements in long horizon returns. The importance of this paper is that they attempt to quantify the proportion of contrarian profits that can be attributed to overreaction. For this purpose, they estimate the expected profits from the return-reversal strategy for a sample of 551 CRSP NYSE-AMEX stocks with non-missing weekly returns 1962 to 1987. Their findings present evidence against overreaction as the only source of contrarian profits. The results show that the proportion of contrarian profits attributable to overreactions is less than 50 percent. In particular, they find systematic lead-lag relationships among returns of size-sorted portfolios as an important source of contrarian profits. They suggest that the returns for larger stocks lead those of smaller ones. However, they cannot provide an explanation for these observed cross autocorrelations.

Jegadeesh and Titman (1995) show that contrarian strategies applied to size-sorted portfolios do not generate significant abnormal returns. In particular, they show that Lo and MacKinlay(1990)s' contrarian portfolios for weekly data on 50 size-sorted portfolios generate small negative returns for a sample period from 1963 to 1990. They also conduct tests that separately examine stock price reactions to common factors and firm specific information by decomposing contrarian profits to their sources based on how stock prices respond to information. Their findings suggest that stock prices overreact to firm specific information while they react with a delay to common factors on average. However, the delayed reactions do not contribute to contrarian profits and the tendency of stock prices to over-react to firm specific information is the likely cause of observed short-horizon contrarian profits. They also argue that the price pressure generated by liquidity motivated trades may be the likely cause of return reversals. Thus, they suggest that increasing liquidity in a market will lead to a decline in profitability of contrarian strategies.

Antoniou, Galariotis and Spyrou (2005) investigate the existence of contrarian profits in Athens Stock Exchange (ASE) using the methodology proposed by Jegadeesh and Titman (1995) and the three-factor model of Fama-French. They report significant contrarian profits which persist even after adjusting for market frictions and risk. The firm specific component overreaction is more effective compared to common factor underreaction in forming up

contrarian profits (only for the sample not corrected for market frictions). When they take market friction into account and as we move from small to large stocks they present a decline in contrarian profits consistent with US findings.

George and Hwang (2007) investigate whether taxes can explain long-term reversals. They argue that investors with locked in gains not to sell winners. This makes sense since capital gains are taxed upon realization and by not selling the winners the investor may delay paying taxes. Then, we expect to observe higher prices and lower expected returns for stocks with large embedded capital gains. The study conducts a test of both overreaction hypothesis and the capital gains lock-in effect based on data from United States and Hong Kong (neither capital gains nor dividends are taxed in Hong Kong). The data for US for 1963-2001 periods includes all NYSE, AMEX and NASDAQ stocks covered by CRSP. Monthly data is used. They form winner and loser portfolios following Debondt and Thaler (1985, 1987) and reversals are examined considering returns to these portfolios. For the US data they find that overreaction hypothesis have no explanatory power. Monthly data for Hong Kong stocks are taken from the Pacific Bain capital Market (PACAP) covering the period from 1980 to 2000. For the Hong Kong data, they suggest that neither overreaction nor the tax hypothesis can predict reversals. They conclude that for the US data, the tax hypothesis is better in explaining long-term reversals compared to overreaction hypothesis.

STUDIES ON MOMENTUM AND UNDERREACTION

The basic evidence of underreaction is that stock prices seem to respond to earnings for about a year after they are announced. The momentum effect identified by Jegadeesh and Titman (1993), using CAPM as the benchmark model is generally considered to be the leading study in explaining underreaction. The idea of momentum refers to the fact that stocks with high returns over the past year tend to have high returns over the following three to six months. As mentioned in the first part of this study, the overreaction idea suggests that buying past losers and selling past winners (contrarian strategies) achieve abnormal returns. On the contrary, the underreaction idea implies that relative strength strategies (RSS) which is a trading strategy based on buying past winners and selling past losers would create abnormal returns. The main purpose of Jegadeesh and Titman (1993) study is to present abnormal returns created by RSS strategies. They consider a total of 16 strategies based on the returns over past 1,2,3,4 quarters and holding periods that vary from 1 to 4 quarters. Skipping a week between the portfolio formation period and the holding period forms a second set of 16 strategies. The study utilizes data from CRSP daily returns file for the period 1965 to 1989. They present the average returns for different buy and sell portfolios as well as the returns for zero cost (buy minus sell or

winners-losers portfolio). The 12-month / 3-month strategy is the most successful zero cost strategy as it provides a return of 1,31% without a time lag between the portfolio formation period and holding period and a return of 1,49% with one week time lag between the two periods. The results suggest that, 6-month formation period returns are around 1% regardless of the holding period. On average, all RSS considered are documented to be profitable.

Jegadeesh and Titman (1993) use two return generating models in order to find the sources of profits generated by RSS. The first model assumes that individual stocks react instantaneously to factor realizations. This model allows for factor-mimicking portfolio returns to be serially correlated and used to decompose profits into three components. The first two components are related to systematic risk and the third one is related to firm specific returns. They state that, the first two components would exist in an efficient market while the third one would be an indicator of market inefficiency. The second model relaxes the instantaneous reaction assumption of the first model and it is used to evaluate whether a lead-lag relationship may provide a partial explanation for the profits generated by RSS. The estimates of betas and average capitalizations for 6-month / 6-month RSS shows that, beta of loser's portfolio is higher than the beta of winner's portfolio and the beta of zero-cost portfolio is negative. This is exactly the opposite of DeBondt and Thaler (1985) results. Average capitalizations of the stocks in loser's portfolio are smaller compared to stocks in winner's portfolio; both are smaller than the average capitalizations of all stocks. They suggest that, this is evidence that profits of RSS are not due to cross-sectional dispersion in expected returns. The negative serial covariance of 6-months returns leads them to suggest that, potential to time the factor is also unlikely to be the source of RSS profits. They find the average serial covariance of idiosyncratic returns to be positive, indicating that a part of RSS profits can be attributed to under reaction to firm specific information. They also examine the time-series variation in RSS profits and conclude that lead-lag relation is not an important source of RSS profits and that RSS profits are related to market under reaction to firm-specific information.

Jegadeesh and Titman (1993) also consider the profitability of RSS strategies within size and beta based subsamples. The purpose is to find whether RSS profits can be attributed to any particular subsample of stocks. They find that RSS produce similar profits when applied to subsamples and the whole sample, so they suggest that RSS profits are not confined to any subsample. The results are not altered much when value weighted index is used as the market proxy. They also note that RSS profits are still significantly positive after accounting for transaction costs. Finally, they find evidence for January effect on RSS profits and the effect is not statistically significant for the sample of largest firms. As the firm size gets smaller the January performance gets worse. Their main finding is that RSS produces positive returns

applied to the whole sample of stocks. Negative returns in sub-sample 1975-1979 are primarily attributed to negative January returns of small firms. If the month of January is excluded, RSS produce positive returns on all periods when applied to all sub-samples.

Conrad and Kaul (1998) suggest that momentum profits are attributable to cross-sectional differences in unconditional expected returns rather than to any time series dependence in returns based on empirical tests supported by simulations and bootstrap experiments. The study is based on a set of trading strategies during 1926-1989 period and during sub periods using the entire sample of available NYSE and AMEX securities. Their trading strategy relies on time series patterns in security returns. A total of 120 strategies including both momentum and contrarian strategies are implemented. Their results suggest that momentum and contrarian strategies are equally likely to be successful. The general pattern is to observe positive and statistically significant medium horizon profits for momentum strategy and long horizon success for the contrarian strategy. In the bootstrap experiments they randomly draw a return for each month for the monthly returns for each stock from the observed distribution of stock returns. The experiment is conducted with replacement for each trial. They argue that this process eliminates any serial correlation in the return series. Their findings suggest that the momentum profits generated by the bootstrap experiment do not differ from that of actual return series. They interpret this finding as evidence that the bootstrap experiment process eliminates any time series dependence.

The study by Jegadeesh and Titman (2002), argues that the results of Conrad and Kaul (1998) are attributable to their methodology. In particular, they criticize Conrad and Kaul (1998) on not taking the small sample biases into account in their tests and bootstrap experiments. Specifically, they argue that since the returns are drawn with replacement in Conrad and Kaul study, it is possible to observe the same return for a stock in both the ranking and holding period which leads to small sample bias. . In the empirical part they study with a sample of all stocks from NYSE ad Amex over the period from 1965 to1997. The unbiased test results of Jegadeesh and Titman (2002) disproves the findings of Conrad and Kaul (1998) and suggest that cross-sectional differences in expected returns can explain very little of the momentum profits.

Jegadeesh and Titman (2001) document several explanations for the momentum strategy profitability. They suggest that we still observe momentum profits in 1990s based on the six-month momentum strategy of Jegadeesh and Titman (1993). They interpret this finding as evidence that the results of the Jegadeesh and Titman (1993) study cannot be attributed to data snooping bias. They also examine the post holding period returns of the momentum portfolios and the finding of negative returns provide evidence in favor of behavioral models but

they also state that these models may at best provide a partial explanation for the momentum anomaly.

Moskowitz and Grinblatt (1999) present evidence that the profitability on momentum investment strategies significantly get smaller if we control for the effects of industry momentum on returns. They use monthly data from CRSP and COMPUSTAT files for the period July 1963 to July 1995. They first consider the strategy of buying firms in industries that are winners over a past ranking period and shorting an equal dollar amount of firms in the loser industries. The value-weighted returns are utilized for firms within industries. When they consider returns across winner/loser industries they employed equal weighting, they observe significant positive returns as a result of this strategy. Then, they consider a "random industry" strategy in order to analyze the momentum profits of firms having the same formation period returns as the firms in the winner and loser industries. In particular, this strategy replaces each true stock in an industry with another stock that had the same past six-month return. Their results suggest that momentum profits are nonexistent for the random industry strategy leads them to conclude that industry component is the cause of momentum profits. They also list the differences between individual stock momentum and industry momentum. They basically state that industry based strategies are in general more profitable and more implementable. The study cannot explain why we observe strong industry momentum phenomenon. They just suggest that the findings may be partly explained by the behavioral models or the risk models. They conclude by suggesting further research on the issue.

Grundy and Martin (2001) present further evidence in favor of momentum for the post 1926 era. Their contribution to the existing literature is that they showed industry effects or cross-sectional differences in expected returns are not the primary cause of momentum phenomenon. They show that the risk-adjusted profitability of momentum strategy is stable across periods. Their results suggest that we can build a profitable dynamically hedged momentum strategy. In particular they show that we can remove 78.6 % of the monthly return variance and increase the mean monthly return significantly. They propose three possible explanations for momentum profits: (i) cross-sectional variability in mean returns, (ii) exposure to industry factors and (iii) momentum in stock specific returns. The term "stock specific returns" is used to refer to returns not related to realizations of Fama-French factors. They find that the first two explanations are unlikely but momentum profits can be (at least partly) attributed to momentum in the stock specific component of returns. Finally they investigate whether there exist any momentum profits even after accounting for transaction costs that we face while undertaking the zero-investment portfolio. They suggest that the transaction costs may explain the persistence of the observed anomaly but the equilibrium underlying the anomaly is still left

unexplained even after accounting for the transaction costs. They conclude by suggesting that it may be appropriate to consider momentum as an additional factor in explaining returns as factors SMB and HMB of Fama-French three-factor model.

More recently, Spyrou et al (2007) present evidence from a different stock market, the London Stock Exchange. They examine short-term reaction to extreme events in UK equity market over the period 1989-2004. In particular they examine short-term (daily) reaction of investors to extreme events focusing on major and directly observable equity portfolios that contain same firms on every event date. They test efficient market hypothesis, overreaction hypothesis and underreaction hypotheses as the null hypotheses of the study. For the large capitalization stocks they find efficient reaction to information. However underreaction is observed for the medium and small capitalization stocks. They cannot attribute the finding of investor underreaction to calendar anomalies, bid ask biases or unique global crisis. They suggest that even after adjusting portfolio returns for the three factors proposed by Fama and French (1996) leaves the implications unchanged. They suggest that their finding of short-term under-reaction is consistent with studies documented short-term under-reaction for US market.

Liu and Zhang (2008) emphasize the importance of risk factor in deriving momentum profits. They use monthly returns from CRSP file for NYSE, Amex and Nasdaq common stocks over the period 1960-2004 and construct momentum portfolios following Jegadeesh and Titman (1993) (the six month portfolio is considered). They find that the momentum strategy is profitable for the sample. They focus on the growth rate of industrial production (MP) as a priced risk factor in standard asset pricing tests. Their findings indicate that recent winners have temporarily higher loadings than recent losers on the growth rate of industrial production.

BEHAVIORAL MODELS OF OVERREACTION AND UNDERREACTION

When we consider the findings of the overreaction and underreaction studies reviewed in previous sections, it is still an ongoing debate whether long term overreaction and short to medium term underreaction can be thought as a general rule. The general intuition while interpreting the findings of these studies is to relate underreaction to conservatism where individuals are slow to change their beliefs and overreaction to optimism of investors and representativeness where investors make decisions based on non-existing upward patterns. Fama (1998) considers two behavioral models. The first model proposed by Barberis, Shleifer and Vishny (1998) and the second model proposed by Daniel, Hirshleifer, and Subramanyam (1998) explain how the judgment biases of investors can produce overreaction to some events and underreaction to others.

Barberis, Shleifer, and Vishny (1998) try to explain the belief formation process of investors that lead to underreaction and overreaction. They propose a parsimonious model of investor sentiment, which is consistent with statistical and experimental evidence. They consider two judgment biases: (i) the representativeness bias (the tendency of individuals to give too much weight to recent patterns in the data and too little to the properties of the population that generates the data which violates the law of probability)(Tversky and Kahneman, 1974) and (ii) conservatism (slow updating of models in the face of new evidence) (Edwards, 1968). They argue that conservatism may underlie the underreaction evidence since conservative individuals only make partial adjustments in their prior estimates of earnings in case of new information. On the other hand, investors using the representativeness heuristics are more likely to display overreaction. Their model, which attempts to integrate these two biases, includes one "representative risk-neutral investor" and one asset, which pay all of its earnings as dividends. The beliefs of this investor are assumed to affect prices. The earnings follow a random walk but the investor falsely believes there are two "states" or "regimes".

In regime 1, investors believe that earnings are mean reverting. This implies that after a realized return following a positive earning shock, the investor falsely believes that this shock will be reversed in the next period. However, random walk assumption implies that a positive shock can equally likely be followed either by a positive or a negative shock in reality. Thus the realized return is not large if the shock is negative as the investor expects it. On the other hand, if the shock is positive then this is unexpected and leads to large and positive realized return. Similarly average realized return for an initial negative earning shock in this state is negative and leads to a positive difference in average realized returns. The authors state that this regime is consistent with the momentum idea of Jegadeesh and Titman (1993). Thus if investors decide in regime 1, we observe underreaction since investors mistakenly think that the change is likely to be temporary.

In regime 2, investors believe that firm's earnings are trending such that positive returns will be followed by positive returns. This leads the investors to overreact and this overreaction leads to reversal of long term returns as documented by DeBondt and Thaler (1985).The investor also believes in an underlying regime switching process that determines the regime at any given time. This process follows a Markov process such that current regime only depends on the regime in past period. For example, if two consecutive shocks of the same sign are observed, the investor thinks that he is in the trending earnings regime (Regime 2).

In order to evaluate their random walk model, the authors make simulation experiments. They simply fix an initial level of earnings and randomly simulate 2000 independent earning sequences each representing a different firm. Six years data is simulated for each firm. They

form two portfolios consisting of all firms with positive returns (similar to winner portfolio idea) and negative returns (corresponding to loser portfolios in previous studies) for each n-year period where n ranges from one to four. The difference between returns of these two portfolios is analyzed for all n-year periods. The results suggest that the difference between winner and loser portfolios are positive in short term and negative in long term consistent with previous empirical findings of momentum in short term and reversal in long term. However they admit that the model falls short of objectively estimating the strength of news announcements and suggest further research for a complete model.

Fama (1998) suggests that this model can explain some of the anomalies but on the whole long term return literature is more consistent with market efficiency prediction that long term reversal and continuation are equally likely chance results.

The alternative model proposed by Daniel, Hirshleifer, and Subrahmanyam (1998) includes risk-neutral informed and risk-averse uninformed investors. The informed investors determine the stock prices and these investors are subject to “overconfidence” and “biased self attribution”. In particular, they exaggerate the precision of their private signals about a stock’s value, which implies overreaction to private information. They also down weight public signals about value, especially when the public signals contradict their private signals due to biased self-attribution, which leads to underreaction to public information. They start by assuming a fixed overconfidence level and later they relax assumption of static overconfidence level by introducing outcome-dependent confidence. In this extension they use the psychological pattern that “events that confirm an individual’s beliefs and actions tend to boost confidence too much, and disconfirming events weaken confidence too little.” Thus the asymmetric shifts in investors’ confidence are attributed to biased self-attribution. They show that with repeated public information arrival, the model yields a humped shaped impulse response function

Similar results are obtained both using fixed and outcome dependent levels for selective events (selective events are defined as events planned to take advantage of the mispricing of a firm’s stock such as non-stock issue announcements by managers of firms whose stocks are priced too high). The basic idea is that the immediate price reaction to a selective event absorbs some of the initial mispricing. Since informed investors overweight their prior beliefs about stock value, the model predicts an incomplete announcement period price response. Introducing outcome dependent confidence also reveals short-run momentum in stock prices and event based predictability even for nonselective events. In general the predictions of Daniel, Hirshleifer and Subrahmanyam (1998) model are close to that of Barberis, Shleifer, and Vishny (1998).

However, Fama (1998) argues that these two behavioral models cannot provide a complete explanation for the big picture and they are not alternatives for market efficiency idea in explaining anomalies. The most serious problem with these psychological explanations is that they are ex-post. In other words, when we observe underreaction we say that the cause may be conservatism and similarly relate observed overreaction with optimism. But then the question is "what are the circumstances for conservatism and optimism" and we have to model which one is the likely observed behavior in any case.

As another alternative, Hong and Stein (1999) propose a model emphasizing the interaction between heterogeneous agents. Their model considers two types of individuals ('news watchers" and "momentum traders") none of which are fully rational. The "news watchers" observe some private information but unable to extract the information of individuals of the same type from prices. The "momentum traders" can condition on past price changes. However information processing ability of this group is also limited. Their forecasts must be "simple" functions of the history of past prices. The model also assumes that private information diffuses gradually across the news watcher population. Under these assumptions, Hong and Stein (1999) show that we can observe underreaction but never overreaction when the market is composed of only market watchers. This result follows from the fact that prices adjust slowly to new information among the considered type of individuals. When momentum traders are added into the picture, overreaction in long horizons is observed. This perverse result is the result of the attempt of momentum traders to profit from the underreaction of news watchers type individuals.

Hong and Stein (1999) argue that any new behavioral theory of asset pricing has to introduce a number of testable and ultimately validated predictions. This was in fact the most criticised point about behavioral models considered so far. They state that their model have 3 basic testable implications: 1) Since information diffuse more slowly in small stocks the theory expects both short run continuation and long run reversals in these stocks, 2) News which kept private in first place and then pronounced to public create more long run overreaction and 3) A relationship between momentum traders horizons and the pattern of return autocorrelations has to be observed.

Massey and Wu (2005) present a more recent explanation for individual behavior. They develop a "system neglect hypothesis" to analyze cases where individual underreaction (overreaction) is more likely. In particular, they argue that overreaction is observed when individuals falsely believe in occurrence of a regime shift before it actually has and underreaction is observed when individuals falsely believe that a regime shift has not occurred when in fact it has. Their hypothesis implies that individuals primarily react to signals of change,

and secondarily to the system that generated the signal. They argue that the pattern of over-reaction and underreaction is systematic based on this hypothesis. They use a Bayesian model with a parametric specification of system neglect model to show that underreaction is most common in unstable environments in which signals are precise, and overreaction is most likely to occur in stable environments in which signals are noisy.

Massey and Wu (2005) also conduct experiments in order to understand the factors affecting the ability of individuals to detect regime shifts. Their computerized experimental setting enables them to compare individual performance against a normative standard. The participants observe signals from two regimes and try to detect regime shifts within the system observing these signals. In their experimental paradigm, an urn that contains more red than blue balls represents the first regime and an urn that contains more blue than red balls represents second regime. These are called “red urn” and “blue urn” respectively. The transition probability is defined as the probability of switching from drawing balls from the red urn to drawing balls from the blue urn. Three basic computer based experimental studies are conducted. The participants of the study are 40 university of Chicago students. In the first one, the subjects judge the posterior transition probability. The second study is also a judgment study but contrary to first experiment, participants are given feedback at the end of each trial. This study confirmed the first experiment and used as evidence that the results cannot be attributed to “error”. The third experiment is a choice study where subjects predict the color of the next observation rather than to provide a probability estimate. These studies reveal that the greatest underreaction occurs in stable/noisy conditions and the greatest overreaction occurs in unstable/precise conditions. They state that all three studies provide evidence for some strong pattern of under and overreaction predicted by the system neglect hypothesis.

SUMMARY AND CONCLUSIONS

The evidence of long term return reversal first documented by DeBondt and Thaler (1985) and short to medium term continuation (momentum) by Jegadeesh and Titman (1993) for the US market has taken considerable attention among researchers. Both ideas are extensively studied in US market and there are also studies that pointed towards similar results in international markets. International evidence suggests that the findings are not unique to US market. Many studies tried to attribute these phenomena to various factors such as size, risk, state of the market and calendar effect. There are also studies that presented some sort of counter evidence but these studies are limited and findings of DeBondt and Thaler and Jegadeesh and Titman seems to remain valid. Many studies point out that the observed systematic patterns cannot be explained with traditional rational asset pricing models and behavioral models that

account for biased individual behavior has to be considered. However there is still lack of a complete testable behavioral theory that integrates short-term underreaction and long-term overreaction evidence.

The findings in literature present a challenge to market efficiency since investors who apply contrarian and relative strength strategies may take advantage of documented overreaction and underreaction without bearing extra risk. Fama (1998) discusses that the three-factor model of Fama and French can explain the overreaction evidence but not the momentum evidence. Thus, evidence regarding reversal and especially momentum in return behavior seems to be a challenge to market efficiency and there is still room for further research on both concepts as well as testable behavioral theories that may explain these empirical findings.

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