"Overreaction" and "Underreaction":
- Evidence for the Portuguese Stock Market -

João Vasco Soares*
and
Ana Paula Serra**

March 2005

** Faculdade de Economia da Universidade do Porto*
*** (corresponding author) CEMPRE, Faculdade de Economia da Universidade do Porto,*
Rua Dr. Roberto Frias, 4200-464 Porto, Portugal
Tel: +35122 557 1255, Fax +35122 550 5050, Email: aserra@fep.up.pt

"Overreaction" and "Underreaction": - Evidence for the Portuguese Stock Market –

Abstract

In the past two decades several studies show and explain the occurrence of financial phenomena that are contrary to the Efficient Markets Hypothesis (EMH) of Fama (1970). Among them, the phenomena of "overreaction" and "underreaction", inspired by cognitive psychology studies, are one of the most important challenges to market efficiency, and helped to build the foundations of Behavioral Finance. We investigate the existence of both these phenomena in the Portuguese Stock Market and try to conciliate their simultaneous occurrence. We thus explore whether Portuguese stock returns are related to return past performance for an extended sample (all stocks listed in the main market) and time period (16 years). We start by exploring the existence of autocorrelation in stock returns: as in previous studies we evaluate whether there is negative autocorrelation in the long run, and positive autocorrelation in the short run. We then proceed in testing whether these phenomena stem from overreaction and underreaction by investors. We use several different testing methodologies to evaluate the robustness of the results (controlling for risk and non-risk factors) and assess the validity of alternative hypotheses that have been put forward to explain continuation and reversal patterns in returns. Finally we examine our findings at the light of the predictions that come out of the theoretical behavioral models that have been developed to explain momentum and reversal in returns. Our results seem to be supportive of the overreaction hypothesis: there is negative correlation in stock returns that is robust to risk and non-risk controls. Further "value" strategies show superior performance and this performance seems to be associated with extrapolation of past sales performance. As for the short run return pattern, we find weak evidence in support of momentum effects that persist after controlling for risk. The momentum effects seem to be associated with an insufficient reaction to earnings announcements surprises. The evidence we gather for the Portuguese stock market is consistent with the results found in well researched, large, liquid developed markets. Altogether the two pieces of evidence (continuation followed by reversal in returns) might reflect the dynamic interaction between "news watchers" and "momentum traders" predicted by the behavioral model of Hong and Stein (1999).

Keywords: Overreaction; Momentum; Underreaction; Behavioral Finance

JEL: *G1; G11 and G14*

"Overreaction" and "Underreaction":

- Evidence for the Portuguese Stock Market -

1. Introduction

In the past two decades several studies highlighted the occurrence of financial phenomena questioning the validity of Efficient Markets Hypothesis (EMH) of Fama (1970). There is now extensive evidence that it is possible to predict future returns on the basis of past returns. Serial correlation in returns is contradictory evidence to the EMH (random walk) hypothesis and coupled with anecdotal evidence of heuristic practices by investors, challenges the assumption of rational price setting. "Overeaction" and "undereaction" behavior are among those anomalous phenomena. Given that the investigation of these facts helps to understand price formation in the stock market, it has attracted the interest of market professionals and lead to the implementation of investment strategies to explore these anomalies.

Most previous studies merely document two stylized facts in stock returns: negative autocorrelation in the long run (over two years) and positive autocorrelation in short horizons (one month up to 1 year). The first piece of evidence is usually associated to overreaction while the latter supposedly reflects underreaction.

The seminal works by De Bondt and Thaler (1985 and 1987) and Jegadeesh and Titman (1993), respectively, for "overreaction" and "underreaction", were the first to show that it was possible to conceive profitable strategies on the basis of the observation of past returns.

De Bondt and Thaler (1985 and 1987) showed that stocks that have registered the lowest returns ("losers") during the previous three to five years did better during the following three to five years than those that previously had the highest positive return

("winners"). The main explanation advanced by De Bondt and Thaler for this negative correlation in returns in the long run was the "Overreaction Hypothesis", derived from the "representativeness" heuristic, as suggested by Tversky and Kahneman (1974): investors would overrate recent information, neglecting or attributing less importance to past news, in their prospects revisions, based on their judgment assessments of probabilities. This would lead to excessive optimism over good news and extreme pessimism over bad news. Stock prices would deviate temporarily from their intrinsic values, originating in the medium-long term a "mean-reverting" effect.

As for the positive autocorrelation in short term returns, Jegadeesh and Titman (1993) showed that a strategy that buy stocks with the highest positive return in the previous 3 (to 12) months (winners) and sell those with the lowest returns (losers) in that same period, yielded significant abnormal returns during the following 3 (to 12) months. They claim that this momentum effect observed in returns would reflect "underreaction" of investors to recent information and would stem from the "conservatism" heuristic advanced by Edwards (1968): investors would slowly adapt to the arrival of recent news flowing into the market, gradually incorporating their expectations into prices. Chan, Jegadeesh and Lakonishok (1996) provide empirical support for this argument: they observe, in simultaneous, momentum in returns and continuation in earnings surprises around earnings announcement dates.

Several alternative theoretical models have been proposed to account for the occurrence of these two phenomena in tandem. These are non-risk, behavioral models (see, for example, Barberis, Shleifer and Vishny (1998), Daniel, Hirshleifer and Subrahmanyan (1998) or Hong and Stein (1999)) that contemplate different frameworks in terms of the type of agents and their dynamic interaction and focus on one particular behavioral bias (biases of conservantism, excess confidence, self-attribution or heuristic decision-making) to produce the empirically observed patterns in returns (continuation followed by reversal).

The purpose of this paper is to explore the existence of these return patterns for the Portuguese stock market. Only a very few papers looked at the predictability of Portuguese stock returns on the basis of past returns. In particular, Alves and Duque (1996) looked at the validity of contrarian stock strategies built upon the findings of BT but their results for a small sample of Portuguese stocks over the period of 1989 to 1994 were inconclusive. In this paper we thus explore whether Portuguese stock returns are related to return past performance for an extended sample (all stocks listed in the main market) and time period (16 years). We start by exploring the existence of serial correlation in stock returns: as in previous studies we evaluate whether there is negative autocorrelation in the long run, and positive autocorrelation in the short run. We then proceed in testing whether these phenomena stem from overreaction and underreaction by investors. We use several different testing methodologies to evaluate the robustness of the results (controlling for risk and non-risk factors) and assess the validity of alternative hypotheses that have been put forward to explain continuation and reversal patterns in returns. Finally we examine our findings at the light of the predictions that come out of the theoretical behavioral models that have been developed to explain momentum and reversal in returns.

Our main findings are the following. Our results seem to be supportive of the overreaction hypothesis: there is negative correlation in stock returns that is robust to risk and non-risk controls. Further "value" strategies show superior performance and this performance seems to be associated with extrapolation of past sales performance. Yet most of the results lack statistical significance. As for the short run return pattern, we find weak evidence in support of momentum effects that persists after controlling for risk. The "momentum" effects seem to be associated with an insufficient reaction to earnings announcements surprises. The evidence we gather for the Portuguese stock market confirm the results found in well researched, large, liquid developed markets.

Altogether, the simultaneous occurrence of the two patterns in returns (continuation followed by long horizon reversal) and the results from the additional tests we run, seem to be consistent with the model of Hong and Stein (1999)

The paper proceeds as follows. Section 2 provides a brief review of the relevant literature and section 3 presents the data and the tests we run. In section 4 we show the empirical results and discuss the main findings. Section 5 concludes.

2. Brief Literature Review

2.1 Overeaction

The seminal works on "overreaction" were by De Bondt and Thaler (BT) (1985 and 1987). Using a sample of stocks listed on the NYSE, De Bondt and Thaler (1985) analysed monthly returns for the period between 1926 and 1982. They showed that stocks that have registered the lowest returns ("losers") over the previous three or five years (the *observation* period) did better during the following three to five years (the *test* period) than those that previously had the highest positive return ("winners"). This contrarian strategy yielded an abnormal market adjusted return of 24.6% for the arbitrage portfolio ("losers" minus "winners). These results of negative serial correlation for 36 months are inconsistent with the weak form of the Efficient Markets Hypothesis of Fama (1970) and could be driven by excessive optimism as described above.

During the last 15 years, several studies came forward with alternative or complementary explanations for the successful performance of strategies based upon the reversal effect in returns, suggesting the observed abnormal returns would result, for example, from biases in computing returns or impropriate risk adjustment. New refined methodologies allowed establishing the robustness of the findings in BT (1985). The more important contributions were:

- Chan (1988): the author proposed a new method to measure the market risk beyond CAPM, allowing time-varying betas;

- Zarowin (1989 and 1990): the author argued that the results of De Bondt and Thaler (1985, 1987) could be contaminated by the "Size-Effect" and/or the "January-Effect";

- Conrad and Kaul (1993): the authors suggest correcting for microstructure biases (bid-ask bounce) in the method employed for returns calculation, especially when long periods were analysed.

In spite of these and other criticisms, the results obtained by De Bondt and Thaler (1985) for the US market were confirmed for other markets: Power, Lonie and Lonie (1991) and Campbell and Limmack (1997) presented similar evidence for the UK; Da Costa (1994), for Brazil; Alonso and Rubio (1990), for Spain; and Mai (1995) for the French market.

Concurrently, Lakonishok, Shleifer e Vishny (LSV) (1994) documented that "Value Strategies" were profitable and linked this result with the "overreaction hypothesis" as well. The authors found that stocks which had performed well in the past and were expected to perform well in the future ("glamour" stocks) obtained inferior returns against those stocks that had had poor past performance and were expected to have a poor future performance (the "value stocks"). Using a sample of stocks listed on the NYSE and AMEX, for the period between 1963 and 1990, the authors formed portfolios grouping the stocks on the basis of BTM ("Book-to-Market"), and measure the returns of the first decile ("glamour stocks") compared with those for the last decile ("value stocks") for a 60 month-period after the portfolio formation. There are three main results in Lakonishok *et al.* (1994). First, the return of the "value portfolio" outperformed by 10%/11% a year the "glamour portfolio" (between 8% and 9% on a size-adjusted basis). Second, the superior performance of "value stocks" could not be explained by risk. Finally, other tests shed

additional light on the combined findings of JT and BT. In particular, LSV examined the growth rates of fundamental variables such as sales and cash flow change between the period prior to portfolio formation and the period after that. They found that those growth rates were superior for glamour stocks before the formation period, but were inferior 2 to 5 years after that, suggesting that investors mistakenly extrapolated the growth rates of fundamental values such as the sales, "overreacted", and gradually proceeded the "mean-reverting", adjusting their expectations and pushing the prices back to the intrinsic values.

2.2 Underreaction

Jegadeesh and Titman (JT) (1993) were the first to refer the pattern of underreaction in returns. Using a sample of stocks listed on the NYSE and AMEX, for the period between 1965 and 1989, they analysed several portfolios described as "*J*-Months/*K* Months", that included stocks based on the return earned during the preceding *J* months and that were held for *K* months. They showed that a strategy that buy stocks with the highest positive return in *J* months (winners), and sell those with the lowest returns in that same period (losers), yielded significant abnormal returns during the following *K* months (here *J* and *K* are in multiples of 3, and not to exceed 12). For example, a 12x3 strategy yielded an abnormal return of 1.49%/month. The authors paid special attention to the case *J*=*K*=6, for which returns were approximately 1% per month. Jegadeesh and Titman (1993) showed that that this excess return could not be explained in terms of CAPM risk - since the post-ranking beta of the "winner minus loser" portfolio was negative - or by time varying risk, size, serial covariance or lead-lag effects. Further the authors measured the differences in returns for the winner and loser portfolio around the quarter earnings announcement dates, and found that, in the first 6 months, winner stocks had a better

performance than loser stocks[1]. This result is consistent with Bernard (1992), that showed average returns around the quarter earnings announcements are positively significant, following positive earnings surprises ("standardized unexpected earnings") in the previous quarter. Bernard (1992) and Jegadeesh and Titman (1993) claim that this evidence supports the hypothesis of "underreaction". Behavioural finance argues that this behaviour could be led by "conservatism" as suggested in Edwards (1968): conservative investors underweight and slowly process the new information that is therefore gradually incorporated into prices.

Several empirical studies challenged the under-reaction argument for explaining the observed momentum effect in returns and proposed a battery of alternative hypotheses[2]. The main competing hypothesis is that momentum would also occur as a result of overreaction. The findings of Chan, Jegadeesh and Lakonishok (1996) are consistent with "underreaction" by investors, since they observe, simultaneously, "momentum" and a "continuation" trend in earnings surprises around the announcement dates.

Yet more recent works have tried to demonstrate the presence of an "overreaction" pattern in "momentum", in line with the model of Daniel, Hirshleifer and Subrahmanyam (1998). Cooper, Gutierrez and Hameed (2003), considering the "state of the market" as a proxy for investor sentiment and for risk aversion, found that the "momentum" profits only occurred when the market was "bullish", which could be in favour of the "overreaction hypothesis". The rationale is that investors are overconfident about their private information and overreact to it. In "up-markets" this sentiment, associated with "self-attribution bias", generates high levels of overconfidence. The increase in overconfidence would generate momentum first and only later overreaction. Using an US

[1] Jegadeesh and Titman (2001) re-examine the momentum strategy for an extended period (1965-1997) excluding NASDFAQ stocks. The momentum strategy (holding winners, selling losers) generates statistically abnormal returns and is robust to CAPM and Fama and French (1993) risk-adjusted returns.

[2] Rouwenhorst (1999) explores whether JT results are market specific. He finds that, just like in the US, there is evidence of momentum effects in international mature and emerging stock markets and the momentum profits are of similar magnitude. Several other single country studies have produced consistent evidence since then.

sample, for the period between 1926 and 1985, they found that the momentum profits in positive market returns were 0.93%, whereas in negative market returns, there were losses of 0.37% and statistically insignificant. The results were also robust to the introduction of CAPM and Fama and French (1993) three-factor model. Similarly, Lee and Swaminathan (2000) examined the relationship between the "momentum effect" and turnover volume. The volume would proxy for the level of investor interest in a stock. On the basis of the original results of JT (1993), they find that the "momentum premium" is higher for high volume stocks both for the "winner" and the "loser" portfolios. A strategy of buying high volume winners stocks and selling high volume losers stocks yielded superior returns when compared with the simple price momentum strategy.

3. Methodology and Data

3.1 Data

We use data gathered from Dathis, which is a database compiled by the Portuguese stock exchange and that is the most comprehensive data set on Portuguese stocks. We collected firm-level data (total returns and market capitalization) for all stocks listed on the Portuguese stock exchange.

Empirical studies studying "overreaction" and "underreaction" require data collection for long periods of time and for a high number of stocks. The sample period runs from 1988 to 2003, summing a total of 16 years. We consider all stocks that have traded in the market during the sample period and not only those trading at the end of the period in order to avoid "survivorship bias.[3,4] For a given stock to be included in the

[3] Up to 1994, Portuguese stocks traded on two exchanges: BVP - Bolsa de Valores do Porto and BVL - Bolsa de Valores de Lisboa. After 1994, the spot trades were concentrated on BVL while BVP kept the derivatives market. In 2000, the two exchanges merged into BVLP - Bolsa de Valores de Lisboa e Porto. In 2002, Euronext took over BVLP and Portuguese stocks trade now on Euronext Lisbon.

[4] In April 1991, the new Capital Markets law (*Lei Sapateiro*) set up three market segments in the Portuguese stock exchange. Regular firms, meeting all exchange requirements (in terms of capital dispersion, market capitalization, turnover and solvency), are listed on *Mercado de Cotações Oficiais* (Market with Official

portfolio it must have traded continuously during all observation period, and at least once during the test period. Given that the some Portuguese market is quite illiquid, only stocks that have an average transaction index superior to 80% were included. The total number of stocks is 82.

We use monthly returns and compute market returns as an equally weighted index of the constituent stocks in sample.[5] Excess returns are computed relative to risk-free rates.[6]

3.2 Methodology

We study, separately, the "overreaction" and the "underreaction" hypotheses. This procedure is due to the need of neat results for each particular phenomenon. While some of the recent theoretical models expressed the concern to jointly evaluate the two effects, no empirical test has been proposed yet enabling that joint analysis. In any case, later on, we will combine the results of the two sets of tests, in order to get a broad view of price formation.

3.2.1 "Overreaction" Tests

To test "overreaction", we use two different tests. The first test evaluates the significance of negative serial correlation in the medium to long term. Mean reversion in stock returns will indicate "overreaction", as long as it is robust to the control of other factors, such as risk adjustments. The second test assesses the profitability of "value strategies". As in Lakonishok, Shleifer and Vishny (1994) we run further tests of "overreaction", in particular direct tests of "extrapolation" of news by investors, as suggested by Tversky and Kahneman (1974).

Quotations). Small and medium firms list on *Segundo Mercado* (Second Market). The firms that do not meet the exchange requirements are listed on *Mercado Sem Cotações* (Market Without Quotations).

[5] Similarly DeBondt and Thaler (1980, 1985) use an equally weighted index. This weighting procedure is consistent with the winner/loser portfolios in the overreaction and momentum tests.

[6] We use t-bill rates and government bond rates, respectively for short and long term returns. When these rates were not available we use term deposit and savings rates.

The reversal portfolios are constructed as in BT. Tests are run for a set of sub-periods over the period sample. For each sub-period, we define an *observation* period and a *test* period. Stocks are ranked on the basis of its past performance in the observation period and assigned into portfolios (winner, loser and arbitrage portfolios). The *winner* portfolio includes the best performing stocks while the *loser* portfolio includes the worst performing stocks. The *arbitrage* portfolio measures the return difference between the winner and the loser portfolios. All the three portfolios are equally weighted at formation and the constituents stocks within are held over the *test* period.

Our sample period covers 15 years of monthly data from 1988 to 2003 and we analyse 24 month/24 month strategies. We thus have 7 non-overlapping observation/test sub-periods[7]. For each of these periods and for each stock, we compute cumulative market-adjusted log returns (CAR) in the observation period, given by:

$$CAR_{i,t} = \sum_{t-24}^{t-1} \mu_{i,t} \ . \qquad (1)$$

$\mu_{i,t}$ is the market-adjusted return for stock i on month t computed as:

$$\mu_{i,t} = R_{i,t} - R_{m,t} \qquad (2)$$

where

$R_{i,t}$: log return for stock i on month t defined as $log\ (P_{i,t}) - log\ (P_{i,0})$.

R_{mt}: market return on month t, defined as an equally weighted average return of all stocks in sample.

Stocks are sorted in quintiles on the basis of these CAR_t. The *winner* portfolio includes the top quintile (P1) stocks, i.e., the 20% best performing stocks. The *loser* portfolio includes the bottom quintile (P5) stocks, i.e., the 20% worst performing stocks. For control purposes we also compute portfolios for the middle quintiles (P2, P3 and P4).

[7] For the *observation* periods, we have 1988-1989; 1990-1991 and so forth up to 2000-2001. The corresponding *test* periods are 1990-1991; 1991-1992 and so forth up to 2002-2003.

To evaluate the performance of these portfolios, we compute the average *CAR* of the constituent stocks for periods in the future up to 24 months as:

$$CAR_{p,z,T} = \sum_{t=1}^{T}\left[(1/N)\sum_{i=1}^{N}\mu_{i,t}\right] \quad (3)$$

where p denotes the portfolio (W=winner, L=loser, A=arbitrage), z refers to the sub-period test in analysis (I, II, III, ..,VII) and T denotes the number of months the portfolio is held (T<=24).

We then calculate the grand mean ($ACAR_p$) for the seven sub-periods CAR_p as:

$$ACAR_{p,T} = \frac{\sum_{z=1}^{Z} CAR_{p,z,T}}{7} \quad (4)$$

If there is negative autocorrelation in returns, then there is mean reversion: the *loser* portfolio makes positive average test period excess returns while the winner portfolio Shows negative excess returns, i.e. $ACAR_L$>0 and $ACAR_W$<0. As a result, an arbitrage strategy (long *losers*, short *winners*) beats the equally weighted index of all companies in sample, i.e. $ACAR_A$=0. To assess the statistical significance of the *ACAR* returns in the test period for the *winner* and the *loser* portfolio, we used a *t*-statistic defined as:

$$t_{p,T} = \frac{ACAR_{p,T}}{S_p/\sqrt{7}} \quad (5)$$

where S_p is the estimated variance for the mean market-adjusted returns across firms (*AR*) assuming time-series independence of monthly mean returns.

$$S_p = \sqrt{\frac{\sum(AR_{p,t} - \overline{AR_{p,T}})^2}{T-1}} x\sqrt{T} \quad (6)$$

To assess the statistical significance of the *ACAR* returns for the *arbitrage* portfolio, we used a *t*-statistic defined as:

$$t_{L-W,T} = \frac{(ACAR_{L,T} - ACAR_{W,T})}{\sqrt{2S_t^2/N}} \quad (7)$$

Given that we use market-adjusted returns it could be the case that the pattern observed in returns reflects improper risk control. Further, several studies have suggested the need to control for other risk and non-risk characteristics such as size, BTM (book-to-market) or bias in performance measurement (due to time-varying risk parameters, calendar effects or bid-ask bounces). To assess the robustness of the negative serial correlation in returns we control for the following risk and non-risk factors proposed in previous related literature:

i) Systematic Risk Adjustment (using CAPM)

$$R_{p,t} - R_{f,t} = \alpha_p + \beta_p (R_{m,t} - R_{f,t}) + \varepsilon_{p,t} \quad (8)$$

where $R_{p,t}$ is an equally-weighted average return of all *constitu*ent stocks in portfolio p, $R_{m,t}$ is defined as above and $R_{f,t}$ is the risk-free rate for period t[8]. β_p denotes portfolio p beta while α_p measures the average abnormal return over the test period. To assess reversals we focus on the sign, magnitude and significance of α_p. If there is reversal in returns then $\alpha_W<0$ and $\alpha_L>0$.

ii) Systematic Risk Adjustment (Chan Method)

$$R_{p,t} - R_{f,t} = \alpha_{p,PF}(1 - D_t) + \alpha_{p,PT} D_t + \beta_{p,PF}(R_{m,t} - R_{f,t}) + \beta_{p,D}(R_{m,t} - R_{f,t}) D_t + \varepsilon_{p,t} \quad (9)$$

where $R_{p,t}$, $R_{m,t}$, $R_{f,t}$, β_p and α_p are defined as above. D_t equals 1 over the test period (*PT*) and 0 over the observation period (*PF*). This test controls for systematic risk as in i) but allows for time varying parameters. To assess reversals we now focus on the sign, magnitude and significance of $\alpha_{p,PT}$. If there is reversal in returns then $\alpha_{W,PT}<0$, $\alpha_{L,PT}>0$ and therefore $\alpha_{A,PT}=0$.

[8] We use weekly returns to magnify sample size.

iii) Size Effect

To control for size, we form two portfolios within each *p* portfolio. That is stocks are sorted in quintiles on the basis of past performance and for each quintile two size portfolios are constructed above and below the quintile median market capitalization. To assess reversals we now focus on the sign, magnitude and significance of $\alpha_{p,\,PT}$. If there is reversal in returns then $ACAR_{LB}$ and $ACAR_{LS}>0$ while $ACAR_{WB}$ and $ACAR_{WS}<0$.

iv) January Effect

To control for the January effect, we compute average *ACARs* for every month and compare January excess returns with those observed for the other 11 months.

v) Three Factor Model Adjustment

Finally we control for risk using the Fama and French (1993) three-factor model.

$$R_{p,t} - R_{f,t} = a_p + \beta_p (R_{m,t} - R_{f,t}) + s_p (SMB_t) + h_p (HML_t) + e_{p,t} \qquad (10)$$

where SMB_t ("Small minus Big") measures the size factor given by the differential in returns of two portfolios containing, respectively, all stocks above and below the sample median market capitalization. *HML* ("High minus Low") measures the value/growth factor given by the differential in returns of two portfolios containing, respectively, all stocks above and below the sample median book-to-market. s_p and h_p are porfolio's *p* exposures to the *SMB* and *HML* factors.

Lakonishok *et al.* (1994) use a different approach to test overreaction. Portfolios are formed on the basis of fundamentals such as Book to Market, Cash-Flow to Price and Earnings-Price ratios. Higher (lower) ratios would proxy bad (good) prospects. If investors form their expectations on the basis of recent news and if they overreact, then the long-term market performance of stocks that investors perceived as bad (good) would be mean-reverting reflecting that investors were overly pessimistic (optimistic). Thus value stocks (higher fundamental ratios) would perform well in the future while growth stocks (lower ratios) would perform well. "Value strategies" would thus inform on the existence of

overreaction by investors if: a) value portfolios outperform growth portfolios in the test period; b) this superior performance is risk-adjusted; and c) it is possible to link these results to news, in the sense that they reflect that investors extrapolate recent news to future prospects as suggested by Tversky and Kahneman (1974). As such, to prove overreaction we must not only assess if value portfolios outperform growth portfolios but also evaluate risk-adjusted performance and perform *direct extrapolation tests*.

We use three years (36 months) of past data to form value and growth portfolios on the basis of *BTM* and Cash-Flow to Price (*C/P*). By combining the two ratios, we obtain four quartiles. Value (growth) stocks belong to the top (bottom) quartile with the highest (lowest) *BTM* and *C/P*. Portfolios are then held for three years following formation date[9]. We compute and assess the significance of CARs and ACARs as described above. To control for risk, we compare the (CAPM) betas of the value and the growth portfolios. To find out whether the performance of the two strategies was in fact driven by extrapolation, we assess how variables such as Sales/Price, Earnings/Price, Dividend Yield and BTM compare, over different periods in time - *t-2* to *t* against *t* to *t+3* – for portfolios formed on the basis of *BTM* and *C/P*. Further, we compare the geometric annual growth rates of Cash Flows (*ACG-average CF growth*), Sales (*ASG- average sales Growth*) and Buy and Hold Returns (*RET- geometric annual return*) before and after portfolio formation. If there is extrapolation, the growth (value) portfolio should observe higher (lower) market ratios at the time portfolios are formed; high (low) *ACG* and *ASG* rates in the observation period (2 years just before formation); and low (high) growth rates in the test period (3 years after formation).

3.2.2 "Underreaction" Tests

[9] We now use overlapping periods given that portfolios are formed on the basis of fundamental variables and not return information. We have eleven test periods: 1991-1993; 1992-1994 and so forth up to 2001-2003.

We first explore the existence of positive serial correlation in returns for short-periods (horizons up to 12 months). The rationale is that, if investors act with "conservatism" or information dissemination is gradual, prices do not correct immediately, and therefore one should observe "momentum" in returns. We analyse twelve strategies of *J*-month x *K*-month strategies (*J*, *K* =3, 6, 12 months, where *J* denotes the observation period and *K* the test holding period). For example, a 12-month x 12-month strategy means forming a portfolio on the basis of the past 12-months returns – that is stocks are ranked in quintiles on the basis of the returns in the previous 12 months and portfolios are formed giving equal weight to each of the stocks within a quintile. These quintile portfolios are then held for 12 months and their return performance over the next 12 months is analysed. The strategy is repeated each quarter/semester/year. For example, for the six-month/six-month strategy we have 31 observation periods and 31 test periods. For each of these periods and for each stock, we compute the CARs in the observation and test periods as described above. If there is momentum, stocks that performed well (badly) in the past, will continue to perform well (badly) in subsequent months. An arbitrage portfolio long in stocks with good recent performance and short in stocks with bad recent performance will thus earn non zero returns.

We analyse the performance of these momentum strategies relative to their expected returns given by the CAPM and the Fama and French (1993) three factor model. For these and other robustness checks as well as for underreaction further tests we focus on the 6-month/6-month strategy[10].

Yet evidence of "momentum" in stock returns is a necessary but not sufficient condition to support "underreaction". Two additional conditions are required:

a) the "momentum" effect must be "linked" to fundamental firm-specific news. In other words, we should observe a "post-earnings-announcement drift", as a

[10] We select this strategy because it better accommodates risk-adjustment tests given the sample size.

consequence of biased insufficient correction or gradual information diffusion and, as such, slow adjustment of prices to relevant news flowing into the market;

b) the "momentum" effect should not be induced by "initial overreaction" for short-term periods, caused by excessive optimism and overvaluation.

Post-Earnings Announcement Drifts

To test whether the continuation pattern in returns reflects underreaction, we analyse whether the observed performance is associated with stock specific news. We focus on earnings news. If winner/loser stocks register positive/negative earnings surprises – i.e., report good/bad news - and observe continuation in returns, this is evidence in favour of the underreaction hypothesis. Prices adjust slowly to earnings surprises reflecting gradual dissemination of the impact of this information or, alternatively, the insufficient reaction could be rooted in investors' conservantism.

To test the "post-earnings announcement drift", we use the same method as in Chan, Jegadeesh and Lakonishok (1996). We compare the trend in portfolios returns, formed on the basis of past returns, with the "Standardized Unexpected Earnings" (*SUEs*) associated with the most recent announcement previous to portfolio formation and with the following three announcements. To compute the *SUE* we use the method proposed by Bernard (1992): *SUE* is computed by taking the periodic earnings surprise and scaling it by the standard deviation. To compute the earnings surprise we compare the actual earnings with the earnings forecast based on previous available earnings records. Thus, we only need observed earnings to compute the *SUE*. On a 6-monthly basis, *SUE* is given by:

$$SUE_{it}=[e_{is}-E(e_{is})]/\sigma_i \quad (11)$$

where e_{is} and $E(e_{is})$ are the observed and expected earnings relative to the period just before portfolio formation.[11] σ_i is the standard deviation of earnings over the previous two years[12]. Good/bad news are then defined on the basis of the average *SUEs* (*t, t+1, t+2* and *t+3*). Figure 1 in appendix illustrates the process.

We perform an additional test as suggested by Chan, Jegadeesh and Lakonishok (1996). We form portfolios on the basis of past earnings surprises and check whether there is a continuation trend as observed in arbitrage momentum portfolio returns. If these "earnings strategies" (long in stocks with the highest *SUE*s and short in stocks with the lowest *SUE*s) are profitable, this is evidence consistent with underreaction.

Initial Overreaction

To test the possibility of "initial overreaction", as the true source of "momentum", we used two different methodologies. As in Cooper, Gutierrez and Hameed (2003) work, we compare momentum ACARs for different "states of the market". If the momentum effect is more pronounced in "bullish markets" and inexistent or less impressive in "bearish markets", it might be in reality driven by "initial overreaction". Moreover, if the momentum in "up-markets" vanishes up to 24 months, culminating in a "reversion", it constitutes an additional proof of excessive reaction by the investors. Momentum would be the initial outcome of "overreaction" that would reverse in later periods. The second test is the one suggested by Lee and Swaminathan (2000). They form two sub-samples, "high volume" vs. "low volume", of winner and loser portfolios, respectively above and below median volume. If investors "overreact" then "high volume winners" and "high volume

[11]Expected earnings are the observed for that same semester in the previous year. We assume earnings are announced with a 2-3 month delay relative to the period they refer to. To compute unexpected earnings for a given semester *t* we thus need information on the previous *t-1* and *t-3* earnings records.
[12] Hence, the *SUE*s were computed starting June 1990.

losers" should earn superior returns in relation to a simple "price strategy", reflecting that investors are more enthusiastic over "high volume" stocks. We briefly refer these results in the next section but tables are not shown for the sake of saving space.

4. Findings

4.1 Overreaction

Long Term Return Reversal

Table 1 presents the returns for the five quintile portfolios (including the *loser* and *winner* portfolios) formed on the basis of the 24-month past returns for holding periods up from 6 to 24 months. The first column shows the past performance of these portfolios and the remaining columns show the average CARs for each holding period. Table A.1 in appendix shows the CARs for each of the seven test periods. Table 1 provides evidence in support of overreaction within the sample of Portuguese stocks. Past losers outperform past winners: the average abnormal return after 24 months of the *loser* portfolio (that lost a -2.90% per month over the past 24 months) is 0.36% p.m. (ACAR of 8.62%), and of the winner portfolio (that earn a 2.7% per month over the past 24 months before portfolio formation) is -0.24% (ACAR of -5.64%). Any contrarian strategy up to 24 months buying the bottom quintile stocks and selling the bottom quintile stocks earns positive (but not statistically significant) abnormal returns. After 24 months the average cumulative abnormal return is 14.26%. Results suggest that the more positive performance for the loser portfolio occurs in the first 12 months after portfolio formation. As for the winner portfolio, the reversal occurs over the second year.

Contrary to previous studies we do not to find an asymmetric (stronger) effect for the loser portfolio. Finally, the results for the intermediate quintiles are mixed.

The results in table A.1 show that reversal holds over the sample period: the cumulative abnormal returns for the arbitrage portfolio for 5 out of the 7 test periods analysed are positive.

Overall the results are consistent with the literature but lack statistically significant.

Robustness Checks

Table 2 shows the results when we adjust performance for market risk (assuming the CAPM is valid). We undertake time series regressions of 104 weekly returns before portfolio formation for the loser, winner and arbitrage portfolios to estimates betas. We then compute the "Jensen alphas" (for the 24-month holding period) as the difference between realized and expected returns. Loser stocks have slightly higher CAPM market betas than winner stocks but the difference is small (albeit statistically significant) and cannot explain the difference in performance outlined above[13]. On the contrary, because over the sample period, market returns have been generally negative, when we control for risk, the reversal is even stronger. The arbitrage portfolio earns 16.5% against the 14.3% reported with no risk adjustment.

Table 3 shows the systematic risk adjustment proposed by Chan (1988), allowing for time varying alphas and betas. Loser stocks are in fact riskier in the test period and winner stocks are less risky (and the decrease is statistically significant) but given the overall negative returns, the reversal in returns does not vanish when we control for risk.

We also examine the performance of these portfolios controlling for size. Table A.2 shows the average, median and standard deviation of the market capitalization for the quintile portfolios formed above. The evidence is consistent with Zarowin (1989): loser stocks are in fact smaller than winner stocks and this is true on average and for each of the test periods. The market capitalization of the median stock in the winner portfolio is

[13] *t*-statistics (reported in parentheses) for aggregate estimates (alphas and betas) in tables 2, 3, 6, 8 and 12 are time-series averages of the periodic *t*-statistics. Theses statistics do not denote the statistical significance of the average estimates.

around 250 million euros, 4.5 times the market cap of the median stock in the loser portfolio (47 million euros). While the loser stocks are in fact the smaller firms in sample, the winner stocks are amongst the largest but the stocks in quintile 3 and 4 seem to be of similar size. Table 6 shows the results with a two way sort on the basis of the 24-month past returns and median size, which gives 10 portfolios (5x2). The arbitrage strategies (SL-SW, BL-BW) shown involve now buying the {small loser, big loser} portfolio and selling the {small winner, big winner} portfolio. Negative long term serial correlation does not seem to be driven by size. The two arbitrage strategies earn positive abnormal returns even if we observe an asymmetric effect: the effect is much stronger for the small stocks' strategy (21.49% against 8.73% for the large stocks). This result reflects that while large or small losers revert, only small winners show that reversal in returns. When we looked at the different test periods, results are not always consistent[14]. In several periods we observe that small losers continue to perform badly over long periods and the same goes for small winners.

We also examine whether return reversals in and outside the month of January. Surprisingly, table 5 indicates that the return reversals occur mainly outside the month of January. In January, loser portfolios perform badly while winner portfolios are positive performers.

Finally we examine Fama and French (1993) three-factor adjusted returns. To compute factor exposures we undertake time series regressions of 104 weekly returns before portfolio formation for the loser, winner and arbitrage portfolios. Overall, the results in table 6 suggest that the three factors seem to be priced. The loser portfolio consists of small and value stocks (high-book value to market) but given that the sample period covers a bear market, the risk adjustment performance continues to show reversal in

[14] Results are not reported here but are available upon request.

returns and is thus magnified. The arbitrage portfolio shows positive average CARs of 31% (significant at 10% level).

Contrarian Strategies and Extrapolation

We use an alternative approach to measure overreaction. Based on previous evidence, value strategies, that is contrarian strategies that buy stocks that have good fundamental ratios and sell stocks that have high fundamental ratios, are profitable. This would result because investors are overly optimistic about "good" companies and overly "pessimistic" about bad companies. Table 7 shows the average CAR up to 36 months for the value-growth quartile portfolios. Recall that these portfolios were formed by sorting sample stocks every year on the basis of two fundamental ratios that are proxies for "value": book to market (that would inform about good/bad companies) and cash flow-to-price (that would inform about good/bad prospects for those companies). The *value (growth)* portfolio includes the top (bottom) quartile stocks, i.e., stocks with high (low) BTM and high (low) C/P. The last row of table 7 shows the returns earned by an arbitrage strategy that buys *value* stocks and sells *growth* stocks. The arbitrage strategy gives average returns of 22.93% after 36 months. Yet these results are not statistically significant. Table A.3 in appendix shows that the positive adjusted returns occur for all test periods except 1997-1999 and for three periods, returns are statistically significant at a 10% level. *Growth* strategies show, as expected, negative returns (the 36-month CAR is -19.89%) and are in fact responsible for the positive performance of the arbitrage strategy. The *value* portfolio gives positive but trivial returns (the 36-month CAR is 3.04%). This asymmetric effect is in contrast with previous studies for other markets that show stronger positive effects due to the very positive performance of value stocks.

When we compare the performance of the value (growth) portfolio before and after formation date, we observe that the value (growth) portfolio shows recent good (bad)

past performance as expected. Yet reversal occurs only for growth stocks. Table 7 shows that the reversal starts in the first year and continues in the second and third years.

Finally table 7 shows the attributes of the four quartile portfolios ranked on the basis of fundamental price ratios. We confirm that value portfolios include the smallest stocks while the value portfolio includes (together with quartile 2) the largest stocks (on average, 10 times larger). Yet as reversal occurs only for the growth portfolio one cannot establish that the return observed is solely due to high ex ante risk associated with size.

Table 8 shows CAPM risk-adjusted returns for all tests periods and on aggregate. We observe that the negative performance of the growth portfolio is robust (and consistent over time). The results for the value portfolio are mixed. In any case betas are very similar for the two portfolios.

To inform whether the negative performance of the growth portfolio is associated with overly optimism we run the direct extrapolation tests explained above. Table 9 contrasts, for the two portfolios, the average values for the fundamental market ratios as well as the past and future cash flows and sales growth rates and stock market performance. The pattern observed over time for the sales growth indicates that the growth portfolio, that initially outperforms the value portfolio, shows in the three years that follow similar growth rates as value stocks. Yet the pattern of CF growth rates is puzzling and reflects the opposite.

Overall these results suggest that the negative performance of growth stocks, reverting past positive performance, could stem from overreaction and reflect a representativeness bias: investors expect that stocks that have attractive price-ratios – reflecting positive recent stock price performance - show positive stock performance in the future. Yet the results of the direct extrapolation tests are mixed.

4.2 Underreaction

Continuation in Returns

Tables 10 and 11 show that the several *J* x *K* strategies *(J,* K=3, 6, 12 months*)* we analyse show positive autocorrelation in returns. The arbitrage strategy 6 x 6 earns average monthly CARs of 1.11% (statistically insignificant). Buying recent good performers yields cumulative 6-month returns of 2.27% (0.38%/month) while selling recent losers yields 4.40% (0.73%/month). For the intermediate portfolios results are inconclusive. The results are consistent with the findings of Jegadeesh and Titman (1993, 2001) where momentum profit occurs up to horizons of around 12 months (for the 6x6 strategy, in particular, their strategy gives 0.95%). The momentum returns are higher for a 12 x 3 strategy (as in JT). The arbitrage returns are around 9% (2.9%/month) The CARs for the arbitrage portfolio peak at around 14% after one year (i.e., an average of 1.17% a month). These figures are mainly informative given that the results are not statistically significant.

For the arbitrage portfolios based on 6-month past performance, the CARs peak after one year to 18 months; subsequent returns are negative: the two-year CAR is 7.31%, i.e., 0.30% a month against an average monthly return of 0.80% for the one-year horizon. This result is driven by the performance of the winner portfolio that flips signs: the two-years CAR is -0.10% against a 2.95% CAR after one year.

The results suggest that the momentum effects are stronger and last longer for the loser portfolio. This asymmetry in results contrasts with previous results where the profitability of the arbitrage portfolio is mainly driven by the continuation in returns observed for the winner portfolio.

Robustness Checks

Tables 12, 13 and 14 show risk adjusted returns.

Table 12 shows continuation market-adjusted returns. Beta estimates for the loser portfolios than for winner portfolios. The resulting market beta for the arbitrage portfolio

is negative but very close to zero.[15] In short, the observed positive autocorrelation in returns cannot be explained on the basis of market risk. After controlling for market risk, returns for the arbitrage portfolio are slightly lower (3.79% against the 6.66% unadjusted CARs).

Previous evidence (see, for example, JT (1993), Liu,Strong and Xu, 1999 and Fama, 1996) suggests that loser portfolios include mainly smaller stocks. Table A.4 in appendix shows the average market capitalization for the portfolios ranked on the basis of the previous 6-month return performance. In fact, on average, and for every portfolio formation period, the loser portfolio shows the lowest average market capitalization. The winner portfolio, and Quintiles 3 and 4 share the larger stocks. The profitability of momentum strategies could result, eventually, from holding long smaller stocks. If that is true the momentum should only observed for that sub-sample of stocks. To control for that bias, we examine portfolio returns with sub-samples stratified by size: we formed two portfolios within each winner/looser portfolios. Table 13 shows these results. The evidence suggests that the momentum profits occur both for small and large stocks and the momentum effects are even stronger for the latter.

Finally table 15 shows Fama and French (1993) three-factor model's adjusted returns. The loser portfolio is loaded on smaller, high book-to-market stocks relative to the winner portfolio. The adjusted CARs for the arbitrage portfolio are now only 2.66% (against the unadjusted 6.66%).

In sum, risk-adjusted CARs are smaller but the arbitrage portfolio positive returns do not vanish. The loser portfolio includes, as suggested in previous studies, smaller high BTM stocks but controlling for these characteristics does not eliminate momentum profits.

[15] We do show here the periodic betas to save space. Those results show an interesting feature: the betas for the winner and loser portfolios change over time. When the market is bearish the latter is riskier while the former is less risky. Yet, when the market is bullish, the betas of the winner portfolios are larger.

Further, we find no evidence that momentum is confined to smaller stocks, for which information diffusion is likely to be slow.

Momentum and Post Earnings Announcements' Drift

Tables 15 and 16 indicate that there seems to be a relation between the drift observed in returns and the arrival of fundamental information.

Table 15 contrasts, for each of quintile portfolios ranked on the previous 6-month returns the average CARs, their fundamental attributes and the observed SUEs. Panel A of table 15 repeats the results shown in table 11; Panel B shows the fundamental characteristics referred before (size and BTM); and Panel C shows the SUEs for the announcement around portfolio formation date and for the 3 following announcements. Panel C shows that the loser (winner) portfolio has negative (positive) standardised unexpected earnings. Further the loser portfolio has the more negative SUEs and this is true for the four announcements analysed. Similarly the winner portfolio has positive standardised unexpected earnings and these are the more positive SUEs observed in all the quintiles except for the first announcement. Comparing Panels A and C, we observe that the continuation in returns seems to follow continuation in earnings surprises. In other words, successive earnings surprises are reflected in momentum in returns: the loser portfolio shows consistent negative earnings for the period up to 2 years after portfolio formation suggesting a U shape format, reflecting the earnings drift is transitory. The same pattern is observed for the CARs over the 24-month period following portfolio formation date. The pattern is similar for the winner portfolio but the reversion in earnings surprises seems to occur after one year. Again the pattern seems to be mimicked by the CARs.

To explore whether this relation between earnings and prices is or not spurious, we partition stocks into ranked quintile portfolios based on the SUEs and evaluate the profitability of these earnings momentum strategies. Table 16 shows the results. Panels A, B and C contain the same information described for table 15. Panel A shows that the

lowest SUE portfolio consists of smaller and value stocks and shows negative CARs that are stronger for the first 18 months; the highest SUE portfolio shows positive returns. The resulting arbitrage portfolio (Highest SUE-Lowest SUE) generates CARS of 4.43%, 5.79% and 9.53%, respectively after 6, 12 and 18 months. These figures are well below the ones presented for the return momentum portfolios but seem to suggest that investors lose/make money after investing in stocks that report unexpected negative/positive earnings. Results in table 16 suggest thus that companies that announce negative/positive earnings continue to so over a period of time. Yet investors do not seem to acknowledge this behaviour and react with conservantism to bad/good news and only gradually update their own earnings estimates. Hence, the returns mimic the continuation trend in SUEs.

Initial Overreaction

Finally, to test the possibility of "initial overreaction", we performed the tests outlined in the methodology section (state of the market; volume). The results, not reported here, are mixed and do not confirm that the initial positive correlation is due to overconfidence.

4.3 Discussion of main findings

Several models have been proposed to account for the observed patterns in returns (continuation followed by reversal). Among these are the models proposed by Daniel, Hirshleifer and Subrahmanyan (1998) and by Hong and Stein (1999).

In the Daniel, Hirshleifer and Subrahmanyan (1998) model investors handle public information (for example, earnings) in an asymmetric way. Overconfident investors about their own private information attribute a positive earnings announcement to their skills (self-attribution bias) and push prices up. As such, one would observe price momentum effects together with the post-earnings announcement drift. Investors forecasting an opposite trend in earnings growth may not react initially but will reverse their beliefs after a

series of positive earnings announcements. This will create a price drift and result in further momentum effects. Yet, when investors find that prices have gone up too high, one should observe a correction in the process and this is more likely to occur after a series of negative earnings announcements. In this model, momentum effects result from initial overreaction.

The evidence we present in this paper does not seem to agree with this prediction: momentum effects seem to be associated with the arrival of new information, more in line with the model of Hong and Stein (1999). In their model the patterns of continuation and reversal in returns reflect the interaction between rational traders (newswatchers) and noise traders (momentum traders). Figure 2 illustrates the set-up of the model. Newswatchers base their investment decisions on news while momentum traders condition their demand on past prices. In Hong and Stein (1999) model, momentum trading and overshooting is due to initial underreaction to private information but does not necessarily imply underreaction to public news (such as earnings announcements). Yet the assimilation of (unexpected) public information by smart traders, as it impacts on their private estimates, could yield the observed post-event drift that our results seem to reflect: not only we observe momentum in returns up to one year but we show that these are associated with surprises in earnings announcements. The authors predict that momentum traders would start trading after observing a positive drift in prices producing further momentum. Our results show that momentum is in fact stronger between six months and one year after the first positive drift. Finally the model predicts that overreaction would occur in a later period reflecting an overshoot in prices. Our results suggest that reversal occurs after a peak at around the 18th month. The results we observe for the value strategies are consistent with the predictions of the model as well: following a positive price performance, growth stocks show very low fundamental price ratios; extrapolation leads to increased demand and produces overreaction.

5. Conclusions

Our main findings are the following. First, our results seem to be supportive of the overreaction hypothesis: there is long term reversion in returns and the effect does not vanish when we adjust for risk sand other control variables. Value strategies earn positive returns that are not explained by ex-ante risk. Yet most of the results lack statistical significance. Second, we find weak evidence in support of momentum effects that persist after controlling for risk. The "momentum" effect seems to be associated with an insufficient reaction to earnings announcements surprises.

The evidence we gather for the Portuguese stock market confirms most of the results found in well researched, large, liquid developed markets.

Altogether, the simultaneous occurrence of the two patterns in returns (continuation followed by long horizon reversal), and the results from the additional tests we run, seem to be consistent with the model of Hong and Stein (1999). We observe momentum effects in returns up to one year. Our results show that momentum is stronger between six months and one year and seems to be associated with surprises in earnings announcements. Our results suggest further that reversal occurs after a peak at around the 18th month. This is consistent with the predictions in Hong and Stein (1999): momentum trading and subsequent overshooting occurs due to initial underreaction to information. The results we observe for the value strategies are also consistent with the model: following a period of positive price performance, growth stocks show very low fundamental price ratios; extrapolation leads to increased demand and produces overreaction.

References

Alonso A. and Rubio, 1990, "Overreaction in the Spanish equity market", *Journal of Banking and Finance,* 14, 469-481.

Alves, P and J. Duque, 1995, "Sobreajustamento no mercado Português", *Estudos de Gestão – Revista do Instituto Superior de Economia e Gestão*, 3 (2).

Barberis, N., A. Shleifer and R. Vishny, 1998, "A model of investor sentiment2, *Journal of Financial Economics,* 49, 307-343.

Bernard, V., 1992, "Stock price reactions to earnings announcements", *Advances in Behavioral Finance,* edited by R. Thaler, New York, Russell Sage Foundation.

Campbell, K. and R. Limmack, 1997, "Long-term overreaction in the UK stock market and size adjustments", *Applied Financial Economics*, 7, 537-548.

Chan, K.C., 1988, "On the contrarian investment strategy", *Journal of Business*, 61, 147-163.

Chan K.C., N. Jegadeesh.and J. Lakonishok, 1996, "Momentum strategies", *Journal of Finance*, 51, 1681-713.

Conrad, J. and G. Kaul, 1993, "The returns to long term winners and losers: bid-ask biases or biases in computed returns", *Journal of Finance*, 48, 39-63.

Cooper, M., R. Gutierrez and A. Hameed, 2003, "Market states and momentum", *Journal of Finance*, 59, 1345-1365.

Da Costa, N., 1994, "Overreaction in the Brazilian stock market", *Journal of Banking and Finance*, 18, 633-642.

Daniel, K., D. Hirshleifer and A. Subrahmanyam, 1998, "Investor psychology and security under-and-overreactions", *Journal of Finance*, 53, 1839-85.

De Bondt, F.M. and R. Thaler, 1985, "Does the stock market overreact?", *Journal of Finance*, 40, 793-805.

De Bondt, F.M. and R. Thaler, 1987, "Further evidence on investor overreaction and stock market seasonality", *Journal of Finance*, 42, 557-81.

Edwards, W., 1968, "Conservatism in human information processing", *Formal Representation of Human Judgement*, edited by Kleinmutz, B., John Wiley and Sons, New York, 17-52.

Fama, E., 1970, "Efficient capital markets: a review of theory and empirical work", *Journal of Finance*, 25, 383-417.

Fama, E. and K. French, 1993, "Common risk factors in the returns of stocks and bonds", *Journal of Financial Economics,* 33, 3-56.

Fama, E. and K. French, 1996, "Multifactor explanations of asset pricing anomalies", *Journal of Finance*, 51, 55-84.

Hong, H. and J. Stein, 1999, "A unified theory of underreaction, momentum trading, and overreaction in asset markets", *Journal of Finance*, 54, 2143-2184.

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

Jegadeesh, N. and S. Titman, 2001, "Profitability of momentum strategies: an evaluation of alternative explanations", *Journal of Finance*, 56, 699-720.

Kahneman, D., P. Slovic and A. Tversky, 1982, *Judgement under uncertainty: heuristics and biases,* Cambridge: Cambridge University Press, 287-293.

Lakonishok, J., A. Shleifer and R. Vishny, 1994, "Contrarian investment, extrapolation, and risk", *Journal of Finance*, 49, 1541-1578.

Lee, C. and B. Swaminathan, 2000, "Price, momentum and trading volume", *Journal of Finance*, 55, 2017-2069.

Liu, W., N. Strong and X. Xu, 1999, "The profitability of momentum investing", *Journal of Business Finance & Accounting*, 26, 1043-1088.

Mai, H., 1995, "Sur-réaction sur le marché Français des actions au Règlement Mensuel 1977-1990, *Finance*, 16(1), 113-136.

Power, D., A. Lonie and R. Lonie, 1991, "The overreaction effect – some UK evidence", *British Accounting Review*, 23, 793-805.

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

Tversky, A.and D. Kahneman, 1974, "Judgement under uncertainty: heuristics and biases"*, Science,* 185, 1124-1131.

Zarowin, P., 1989, "Does the stock market overreact to corporate earnings information?", *Journal of Finance*, 44, 1385-1399.

Zarowin, P., 1990, "Size, seasonality, and stock market overreaction", *Journal of Financial and Quantitative Analysis*, 25, 113-125.

TABLE 1

OVERREACTION – NEGATIVE AUTOCORRELATION

Market adjusted average CARs in test period (up to 24 months) for winner, loser and arbitrage portfolios

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Portfolio	Formation Period	Months after the formation date			
	-24 months	6 months	12 months	18 months	24 months
Loser	**-69.64%** ***(-3.14)****	**0.10%** ***(0.01)***	**7.37%** ***(0.49)***	**6.47%** ***(0.36)***	**8.62%** ***(0.40)***
Quintile 2	-21.06% *(-1.00)*	-2.20% *(0.31)*	-0.75% *(-0.07)*	-7.51% ***(-0.52)***	-10.10% ***(-0.56)***
Quintile 3	2.28% *(-0.14)*	0.14% *(-0.02)*	-0.49% *(-0.04)*	4.11% *(0.28)*	3.11% *(0.18)*
Quintile 4	24.34% *(1.30)**	-1.42% *(-0.18)*	-4.64% *(-0.43)*	-5.05% *(-0.35)*	-8.54% *(-0.53)*
Winner	**64.49%** ***(2.98)****	**-0.53%** ***(-0.08)***	**-0.90%** ***(-0.07)***	**-1.42%** ***(-0.10)***	**-5.64%** ***(-0.35)***
Arbitrage	**-134.13%** ***(-6.13)****	**0.62%** ***(0.07)***	**8.27%** ***(0.59)***	**7.89%** ***(0.49)***	**14.26%** ***(0.75)***

TABLE 2

OVERREACTION – POSITIVE AUTOCORRELATION WITH CAPM RISK ADJUSTMENT
Market-model adjusted average CARs (alphas) for 24-month test periods and CAPM betas estimated for winner, loser and arbitrage portfolios
t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Test Period	Loser		Winner		Arbitrage	
	$\alpha 1$	β_0	$\alpha 1$	β_0	$\alpha 1$	β_0
1990-1991	20.61% *(1.09)*	0.98 *(11.61)***	11.66% *(0.54)*	1.08 *(10.81)***	8.95% *(0.44)*	-0.10% *(-0.70)*
1992-1993	30.36% *(0.94)*	1.29 *(15.89)***	-38.28% *(-2.73)***	0.75 *(8.75)***	68.64% *(2.76)***	0.53 *(3.74)***
1994-1995	-0.25% *(-0.01)*	1.22 *(11.17)***	-12.00% *(-0.01)*	1.22 *(11.30)***	11.75% *(0.56)*	-0.01 *(-0.04)*
1996-1997	-10.67% *(-0.48)*	1.19 *(10.29)***	-18.94% *(-1.60)**	1.08 *(10.78)***	15.51% *(1.31)*	-26.08% *(-1.47)*
1998-1999	7.93% *(0.51)*	0.57 *(7.01)***	11.71% *(0.66)*	1.25 *(16.44)***	-3.78% *(-0.23)*	-0.69 *(-5.07)***
2000-2001	13.69% *(0.94)*	0.91 *(14.07)***	5.35% *(0.49)*	1.18 *(17.30)***	8.34% *(0.77)*	-0.26 *(-2.33)**
2002-2003	8.94% *(0.47)*	1.85 *(23.05)***	6.37% *(0.46)*	0.50 *(7.10)*	2.57% *(0.16)*	13.49% *(12.25)***
Aggregate	**11.08%** ***(0.52)***	**1.15** ***(32.75)****	**-5.42%** ***(-0.34)***	**1.00** ***(28.72)****	**16.50%** ***(0.87)***	**0.15** ***(2.56)****

TABLE 3

OVERREACTION – POSITIVE AUTOCORRELATION WITH CHAN RISK ADJUSTMENT

Market-model adjusted average CARs (alphas) for 24-month observation and 24-month test periods and betas estimated for winner, loser and arbitrage portfolios

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Test Period	Loser				Winner				Arbitrage			
	α_0	α_1	β_o	β_1	α_0	α_1	β_o	β_1	α_0	α_1	β_o	β_1
1990-1991	-0.008 *(3.50)***	0.002 *(0.95)*	0.947 *(13.93)***	0.082 *(0.68)*	0.009 *(2.96)***	0.001 *(0.43)*	1.117 *(13.63)***	-0.036 *(-0.25)*	-0.017 *(-4.12)*	0.001 *(0.25)*	-0.170 *(-1.46)*	0.118 *(0.57)*
1992-1993	-0.007 *(-3.27)***	0.004 *(1.78)**	1.199 *(14.12)***	0.391 *(3.29)***	0.006 *(2.73)***	-0.004 *(-1.93)**	0.825 *(9.93)***	0.070 *(0.60)*	-0.013 *(-3.66)***	0.007 *(2.26)***	0.374 *(2.71)***	0.321 *(1.67)*
1994-1995	-0.008 *(-3.19)***	0.000 *(0.09)*	1.200 *(11.65)***	0.053 *(0.28)*	0.008 *(3.65)***	-0.002 *(-0.75)*	1.239 *(14.26)***	-0.119 *(-0.76)*	-0.016 *(-4.36)***	0.002 *(0.50)*	-0.039 *(-0.26)*	0.172 *(0.64)*
1996-1997	-0.006 *(-3.19)***	-0.001 *(-0.44)*	1.113 *(8.35)***	0.010 *(0.04)*	0.006 *(3.98)***	0.000 *(-0.22)*	1.152 *(13.41)***	-0.432 *(-3.87)***	-0.012 *(-3.96)***	-0.001 *(-0.22)*	-0.038 *(-0.22)*	0.477 *(2.07)***
1998-1999	-0.005 *(-2.86)***	0.001 *(0.42)*	0.628 *(7.10)***	0.166 *(1.54)*	0.006 *(3.24)***	0.001 *(0.76)*	1.190 *(13.95)***	0.116 *(1.11)***	-0.011 *(-3.69)***	-0.001 *(-0.19)*	-0.562 *(-3.92)***	0.050 *(0.28)*
2000-2001	-0.005 *(-3.26)***	0.001 *(0.44)*	0.918 *(15.68)***	-0.186 *(-2.18)***	0.005 *(3.24)***	0.000 *(-0.31)*	1.174 *(20.50)***	-0.277 *(-3.31)***	-0.010 *(-4.13)***	0.001 *(0.48)*	-0.256 *(-2.81)***	0.091 *(0.68)*
2002-2003	-0.005 *(-2.58)***	0.001 *(0.28)*	1.822 *(26.20)***	-0.283 *(-2.13)***	0.006 *(3.80)***	0.001 *(0.60)*	0.534 *(8.54)***	0.205 *(1.72)**	-0.011 *(-4.19)***	0.000 *(-0.18)*	1.288 *(12.96)***	-0.488 *(-2.58)***
Aggregate	**-0.006** ***(-8.03)****	**0.001** ***(1.33)***	**1.118** ***(33.47)****	**0.033** ***(0.58)***	**0.006** ***(8.88)****	**0.000** ***(-0.53)***	**1.033** ***(35.42)****	**-0.068** ***(-1.79)****	**-0.013** ***(-10.5)****	**0.001** ***(1.08)***	**0.085** ***(2.64)****	**0.106** ***(1.25)***

TABLE 4

OVERREACTION – SIZE EFFECTS

Market-model adjusted CARs for winner small, winner big, loser-small, loser-big and arbitrage-small and arbitrage-big portfolios vs. winner, loser and arbitrage for each 24-month test period

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Test Period	Loser		Winner		Arbitrage	
	Small	Big	Small	Big	Small	Big
1990-1991	17.10% *(0.62)*	27.44% *(1.12)*	21.75% *(0.74)*	-10.78% *(-0.39)*	-4.64% *(-0.16)*	38.22% *(1.46)**
1992-1993	44.14% *(1.17)*	10.12% *(0.24)*	-84.70% *(-3.04)***	13.71% *(0.80)*	128.85% *(3.88)***	-3.59% *(-0.11)*
1994-1995	1.58% *(0.04)*	-19.72% *(-1.37)**	-29.75% *(-1.37)**	-3.36% *(-0.14)*	31.33% *(0.98)*	-16.36 *(-0.81)*
1996-1997	44.22% *(1.24)*	-37.25% *(-1.50)**	-24.35% *(-1.40)**	-3.16% *(-0.24)*	68.57% *(2.44)***	-34.09% *(-1.72)**
1998-1999	-10.74% *(-0.40)*	26.99% *(1.39)**	14.58% *(0.74)*	11.31% *(0.34)*	-25.32% *(-1.08)*	15.68% *(0.58)*
2000-2001	-10.30% *(-0.46)*	50.55% *(2.24)***	13.97% *(0.75)*	-12.97% *(0.91)*	-24.27% *(-1.18)*	63.53% *(3.38)***
2002-2003	-9.14% *(-0.39)*	7.64% *(0.29)*	14.96% *(0.79)*	9.92% *(0.61)*	-24.10% *(-1.13)*	-2.28% *(-0.10)*
Aggregate	**10.98%** ***(0.35)***	**9.39%** ***(0.36)***	**-10.51%** ***(-0.47)***	**0.67%** ***(0.03)***	**21.49%** ***(0.79)***	**8.73%** ***(0.36)***

TABLE 5

OVERREACTION – JANUARY EFFECT

January effects: Market adjusted ARs/CARs per month

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Test Period	Loser				Winner			
	All Months	Jan	Feb-Sep	Oct-Dec	All Months	Jan	Feb-Sep	Oct-Dec
t, t+1	*0.61%* (0.48)	***-3.04%*** **(-0.69)**	*0.69%* (0.48)	*1.64%* (0.70)	*-0.07%* (-0.07)	***2.30%*** **(0.64)**	*-0.38%* (0.30)	*-0.06%* (-0.03)
t+1, t+2	*0.10%* (0.09)	***0.52%*** **(0.12)**	*0.11%* (0.07)	*-0.05%* (-0.02)	*-0.40%* (-0.47)	***-0.15%*** **(-0.05)**	*-0.07%* (-0.06)	*-1.36%* (-0.86)
t, t+2	*0.71%* (0.40)	***-2.53%*** **(-0.41)**	*0.80%* (0.34)	*1.58%* (0.44)	*-0.47%* (-0.35)	***2.15%*** **(0.47)**	*-0.45%* (-0.26)	*-1.41%* (-0.53)

TABLE 6

OVERREACTION - POSITIVE AUTOCORRELATION WITH FAMA AND FRENCH (1993) THREE-FACTOR RISK ADJUSTMENT

Three-factor model adjusted average CARs (alphas), betas, size and value/growth exposures (observation period) for winner, loser and arbitrage portfolios for each test period

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Test Period	Loser				Winner				Arbitrage			
	α_p	β_p	s_p	h_p	α_p	β_p	s_p	h_p	α_p	β_p	s_p	h_p
1990-1991	10.3% *(0.54)*	0.904 *(11.54)***	-0.211 *(-2.24)***	-0.138 *(-1.49)*	9.6% *(0.45)*	1.117 *(9.73)***	-0.071 *(-0.61)*	-0.069 *(-0.61)*	0.7% *(0.03)*	-0.213 *(-1.28)*	-0.141 *(-0.84)*	-0.069 *(-0.42)*
1992-1993	59.7% *(1.85)**	1.042 *(13.51)***	0.355 *(3.71)***	0.520 *(6.34)***	-31.9% *(-2.27)***	1.004 *(10.66)***	0.186 *(1.59)*	-0.284 *(-2.83)***	91.6% *(3.68)***	0.038 *(0.26)*	0.170 *(0.96)*	0.804 *(5.32)***
1994-1995	10.0% *(0.43)*	0.754 *(6.97)***	0.544 *(5.92)***	0.455 *(4.32)***	-14.8% *(-0.78)*	1.508 *(11.98)***	-0.014 *(-0.13)*	-0.466 *(-3.80)***	24.8% *(1.18)*	-0.754 *(-4.52)***	0.558 *(3.94)***	0.922 *(5.67)***
1996-1997	2.5% *(0.11)*	0.958 *(9.53)***	0.524 *(5.58)***	0.020 *(0.19)*	-41.5% *(-3.51)***	1.195 *(12.25)***	-0.220 *(-2.42)***	-0.204 *(-2.04)***	43.9% *(2.48)***	-0.238 *(-1.61)*	0.745 *(5.43)***	0.223 *(1.49)*
1998-1999	18.9% *(1.21)*	0.703 *(9.36)***	0.226 *(2.51)***	0.370 *(4.28)***	-14.7% *(-0.83)*	1.098 *(17.50)***	-0.394 *(-5.25)***	-0.410 *(-5.67)***	33.7% *(2.01)***	-0.395 *(-3.62)***	0.620 *(4.75)***	0.780 *(6.21)***
2000-2001	14.6% *(1.00)*	1.045 *(18.53)***	0.419 *(6.17)***	0.466 *(5.91)***	7.6% *(0.70)*	1.059 *(19.53)***	-0.412 *(-6.33)***	-0.635 *(-8.40)***	7.0% *(0.55)*	-0.014 *(-0.17)*	0.831 *(8.44)***	1.101 *(9.63)***
2002-2003	13.6% *(0.72)*	1.717 *(21.52)***	0.002 *(0.02)*	-0.361 *(-3.25)***	1.22% *(0.09)*	0.459 *(6.77)***	-0.070 *(-0.92)*	-0.338 *(-3.60)***	12.4% *(0.75)*	1.259 *(11.26)***	0.072 *(0.58)*	-0.022 *(-0.14)*
Aggregate	**18.5%** ***(0.86)***	**1.122** ***(33.66)****	**0.248** ***(7.04)****	**0.160** ***(4.32)****	**-12.1%** ***(-0.76)***	**1.053** ***(31.26)****	**-0.131** ***(-3.68)****	**-0.202** ***(-5.41)****	**30.6%** ***(1.62)****	**0.070** ***(1.30)***	**0.380** ***(6.71)****	**0.363** ***(6.10)****

TABLE 7

OVERREACTION - VALUE STRATEGIES

Market adjusted average CARs (before and after portfolio formation) and fundamental ratios for portfolios formed on the basis of BTM ("Book to Market") and C/P ("Cash-Flow to Price")

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Portfolio	Before	After (Test Period)			Multiples				
	-24 m	**12 m**	**24 m**	**36 m**	**BTM**	**C/P**	**E/P**	**D/P**	**CB**
Value	-20.11% *(-1.10)*	-1.06% *(-0.07)*	4.62% *(0.23)*	**3.04%** ***(0.13)***	1.572	0.468	0.088	0.027	98.5
Quartile 2	-26.48% *(-1.08)*	-3.33% *(-0.20)*	-3.29% *(-0.13)*	**1.69%** ***(0.06)***	1.644	0.060	-0.105	0.010	185.8
Quartile 3	14.75% *(0.80)*	10.19% *(0.88)*	13.26% *(0.79)*	**12.75%** ***(0.63)***	0.608	0.363	0.109	0.033	1.054.8
Growth	18.85% *(0.96)*	-5.99% *(-0.48)*	-18.57% *(-1.06)*	**-19.89%** ***(-0.91)***	0.510	0.081	-0.020	0.018	1.021.8
Value – Growth	**-38.96%** ***(-2.06)****	**4.93%** ***(0.37)***	**23.19%** ***(1.24)***	**22.93%** ***(1.01)***	**-**	**-**	**-**	**-**	**-**

TABLE 8

VALUE STRATEGIES – OVERREACTION WITH CAPM RISK ADJUSTMENT

Market-model adjusted average CARs (alphas) and betas (36-month test periods) for value and growth portfolios

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Formed in	Value		Growth		Formed in	Value		Growth	
	α	β	α	β		α	β	α	β
1990	33.60% *(1.39)**	1.11 *(13.94)***	-2.26% *(-0.08)*	0.87 *(12.41)***	**1996**	-11.23% *(-0.60)*	0.83 *(8.79)***	-5.46% *(-0.21)*	1.24 *(10.32)***
1991	-6.95% *(-0.18)*	1.26 *(14.83)***	-12.89% *(-0.48)*	0.85 *(8.84)***	**1997**	-4.41% *(-0.24)*	1.05 *(14.34)***	-18.79% *(-0.75)*	0.97 *(14.37)***
1992	-22.41% *(-0.75)*	1.41 *(11.70)***	-21.45% *(-1.04)*	0.67 *(7.16)***	**1998**	35.29% *(1.52)**	0.98 *(18.01)***	-9.07% *(-0.48)*	1.34 *(19.48)***
1993	-6.73% *(-0.28)*	1.57 *(15.25)***	-65.89% *(-2.97)***	1.28 *(13.95)***	**1999**	9.82% *(0.45)*	1.09 *(12.45)***	12.57% *(1.01)*	1.22 *(14.41)***
1994	-31.30% *(-1.56)**	1.14 *(16.80)***	-75.02% *(-3.55)***	1.32 *(16.41)***	**2000**	20.79% *(1.18)*	0.75 *(9.82)***	-26.12% *(-1.83)**	0.55 *(6.83)***
1995	-7.58% *(-0.55)*	1.05 *(14.34)***	-12.12% *(-0.59)*	1.03 *(8.57)***	**All**	**-0.81%** ***(-0.03)***	**1.13** ***(44.59)****	**-21.50%** ***(-0.98)***	**1.07** ***(40.99)****

TABLE 9

OVERREACTION - VALUE AND GROWTH PORTFOLIOS ATTRIBUTES

	Value	Growth
Panel A: Fundamental Variables		
BTM	1.572	0.510
C/P	0.468	0.081
E/P	0.088	-0.020
S/P	3.605	1.284
D/P	0.027	0.018
Panel B: Past Performance		
ACG (-2,0)	57.46%	34.52%
ASG (-2,0)	19.77%	28.78%
Return (-2,0)	-20.11%	18.85%
Panel C: Future Performance		
ACG (0,3)	15.55%	23.08%
ASG (0,3)	15.64%	14.69%
Return (0,3)	3.04%	-19.89%

TABLE 10

UNDERREACTION – POSITIVE AUTOCORRELATION (I)

Market-adjusted average CARs in test periods for portfolios based on past return performance: *J*-month/*K*-month strategy. *J*=6, 12; *K*=3, 6, 12

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Formation Period (*J*)	Portfolio	Test Period (*K*)		
		3 months	6 months	12 months
6 Months	Winner	1.45% *(-0.23)*	2.27% *(0.23)*	2.95% *(0.25)*
	Loser	-1.62% *(0.19)*	-4.40% *(-0.41)*	-6.64% *(-0.46)*
	Arbitrage	**3.07%** ***(0.43)***	**6.66%** ***(0.65)***	**9.59%** ***(0.73)***
12 Months	Winner	3.13% *(-0.40)*	3.76% *(0.39)*	5.54% *(0.45)*
	Loser	-5.54% *(-0.65)*	-5.71% *(-0.47)*	-8.47% *(-0.51)*
	Arbitrage	**8.67%** ***(1.07)***	**9.47%** ***(0.87)***	**14.02%** ***(0.91)***

TABLE 11

UNDERREACTION – POSITIVE AUTOCORRELATION (II)

Market-adjusted average CARs (observation and test periods) for portfolios based on past return performance: 6-month/*K*-month strategy. *K*=6, 12, 18 and 24.

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Portfolio	Formation Period	Test Period			
	-6 months	**6 months**	**12 months**	**18 months**	**24 months**
Loser	-32.46% *(-3.29)***	-4.40% *(-0.41)*	-6.64% *(-0.46)*	-8.28% *(-0.46)*	-7.41% *(-0.37)*
Quintile 2	-10.91% *(-1.61)**	0.55% *(0.06)*	-1.36% *(-0.12)*	-1.45% *(-0.11)*	-0.90% *(-0.06)*
Quintile 3	1.05% *(-0.17)*	-0.09% *(-0.01)*	0.09% *(0.01)*	0.08% *(0.01)*	-0.40% *(-0.03)*
Quintile 4	11.40% *(1.44)**	0.41% *(0.05)*	2.63% *(0.25)*	-3.63% *(0.26)*	4.03% *(0.26)*
Winner	30.96% *(3.52)***	2.27% *(0.23)*	2.95% *(0.25)*	2.44% *(0.16)*	-0.10% *(-0.01)*
Arbitrage	63.42% *(6.79)***	**6.66%** ***(0.65)***	**9.59%** ***(0.73)***	**10.73%** ***(0.64)***	**7.31%** ***(0.38)***

TABLE 12

UNDERREACTION - POSITIVE AUTOCORRELATION WITH CAPM RISK ADJUSTMENT
Market-model adjusted average CARs (alphas) and CAPM betas (observation period) for winner, loser and arbitrage portfolios
t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

	Winner		Loser		Arbitrage	
	$\alpha 1$	β_0	α_1	β_0	α_1	β_0
Average	1.16% *(0.12)*	1.07 *(65.95)***	-2.63% *(-0.24)*	1.14 *(67.32)***	3.79% *(0.37)*	-0.07 *(2.70)***

TABLE 13

UNDERREACTION - POSITIVE AUTOCORRELATION CONTROLLING FOR SIZE

Market-model adjusted average CARs for winner small, winner big, loser-small, loser-big and arbitrage-small and arbitrage-big portfolios vs. winner, loser and arbitrage CARs

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

	Loser		**Winner**		**Arbitrage**	
	Small	**Big**	**Small**	**Big**	**Small**	**Big**
	-4.41% *(-0.27)*	-3.84% *(-0.31)*	1.08% *(0.08)*	4.39% *(0.36)*	5.49% *(0.37)*	8.23% *(0.67)*
Average	-4.40%		2.27%		6.66%	
Difference vs. Average	-0.01%	0.56%	-1.19%	2.12%	-1.17%	1.57%

TABLE 14

UNDERREACTION - POSITIVE AUTOCORRELATION WITH FAMA AND FRENCH (1993) THREE FACTOR RISK ADJUSTMENT

Three-factor model adjusted average CARs (alphas), betas, size (market capitalization) and value/growth exposures (observation period) for winner, loser and arbitrage portfolios.

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Portfolio	Fama and French (1993) three-factor model exposures				Attributes	
	α_p	**β_p**	**s_p**	**h_p**	**Size (MC)**	**BTM**
Loser	-1.26% *(-0.12)*	1.137 *(67.78)***	0.094 *(4.91)***	0.019 *(0.93)*	403 975	1.24
Winner	1.41% *(0.15)*	1.055 *(65.95)***	0.023 *(1.25)*	-0.024 *(-0.96)*	655 634	0.69
Arbitrage	2.66% *(0.26)*	-0.083 *(-3.03)***	-0.071 *(-1.98)***	-0.043 *(-1.20)*		

TABLE 15

UNDERREACTION – SUE (I)

Market-adjusted average 6-, 12-, 18- and 24-month CARs, fundamental attributes and SUE ("Standardized Unexpected Earnings") for portfolios ranked on the basis of the previous 6-months return performance

	Loser	*Quintile 2*	*Quintile 3*	*Quintile 4*	*Winner*	*Arbitrage*
Panel A. Average CARs						
Return (-6;0)	-32.46%	-10.91%	1.05%	11.40%	30.96%	63.42%
Return (0;6)	-4.40%	0.55%	-0.09%	0.41%	2.27%	6.66%
Return (0;12)	-6.64%	-1.36%	0.09%	2.63%	2.95%	9.59%
Return (0;18)	-8.28%	-1.45%	0.08%	3.63%	2.44%	10.73%
Return (0;24)	-7.41%	-0.90%	-0.40%	4.03%	-0.10%	7.31%
Panel B. Fundamentals						
Market Cap.	403 975	576 201	677 982	808 364	655 634	
BTM	1.24	1.02	0.86	0.82	0.69	
Panel C: SUEs (Standardized Unexpected Earnings)						
SUE 1	-0.256	0.092	-0.036	0.337	0.268	0.524
SUE 2	-0.172	0.001	0.001	0.294	0.469	0.641
SUE 3	-0.199	-0.135	0.084	0.303	0.270	0.469
SUE 4	-0.081	-0.025	-0.037	0.124	0.217	0.298

TABLE 16

UNDERREACTION – SUE (II)

Market-adjusted average 6-, 12-, 18 and 24 CARs and fundamental attributes of SUE ("Standardized Unexpected Earnings") ranked portfolios

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

	Lowest SUE	***Quintile 2***	***Quintile 3***	***Quintile 4***	***Highest SUE***	**Arbitrage**
Panel A. Average CARs						
Return (-6;0)	-3.51% *(-0.45)*	-1.61% *(-0.18)*	1.05% *(-0.39)*	1.23% *(0.15)*	6.95% *(0.68)*	**10.46%** ***(1.15)***
Return (0;6)	-3.12% *(-0.40)*	0.15% *(0.02)*	-1.81% *(-0.21)*	4.24% *(0.58)*	1.33% *(0.14)*	**4.45%** ***(0.50)***
Return (0;12)	-3.77% *(-0.29)*	0.20% *(0.02)*	-0.54% *(-0.04)*	3.26% *(0.28)*	2.02% *(0.16)*	**5.79%** ***(0.46)***
Return (0;18)	-6.76% *(-0.44)*	1.52% *(0.10)*	0.67% *(0.04)*	1.18% *(0.08)*	2.77% *(0.18)*	**9.53%** ***(0.62)***
Return (0;24)	-4.62% *(-0.25)*	-0.26% *(-0.01)*	-0.38% *(-0.02)*	0.91% *(0.05)*	2.66% *(0.15)*	**7.27%** ***(0.40)***
Panel B. Fundamentals						
Market Capitalizat.	482 132	703 397	495 666	558 299	590 382	
BTM	1.00	0.95	0.95	0.95	0.96	
Panel C. SUEs (Standardized Unexpected Earnings)						
SUE 1	-1.825	-0.585	0.022	0.657	2.213	**4.039**
SUE 2	-0.487	-0.238	0.028	0.570	0.753	**1.240**
SUE 3	-0.036	-0.186	-0.020	0.299	0.133	**0.169**
SUE 4	-0.081	-0.025	-0.037	0.124	0.217	**0.298**

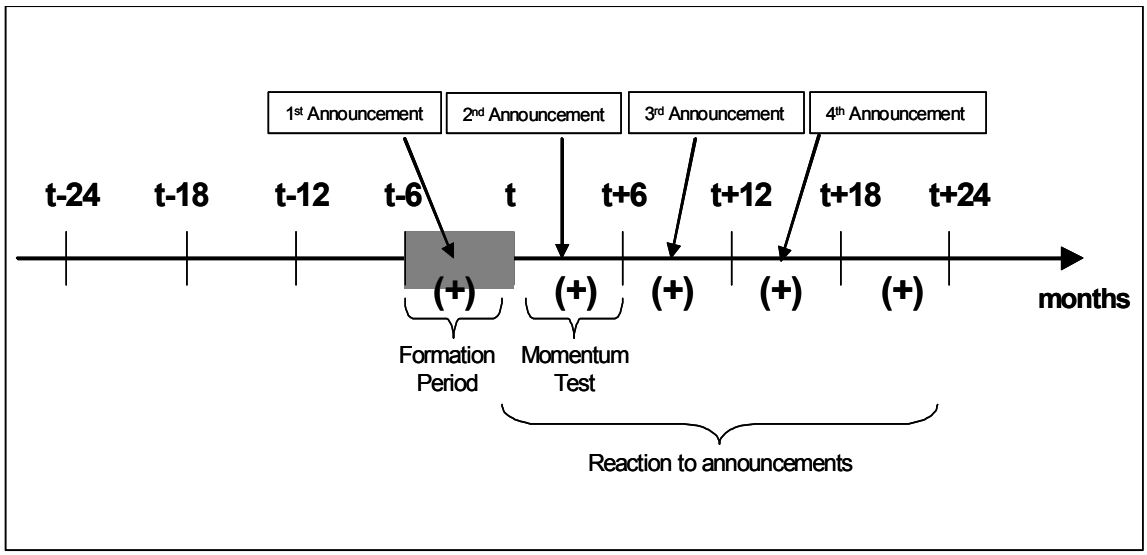

Figure 1
Undereaction and Earnings Announcements

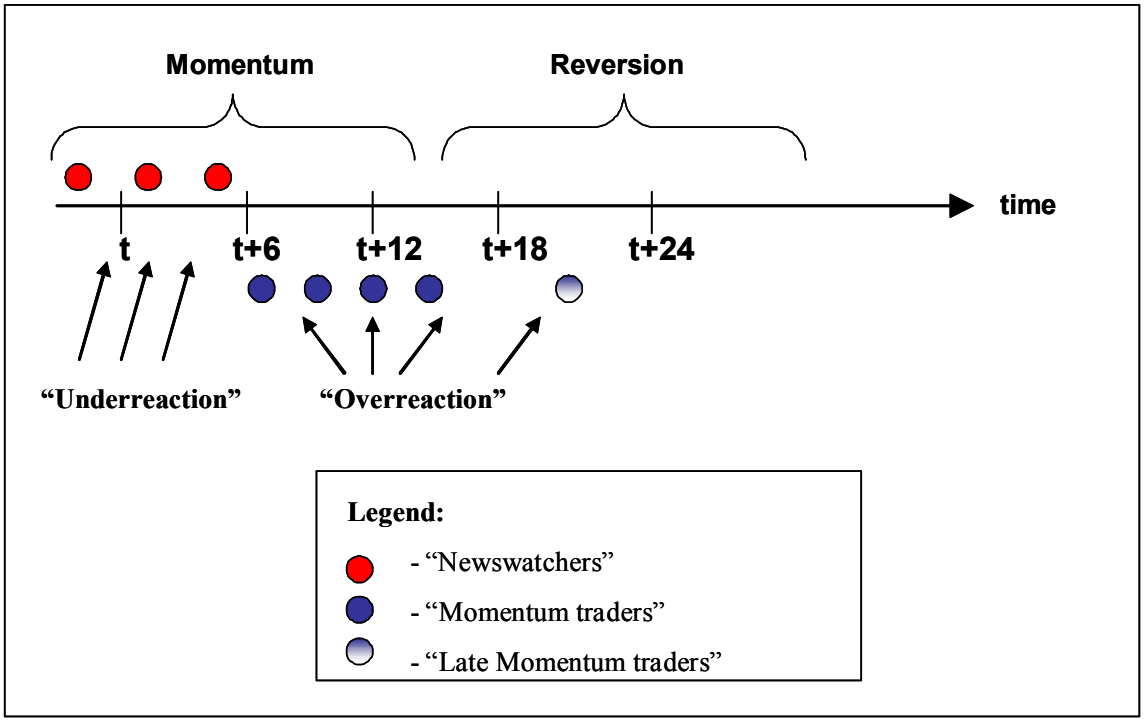

Figure 2
Overeaction and Undereaction: Evidence from the Portuguese stock market vs. Hong and Stein (1999)

Appendix A - Additional Tables

TABLE A.1

OVERREACTION - NEGATIVE AUTOCORRELATION

Market-adjusted CARs in each of the 24-month test periods for winner, loser and arbitrage portfolios

# indicates the number of stocks in each quartile. *t*-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Test Period	#	Portfolio					
		Loser	Quintile 2	Quintile 3	Quintile 4	Winner	Arbitrage
1990-1991	4	**22.27%** ***(1.18)***	-19.59% *(-0.92)*	-15.59% *(-0.70)*	-14.68% *(-0.65)*	**5.48%** ***(0.26)***	**16.79%** ***(0.83)***
1992-1993	5	**27.13%** ***(0.84)***	-39.61% *(-2.27)***	-20.03% *(-0.87)*	-1.96% *(-0.09)*	**-35.50%** ***(-2.53)****	**62.63%** ***(2.52)****
1994-1995	5	**-6.94%** ***(-0.30)***	-1.13% *(-0.05)*	-0.25% *(-0.02)*	12.64% *(0.81)*	**-19.19%** ***(-1.02)***	**12.25%** ***(0.58)***
1996-1997	7	**-2.33%** ***(-0.11)***	-25.77% *(-1.66)**	5.28% *(0.45)*	-17.99% *(-1.28)*	**-15.27%** ***(-1.29)***	**12.93%** ***(0.73)***
1998-1999	9	**5.43%** ***(0.35)***	-6.82% *(-0.40)*	18.44% *(1.22)*	-20.20% *(-1.78)***	**13.18%** ***(0.74)***	**-7.75%** ***(-0.46)***
2000-2001	7	**16.74%** ***(1.15)***	16.48% *(1.58)*	34.18% *(1.78)***	0.97% *(0.07)*	**-1.00%** ***(-0.09)***	**17.75%** ***(1.38)****
2002-2003	9	**-1.95%** ***(-0.10)***	5.77% *(0.35)*	-0.24% *(-0.02)*	-18.50% *(-1.90)***	**12.80%** ***(0.93)***	**-14.75%** ***(-0.10)***
Aggregate	**7**	**8.62%** ***(0.40)***	-10.10% *(-0.56)*	3.11% *(0.18)*	-8.54% *(0.59)*	**-5.64%** ***(-0.35)***	**14.26%** ***(0.75)***

TABLE A.2

OVERREACTION – SIZE EFFECTS

Average market capitalization (€) at formation date for portfolios ranked on the basis of the previous 24-month return performance

Period	Loser	Quintile 2	Quintile 3	Quintile 4	Winner	All
1989	55 505	261 353	29 238	99 051	100 866	113 411
1991	78 772	91 073	198 862	42 423	92 019	99 051
1993	9 494	80 030	237 010	656 274	122 732	220 445
1995	34 965	78 943	480 832	251 837	393 264	251 237
1997	279 152	273 467	755 798	704 832	1 562 593	716 297
1999	115 667	823 054	893 359	2 616 017	2 236 770	1 350 752
2001	743 233	508 941	2 790 337	1 795 855	915 435	1 340 038
Average	**208 414**	**364 859**	**922 032**	**1 096 489**	**928 871**	**700 558**
Median	46 628	139 568	213 634	192 480	247 760	127 535
St. Deviation	432 414	800 766	1 923 402	2 301 587	1 402 760	1 554 751

TABLE A.3

OVERREACTION – VALUE STRATEGIES

36-month market adjusted CARs and fundamental ratios for portfolios formed on the basis of BTM ("Book to Market") and C/P ("Cash-Flow to Price")

t-statistics are reported in parentheses. ** and * denote statistical significance at the 5% and 10% level.

Formation Year	Portfolio				
	Value	**Quartile 2**	**Quartile 3**	**Growth**	**Value - Growth**
1990	34.80% *(1.44)*	-57.13% *(-1.36)*	25.40% *(1.15)*	-3.65% *(-0.13)*	**38.46%** ***(1.46)***
1991	-3.87% *(-0.22)*	-39.12% *(-0.82)*	21.02% *(0.86)*	-14.51% *(-0.54)*	**10.64%** ***(0.33)***
1992	-10.27% *(-0.34)*	35.32% *(1.11)*	-26.45% *(-0.99)*	-31.18% *(-1.52)*	**20.91%** ***(0.81)***
1993	-2.16% *(-0.09)*	27.78% *(1.01)*	8.27% *(0.52)*	-63.66% *(-2.87)***	**61.50%** ***(2.64)****
1994	-20.76% *(-1.03)*	-8.26% *(-0.43)*	22.51% *(1.44)*	-49.32% *(-2.33)***	**28.56%** ***(1.39)***
1995	-2.35% *(-0.17)*	4.61% *(0.21)*	-1.09% *(-0.06)*	-10.12% *(-0.50)*	**7.77%** ***(0.45)***
1996	-19.98% *(-1.06)*	-38.15% *(-1.89)**	14.61% *(0.61)*	7.06% *(0.27)*	**-27.04%** ***(-1.21)***
1997	-6.28% *(-0.34)*	9.66% *(0.47)*	1.00% *(0.04)*	-17.61% *(-0.71)*	**11.33%** ***(0.52)***
1998	25.28% *(1.52)*	13.59% *(0.50)*	29.42% *(1.54)*	-15.53% *(-0.82)*	**50.80%** ***(2.39)****
1999	3.33% *(0.15)*	63.87% *(2.78)***	26.86% *(1.60)*	-3.35% *(-0.27)*	**6.67%** ***(0.37)***
2000	25.72% *(1.46)*	6.42% *(0.39)*	18.66% *(1.45)*	-16.92% *(-1.18)*	**42.64%** ***(2.66)****
Average	**3.04%** ***(0.13)***	**1.69%** ***(0.06)***	**12.75%** ***(0.63)***	**-19.89%** ***(-0.91)***	**22.93%** ***(1.01)***

TABLE A.4

UNDERREACTION – SIZE EFFECTS

Three-year Average Market Capitalization (€) for portfolios ranked on the basis of the previous 6-month return performance

Period	Loser	Quintile 2	Quintile 3	Quintile 4	Winner	All
1989-91	109 153	81 945	112 758	103 757	107 506	102 259
1992-94	110 952	108 833	168 258	222 596	134 729	149 679
1995-97	132 830	287 633	365 4557	374 055	485 744	327 562
1998-00	645 085	759 977	1 060 395	1 323 665	1 301 202	1 019 174
2001-03	816 617	1 290 329	1 290 651	1 505 181	825 709	1 136 992
Average	403 975	576 201	677 982	808 364	655 634	623 897
Median	72 240	93 405	155 586	161 060	152 250	123 552
St. Deviation	993 216	1 454 888	1 506 926	1 739 177	1 197 074	1 404 622