

Momentum Strategies in the Portuguese Stock Market

Lobão, Júlio

Da Mota Lopes, Cátia

► RECEIVED: 30 MAY 2013

► ACCEPTED: 25 SEPTEMBER 2013

Abstract

The main purpose of our study is to explore the existence of return continuation in the Portuguese Stock Market, thus investigating its efficiency at the weak form level. Using a monthly sample that goes from January 1988 to April 2012, the most extensive sample ever used for the analysis of momentum profitability in the Portuguese Stock Market, we construct 32 different strategies. We show that strategies which buy stocks that have performed well in the past and sell stocks that have poor performances previously –momentum strategies– can generate significant positive returns over three to twelve months holding periods. Concerning the performance of momentum strategies in the long run, our results seem to support the underreaction hypothesis.

Keywords:

Momentum strategies, Portugal, Stock market, Underreaction hypothesis

JEL classification:

G15.

Estrategias de Momentum en el Mercado de Valores Portugués

Lobão, Júlio

Da Mota Lopes, Cátia

Resumen

El principal propósito de este estudio es explorar la existencia de continuación en las rentabilidades del Mercado de Valores Portugués, analizando, por tanto, su eficiencia en la forma débil. A partir de una muestra mensual que abarca el periodo comprendido entre Enero de 1998 y Abril de 2012, la muestra más extensa que se haya utilizado nunca para analizar la rentabilidad del momentum en el Mercado Bursátil Portugués, se construyen 32 estrategias diferentes. Se observa que las estrategias que compran activos que han tenido un buen rendimiento en el pasado y que venden aquellos que presentaron un rendimiento pobre –estrategias de momentum– pueden generar retornos positivos significativos en periodos de mantenimiento de entre tres y doce meses. Por lo que se refiere al funcionamiento de este tipo de estrategias en el largo plazo, nuestros resultados parecen apoyar la hipótesis de infra-reacción.

Palabras clave:

Estrategias de momentum, Portugal, mercado de valores, hipótesis de infra-reacción.

■ 1. Introduction

Momentum strategies are based on the continuation of existing trends in the market. According to these strategies, investors should buy past winner stocks and sell past loser stocks, because at least in the short-term it is more likely that a rising asset price continues to rise further than the opposite (Jegadeesh and Titman, 1993).

Similar to other trading strategies, momentum is related to the underreaction and overreaction anomalies. By conceiving profitable strategies based on past returns' observation, momentum strategies challenge the Efficient Market Hypothesis (EMH). Namely momentum strategies question one of its implications, i.e., that is not possible to systematically beat the market by analyzing past prices:

“If stock prices either overreact or underreact to information, then profitable trading strategies that select stocks based on their past returns will exist.”

Jegadeesh and Titman (1993, p. 68)

The seminal work by Jegadeesh and Titman (1993) reveals that the future stock returns may be predicted from their past performances. These authors found that momentum strategies result in profits of about 1 percent per month in the year following the portfolios' formation.

Since then, momentum strategies have been studied in many other markets. It is worth to study the momentum effect in other markets outside the US because, given that the history of the US stock markets is unique in its success, the results obtained there may not be directly extrapolated to other markets. In fact, there are empirical studies that suggest the specificities of each country can help explain the existence and intensity of the momentum effect (Chui *et al.*, 2010). Regarding the Portuguese stock market, there are already two studies done (Soares and Serra, 2005; Pereira, 2009); however, none of them have presented significant statistical results that can prove or disprove the existence of return predictability based on past returns.

The main purpose of this article is to explore the existence of return continuation in the Portuguese Stock Market. The present study has some differences from the precedent investigations for the Portuguese stock market, as we use an extended sample (approximately 24 years), similarly to the sample periods used in the main international studies. In fact, it is thus far the most extensive sample ever used for the analysis of momentum profitability in the Portuguese stock market. We will follow the Jegadeesh and Titman (1993) methodology, with the division of the sample into deciles. Finally, our study will be the first to focus exclusively on the performance of momentum strategies for the Portuguese Stock Market.

Using a monthly sample that goes from January 1988 to April 2012, we construct 32 different strategies. Initially, we verify, for each one of these strategies, the profitability of winner portfolios over losers. Then, we will focus only on one strategy aiming to analyze the portfolios' characteristics, as well as its profitability over long horizons.

The work proceeds as follows. Firstly, section 2 provides a brief review of the relevant literature. In section 3 we present the data and the methodology and we discuss the empirical results and the main findings. Finally, section 4 presents the conclusions of our study.

■ 2. Literature Review

A momentum strategy aims to capitalize on the continuance of existing trends in the market. This strategy is based on the belief that large price increases of a security will be followed by additional gains and vice versa for declining values (Jegadeesh and Titman, 1993).

In the early literature, Levy (1967) claimed that a trading rule involving a stock purchase when its current price is substantially higher than its average, over the last 27 weeks, tends to yield abnormal returns. However, the most quoted study on the subject belongs to Jegadeesh and Titman (1993). The authors analyzed the US markets (NYSE and AMEX), between 1965 and 1989, and concluded that, over medium-term horizons (three to twelve months), stocks with higher returns will continue to outperform stocks with low past returns, over the same period of time. For instance, the six-month winners (stocks whose past six-month returns rank in the top decile) outperformed the six-month losers (stocks whose past six-month returns rank in the bottom decile) with an average excess return of about 1 percent per month, over the following six months.

The original findings of Jegadeesh and Titman (1993) appear to be applicable in other markets besides the United States'. Similar results can be found in Rouwenhorst (1998), with a sample of 12 European stock markets¹ during the period from 1978 to 1995, and in Hart *et al.* (2003), for 32 emerging markets². Chui *et al.* (2000) documented that, with the exception of Japan and Korea, momentum strategies work

¹ Rouwenhorst (1998) considered in his sample twelve European countries: Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland and United Kingdom.

² The 32 markets analyzed by Hart *et al.* (2003) are: Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela, China, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Sri Lanka, Taiwan, Thailand, Czech Republic, Greece, Hungary, Poland, Portugal, Russia, Slovakia, Turkey, Egypt, Israel, Jordan, Morocco, South Africa and Zimbabwe.

in Asian markets³ too. Foerster *et al.* (1995) followed the same procedure of Jegadeesh and Titman (1993), using Canadian data from 1978 to 1993, and recognized stronger evidence of momentum stock returns.

Considering the popularity and visibility of this market “anomaly”, according to the EMH (Fama, 1970), the profitability of momentum strategies should cease to exist. However, Jegadeesh and Titman (2001b) showed that momentum profits have continued in the 90’s⁴, demonstrating that the original results were not a product of data snooping bias, as noted by Lo and MacKinlay (1990).

After Jegadeesh and Titman’s (1993) ground-breaking work, momentum strategies have attracted substantial research.

Several studies have focused on the relationship between momentum profits and stock characteristics, giving a special emphasis to the firm size. Most of them have found that momentum profits are negatively correlated to the firm size (Jegadeesh and Titman, 1993, 2001b; Rouwenhorst, 1998; and Hong *et al.*, 2000). However, some texts conclude otherwise (e.g., Israel and Moskowitz, 2012).

Momentum researchers have also focused on the long run performance of momentum strategies, following the results provided by De Bondt and Thaler (1985, 1987). These authors have concluded that, over 3 to 5 years, past losers outperform past winners, which is the opposite of momentum strategy findings for short-term horizons.

Jegadeesh and Titman (1993) documented that momentum profits slowly dissipate over long horizons. For instance, a zero-cost portfolio strategy⁵, based on the past six months return, generates a cumulative return of 9.5 percent over the first year, but loses more than a half of this return in the following two years. Similar results have been found by Lee and Swaminathan (2000) and Jegadeesh and Titman (1999).

On the other hand, George and Hwang (2004) showed that future returns, estimated using a 52-week high criterion, don’t reverse in the long run. Therefore, they suggest that short-term momentum and long-term reversals are not likely to be components of the same phenomenon.

While the momentum profitability in short horizons have been well accepted, financial economists are far from reaching a consensus on their causes.

³ Besides Japan and Korea, Chui *et al.* (2000) examine Hong Kong, Indonesia, Malaysia, Singapore, Taiwan, and Thailand.

⁴ Jegadeesh and Titman (1993) use a sample period from 1965 to 1989 and in their 2001 study they extend the sample period from 1965 to 1998.

⁵ A zero-cost portfolio strategy consists on buying the winner’s portfolio and selling the loser’s portfolio (Rouwenhorst, 1998).

Jegadeesh and Titman (2001a) consider the underreaction to new information as a natural explanation for those profits. In that case the good performance of a winner portfolio will continue until all the news are incorporated in prices. Chan *et al.* (1996) and Hong *et al.* (2000) found evidence consistent with this explanation:

“(...) if a firm releases good news and stock prices only react partially to the good news, then buying the stocks after the initial release of the news will generate profits.”

Jegadeesh and Titman (2001a, p. 7)

Concerning the momentum reversals on long horizons, Lee and Swaminathan (2000) and Jegadeesh and Titman (2001b) interpreted this as a consequence of, not only underreaction, but delayed overreaction. These authors have concluded that strategies that buy past winners and sell past losers will be profitable in the short-run, however, the deviations from fundamental values are only temporary and cumulative momentum profits will disappear or even turn negative in the long run.

While some authors have argued that these results provide strong evidence of “market inefficiency”, since according to the EMH, investors cannot earn extra returns without bearing extra risk (Fama, 1970), others affirmed that the returns from these strategies are a compensation for risk (Chan, 1988; Fama and French, 1996).

Therefore, some authors tested whether cross-sectional differences in risk may explain momentum profits, by examining the risk adjusted returns under specific asset pricing models. For example, Jegadeesh and Titman (1993) adjusted their results for risk using the CAPM⁶, while Fama and French (1996) and Jegadeesh and Titman (2001b) used the Three-Factor Model. Their results indicate that the cross-sectional differences in expected returns under the two asset pricing models cannot explain momentum profits.

Given the limitations of risk-based explanations for momentum profits, some researchers have turned their attentions to behavioral models in order to clarify this occurrence.

The behavioral models attempt to explain the momentum profits through investors’ overconfidence or by the way that investors interpret firm’s specific information. These models are based on the idea that momentum profits arise because of inherent biases of investors (Jegadeesh and Titman, 2001a).

⁶ Jegadeesh and Titman (1993) show that momentum profits can’t be explained by the market risk. The authors find that the best performers appear to be no more risky than the worst performers. Therefore, standard risk adjustments tend to increase rather than decrease the return spread between past winners and past losers.

In Barberis *et al.* (1998) model, underreaction is motivated by the investor's conservatism bias that makes prices to adjust slowly to the information. The overreaction is caused by the representative heuristic⁷ that may lead investors to mistakenly conclude that a winner portfolio will continue to win in the future.

Daniel *et al.* (1998) proposed a model that is also consistent with the short-term momentum and the long-term reversals (overreaction). They suggested that informed traders can be characterized by overconfidence and self attribution biases, therefore investors perceive themselves as more able to value stocks than they actually are.⁸ When the investors receive confirming public information, their confidence rises, but the inverse causes confidence to fall only modestly, if at all. The authors concluded that overconfidence leads to negative long-run autocorrelations while biased self-attribution results in positive short-run autocorrelations.

Hong and Stein (1999) do not directly appeal to any behavioral biases, but they consider two types of investors who trade based on different sets of information: "news watchers" obtain signals about future cash and "momentum traders" who make forecasts based on historical prices. Based on that, when good news are observed, "news watchers" will push the prices up, but not enough. Consequently, "momentum traders" will buy these stocks, pushing the prices up again. This round of momentum trading creates a further price increase, leading to a further round of momentum trading, and so on. When "momentum traders" implement "naive momentum strategies" their trades will finally lead to overreaction in long horizons.

More recently, Grinblatt and Han (2005) show that the momentum effect may be explained by the disposition effect. The demand for a stock by a disposition investor deviates from that of a fully rational investor with the distortions being inversely related to the unrealized gain experienced on the stock. This makes prices depart from those predicted by the rational models.

Although behavioral models present a number of different interesting facts to explain the existence of momentum profits, financial economists are far from reaching consensus on what generates momentum profits, turning this subject into an interesting area for future research.

⁷ Conservatism means that investors are slow in updating their beliefs in the face of new evidence. The representative heuristic is the tendency of individuals to identify "an uncertain event, or a sample, by the degree to which it is similar to the parent population." (Tversky and Kahneman, 1974: 1124).

⁸ The self-attribution bias occurs when people attribute successful outcomes to their own skill but blame unsuccessful outcomes on bad luck.

■ 3. Analysis of the Portuguese Case

The Portuguese stock market has been included in some of the existing international studies about the momentum effect. For instance, Griffin *et al.* (2003) have considered Portugal in their international sample; however, they found that there were no statistical significant momentum profits, at a five percent significance level.

Specifically for the Portuguese stock market, Soares and Serra (2005) verified the existence of momentum strategies' profitability in short-term horizons. The authors considered a sample of 82 stocks, from 1988 to 2003 and concluded that momentum effects persist even after the risks have been accounted for. Nevertheless, most results lack statistical significance.

More recently, Pereira (2009) examined the existence of momentum and contrarian profits in the Portuguese stock market, from January 1997 to December 2008. The author found that, for formation and holding periods of one to twelve months, the monthly average returns of the top winners' portfolio are 0.97 percent; while the top losers' portfolio's monthly average returns are about -0.16 percent, thus concluding that a momentum strategy can provide returns of approximately 1 percent. However, similarly to Soares and Serra (2005), most of these results are not statistically significant.

3.1. Data

In our study we considered the stocks that integrate the Portuguese Stock Index Geral (PSI Geral). The sample period runs from January 1988 to April 2012 (about 23 years), in order to meet the needs of data required by this kind of empirical studies. For instance, Rouwenhorst (1998) considered 17 years (from 1978 to 1995) and Jegadeesh and Titman (1993) analyzed a sample of 24 years of data (1965 to 1989). Thus, in this article we consider the most extensive sample used for the analysis of momentum profitability in the Portuguese stock market.

For a specific stock to be included in our sample, it must belong to the PSI Geral and must have been traded continuously at least for 25 months, since one of our strategies needs 12 months as observation period (J), 1 month of delay between the observation and the formation of the portfolio and 12 months of holding period (K). Using Datastream database, we have collected the Total Return Index (TRI). Thereby, we obtained the stock returns adjusted for stock splits, dividends and right issues.

All stocks, except one, comply with the limitations established for our sample. Thus, we have not included the "Teixeira Duarte" stock data because, in the analysis period, this stock only had 20 months of trading. Therefore, although we could have used

this stock data for studying other strategies with smaller observation and holding periods, we decided instead to consider the same number of stocks in all strategies, avoiding taking into account some stock returns in one and not in other strategies (and its consequent bias).

As a result, the number of stocks in the sample varies between 11 stocks at the beginning and 51 stocks at the end of the studied sample. Since in the beginning our sample only comprised 11 stocks, the winner and the loser portfolios were constituted by one stock each; however, this only happened in the first three months of our study.

In addition to the *TRI*, we have collected, from Datastream, the Market Capitalization Values and the Datastream Historical Betas.⁹

3.2. Methods

We follow the work of Jegadeesh and Titman (1993) as a reference to construct the different momentum strategies, as well as the further tests and analysis.

Hence, the strategies implemented in this study select stocks based on their past returns over the last 3, 6, 9 and 12 months and hold the selected stocks for periods of 3, 6, 9 and 12 months. By examining the profitability of a number of these strategies, our study investigates the efficiency of the Portuguese stock market.

For the construction of the relative strength strategies, we transformed the daily data into monthly data. Thus, with the *TRI* we calculated the monthly returns, as follows:

$$\text{Monthly Return } t = \ln(\text{TRI}_{\text{last day of month } t} / \text{TRI}_{\text{last day of month } t-1}) \quad (1)$$

The relative strength strategies were constructed in the following way: at the end of each month t , all stocks are ranked into deciles based on their past J -month returns (J equals 3, 6, 9 or 12). Based on these rankings, the stocks are assigned to one of ten decile portfolios, which are equally weighted at formation. In the extreme deciles we have the winner and the loser portfolios. In each month t , the strategy buys the winner portfolio and sells the loser, holding this position for the K subsequent months (K equals 3, 6, 9 or 12 months) (Jegadeesh and Titman, 1993). During the holding period (K months) the portfolios were not re-balanced. A strategy with a J -month

⁹ According to the Datastream Definitions Guide, "the beta factor is derived by performing a least squares regression between adjusted prices of the stock and the corresponding Datastream market index. The historic beta so derived is then adjusted using Bayesian techniques to predict the probable behavior of the stock price on the basis that any extreme behavior in the past is likely to average out in the future. This adjusted value, or "forecast" beta, is represented by the BETA datatype. The Datastream beta factor is calculated using stock prices and market indices as the only variables".

ranking period and a K -month holding period is a J -month/ K -month strategy. As J and K can be equal to 3, 6, 9 or 12 months we studied a total of 16 strategies.

Since bid-ask spread bounce can attenuate the continuation effect, we reported a second set of 16 strategies that skip a month between the portfolio formation and the holding period. By delaying a month, as in Rouwenhorst (1998), we avoid some of the bid-ask spread, price pressure and lagged reaction effects that underlie the evidence documented in Lehmann (1990).

To increase the power of the tests we will perform, the strategies we examined included portfolios with overlapping holding periods, i.e., in any given month t , the strategies hold a series of portfolios that are selected in the current month, as well as in the previous $K-1$ months. For instance, the winner portfolio of a 6-month/6-month strategy in December comprises 10 percent of the stocks with the highest returns over the previous period from June to November, May to October and so on, up to the previous January to June period.

Following the approach described above, we computed the average monthly returns of the different buy (winner) and sell (loser) portfolios, as well as the zero-cost (winners minus losers portfolios) and, for each of the ranking and holding periods, we have tested the significance of the excess returns from buying winners and selling losers (Rouwenhorst, 1998). As a reference, we calculated the average monthly returns of the market portfolio, which contains the whole sample of stocks used in this study weighted equally, for all the holding periods (3, 6, 9 or 12, with or without 1 month delay). In order to test the significance of the excess returns, we used a t -test, with the null hypothesis being that, for the same holding period, there is no difference in the average returns of winner and loser portfolios.

To make the comparison between the zero-cost and the market portfolios, we have focused on the strategies that have 6 month ranking periods, with no delay in the formation of the portfolios. For each holding period, we conducted a test to determine whether the difference between the average monthly returns of these two portfolios is or not zero, in order to verify if the zero-cost strategy had significantly different average returns from those achieved by the market portfolio. In case we confirm that, we can conclude for the existence of abnormal returns from this trading strategy.

Since many of the studies on small capital markets (e.g., Griffin *et al.*, 2003, and Fama and French, 2012) have adopted a division of the stock data into quintiles instead of deciles, we decided to rank also the data into five portfolios for all the holding periods, in order to verify whether the obtained results are significantly altered. Therefore, the winner portfolio comprises 20 percent (instead of 10 percent) of the stocks with the highest returns over the previous 6 months period and the loser

portfolio 20 percent of the stocks with the lowest returns. Thus, we present the average monthly returns in accordance with the portfolio construction suggested by Soares and Serra (2005) for the Portuguese stock market.

As in the main literature, the remainder of our study will concentrate on portfolios formed on the basis of 6 month ranked returns and held for 6 months (6-month/6-month strategy), that does not skip a month between the portfolio formation period and the holding period.

Centering on this strategy, we have calculated the average returns and standard deviations of its 10 deciles portfolios. We performed an *F*-test, as in Rouwenhorst (1998), in order to analyze the equality of the momentum portfolios' returns.

In order to present a summary statistic for this strategy, we estimated the portfolios' averages for the two most common indicators of systematic risk: the post-ranking betas of the ten 6-month/6-month relative strength portfolios and the average market capitalization of the stocks included on these portfolios.

As mentioned in the previous subsection, the Betas and the Market Capitalization had some data flaws, especially in periods previous to 1995. In order to overcome this limitation, we have considered that stocks with missing data have a Beta or Market Capitalization equal to the average of the portfolio in which they belong.

We did not examine the profitability of the 6-month/6-month relative strength strategies within size and beta subsamples, as in Jegadeesh and Titman (1993), due to the reduced number of stocks in the Portuguese stock market. This kind of analysis would allow us to examine whether the profitability of the strategy is confined to any particular subsample of stocks. This way, we would only be able to characterize the portfolios concerning the variables size or average beta.

In addition, we examined the returns of the momentum portfolio, also known as relative strength portfolio, in "event time" as Jegadeesh and Titman (1993). This analysis can provide some evidence about the profitability of momentum strategies over long horizons for the Portuguese stock market. In case we observe significant positive returns in the months beyond the holding period ($K=12$), that would suggest that the zero-cost portfolio systematically selects stocks that have higher than average unconditional returns and, in case we observe significant negative returns, that would indicate that price changes during the holding period are at least partially temporary. Therefore, we have calculated the average monthly and cumulative returns of the zero-cost portfolio in the 36 months after the portfolio formation date. We have also performed significance tests for the monthly average returns.

Essentially, the tests and analysis that we present in this section, will allow us to verify the existence of return continuation over 3 to 12 months and to provide some evidence about the most relevant potential sources of momentum profitability: the risk measured by the portfolio's betas and the average size of stocks.

3.3. Results

This section documents the average returns of the momentum portfolios, between January 1988 and April 2012, using data from the Portuguese Stock Market. In the following subsections we will comment the results obtained on relative strength portfolios (3.3.1.), on relative strength portfolios and market portfolios (3.3.2.), on betas and market capitalizations of relative strength portfolios (3.3.3.) and finally on the performance of relative strength portfolios in long horizons (3.3.4.).

3.3.1. Relative strength portfolios

Table 1 reports the average returns of the different buy and sell portfolios, as well as the zero-cost (winners minus losers' portfolios) for the 32 described strategies. The portfolios within Panel A are formed at the end of the performance ranking period, while the portfolios within Panel B are formed with one-month delay.

● **Table 1. Monthly Average Returns of Relative Strength Portfolios**

Ranking Period (J)	Portfolio	Panel A				Panel B			
		Holding Period (K)				Holding Period (K)			
		3	6	9	12	3	6	9	12
3	Loser	-0.83%	-0.88%	-0.89%	-0.75%	-1.07%	-1.01%	-0.90%	-0.74%
	Winner	0.73%	0.57%	0.39%	0.26%	0.78%	0.53%	0.36%	0.20%
	Winner-Loser	1.56%	1.45%	1.28%	1.01%	1.84%	1.54%	1.26%	0.94%
	(t-stat)	3.5272**	4.3236**	4.4450**	4.1147**	4.1277**	4.7249**	4.4002**	3.8624**
6	Loser	-1.21%	-1.12%	-0.96%	-0.87%	-1.21%	-1.07%	-0.94%	-0.82%
	Winner	0.52%	0.33%	0.20%	0.08%	0.60%	0.28%	0.14%	0.05%
	Winner-Loser	1.74%	1.45%	1.16%	0.95%	1.81%	1.35%	1.08%	0.87%
	(t-stat)	3.9276**	4.2062**	4.0134**	3.8142**	3.9977**	3.9891**	3.8366**	3.5043**
9	Loser	-0.99%	-0.94%	-0.85%	-0.77%	-1.02%	-0.93%	-0.84%	-0.73%
	Winner	0.48%	0.19%	0.01%	-0.09%	0.37%	0.08%	-0.06%	-0.14%
	Winner-Loser	1.46%	1.13%	0.86%	0.68%	1.40%	1.01%	0.78%	0.59%
	(t-stat)	3.2575**	3.3793**	3.0589**	2.7224**	3.2135**	3.0731**	2.7882**	2.3790*
12	Loser	-0.83%	-0.77%	-0.78%	-0.72%	-0.87%	-0.83%	-0.78%	-0.69%
	Winner	0.08%	-0.03%	-0.06%	-0.12%	-0.02%	-0.03%	-0.08%	-0.11%
	Winner-Loser	0.91%	0.74%	0.71%	0.60%	0.85%	0.79%	0.70%	0.58%
	(t-stat)	2.0650*	2.2550*	2.4938*	2.3993*	1.9932*	2.4348*	2.5142*	2.4004*
Average Monthly Returns of an Equally Weighted Market Portfolio		-0.096%	-0.079%	-0.0565%	-0.0299%	-0.0859%	-0.0705%	-0.0928%	-0.0277%

(*) Significant at the 5% significance level. (**) Significant at the 1% significance level. Sample period: January 1988 to April 2012.

The returns of all zero-cost portfolios are positive, i.e., past winners outperformed past losers. All excess returns of winners over losers are statistically significant at a 5 percent level, being the strategies with shorter ranking periods significant at 1 percent level of significance.

Regarding the possibility of momentum profits existence due to delayed reaction to new information, our results proved otherwise, since the average monthly returns in Panel B were higher than the average monthly returns in Panel A.

The most successful zero-cost strategy, which provided the highest returns among the other strategies, selects stocks based on their returns over the previous 3 months, skipping a month between the ranking period and the portfolio formation, and then holds the portfolio for 3 months (3-month/3-month strategy in Panel B). This zero-cost portfolio yields 1.84 percent per month (superior to the performance of the most successful zero-cost portfolio in Jegadeesh and Titman's (1993) sample). For the same ranking and holding period, the bottom decile (loser) portfolio in Panel A performed negative returns of -0.83 percent, 1.56 percent less than the top decile (winner) portfolio, which returns 0.73 percent.

In Panel A, the most profitable zero-cost portfolio is the 6-month/3-month strategy, with an average monthly return of 1.74 percent.

As in Rouwenhorst (1998) we verified that, independently of the interval used for ranking, the average monthly returns tend to fall for longer holding periods.

In the last line of Table 1, we report, as a reference, the average monthly return of an equally weighted market portfolio. We observe that the average monthly returns of the zero-cost portfolios, for each of the 32 strategies, are higher in every case than the average monthly returns of the market portfolio.

We can conclude, from the results of Table 1, that relative strength strategies are on average quite profitable, as in Jegadeesh and Titman (1993). For each of the ranking and holding periods, we can observe that past winners have outperformed past losers by about 1.1 percent per month. The monthly return ranges from 0.58 percent, in the 12-month/12-month Panel B strategy, to 1.84 percent, in the 3-month/3-month Panel B strategy.

3.3.2. *Relative strength portfolios and market portfolios*

In Table 2, we report the differences between the relative strength portfolios and the market equally weighted portfolio, for the different K holding periods. As mentioned previously, many of the studies on small capital markets divided the

stock data into quintiles instead of deciles. Therefore, we have decided to rank the data into five portfolios for all the holding periods, in order to verify whether the obtained results were significantly altered. Thus, we present the average monthly returns in accordance with the portfolio construction suggested by Soares and Serra (2005) for the Portuguese stock market and we have also compared them with the average returns of the market equally weighted portfolio.

● **Table 2. Average Monthly Returns of Relative Strength Portfolios and Market Portfolio**

Holding Period (K)	Portfolio	Deciles	Average return Quintiles
3	Winner	0.52%	0.51%
	Loser	-1.21%	-0.96%
	Winner – Loser	1.74%	1.47%
	Average Monthly Returns of an Equally Weighted Market Portfolio	-0.10%	-0.10%
	t-stat	4.5570	4.6341
6	Winner	0.33%	0.36%
	Loser	-1.12%	-0.89%
	Winner – Loser	1.45%	1.25%
	Average Monthly Returns of an Equally Weighted Market Portfolio	-0.08%	-0.08%
	t-stat	5.0487	5.2061
9	Winner	0.20%	0.24%
	Loser	-0.96%	-0.78%
	Winner – Loser	1.16%	1.02%
	Average Monthly Returns of an Equally Weighted Market Portfolio	-0.06%	-0.06%
	t-stat	4.8390	4.9607
12	Winner	0.08%	0.16%
	Loser	-0.87%	-0.64%
	Winner – Loser	0.95%	0.79%
	Average Monthly Returns of an Equally Weighted Market Portfolio	-0.03%	-0.03%
	t-stat	4.4334	4.2578

All the t-statistics are significant at the 1% significance level.

Although, for all the holding periods, the quintile zero-cost portfolios presented smaller average returns than the decile zero-cost portfolios, the main findings are the same and the difference between the monthly average returns is not significant.

Thus, we have continued to use the decile portfolios in the remainder of our study, continuing to follow the portfolio construction presented by Jegadeesh and Titman (1993).

The *t*-test performed to determine whether the zero-cost strategy had significant different average returns from those achieved by the market portfolio, allows us to conclude the existence of abnormal returns based on this trading strategy.

We can verify that, for the quintile strategies, the zero-cost portfolio has positive average returns, i.e., the six-month past winners outperformed the six-month past losers, for each of the *K* holding periods.

In conclusion, we can say that, for all the *K* holding periods, the winners minus losers portfolios significantly outperformed the equally weighted market portfolio. This market portfolio, for the different holding periods presented negative monthly average returns (although near zero), while the monthly average returns of the “buy past winners and sell past losers” strategies were positive.

3.3.3. Betas and Market Capitalizations of Relative Strength Portfolios

The rest of our study concentrates on portfolios formed on six-month ranked returns basis, formed at the end of the ranking period and held for six months (6-month/6-month strategy), following the main literature (e.g., Jegadeesh and Titman, 1993, 2001b; Rouwenhorst, 1998).

Next, we analyze the average returns and standard deviations of the ten relative strength portfolios (P1 to P10, being P1 the loser Portfolio and P10 the winner), connecting the obtained results with the two most common indicators of systematic risk: Betas and Market Capitalization.

● **Table 3. Betas and Market Capitalizations of Relative Strength Portfolios**

Portfolio	Average Return	Standard Deviation	Beta	Average Size
Loser	-1.12%	0.0425	1.0203	496.6
P2	-0.61%	0.0400	0.8162	2621.2
P3	-0.14%	0.0369	0.7747	2301.2
P4	-0.15%	0.0344	0.8039	2590.6
P5	-0.17%	0.0378	0.7897	2778.2
P6	0.13%	0.0327	0.8104	2933.8
P7	0.16%	0.0353	0.8176	3101.2
P8	0.18%	0.0331	0.8327	3405.5
P9	0.40%	0.0337	0.8861	3007.4
Winner	0.33%	0.0389	0.9409	2586.5
Winner - Loser	1.45%	0.2401	-0.0793	
<i>F</i> -test	4.4962			

Focusing on the average returns, we can verify that the lowest past returns portfolios (from Loser Portfolio to P5) continued to have the worst performances in the six subsequent months and the ninth decile portfolio (P9) had the higher average return.

Accordingly, the first column shows that higher past six-month returns is on average associated with stronger future six-month returns. Similarly to Rouwenhorst (1998) we have performed an *F*-test, that strongly rejected the equally hypothesis between the monthly average returns of the 10 relative strength portfolios.

Rouwenhorst (1998) has found a *U*-shaped standard deviation of decile portfolios. In our sample, the standard deviations were not perfectly *U*-shaped, although the winner and loser portfolios had higher standard deviations than the portfolios in the middle deciles.

Portfolios with higher standard deviations, *caeteris paribus*, are more likely to show more volatile performances (Rouwenhorst, 1998). The standard deviation of the excess return of winners over losers is about 2.4 percent per month.

In the third column, we report the average betas for the ten portfolios. Accordingly to the Jegadeesh and Titman's (1993) results, the extreme decile portfolios have higher betas than the average beta (for the full sample).

Since the beta of the losers' portfolio is higher than the winners' portfolio beta, the zero-cost portfolio has a negative beta not statistically different from zero, i.e. not significant. This leads us to conclude that the excess returns of winners over losers is unlikely to be explained by their covariance with the market, since, according to Rouwenhorst (1998), it would be necessary for the beta of the winners to exceed the beta of the losers by about two units, so that market risk could explain a continuation effect of 1 percent per month.

In the last column, we report the average market capitalizations of the decile portfolios. The findings are not surprising: as in Rouwenhorst (1998), the losers' portfolio presents the lowest average size and both (winners and losers) are, on average, smaller than the mean.

We did not examine the profitability of the 6-month/6-month relative strength strategies within size and beta subsamples, as in Jegadeesh and Titman (1993), due to the reduced number of stocks in the Portuguese stock market. As we have already mentioned, this kind of analysis would allow us to examine whether the profitability of the strategy is confined to any particular subsample stocks, since extant empirical evidence indicates that size and beta are related to expected returns.

In spite of this limitation, we can conclude that the deciles used in the winners-losers strategy are usually constituted by small-firms stocks. The results also suggest that the excess momentum returns cannot be explained by their portfolios' betas.

3.3.4. Performance of Relative Strength Portfolios in Long Horizons

As in all the other studies on this subject, we could not fail to analyze the performance of Relative Strength Portfolios in each of the 36 months following the portfolio formation date. This analysis can also provide additional insights about whether the profits are due to overreaction or to underreaction.

Table 4 reports the average monthly and the cumulative returns of the zero-cost portfolio over 36 months after the formation date.

● **Table 4. Average Returns of Relative Strength Portfolios in Long Horizons**

t	Monthly Return	Cumulative Return	t	Monthly Return	Cumulative Return	t	Monthly Return	Cumulative Return
1	1.29%	1.29%	13	0.07%	11.11%	25	-0.54%	11.34%
t-stat	2.1737		t-stat	0.1228		t-stat	-1.1174	
2	2.36%	3.64%	14	0.40%	11.51%	26	0.33%	11.66%
t-stat	3.6444***		t-stat	0.6732		t-stat	0.6841	
3	1.77%	5.42%	15	0.24%	11.74%	27	-0.06%	11.60%
t-stat	2.7567***		t-stat	0.4410		t-stat	-0.1331	
4	1.18%	6.59%	16	0.49%	12.24%	28	0.28%	11.88%
t-stat	1.8769**		t-stat	0.9076		t-stat	0.6526	
5	0.95%	7.54%	17	0.36%	12.60%	29	-0.42%	11.46%
t-stat	1.4764*		t-stat	0.7114		t-stat	-0.8558	
6	0.73%	8.28%	18	-0.21%	12.39%	30	0.47%	11.93%
t-stat	1.2197		t-stat	-0.3693		t-stat	0.9962	
7	0.42%	8.70%	19	-0.39%	12.01%	31	-0.78%	11.15%
t-stat	0.7161		t-stat	-0.6969		t-stat	-1.3304*	
8	0.94%	9.64%	20	-0.17%	11.84%	32	0.45%	11.60%
t-stat	1.4964		t-stat	-0.2665		t-stat	0.7456	
9	0.36%	10.00%	21	-0.21%	11.63%	33	-0.35%	11.25%
t-stat	0.6442		t-stat	-0.3591		t-stat	-0.5553	
10	0.46%	10.46%	22	-0.13%	11.49%	34	0.07%	11.33%
t-stat	0.8438		t-stat	-0.2329		t-stat	0.1176	
11	0.21%	10.68%	23	0.00%	11.49%	35	0.48%	11.81%
t-stat	0.3782		t-stat	-0.0030		t-stat	0.8325	
12	0.37%	11.04%	24	0.38%	11.88%	36	-0.08%	11.73%
t-stat	0.6574		t-stat	0.7820		t-stat	-0.1451	

(*) Significant at the 10% significance level. (**) Significant at the 5% significance level. (***) Significant at the 1% significance level.

The average monthly returns in the first year are positive, but the results are significant solely in the first four months after the portfolio formation date. The average monthly returns are both positive and negative during the second and the third year, which does not happen in the first year.

The cumulative returns reach a maximum of 12.6 percent at the end of 17 months. However, we verified that, in the following months, this cumulative return does not reverse, standing approximately in 11 percent, which is a small decrease in relation to the maximum cumulative return reached.

Figure 1. Evolution of the monthly and cumulative average returns in long horizons

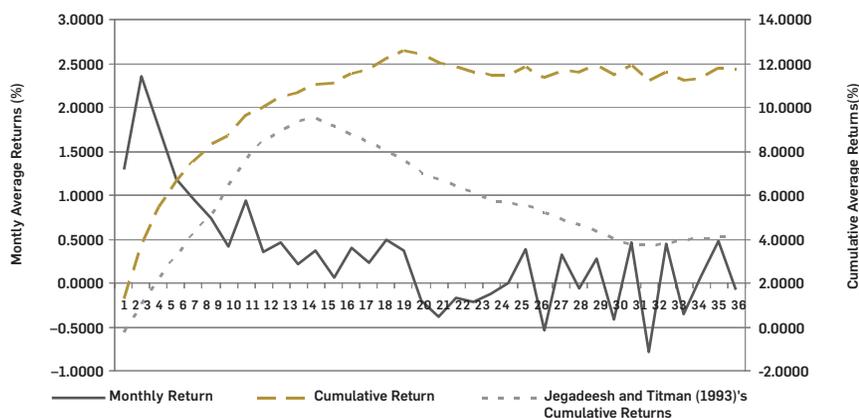


Figure 1 presents the monthly and cumulative average returns of the zero-cost portfolio reported in Table 4. In the monthly returns we can observe significant positive returns and the graph shows perfectly the mixture of positive and negative returns verified specially in the third year. The line for the cumulative returns shows the inexistence of momentum return reversals over the 36 months period, especially when compared with the Jegadeesh and Titman (1993)'s cumulative returns.

In their sample, Jegadeesh and Titman (1993) observed negative returns beyond the 12th month, suggesting that the positive returns over the first 12 months may not be permanent. Contrarily to their findings, we did not observe consistently negative average monthly returns in the months beyond the holding period, but a mixture of, non-significant, positive and negative returns.

Based on the results obtained, we are led to conclude that momentum strategies for the Portuguese stock market do not show any return reversal over long horizons.

However, we cannot rule out that the positive returns in the first 12 months are due to overreaction or underreaction, since our results are a mixture of positive and

negative returns and, moreover, we did not find significantly different from zero monthly returns, at a 5 percent level, beyond the fourth month.

Nevertheless, our results seem to draw some clues indicating underreaction as the main cause of the momentum profitability in this market, in line with the non-reversal returns in the long-term.

■ 4. Conclusions

By challenging the notions of Efficient Market Hypothesis, momentum strategies have attracted financial researchers to, not only, study the momentum profitability in different stock markets, but also to study different causes and explanations for these profits.

Although several studies found evidence of momentum profitability, specifically for the Portuguese stock market, the studies done so far didn't found statistically significant results that prove or disprove the existence of return predictability based on past returns. Therefore, our purpose was to explore, with an extended sample period, the existence of return continuation, as well as investigate the Portuguese stock market efficiency at the weak form level (Fama, 1970).

As we have reported in the last section, the main findings of our study indicate the existence of momentum profitability in the short-run, confirming, thus, most of the results found in the main international literature, for large and liquid markets.

Following Jegadeesh and Titman (1993) methodology, we analyzed 32 different momentum strategies. For all of them, past winners significantly outperform the past losers portfolio in about 1.1 percent per month, for each ranking and performance periods. For instance, a strategy that selects stocks based on their past 6-month returns and holds them for 6 months presents a 1.45 percent monthly return.

Therefore, we were led to conclude that it is possible to predict future returns based on past performance, at least in the short run. Our findings seriously call into question the EMH in the Portuguese stock market, since, according to this assumption, there is no possibility to conceive profitable strategies based on past returns' observations.

Although the main findings of our study point to the existence of momentum profits in the Portuguese stock market, the causes of momentum are not, yet, fully ascertained. Due to the reduced number of stocks, we were not able to study size and beta subsamples, as in the Jegadeesh and Titman (1993). Nevertheless, following the

Rouwenhorst (1998) example, we have characterized all the deciles' portfolios regarding to their volatility, their beta and firms size.

Through this characterization, we could verify that winner's and loser's portfolios presented higher volatility than the portfolios in the middle deciles, and both winner's and loser's portfolios were constituted by small stocks on average, being the losers smaller than the winners. Concerning to the most common risk factor, our portfolios' betas seem to suggest that momentum profits are unlikely to be explained by risk, since the winners' beta are even lower than the losers'.

Lastly, concerning to the performance of momentum profits over long horizons, we found that there is no significant return reversal over long horizons, contrarily to Jegadeesh and Titman's (1993) findings. After reaching maximum cumulative return, at the 17th month, the return reversals are very low (about 1 percent).

However, we cannot rule out that the positive returns in the first 12 months are due to overreaction or underreaction, since our long term results were not conclusive. Moreover, we did not find monthly returns significantly different from zero, at a 5 percent level, beyond the fourth month.

Nevertheless, our findings seem to draw some clues indicating underreaction as the main cause of the momentum profitability in this market, in line with the non-reversal returns in the long-term.

However, we should always present these results with some caution, because there may be limitations derived from the methodological choices that we have made. For instance, in our sample we only take into account stocks that belong to PSI Geral, i.e. we only consider stocks that remain "alive", which can induct a "survivorship bias" to our results. Concerning to this option, our choice can be justified by our objective to obtain the largest sample period possible compared to the available data. Although we did not know the impact due to "survivorship bias" in the results, we cannot rule out the hypothesis that our results may have been influenced by this bias.

References

- Barberis, N., Shleifer, A. and Vishny, R. (1998). A Model of Investor Sentiment, *Journal of Financial Economics*, **49**(3), pp. 307-343.
- Chan, K. (1988). On the Contrarian Investment Strategy, *Journal of Business*, **61**(2), pp. 147-164.

- Chan, K., Jegadeesh, N. and Lakonishok, J. (1996). Momentum Strategies, *Journal of Finance*, **51**(6), pp. 1681-1713.
- Chui A., Wei, K. and Titman, S. (2000). Momentum, Legal Systems and Ownership Structure: An Analysis of Asian Stock Markets, Working Paper, University of Texas.
- Chui, A., Titman, S. and Wei, K.C.J. (2010). Individualism and Momentum around the World, *Journal of Finance*, **65**(1), pp. 361-392.
- Daniel, K., Hirshleifer, D. and Subrahmanyam, A. (1998). Investor Psychology and Security Market Under and Overreactions, *Journal of Finance*, **53**(6), pp. 1839-1885.
- De Bondt, W. and Thaler, R. (1985). Does the Stock Market Overreact?, *Journal of Finance*, **40**(3), pp. 793-805.
- De Bondt, W. and Thaler, R. (1987). Further Evidence on Investor Overreaction and Stock Market Seasonality, *Journal of Finance*, **42**(3), pp. 557-581.
- Fama, E. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work, *Journal of Finance*, **25**(2), pp. 383-417.
- Fama, E. and French, K. (1996). Multifactor Explanations of Asset Pricing Anomalies, *Journal of Finance*, **51**(1), pp. 55-84.
- Fama, E. and French, K. (2012). Size, Value, and Momentum in International Stock Returns, *Journal of Finance*, **105**(3), pp. 457-472.
- Foerster, S., Prihar, A. and Schmitz, J. (1995). Back to the Future: Price Momentum Models and How they Beat the Canadian Equity Markets, *Canadian Investment Review*, **7**(4), pp. 9-13.
- George, T. and Hwang, C. (2004). The 52-week High and Momentum Investing, *Journal of Finance*, **59**(5), pp. 2145-2176.
- Griffin J., Ji, X. and Martin, J. (2003). Momentum Investing and Business Cycle Risk: Evidence from Pole to Pole, *Journal of Finance*, **58**(6), pp. 2515-2547.
- Grinblatt, M. and Han, B. (2005). Prospect Theory, Mental Accounting and Momentum, *Journal of Financial Economics*, **78**(2), pp. 311-339.
- Hart J., Slagter, E. and Dijk, D. (2003). Stock Selection Strategies in Emerging Markets, *Journal of Empirical Finance*, **10**(1-2), pp. 105-132.
- Hong, H. and Stein, J. (1999). A Unified Theory of Underreaction, Momentum Trading and Overreaction in Asset Markets, *Journal of Finance*, **54**(6), pp. 2143-2184.
- Hong, H., Lim, T. and Stein, J. (2000). Bad News Travels Slowly: Size, Annalistic Coverage and the Profitability of Momentum Strategies, *Journal of Finance*, **55**(1), pp. 265-295.
- Israel, R. and Moskowitz, T. (2012). The Role of Shorting, Firm Size and Time on Market Anomalies, Chicago Booth Research Paper, **78**, pp. 12-22.
- Jegadeesh, N. and Titman, S. (1993). Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency, *Journal of Finance*, **25**(1), pp. 65-91.

- Jegadeesh, N. and Titman, S. (1999). Profitability of Momentum Strategies: An Evaluation of Alternative Explanations, NBER Working Paper Series 7159.
- Jegadeesh, N. and Titman, S. (2001a.). Momentum, University of Illinois Working Paper.
- Jegadeesh, N. and Titman, S. (2001b). Profitability of Momentum Strategies: An Evaluation of Alternative Explanations, *Journal of Finance*, **56**(2), pp. 699-720.
- Lee, C. and Swaminathan, B. (2000). Price Momentum and Trading Volume, *Journal of Finance*, **55**(5), pp. 2017-2069.
- Lehmann, B. (1990). Fads, Martingales and Market Efficiency, *Quarterly Journal of Economics*, **105**(1), pp. 1-28.
- Levy, R. (1967). Relative Strength as a Criterion for Investment Selection, *Journal of Finance*, **22**(4), pp. 595-610.
- Lo, A. and MacKinlay, A. (1990). When are Contrarian Profits Due to Stock Market Overreaction? *Review of Financial Studies*, **3**(2), pp. 175-205.
- Pereira, P. (2009). Momentum and Contrarian Strategies in the Portuguese Stock Market, ISCTE Business School - Master in Finance Dissertation.
- Rouwenhorst, K. (1998). International Momentum Strategies, *Journal of Finance*, **53**(1), pp. 267-284.
- Soares, J. and Serra, A. (2005). "Overreaction" and "Underreaction": Evidence for the Portuguese Stock Market, *Caderno de Valores Mobiliários*, **22**, pp. 55-84.
- Tversky, A. and Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases, *Science*, **185**, pp. 1124-1131.

