A multidimensional-risk explanation of the momentum effect in the Tunisian stock market through the five-factor model of Fama and French (2015)

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Abstract: Using the recent five-factor-model of Fama and French (2015), this paper examines whether the profitability of momentum strategies in the Tunisian stock market can be explained by the risk. We found that the momentum profits adjusted for the market, size, book to market, operating profitability and investment risks are statistically and economically significant. A momentum strategy could yield, on average, a risk adjusted profit more than 4%. The momentum effect seems to be a robust anomaly in the Tunisian market rejecting the weak form of the efficient market hypothesis.

Key words: Momentum, momentum strategies, efficient market hypothesis, risk, five-factor model, Tunis Stock Exchange.

JEL classification: G12

1. Introduction

Financial theory was built around the efficient-market hypothesis (EMH) whose weak form assumes that stock returns should not be predictable based on past returns. However, since the 1980s several theoretical and empirical studies have shown that financial markets are not as efficient as we thought. These studies documented several anomalies that seriously challenged the efficient-market hypothesis. One of these anomalies is the momentum effect documented by Jegadeesh and Titman (1993). These authors showed that stocks having the best performance in terms of returns (winning stocks) over a short period in the past continue to generate a good performance in the subsequent short period; however stocks having the worst performance (losing stocks) continue to suffer a bad performance. A "momentum strategy" which sells losing stocks, buys winning ones and holds these positions for a period of 3-12 months generates positive abnormal returns. Nowadays, the Momentum profitability is well documented in the vast majority of developed and emerging markets around the world.

In developed markets, evidence of momentum profitability was found, among others, by Fama and French (1996), Moskowitz and Grinblatt (1999), Rachev et al. (2007), Bulkley and Nawosah (2008), and Min and Kim (2016) in the US market; Glaser and Weber (2001) in Germany; Hou and Mcknight (2004) in Canada; Galariotis, Holmes and Ma (2007) in the London stock market, and Demir et al. (2004) in the Japanese market. International evidence was provided by Rouwenhorst (1998) in 12 European countries over the period 1978–1995; and Fama and French (2012) in 22 out of 23 countries of North America, Europe and Asia Pacific for the period 1989–2011

In emerging markets, momentum was documented by Cakici et al. (2013) in Asia and Latin America; Ejaz and Polak (2015) in six countries of the Middle East; Polak and Ejaz (2012) in India; Alphonse and Nguyen (2013) in Vietnam; Shumway and Wu (2006) in China, and Boussaidi and Hmida (2017) in Tunisia. Evidence of trading volume-based-momentum profitability was, also, reported by Bornholt et al. (2015) in 34 out of 37 developed and emerging countries for the period 1995–2009.

To contribute to the emerging markets literature, we consider the Tunisian stock market. In a recent paper, Boussaidi and Hmida (2017) used the cumulative abnormal returns as in De Bondt and Thaler (1985) and the stock returns as in Jegadeesh and Titman (1993) to measure the performance of the loser and the winner portfolios for formation and holding periods ranging from 3 to 12 months. They found evidence of momentum

profitability especially for the sub-period 2003–2015. However, the authors did not address the risk issue. In fact, although the momentum effect is now a well-established stock market anomaly, it is subject to strong conflicting explanations. One of these explanations attributes this anomaly to the risk. The most widely used risk model is the Capital Asset Pricing Model (CAPM) of Sharpe (1964), Mossin (1966) and Lintner (1965). To remedy for the CAPM inability to explain some anomalies, Fama and French (1996) developed a three-factor model as an extension of the CAPM, including a risk related to the firm size and a risk related to the Book to Market ratio. This model showed a good performance in explaining many anomalies except the momentum effect, which remains the most robust anomaly challenging the efficient-market hypothesis. Recently, Fama and French (2015) have augmented their three-factor model by two factors: operating profitability and investment. They showed that this model have a good performance in explaining portfolio returns. The purpose of this paper is to test whether this risk model explains the momentum effect in the Tunisian stock market.

The remainder of the paper is organized as follows. Section 2 presents the model and details the construction methodology of the portfolios used to compute the model variables. Section 3 describes the data and presents the descriptive statistics. Section 4 analyses our empirical results. Section 5 concludes the paper.

2. Research design

To test whether the risk explains the momentum profitability, we use the recent five-factor model of Fama and French (2015). This model offers a multidimensional explanation since the risk does not only take the form of market risk. Instead, the model exposes stocks to risks related to firm size, book-to-market, operating profitability and investment.

2.1 The model

Returns on the loser, winner, and winner minus loser are regressed on the five risk factors as follows:

$$R_{it} - R_{ft} = a_i + \beta_i \left(R_{mt} - R_{ft}\right) + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + \varepsilon_{it} \quad (1)$$

This model implies that the excess return of a portfolio *i* (R_i-R_f) is explained by five risk premiums: (i) (*Rm-Rf*) is the market portfolio return in excess of the risk-free rate; *(ii)* SMB (*Small Minus Big*) is the return on a diversified portfolio of small stocks minus the return on a diversified portfolio of big stocks; (*iii*) HML *(High Minus Low)* is the difference between the returns on a diversified portfolio of stocks having high Book to Market and the returns on portfolio of stocks having low Book to Market; *(iv)* RMW (*Robust Minus Weak*) is the difference between the returns on a diversified portfolio of stocks with high operating profitability and the returns on a portfolio of stocks having low profitability; *(v)* CMA (*Conservative Minus Aggressive*) is the difference between the returns on a diversified portfolio of low investment firms and the returns on a diversified portfolio of high investment firms.

The endogenous variable R_i, is the return on the winner portfolio, R_W, the return on the losing portfolio R_L, or the return on the arbitrage portfolio (winner minus loser) $R_{W\text{-}L}$. The arbitrage portfolio consists of a long position on the winner and a short position on the loser (winner minus loser). *Rm* is the monthly market portfolio return; R_f is the monthly risk-free rate. Given that the momentum strategy is a zero-investment strategy, we exclude the risk-free rate from the left side of the regression corresponding to the arbitrage portfolio.

α , β, *s*, *h*, *r* and *c* are parameters to estimate. β, *s*, *h*, *r* and *c* denote the sensitivity of each of the three portfolios (Winner, Loser and Winner-Loser) to the five-risk factors. They reflect the portfolio exposures to these factors. The constant α measures the excess return adjusted for the five risk factors. If the exposures to the five risk factors, β, *s*, *h*, *r* and *c*, are able to capture all the variation in the expected returns, the constant α should not significantly be different from zero for the three portfolios.

2.2. Construction of the portfolios

To better isolate the premiums in average returns related to size, Book to Market, operating profitability and investment, we construct, as in Fama and French (2015),

2x2x2x2 portfolios based on these four criteria. The construction methodology of these 16 portfolios is detailed as follows:

First, at the end of June of each year of the period July 2003 to December 2015, all firms listed on the Tunisian Stock market are ranked based on market capitalization (end of June stock price times shares outstanding), and assigned to two groups: 50% of the firms having the smallest capitalization (denoted S) and 50% having the biggest capitalization (denoted B). Both groups are composed of an equal number of firms.

Second, we use the Book to Market ratio as a ranking criterion. In June of year N, stocks are ranked based on their B/M of the previous year (N-1). We also form two groups: 50% of firms with the lowest B/M (denoted L) and 50% of firms having the highest B/M (denoted H). This ratio is the book value of equity of the year N-1 divided by the market value of equity at the end of December of year N-1. Similarly to Fama and French (1996, 2015) we use the end of year N-1 market value to get a book value in the numerator aligned with the market value in the denominator.

This time, we rank firms in June of year N based on their profitability in year N-1. Profitability is measured using accounting data for the fiscal year ending in N-1 as operating profitability at the end of fiscal year N-1 divided by book equity at the end of fiscal year N-1. This variable will be called operating profitability, OP. The portfolio of the 50% of firms having the lowest OP is labeled W (Weak OP). However, the portfolio of the 50% of firms having the highest OP is labeled R (Robust OP).

Finally, we classify firms in the same month based on the investment criterion measured by the growth of total assets at the end of the fiscal year N-1 divided by total assets at the end of N-2. The portfolio of the 50% of firms having the lowest investment is labeled conservative investment (denoted C) whereas the portfolio of the 50% of firms having the highest investment is labeled aggressive investment (denoted A).

Consequently, we obtain 8 groups of stocks: S, B, L, H, W, R, C and A summarized in table 1. The final step is to form 2x2x2x2 portfolios (i.e. 16 portfolios) from the intersection of these 8 groups as follows: SHRC, SHRA, SHWC, SHWA, SLRC, SLRA, SLWC, SLWA, BHRC, BHRA, BHWC, BHWA, BLRC, BLRA, BLWC, BLWA. For example, SHRC is the portfolio of firms having simultaneously Small Cap, High Book to Market, Robust Profitability and Conservative Investment.

Table 1. The 8 groups of stocks formed based on the 4 criteria of Fama and French (2015)

Market Capitalisation	Small Cap.	S
	Big Cap.	B
Book to Market, B/M	High B/M	H
	Low B/M	L
Operating profitability, OP	Robust OP	R
	Weak OP	W
Investment, Inv	Conservative Inv.	C
	Aggressive Inv.	A

After defining and constructing the 16 portfolios, we compute their monthly value-weighted returns from July of year N to June of year N+1. The portfolios are, thus, reconstructed in June of each year. Returns are calculated from July N to ensure that accounting data for fiscal year N-1 such as book value of equity, operating profitability and total assets used to compute the B/M, the OP and the Investment variables, respectively, are known at that time. In fact, the six-month gap between the end of fiscal year N-1 and the releasing time of the annual reports is necessary to make these reports publically available.

2.3. The risk premiums

Once the returns of the 16 portfolios are computed, we then calculate the risk premiums corresponding to the four factors (SMB, HML, RMW and CMA) as follows:

SMB is the average of the eight small stock portfolio returns minus the average of the eight big stock portfolio returns.

HML is the difference between the average of the eight High B/M stock portfolio returns and the average of the eight Low B/M stock portfolio returns.

RMW is the average of the eight robust profitability stock portfolio returns minus the average of the eight weak profitability stock portfolio returns.

CMA is the average of the eight conservative investment stock portfolio returns minus the average of the eight aggressive investment stock portfolio returns.

These variables are computed as follows:

$$SMB = \frac{(SHRC + SHRA + SHWC + SHWA + SLRC + SLRA + SLWC + SLWA)}{8} - \frac{(BHRC + BHRA + BHWC + BHWA + BLRC + BLRA + BLWC + BLWA)}{8} \quad (2)$$

$$HML = \frac{(SHRC + SHRA + SHWC + SHWA + BHRC + BHRA + BHWC + BHWA)}{8} - \frac{(SLRC + SLRA + SLWC + SLWA + BLRC + BLRA + BLWC + BLWA)}{8} \quad (3)$$

$$RMW = \frac{(SHRC + SHRA + SLRC + SLRA + BHRC + BHRA + BLRC + BLRA)}{8} - \frac{(SHWC + SHWA + SLWC + SLWA + BHWC + BHWA + BLWC + BLWA)}{8} \quad (4)$$

$$CMA = \frac{(SHRC + SHWC + SLRC + SLWC + BHRC + BHWC + BLRC + BLWC)}{8} - \frac{(SHRA + SHWA + SLRA + SLWA + BHRA + BHWA + BLRA + BLWA)}{8} \quad (5)$$

The market risk factor (R_m - R_f) is the market return in excess of the risk-free interest rate where R_m is the equal-weighted returns, each month, of the stocks composing the 2x2x2x2 portfolios. R_f is proxied, as in Gunaratne and Yonesawa (1997), by the Money Market Rate.

2.4. The momentum profits

At the end of each month *t* from July 2004 to December 2015, stocks are ranked based on their continuously-compounded returns for the past 3, 6, 9 and 12 months (formation period, *J*). The continuously-compounded monthly return of each stock is the natural logarithm of the end of month *t* stock price adjusted for dividends to the end of month *t-1* stock price. To be selected in each formation period, a stock must have sufficient return observations. The stocks are, then, assigned to three groups (terciles) or to five groups (quintiles). The tercile (or quintile) of stocks having the highest returns is called winner portfolio (*W*) whereas the tercile (or quintile) of stocks having the lowest returns is called loser portfolio (*L*). If the number of stocks is not perfectly divisible by 3 or 5, it will be rounded to the nearest integer to ensure the extreme portfolios have the same number of stocks. The two portfolios are reconstructed each month and the return on each one of them is the equal-weighted returns of the *n* stocks composing it. The performance of the extreme portfolios is tracked during the next K months where K= 3, 6, 9 and 12 (the holding period). However, if the stock's return is missing during the holding period because the firm was delisted during that period, the stock will be dropped from the portfolio and the average return is calculated based on the available returns. The momentum strategy sells the loser portfolio, buys the winner one and holds these positions for the holding period. We refer to such strategy as a (J/K) strategy. The return generated by this strategy is the return on the winner portfolio minus the return on the loser one. We revise, as in Jegadeesh and Titman (1993), the weights on 1/K of the stocks in the entire portfolio in each month and carry over the rest from the previous month.

3. Data and descriptive statistics

We collect stock market and accounting data for all the firms listed in the Tunis Stock exchange from July 2003 to December 2015. Stock market data include end-of-month closing prices and number of shares outstanding. These data will be used to compute stock returns and market capitalization. The accounting data include book equity, total assets and operating income. These data will be used to construct the factors of Fama and French (2015). Book equity and total assets are collected from the firms' balance sheet; however Operating Income is collected from the income statement. These financial statements are downloaded from the website of the Tunis Stock Exchange (www.bvmt.com.tn) and the Financial Market Council (www.cmf.org.tn). We also collect the Market money rate from the Tunisian central bank web site (www.bct.gov.tn). Table 2 shows that, during the 13 years of our sample period, the number of firms listed in the Tunis stock exchange has increased from 47 at the year-end 2003 to 80 at the year-end 2015. In spite of the unfavorable economic conditions after the 2011 Tunisian revolution, the stock market has known an increase in the number of Initial Public Offerings compared to the pre-revolution period.

Table 2. Evolution of the number of listed firms on the Tunis Stock Exchange

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
n	47	47	47	50	52	51	53	57	59	60	68	76	80

Note: The table displays the year-end number of companies listed.

Table 3 displays the descriptive statistics of the returns on the extreme tercile portfolios and the risk premiums for some formation and holding periods (Similar results were found with quintiles portfolios). For all the combinations of the formation and holding periods, the winner portfolio returns are, on average, positive; while loser portfolio returns are negative. This indicates that the winner portfolio outperforms, on average, the loser portfolio. A preliminary diagnostic based on the standard deviation indicates that the winner returns are slightly more volatile than the loser returns. Furthermore, the probability corresponding to Jarque-Béra statistic is generally superior to 5% indicating that the null hypothesis of normality cannot be rejected. This means that the portfolios' returns are normally distributed.

Table 3. Descriptive statistics

	$R_{L,3/3}$	$R_{W,3/3}$	$R_{L,3/6}$	$R_{W,3/6}$	$R_{L,6/9}$	$R_{W,6/9}$	$R_{L,9/6}$	$R_{W,9/6}$	$R_{L,12/9}$	$R_{W,12/9}$	SMB	HML	RMW	CMA
Mean	-0,006	0,001	-0,009	0,015	-0,015	0,035	-0,014	0,024	-0,006	0,020	0,005	0,005	-0,003	-0,001
Median	0,002	0,002	-0,012	0,024	-0,017	0,069	-0,020	0,044	-0,016	0,054	0,005	0,008	0,003	-0,002
Max	0,145	0,198	0,199	0,259	0,264	0,306	0,195	0,273	0,235	0,371	0,176	0,273	0,199	0,205
Min	-0,198	-0,274	-0,177	-0,226	-0,267	-0,217	-0,174	-0,287	-0,265	-0,304	-0,228	-0,185	-0,189	-0,204
Std. Dev.	0,064	0,083	0,083	0,113	0,120	0,127	0,089	0,123	0,115	0,148	0,053	0,046	0,047	0,043
Skewness	-0,182	-0,429	0,197	0,117	0,147	-0,185	0,200	-0,175	0,142	-0,216	-0,363	0,844	-0,074	-0,211
Kurtosis	2,744	3,762	2,336	2,633	2,581	2,453	2,200	2,786	2,228	2,852	6,513	13,24	7,924	12,229
Prob. (J-B)	0,565	0,023	0,180	0,580	0,471	0,286	0,100	0,617	0,143	0,548	0,000	0,000	0,000	0,000

Notes: L is the loser tercile portfolio; W is the winner tercile portfolio; J/K denotes formation/ holding periods. Prob. (J-B) is the probability of the Jarque and Béra (1984) statistic to test for the null of normality. The number of monthly observations is 138. The sample period is July 2003 to December 2015.

To check the relevance of the construction methodology of the risk premiums, we examine the correlation between them. Table 4 displays the correlation coefficients between the four factors of Fama and French (2015). These coefficients vary between -0.3842 and 0.0023, thus indicating low correlation between the four premiums. These correlations suggest that the methodology of the construction of the 2x2x2x2 portfolios offers a reliable independence in risk premiums. In sum, there is no problem of multicollinearity between the five risk premiums.

Table 4. Correlation between the risk factors

	R_m-R_f	SMB	HML	RMW	CMA
R_m-R_f	1	0,0430	0,0043	0,2925	0,0044
SMB		1	-0,3842	0,0023	-0,0913
HML			1	-0,1565	0,1250
RMW				1	-0,2967
CMA					1

Notes: SMB: Small minus Big Capitalization, HML: High minus Low Book to Market, RMW: Robust minus Weak Operating profitability, CMA: Conservative minus Aggressive investment.

4. Empirical results

Table 5 displays the constant resulting from the regression of the winner minus loser return on the five factors of Fama and French (2015) as in equation 1 for different formation (J) and holding (K) periods. The constant is the abnormal return generated by the momentum strategy or the risk adjusted momentum profit. Panel A is when the winner and loser portfolios are the extreme terciles; Panel A is when they are quintiles.

Panel A shows that the excess returns are significantly positive except for the strategy (12/12) when the extreme portfolios are formed in terciles and the strategies (12/9) and (12/12) when they are formed in quintiles. This implies that the winner portfolio always outperforms the loser portfolio. This performance is not sensitive to the methodology of the construction of the extreme portfolios (terciles or quintiles). Furthermore, the momentum profits generally seem to increase monotonically with the investment horizon especially for a 3-month formation period. In fact, the momentum strategy generates 1.08%; 2.28%; 3.32% and 4.52% per month for investment horizon of 3, 6, 9 and 12 months, respectively. The momentum profits are also economically significant. The most profitable strategy is the one that selects the quintile portfolios of stocks based on their performance during the 3 past months and holding them for the subsequent 12 months (the 3/12 strategy). Such a strategy generates a risk adjusted profit of 4.71% per month (t-stat=5.591).

We focus next on the contribution of the five factors to the explanation of momentum profits. Specifically, we check whether the winner portfolio generates a superior return because it is exposed to more risk than the loser.

Table 6 displays the OLS estimation results of the regression of returns on the extreme portfolios and the momentum portfolio on the five factors of Fama and French (2015) for six strategies: (3/12), (6/9), (6/12), (9/9), (9/12) and (12/12).

A statistical diagnostic of the model shows that the risk premiums $(R_m - R_f)$, SMB, HMB, RMW and CMA explain a small proportion of the variation in returns of the extreme portfolios (winner and loser). This proportion varies from 3.72% to 6.28%. In the regression of the winner minus loser returns, the R^2 slightly improved, indicating that the 5 factors of Fama and French (2015) explain between 6.45% and 8.17% of the variation in returns.

The second column of the table indicates that the market risk, given by β, does not generally seem to explain the outperformance of the winner portfolio relative to the loser. In fact, although the beta of the winner is superior to the beta of the loser for the vast majority of strategies, it is not significantly different from zero. The exceptions are (6/12),

(9/12) and (12/12) strategies where the arbitrage portfolio exhibits a sensitivity to market risk indicating that the winner is significantly riskier than the loser in terms of market risk.

In terms of the size related risk, to say that this risk explains the outperformance of the winner portfolio relative to the loser, we should find that s_w is significantly greater than s_L. This means that the winner portfolio outperforms the loser because it includes small cap firms. Again, the winner portfolio is exposed to more risk than the loser portfolio; but in no way, this risk is significantly different from zero.

Column 4 of the table shows that the winner portfolio has an insignificant positive sensitivity to the B/M premium, whereas the losing portfolio has an insignificant negative sensitivity. The difference between the sensitivity of the winner and the sensitivity of the loser is only significantly positive in the case of (6/9) and (9/9) strategies. Except these two strategies, the B/M related risk does not seem to explain the momentum effect.

RMW associated-coefficient is significantly negative for the extreme portfolios and the winner-loser portfolio. This indicates that these portfolios show a negative sensitivity to this factor, which indicates that they generally behave like low profitability firms.

The sensitivity of the winner and the loser portfolios' returns to CMA is positive, indicating that these portfolios returns tend to behave like those of firms having low investment. This sensitivity is relatively higher for the Loser than the Winner ($c_L > c_W$) which causes a negative sensitivity of the arbitrage portfolio to this risk factor only in the case of the strategy (3/12). This indicates that the outperformance of the winner relative to the loser cannot generally be explained by the investment related risk.

The momentum return of the most profitable strategy (3/12) shows a negative sensitivity to RMW and CMA: r_{W-L} = -0.4050 (t = -2.446) and c_{W-L}= -0.3318 (t = -1.933). This means that the returns of this strategy tend to behave like those of firms that invest a lot despite low profitability. In other words, this strategy tends to select firms that adopt an aggressive investment strategy despite their low operating profitability.

If the extreme portfolios are formed by quintiles (table 7), the most robust sensitivity of the momentum portfolio is the sensitivity to *RWM* factor.

Table 5. Momentum profits adjusted for multidimensional risk

Panel A. Terciles				
	J = 3	J = 6	J = 9	J = 12
K = 3	0.0108*	0.0172***	0.0197***	0.0191***
	(1.841)	(3.174)	(3.129)	(2.712)
K = 6	0.0228***	0.0311***	0.0357***	0.0233***
	(4.069)	(5.111)	(4.260)	(2.684)
K = 9	0.0332***	0.0461***	0.0405***	0.0227**
	(5.560)	(5.958)	(4.146)	(2.390)
K = 12	0.0452***	0.0451***	0.0365***	0.0156
	(6.359)	(4.982)	(3.526)	(1.510)
Panel B. Quintiles				
	J = 3	J = 6	J = 9	J = 12
K = 3	0.0119*	0.0144**	0.0179**	0.0180**
	(1.767)	(2.000)	(2.300)	(2.177)
K = 6	0.0286***	0.0210**	0.0290***	0.0251**
	(4.486)	(2.496)	(3.072)	(2.408)
K = 9	0.0373***	0.0329***	0.0316***	0.0140
	(5.330)	(3.147)	(2.523)	(1.212)
K = 12	0.0471***	0.0279**	0.0276*	-0.0055
	(5.591)	(2.360)	(1.944)	(-0.443)

Notes: This table presents the risk adjusted abnormal returns of the momentum strategies over the period July

2003–December 2015. These returns are given by the constant in model 1. J and K denote the formation and the holding periods, respectively. Numbers in parentheses are *t statistics*. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

Table 6. Regression of the returns of loser tercile, winner tercile and arbitrage portfolios on the five factors of Fama and French (2015)

	α	R_m-R_f	*SMB*	*HML*	*RMW*	*CMA*	R^2
Loser [3/12]	-0.0134	-0.1176	0.0870	-0.2389	-0.0552	0.5580*	4.05%
	(-1.132)	(-0.341)	(0.319)	(-0.760)	(-0.200)	(1.954)	
Winner [3/12]	0.0318***	0.0679	0.0839	-0.0005	-0.4602*	0.2262	3.72%
	(2.701)	(0.198)	(0.309)	(-0.002)	(-1.678)	(0.796)	
W-L [3/12]	0.0452***	0.1855	-0.0031	0.2383	-0.4050**	-0.3318*	7.62%
	(6.359)	(0.896)	(-0.019)	(1.262)	(-2.446)	(-1.933)	
Loser [6/9]	-0.0178*	0.2014	0.2965	-0.2493	-0.0584	0.5616**	7.67%
	(-1.727)	(0.669)	(1.243)	(-0.909)	(-0.243)	(2.252)	
Winner [6/9]	0.0282***	0.1984	0.3497	0.1546	-0.4177	0.3170	5.91%
	(2.551)	(0.615)	(1.368)	(0.526)	(-1.620)	(1.186)	
W-L [6/9]	0.0461***	-0.0029	0.0532	0.4039*	-0.3593**	-0.2446	7.89%
	(5.958)	(-0.013)	(0.298)	(1.967)	(-1.995)	(-1.310)	
Loser [6/12]	-0.0139	-0.2974	0.0895	-0.1441	-0.0554	0.5865**	4.39%
	(-1.160)	(-0.851)	(0.323)	(-0.452)	(-0.198)	(2.025)	
Winner [6/12]	0.0350***	0.2623	0.1615	0.0515	-0.4895*	0.2392	3.75%
	(2.730)	(0.702)	(0.545)	(0.151)	(-1.649)	(0.773)	
W-L [6/12]	0.0451***	0.5617**	0.0723	0.1942	-0.4347**	-0.3460	6.45%
	(4.982)	(2.129)	(0.345)	(0.807)	(-2.061)	(-1.582)	
Loser [9/9]	-0.0176*	0.0464	0.2260	-0.2280	-0.0131	0.5674**	6.19%
	(-1.705)	(0.154)	(0.948)	(-0.832)	(-0.054)	(2.277)	
Winner [9/9]	0.0229*	0.2773	0,4316	0,3142	-0.5151*	0.2543	6.28%
	(1,859)	(0,771)	(1,513)	(0,958)	(-1,791)	(0,853)	
W-L [9/9]	0,0405***	0,2309	0,2056	0,5422**	-0,5020**	-0,3131	8,17%
	(4,146)	(0,811)	(0,910)	(2,088)	(-2,204)	(-1,326)	
Loser [9/12]	-0,0126	-0,4116	0,0609	-0,1034	-0,0288	0,5362	4,63%
	(-1,118)	(-1,257)	(0,235)	(-0,346)	(-0,110)	(1,975)	
Winner [9/12]	0,0239*	0,2001	0,2039	0,1322	-0,5322*	0,1291	3,39%
	(1,762)	(0,506)	(0,650)	(0,367)	(-1,683)	(0,394)	
W-L [9/12]	0,0365***	0,6117**	0,1430	0,2356	-0,5034**	-0,4071	6,51%
	(3,526)	(2,029)	(0,598)	(0.857)	(-2.088)	(-1.629)	
Loser [12/12]	-0.0028	-0.5092*	0.0854	0.0684	-0.0125	0.4489	4.67%
	(-0.258)	(-1.657)	(0.344)	(0.240)	(-0.050)	(1.731)	
Winner [12/12]	0.0128	0.1400	0.2480	0.2357	-0.5510*	0.1259	3.80%
	(0.928)	(0.347)	(0.776)	(0.641)	(-1.709)	(0.377)	
W-L [12/12]	0.0156	0.6493**	0.1625	0.1673	-0.5385**	-0.3231	6.54%

	(1.510)	(2.155)	(0.681)	(0.609)	(-2.236)	(-1.294)

Notes: Numbers in parentheses are *t statistics*. ***, ** and * indicate significance at 1%, 5% and 10% levels.

Table 7. Momentum profits explanation by the 5 factors of Fama and French (2015): portfolios formed by quintiles

	α	R_m-R_f	*SMB*	*HML*	*RMW*	*CMA*	R^2	*Prob(F)*
W-L [3/12]	0,0471***	0,4126*	0,0685	0,1180	-0,5061***	-0,1905	6,18%	13,02%
	(5,591)	(1,682)	(0,352)	(0,528)	(-2,581)	(-0,937)		
W-L [6/9]	0,0329***	0,1496	0,0403	0,5651**	-0,4944**	-0,0905	8,34%	4,03%
	(3,147)	(0,491)	(0,167)	(2,033)	(-2,029)	(-0,358)		
W-L [6/12]	0,0279**	0,6777	0,1524	0,3794	-0,7177**	-0,4313	8,21%	4,35%
	(2,360)	(1,969)*	(0,559)	(1,209)	(-2,609)	(-1,512)		
W-L [9/9]	0,0316***	0,3481	0,1532	0,7373**	-0,6276**	-0,4061	8,86%	2,99%
	(2,523)	(0,953)	(0,529)	(2,214)	(-2,149)	(-1,341)		
W-L [9/12]	0,0276*	0,8053*	0,2808	0,5400	-0,7002**	-0,6380*	7,86%	5,30%
	(1,944)	(1,944)	(0,855)	(1,430)	(-2,114)	(-1,858)		
W-L [12/12]	-0,0055	0,6886*	0,2969	0,4474	-0,5762**	-0,3177	6,71%	9,87%
	(-0,443)	(1,912)	(1,040)	(1,363)	(-2,001)	(-1,064)		

Notes: This table presents the returns of a few momentum strategies J/K that sell the loser portfolio L, and buys the Winner portfolio W, and hold these positions for the next K months. The winner portfolios si the quintile of the stocks having the highest returns for J past months. The Loser portfolio is the quintile of the stocks having the lowest returns over the same past period. Values in parentheses denote *t - Statistic*. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

In sum, the risk model of Fama and French (2015) fails to explain the profitability of momentum strategies in the Tunisian stock market. This strategy remains profitable even after adjusting its returns to a multidimensional risk.

Rejecting the risk explanation of the momentum effect is in favor of the investors' irrational behavior. Proponents of behavioral finance attribute this effect to the investor underreaction to new information and offer panoply of psychological biases that explain it such as the overconfidence bias (Daniel, Hirshleifer and Subrahmanyam, 1998), the conservatism (Barberis, Shleifer and Vishny, 1998) and the Disposition effect (Grinblatt and Han, 2005).

5. Conclusion

The momentum effect, documented by Jegadeesh and Titman (1993), is a stock market anomaly which means that stocks that have generated high returns (winning stocks) over a period of 3 to 12 months continue to generate the same performance; and stocks with relatively low or negative returns (losing stocks) during the same period continue to perform poorly during the subsequent 3 to 12 months. A momentum strategy which consists in selling the portfolio of losing stocks and buying the portfolio of winning stocks generates positive return.

Proponents of the efficient markets hypothesis attribute the momentum profits to the risk in the sense that the winner stocks are riskier than the losing stocks. To examine this hypothesis in the Tunisian stock market, we considered the multifactor-risk model of Fama and French (2015) which assumes that the returns are determined by 4 common risk factors in addition to the market risk.

We considered all the securities listed on the Tunis stock exchange over the period July 2003–December 2015. The winner and loser

portfolios' returns as well as the winner minus loser returns for different formation and holding periods ranging from 3 to 12 months are regressed on the 5 risk premiums. Our results indicate that momentum profits are statistically and economically significant except for 12-month formation and holding periods. The momentum effect on the Tunisian stock market seems to resist to the five-factor model of Fama and French (2015).

However, zero net investment momentum strategies remain unexploitable in the Tunisian context since they are based on the short sale of winning stocks which is forbidden in Tunisia. Given the robustness of this anomaly in the Tunisian context, a robustness sustained by statistical and economic significance of momentum profits, we recommend that the financial market council, the authority of the Tunisian stock market, revise their stock market policy in order to attract investors interested in such a strategy and to dynamise the Tunisian stock market, which remains a "conservative" market.

Given that the risk-based rational hypothesis fails to explain the momentum effect, the investors' underreaction hypothesis seems to be a plausible explanation for this effect. To explore this hypothesis, it will be convenient to consider some psychological biases such as the overconfidence, the conservatism, the representativeness heuristic and the disposition effect.

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Appendix

The Firms composing our sample during the period July 2003 to December 2015 are: ADWYA, AETECH, AIR LIQUIDE, ALKIMIA, AMEN BANK, AMEN LEASE, AMS, ARTES, ASS MULTI ITTIHAD, ASSAD, ASTREE, ATB, ATL, ATTIJARI BANK, ATTIJARI LEASING (GENERAL LEASING), BEST LEASE, BH, BIAT, BNA, BT, BTE, CARTE, CARTHAGE CEMENT, CARTHAGO, CELLCOM, CEREALIS, CIL, CIMENTS DE BIZERTE, CITY CARS, DELICE HOLDING, EL MAZRAA, EL WIFACK LEASING, ELBENE (TUNISIE LAIT), ELECTROSTAR, ENNAKL AUTOMOBILES, ESSOUKNA, EURO-CYCLES, GIF, HANNIBAL LEASE, HEXABYTE, ICF, LAND OR, MAGASIN GENERAL, MAGHREB INTERN PUB, MODERN LEASING, MONOPRIX, MPBS, NEW BODY LINE, OFFICEPLAST, ONE TECH HOLDING, PBH, PLACEMENT DE TUNISIE, POULINA GP HOLDING, SAH, SALIM, SERVICOM, SFBT, SIAME, SIMPAR, SIPHAT, SITS, SOMOCER, SOPAT, SOTEMAIL, SOTETEL, SOTIPAPIER, SOTRAPIL, SOTUMAG, SOTUVER, SPDIT SICAF, STAR, STB, STEQ, STIL, STIP, STS (STE TUN DU SUCRE), TAWASOL GP HOLDING, TELNET HOLDING, TPR, TUNINVEST SICAR, TUNIS RE, TUNISAIR, TUNISIE LEASING, UADH, UBCI and UIB.