Using Volatility to Improve Momentum Strategies

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Abstract

This paper attempts to enhance momentum strategy by using volatility effect. To achieve this objective, double sorting portfolio is used and data is collected from 10 Arabic market indices over the period of 1990-2014. A simple modification to the traditional momentum strategy provides highly profitable results in Arabic market indices. While traditional momentum alone provides significant abnormal raw return of 1.16% per month over the six-month holding period, new momentum strategy based on double sort suggested by this study represented via recent winners with low-volatility outperform recent losers with high-volatility and it provides significant abnormal raw returns of 2.60% per month over the same holding period. Finally, either traditional momentum or momentum with volatility strategies can't be explained by two factor model

Keywords: volatility, momentum, strategy, two-factor model

1. Introduction

Over the past two decades, momentum effect has been considered a big challenge to efficient market theory, since in efficient markets the investor cannot achieve profit over the long- term by investing in stocks that have done well over 3, 6, 9 and 12 months. According to efficient markets theory, investors cannot achieve additional returns without bearing additional risk. Behavioral finance has assisted in explaining how the momentum anomaly could exist. Therefore, this paper will address this gap by investigating whether there is a momentum effect on the 10 Arabic indices.

To examine whether the momentum strategy can be improved, this study uses double sort 10 Arabic indices employing a momentum strategy as the first sort variable and a volatility strategy as the second sort variable. Previous studies related to momentum use past 3, 6, 9 and 12-month returns to sort securities into portfolio, this study adopt this practice for first sort variable. The volatility strategy was calculated based on past 6 and 12 months in double sorts. In other words, the strategy in the current study is formed by selling the portfolio that includes indices that have achieved poorly over the past 3, 6, 9 and 12 months with relatively high volatility "SLHV". On the other hand, buying the portfolio that includes those indices that have achieved well over the past 3, 6, 9 and 12 months with relatively low volatility "SWLV".

This study addresses 10 Arabic market indices while previous studies address either developed or developing market indices without giving the attention for these Arabic market indices such as Bornholt and Malin (2013). unlike the Gharaibeh and Al-Eitan (2015) this paper adopts momentum and momentum with volatility strategies rather than momentum and 52wk high strategies. While Ejaz and Polak (2014) use 7 stock markets of 6 Middle East countries to investigate only momentum effect, this paper comprehensively investigates momentum and momentum with volatility effects at the level of 10 Arabic market indices. In addition, the current study considers the international two-factor model applied by Balvers and Wu (2006) to risk-adjust raw returns rather than applying the capital asset pricing model (CAPM) like Ejaz and Polak (2014).

This paper contributes to the literature in two ways. Firstly, while previous studies examine momentum at the level of developed or emerging market indices, this study investigates the topic at the 10 Arabic indices level. The main finding from this paper is that there is strong evidence of momentum at the level of Arabic indices. Secondly, this paper compares and contrasts the momentum strategy with the new double sort strategy based on momentum with volatility suggested by the current study.

The results show that the new momentum with volatility strategy has consistently larger profits than the momentum strategy. The rest of this paper is arranged as follows. Section 2 presents the relevant literature. The data and methodology used in the current study is discussed in Section 3. Section 4 analyzes the results for both raw and risk adjusted returns. Finally, Section 5 concludes the paper.

2. Literature Review

Ang, Hodrick, Xing, and Zhang (2006) investigate the relationship between the pricing of aggregate volatility risk and the cross-section of stock returns. They follow Breeden, Gibbons, & Litzenberger (1989) and Lamont (2001) methodology to construct a factor to mimic innovations in market volatility. They show that there is a negative relationship between stocks that have sensitive to innovations in aggregate volatility and idiosyncratic volatility with average returns. In the other words, they find that stocks that have high sensitivities to innovations in aggregate volatility and high idiosyncratic volatility relative to Fama & French (1993) achieve low average returns.

Berrada and Hugonnier (2008) explain the relationship between idiosyncratic volatility and stock returns by developing a model of company investment under incomplete information assumption. This model has a new implication for the cross-section of stock returns. Particularly, the model predict that the idiosyncratic volatility anomaly can be mitigated by controlling for earning forecast errors and this implication is consistent with the result of Jiang, Xu & Yao (2007). They find that idiosyncratic volatility is negatively related to stock returns in the length of expansions and recessions and this finding is consistent with findings documented by Jiang et al. (2007), Brockman and Yan (2008) and Ang et al. (2006, 2008). Surprisingly, they show that the idiosyncratic volatility is positively (negatively) related to stock returns after good (bad) news.

Blitz and Van Vliet (2008) examined whether classic cross-sectional return patterns, that are documented at the security level, can also exist across asset classes. They used a single global tactical asset allocation (GTAA) model to directly compare the attractiveness of a broad range of asset classes, as well as to develop a given strategic asset allocation. Blitz and Van Vliet (2008) found that value and momentum strategies across 12 asset classes earn economically and statistically significant abnormal returns. In particular, 7% to 8% return premiums have been documented for the 1-month, 12-months momentum and value GTCAA strategies over 1986-2007. They confirmed the findings of previous studies that there is a 1-month momentum effect at industry level, in contrast to the existence of a 1-month reversal effect documented at the individual stock level. They reported an alpha of 12% when combining momentum and value factors for their GTCAA strategy. Their findings challenge the concept of market efficiency because they show that the value and momentum effects extend across other asset classes.

George and Hwang (2010) have constructed three idiosyncratic volatility measures by using monthly return based on past five years, daily returns of the previous year and daily returns of the prior month. They confirm the finding of the AHXZ (2006) that the return is negatively related to idiosyncratic volatility after controlling firm size and controlling for January. This relationship is assigned to mispricing of the subsample of high-volatility stocks, which are not generally followed by analysts. Outside of low coverage stocks, idiosyncratic volatility is insignificantly or positively related to returns when measured as in AHXZ. They point out that the AHXZ finding related to distinct patterns in earnings can be explained by the market overestimates the persistence of earnings growth for low-coverage stocks with high idiosyncratic return volatility. They report a comparable finding for stocks sorted on the volatility of share turnover, recommending that Chordia, Subrahmanyam & Anshuman (2001) document that the return is negatively related to turnover volatility also attribute to mispricing coupled with limits of arbitrage and information uncertainty.

Recently, Bornholt and Malin (2011) investigated whether each index's recent volatility can be employed to enhance the profitability of the standard momentum approach. In other words, a double-sorting procedure was used to test whether a momentum/volatility strategy outperforms the standard single-sorted momentum strategy. They used international indices grouped as developed and emerging markets. Bornholt and Malin (2011) found that the momentum/volatility strategy provided only small enhancements over pure momentum in the case of developed markets, however the new strategy performed surprisingly well when applied to emerging markets. Recent high volatility winners outperformed recent low volatility losers on an average annualized basis by 17.4% during the holding period.

On the other hand, the long portfolio of the pure momentum strategy outperformed the short portfolio by 9.1%. Furthermore, for the case of emerging markets, they showed that high volatility winners achieve an average annualized return of 28.3%, and an alpha of 21.1%. Asness, Moskowitz and Pedersen (2013) investigated whether a combined value/ momentum strategy based on individual assets provides abnormal returns within countries and across different asset classes. They showed that the value/momentum strategy generates abnormal returns across markets and asset classes and that the profitability of the value (momentum) strategy in one asset class is positively related to the profitability of the value (momentum) strategy in other asset class. Moreover, they found that value and momentum are negatively correlated within and across asset classes. While liquidity and macro risks seem to be important common components of value and momentum, they leave a significant portion of both unexplained.

Looking at the Arabic market region, Gharaibeh and Al-Eitan (2015) investigates whether there is momentum and 52 wk high strategies at the level of 10 Arabic market indices. They find that momentum effect is present and it economically significant while the 52 wk high effect is unprofitable. They conclude that the 52 wk high effect is not as regular as the momentum effect. In the Amman stock exchange market, Gharaibeh (2015) examines whether there is a momentum effect on Jordan firm returns. He finds that momentum effect is only statistically significant for the large-sized portfolios at Jordan firm returns. Using data of Morocco Stock Exchange from 1995 through 2014, Gharaibeh (2016) shows strong evidence of momentum effect. He confirmed that the momentum effect is still statistically significant when applying to sub-period sample.

3. Data and Methodology

Monthly returns are calculated from monthly prices with reinvested gross dividend of 10 Morgan Stanley Capital International (MSCI) indices downloaded from Data stream. The time frame of the study extends from February 1988 through September 2014. Table 1 summarizes the 10 Arabic countries, together with average monthly return, standard deviation, skewness and kurtosis data for each index.

Table 1 details descriptive statistics over the period February 1988 through September 2014 for the 10 Arabic indices, showing average monthly returns, standard deviation, Skewness and Kurtosis for each index. Table 1 shows big difference in the mean and standard deviation of average returns. Egypt and Lebanon have the biggest monthly average (over 2% per month). On the other hand, the Bahrain has the lowest average at -0.33. The 10 Arabic indices have an average monthly return of 1.40% and an average standard deviation of 8.18%. The study compares and contrasts the pure momentum and the momentum with volatility strategies applied to 10 Arabic indices. The next two sections detail the pure momentum and the momentum with volatility strategies used in this paper.

3.1 Momentum strategy

The momentum portfolios have been formed as follows. At the beginning of each month *t*, the 10 Arabic indices in Table 1 are classified based on their past *J*-month returns (*J* = 3, 6, 9 and 12 months). For a given *J*, the short-term winner (SW) portfolio includes the 50% of indices that have the highest past *J*-month returns whereas the short-term loser (SL) portfolio includes the 50% of indices that have the lowest past *J*-month returns. The momentum strategy (SW-SL) buys the short-term winner portfolio and sells the short-term loser portfolio. Portfolios are held for *K*-month holding periods, where *K* = 1, 3, 6, 9 and 12 months. For this single-sort strategy, this study maintains a 1-month gap between the end of the *J*-month formation period and the beginning of the *K*-month holding period. A gap of one month is consistent with previous studies such as Jegadeesh and Titman (1993). Jegadeesh and Titman (1993) found that skipping the first one month after the end of the formation period improves the performance of the momentum strategy and provides stronger results since this practice helps avoid any short-term reversals being compensated by the short-term continuation of returns.

3.2 Momentum with Volatility Strategy

In the momentum strategy, the investor buys a portfolio of short-term winners and sells a portfolio of short-term losers. The success of such a strategy is dependent on the indices in the portfolios continue their short-term past performances. One problem with this strategy is that these indices may not all be equally ready to continue. Having a one month gap between the end of the formation period and the beginning of the holding period may increase continuation impacts but it does not guarantee that the short-term winner and loser indices improve the continuation by the end of the 1 month gap.

As discussed in the beginning of this paper, Bornholt and Malin (2011) suggest momentum with volatility strategies in order to select those short-term winners and losers that are related to the volatility. In other words, the momentum with volatility approach uses the volatility performances of the short-term winners and losers in a double-sort procedure. Particularly, the momentum with volatility strategy buys short-term winners with relatively high volatility and sells short-term losers with relatively low volatility.

The momentum with volatility approach is a double dependent sort procedure, and is described as follows. The first sort is the same as the momentum strategy sort. The 10 indices are classified at the beginning of each month based on their most recent past *J*-month returns. For a given *J*, the short-term winner portfolio (SW) includes the 50% of indices with the lowest past *J*-month returns, while the short-term loser portfolio (SL) contains the 50% of indices with the highest past *J*-month returns. The indices in the SW and SL portfolios are further classified in the second stage based on their past *J*2-month volatilities, where *J*2 = 6 or 12 months. This means that these *J*2-volatilities are from the last *J*2 months of the *J*-month formation period. For a given *J* and *J*2, the SWHV portfolio contains the 50% of SW indices with the largest *J*2-month volatilities (here HV indicates 'high volatility'). Similarly, the SLLV portfolio contains the 50% of SL indices with the lowest *J*2-month volatilities (where LV denotes 'low volatility').

This procedure means that out of the total of 10 Arabic indices, the short-term winner and short-term loser portfolios of the momentum strategy each contain 5 indices, while the momentum with volatility SWHV and SLLV portfolios each contain 2 indices. The momentum with volatility strategy (SWHV-SLLV) buys short-term winners with relatively high volatility (SWHV) and sells short-term losers with relatively low volatility (SLLV). Bornholt and Malin (2011) shows that this strategy provide marginally larger profits than will the corresponding momentum strategy.

Alternatively, the current study suggests another way to improve the momentum strategy; therefore, it constructs the double-sorts in opposite way in terms of volatility as the second variable. Thus, The double-sorts is also constructed by buying the portfolio that includes indices that have performed well over the past recent *J*-month returns (*J* = 3, 6, 9 and 12-month) and that have also demonstrated relatively low volatility (SWLV), and selling the portfolio that includes those indices that have performed poorly over the past recent *J*-month returns (*J* = 3, 6, 9 and 12-month) with relatively high volatility (SLHV). The key insight of the momentum with volatility approach is this strategy should outperform the corresponding momentum strategies.

As with the momentum strategy, all portfolios in the momentum with volatility strategy are held for a *K*-month holding period, where *K* = 1, 3, 6, 9 or 12 months. While a 1-month gap is employed between the end of the formation period and the beginning of the holding period for the momentum strategy, the momentum with volatility strategy in this study follows the method of Bornholt and Malin (2011) by having only a one-month gap between the end of the formation period and the beginning of the holding period. The current study uses Jegadeesh and Titman's (1993) overlapping portfolio method for the holding period returns of all strategies to avoid overlapping returns, and to enhance test power. For expositional convenience, the 6-month holding period case (*K* = 6) will be the major focus of this paper comments about the empirical results in the next section.

Table 1: Summary statistics of stock index returns

country	Mean%	S.D%	Skewness	Kurtosis
Egypt	2.56	9.95	1.00	4.62
Lebanon	2.18	9.24	1.31	5.54
Morocco	1.89	5.77	0.46	2.55
Qatar	1.84	8.74	-0.13	1.66
Kuwait	1.37	7.06	-0.16	0.76
Jordan	1.33	5.21	-0.10	2.05
Oman	1.19	6.17	-1.31	5.01
UAE	1.09	11.00	0.19	1.40
Sudia Arabia	0.86	11.46	-0.08	-0.62
Bahrain	-0.33	7.18	-0.61	2.99
AVERAGE	**1.40**	**8.18**		

4. Results

This section analyses the results for both the momentum and momentum with volatility strategies in terms of raw and risk-adjusted results.

4.1 Momentum results

Table 2 report results for the long (SW), short (SL), and long-short (SW-SL) momentum portfolios for several (*J*, *K*) combinations. Table 2 contains the results for formation period lengths of *J* = 3, 6, 9 and 12 months. Each table presents the equal-weighted average monthly portfolio returns in percentages for *K*-month holding periods (*K* = 1, 3, 6, 9 and 12 months) in columns 3 through 6. The momentum results in Table 2 show that the strategy profits (SW-SL) are positive over all *K*-month holding periods if *J* = 3, 6, 9 or 12 months. Table 2 shows significant momentum SW-SL profits for all *J* = 3 to 6 months and all *K*. As an example, for the 6-month formation period and 6-month holding period (*K*=6) case, the difference between the average monthly returns of the SW portfolio and the SL portfolio is 1.16% per month (*t*-stat 2.60), which is statistically significant. In general, the holding period returns in Table 2 provide evidence of momentum effect at the Arabic indices level. Consequently, next consider the results for using volatility effect based on double-sort in the Table 3.

Table 2: Profitability of Momentum Strategies.

		Holding Months				
J	**Portfolio**	**K =1**	**K =3**	**K =6**	**K =9**	**K =12**
3	SW	1.33%	1.38%	1.21%	1.06%	0.91%
		(2.93)	(3.13)	(2.86)	(2.58)	(2.21)
	SL	0.04%	-0.20%	-0.01%	0.02%	0.07%
		(0.09)	(-0.44)	(-0.02)	(0.04)	(0.14)
	SW-SL	1.29%	1.57%	1.22%	1.04%	0.84%
		(2.53)	(3.66)	(3.32)	(3.31)	(2.9)
6	SW	1.48%	1.44%	1.08%	0.87%	0.73%
		(2.88)	(2.84)	(2.35)	(2.02)	(1.69)
	SL	-0.34%	-0.30%	-0.07%	-0.02%	-0.03%
		(-0.73)	(-0.6)	(-0.14)	(-0.04)	(-0.05)
	SW-SL	1.82%	1.74%	1.16%	0.90%	0.76%
		(3.45)	(3.48)	(2.6)	(2.37)	(2.1)
9	SW	1.16%	0.95%	0.69%	0.56%	0.42%
		(2.21)	(2.03)	(1.62)	(1.31)	(0.97)
	SL	-0.25%	-0.13%	-0.01%	0.04%	-0.02%
		(-0.46)	(-0.25)	(-0.02)	(0.07)	(-0.03)
	SW-SL	1.40%	1.09%	0.70%	0.53%	0.43%
		(2.42)	(2.08)	(1.55)	(1.3)	(1.12)
12	SW	0.77%	0.61%	0.33%	0.15%	-0.04%
		(1.38)	(1.21)	(0.71)	(0.33)	(-0.08)
	SL	-0.15%	-0.11%	0.06%	0.02%	-0.06%
		(-0.29)	(-0.21)	(0.11)	(0.04)	(-0.1)
	SW-SL	0.91%	0.72%	0.27%	0.13%	0.02%
		(1.49)	(1.25)	(0.51)	(0.27)	(0.04)

4.2 The momentum with volatility strategy results

One of the objectives of the current study is to examine whether the momentum with volatility approach can improve the performance of the traditional momentum strategy. The momentum with volatility strategy suggested by Bornholt and Malin (2011) is based on buying those short-term winners with relatively high volatility performances and selling those short-term losers with relatively low volatility performances. Momentum and volatility strategies proposed by Bornholt and Malin (2011) enhanced the traditional momentum strategies. This section reports momentum with volatility results.

Table 3 provides the results of the momentum with volatility strategies for the Arabic indices showing the average monthly returns of the longs (SWHV), shorts (SLLV), and the arbitrage (SWHV-SLLV) portfolios, together with their *t*-statistics. The results in Table 3 demonstrate considerable differences from the results in Table 2. Table 3 shows insignificant momentum with volatility SWHV-SLLV profits for all *J1* and *J2* months and all *K*. For the 6-month formation period case with a six-month holding period (*K*= 6), for example, past short-term winners with high volatility produce an average of 0.27% per month whereas past short-term losers with low volatility provide an average of only 0.10 % per month over the same period. The resulting SWHV-SLLV difference of 0.18% per month is statistically insignificant (*t*-stat 0.38).

Overall, the results in Table 3 show that the momentum with volatility strategies suggested by Bornholt and Malin (2011) does not enhance the profitability of the momentum strategies. Therefore, the current study proposes new momentum with volatility strategy based on buying those short-term winners with relatively low volatility performances and selling those short-term losers with relatively high volatility performances. This new strategy suggested by this paper is different from Bornholt and Malin's (2011) strategy in terms of volatility. While the arbitrage portfolio of Bornholt and Malin's (2011) strategy based on (SWHV-SLLV), the current study prefer to use this new strategy in opposite way in terms of volatility as (SWLV-SLHV). Tables 4 and 5 consider the results for the new momentum with volatility suggested by this paper.

Table 4 demonstrates that the average monthly returns of the momentum with volatility strategies SWLV-SLHV are larger than 2% per month and they are statistically significant for all formation and holding periods, except of *J*/*J2* = 3/6 case with a six-month holding period where the average monthly returns is 1.69% per month and it is weakly significant. For example, the J/J2 = 6/6 case with a six-month holding period (*K*= 6). Short-term winners that are low volatility provide an average of 1.11% per month. In contrast, short-term losers that are high volatility generate an average of -1.49 per month over the same period. Consequently, the momentum with volatility strategy (SWLV-SLHV) produces a significant 2.60% per month (*t*-stat 2.89). Generally, a comparison of Table 4 with Table 2 demonstrates that the momentum with volatility strategy outperforms the corresponding *J* = 3, 6, 9 or 12 momentum strategy with for all holding periods.

The robustness of these findings to the choice of range of past volatility can be checked by replacing the past one-year volatility instead of past six-month volatility with momentum strategy. Thus, whereas momentum with past six-month volatility in Table 4, momentum with past one-year volatility in Table 5. The result in Table 5 tells a similar story for the momentum with volatility strategies. Table 5 confirms the previous findings in Table 4. The SWLV-SLHV returns provide statistically significant profits for all holding periods. Consider, for example, the 6/12 case in Table 6 there is a significant *K* =6 returns of 2.92% (*t*-stat 3.00) which is larger than traditional momentum strategy presented in Table 2. Comparing this result with the corresponding results in Table 2 demonstrates that the momentum with volatility approach has much larger returns. This proposes that the momentum with volatility approach suggested by the current study achieve larger holding period profitability is by avoiding indices that have high volatility.

Table 3: Profitability of Momentum/Momentum with 6-month Volatility Strategies

			Holding Months				
J1	**J2**	**Portfolio**	**K =1**	**K =3**	**K =6**	**K =9**	**K =12**
3	6	SWHV	0.62%	0.61%	0.45%	0.30%	-0.04%
			(1.14)	(1.16)	(0.9)	(0.6)	(-0.09)
		SLLV	0.34%	0.21%	0.26%	0.32%	0.30%
			(0.67)	(0.48)	(0.6)	(0.71)	(0.64)
		SWHV-SLLV	0.29%	0.40%	0.19%	-0.02%	-0.35%
			(0.51)	(0.82)	(0.45)	(-0.07)	(-1.09)
6	6	SWHV	0.67%	0.65%	0.27%	0.01%	-0.32%
			(1.06)	(1.1)	(0.52)	(0.02)	(-0.63)
		SLLV	0.29%	0.01%	0.10%	0.13%	0.06%
			(0.58)	(0.02)	(0.23)	(0.3)	(0.12)
		SWHV-SLLV	0.38%	0.64%	0.18%	-0.13%	-0.37%
			(0.61)	(1.19)	(0.38)	(-0.33)	(-1.06)
9	6	SWHV	0.85%	0.58%	0.32%	-0.01%	-0.26%
			(1.54)	(1.17)	(0.66)	(-0.02)	(-0.54)
		SLLV	0.06%	0.09%	0.27%	0.26%	0.20%
			(0.12)	(0.2)	(0.64)	(0.59)	(0.45)
		SWHV-SLLV	0.79%	0.49%	0.04%	-0.27%	-0.47%
			(1.36)	(0.99)	(0.09)	(-0.66)	(-1.23)
12	6	SWHV	0.53%	0.49%	0.05%	-0.20%	-0.44%
			(0.88)	(0.95)	(0.11)	(-0.42)	(-0.93)
		SLLV	0.25%	0.26%	0.23%	0.14%	0.03%
			(0.51)	(0.57)	(0.52)	(0.31)	(0.06)
		SWHV-SLLV	0.29%	0.24%	-0.17%	-0.33%	-0.47%
			(0.47)	(0.48)	(-0.39)	(-0.84)	(-1.23)

Table 4: Profitability of Momentum/Momentum with 6-month Volatility Strategies

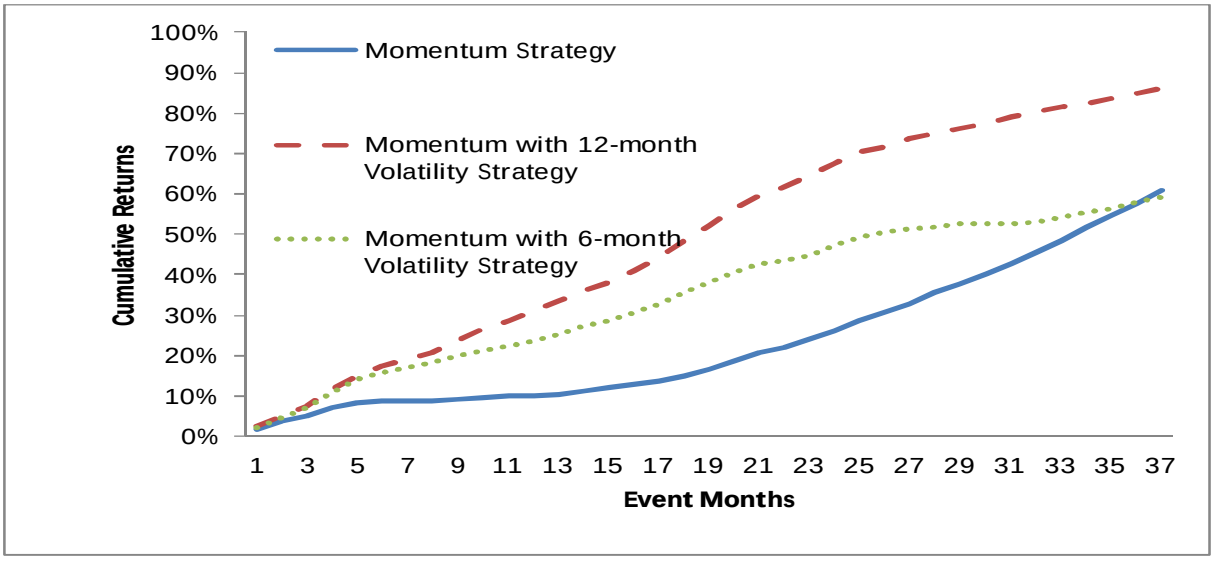
			Holding Months				
J1	**J2**	**Portfolio**	**K =1**	**K =3**	**K =6**	**K =9**	**K =12**
3	6	SWLV	1.32%	1.42%	1.34%	1.11%	1.00%
			(2.44)	(2.74)	(2.63)	(2.16)	(1.96)
		SLHV	-0.36%	-0.95%	-1.08%	-1.40%	-1.62%
			(-0.38)	(-0.96)	(-1.07)	(-1.38)	(-1.55)
		SWLV-SLHV	1.69%	2.37%	2.42%	2.51%	2.62%
			(1.91)	(2.94)	(3.38)	(3.51)	(3.43)
6	6	SWLV	1.44%	1.23%	1.11%	1.00%	0.94%
			(2.57)	(2.25)	(2.08)	(1.94)	(1.81)
		SLHV	-1.18%	-1.41%	-1.49%	-1.67%	-1.99%
			(-1.14)	(-1.27)	(-1.28)	(-1.45)	(-1.74)
		SWLV-SLHV	2.62%	2.64%	2.60%	2.67%	2.93%
			(2.9)	(2.87)	(2.89)	(3.11)	(3.34)
9	6	SWLV	1.29%	1.48%	1.18%	1.05%	0.92%
			(2.22)	(2.6)	(2.14)	(2)	(1.75)
		SLHV	-1.31%	-1.39%	-1.51%	-1.74%	-2.19%
			(-1.1)	(-1.17)	(-1.34)	(-1.6)	(-1.97)
		SWLV-SLHV	2.61%	2.87%	2.69%	2.79%	3.11%
			(2.36)	(2.83)	(2.86)	(3.15)	(3.43)
12	6	SWLV	1.35%	1.28%	1.36%	1.18%	1.03%
			(2.51)	(2.38)	(2.51)	(2.17)	(1.91)
		SLHV	-1.30%	-1.30%	-1.28%	-1.69%	-2.30%
			(-1.18)	(-1.08)	(-1.06)	(-1.39)	(-1.88)
		SWLV-SLHV	2.65%	2.58%	2.64%	2.87%	3.33%
			(2.59)	(2.49)	(2.64)	(2.88)	(3.3)

Table 5: Profitability of Momentum/Momentum with 12-month Volatility Strategies

			Holding Months				
J1	**J2**	**Portfolio**	**K =1**	**K =3**	**K =6**	**K =9**	**K =12**
3	12	SWLV	1.43%	1.41%	1.26%	0.99%	1.11%
			(2.53)	(2.57)	(2.32)	(1.81)	(1.96)
		SLHV	-0.45%	-1.32%	-1.21%	-1.77%	-2.36%
			(-0.45)	(-1.23)	(-1.07)	(-1.52)	(-1.98)
		SWLV-SLHV	1.88%	2.73%	2.47%	2.75%	3.48%
			(2.11)	(3.12)	(3.04)	(3.36)	(4.18)
6	12	SWLV	1.89%	1.69%	1.43%	1.26%	1.22%
			(3.17)	(3)	(2.72)	(2.44)	(2.26)
		SLHV	-0.62%	-1.26%	-1.49%	-1.95%	-2.43%
			(-0.56)	(-1.07)	(-1.18)	(-1.5)	(-1.79)
		SWLV-SLHV	2.51%	2.95%	2.92%	3.21%	3.65%
			(2.48)	(2.97)	(3.00)	(3.3)	(3.56)
9	12	SWLV	1.66%	1.52%	1.14%	1.12%	0.97%
			(2.81)	(2.6)	(2.07)	(2.05)	(1.72)
		SLHV	-0.85%	-1.43%	-1.49%	-1.77%	-2.56%
			(-0.69)	(-1.15)	(-1.21)	(-1.47)	(-2)
		SWLV-SLHV	2.52%	2.95%	2.63%	2.89%	3.53%
			(2.29)	(2.75)	(2.54)	(2.92)	(3.39)
12	12	SWLV	1.09%	1.12%	1.10%	0.96%	0.84%
			(2.06)	(2.12)	(2.09)	(1.8)	(1.57)
		SLHV	-1.17%	-1.44%	-1.43%	-1.92%	-2.63%
			(-1.05)	(-1.18)	(-1.16)	(-1.53)	(-2.03)
		SWLV-SLHV	2.26%	2.56%	2.53%	2.87%	3.47%
			(2.22)	(2.42)	(2.46)	(2.74)	(3.19)

Figure 1: Cumulative Returns of Strategies

This graph provides the cumulative returns for the pure momentum strategy (SW-SL), the Momentum with 6-month volatility strategy (SWLV-SLHV) and the Momentum with 12-month volatility strategy (SWLV-SLHV) for the 36 months following the end of the formation period.



The post-formation behavior of the momentum and momentum with volatility strategies' profits is also illustrated in Figure 1. Figure 1 shows the post-formation cumulative returns of the momentum strategy (SW-SL), the momentum with past six-month volatility strategy (SWLV-SLHV) and the momentum with past 12-month volatility strategy (SWLV-SLHV) using non-overlapping (K = 1) for the 36 months following the end of the formation period. For the momentum strategy depicted, it is evident that the momentum performance shows no signs of slowing down by the end of the first 12 or 36 post-formation months. For momentum with volatility strategies depicted, they are both evident either momentum with past 6-month volatility or momentum with 12-month volatility that these strategies enhance the traditional momentum performance.

Table 6: Risk adjusted Momentum/ Momentum and volatility profits

Portfolio	Two-factor model			
	α	b_{wld}	b_{vmg}	Adj R^2
Panel A: Pure Momentum Strategy				
SW	1.0108	0.3854	-0.4414	3.80%
	(160.64)	(2.16)	(-1.75)	
SL	0.9941	0.9341	-0.8163	16.30%
	(124.16)	(2.96)	(-1.94)	
SW-SL	0.0167	-0.5487	0.3749	11.60%
	(3.15)	(-2.74)	(1.43)	
Panel B: Momentum and Volatility Strategy				
SWLV	1.0127	0.4172	-0.4729	8.10%
	(193.19)	(2.76)	(-2.11)	
SLHV	0.9785	1.5073	-1.421	20.20%
	(79.56)	(3.01)	(-2.17)	
SWLV-SLHV	0.034	-1.09	0.948	17.40%
	(3.6)	(-2.91)	(1.89)	

4.3 Risk adjustments

To test whether the profits of these strategies should be considered a reward for bearing risk, the profits of the momentum and momentum with past 12-month volatility strategies are risk adjusted employing the Two-factor model. The two-factor model comprises of a market factor and a value minus growth factor (VMG) as follows:

$$R_{pt} - R_{\text{ft}} = \alpha_p + \beta_{p,mkt}(R_{mt} - R_{\text{ft}}) + \beta_{p,vmg}VMG_t + \varepsilon_{pt} \quad (1)$$

where the dependent variable *Rp, t - Rf,t* is the monthly excess return of a portfolio of interest (whether it's the long, short or the arbitrage portfolio of a strategy), *Rp,t* indicates to the monthly return of portfolio *p* at time *t* and *Rf,t* the monthly risk free rate at time *t* represented by the one-month US T-bill return. The independent factors for the two models are as follows: *Rwld, t-Rf,t* corresponds to the excess return on the MSCI World market portfolio at time *t* and *VMGt* or Value minus Growth is the return on the MSCI World Value Index minus the return on the MSCI World Growth Index at time *t*. The monthly values of the MSCI world market index and the MSCI world value and growth indices were obtained from Data stream. The monthly returns for the Ibbotson and Associates one-month treasury-bill risk free rate were downloaded from Kenneth French's website. The two-factor model risk adjustment covers the period from their first available months January 1989 until September 2013. The coefficients *βp* and vp are the regression loadings corresponding to the factors of the model, while the intercept *αp or* (alpha) refers to the risk-adjusted abnormal profits of the portfolio over the estimation period. The *t*-values corresponding to the regression coefficients are corrected for heteroskedasticity using White's (1980) test.

Table 6 shows the estimated regression coefficients and the associated *t*-statistics for the long, short and long-short portfolios for the momentum and momentum with volatility strategies with six-month holding periods (K = 6). The alphas of the two strategies either momentum or momentum with volatility zero-cost portfolios (SW-SL, SWLV-SLHV, respectively) in Panel A and B are large (1.67%, and 1.34% per month) and statistically significant (*t*-stat 3.15 and 3.60, respectively). Clearly, the results in Panel A and B show that there are momentum and momentum with volatility effects that cannot be explained by the two-factor model.

5. Conclusion

This paper has investigated whether momentum strategies applied to 10 Arabic indices can be enhanced by taking into account each index's volatility. The momentum with volatility strategy based on double-sorts provides big improvements over the traditional momentum strategy. The momentum strategy provides statistical significant profit of 1.16% per month. Short-winner with low past six-month volatility outperforms short-loser with high past six-month volatility on an average basis by 2.60% per month. While these findings are important to practitioners, they also suppose opportunities for future research into whether past volatility can improve momentum strategy either at the level of stocks or industries. In addition, there is implication for academic research. The returns of 10 Arabic market indices of both momentum and momentum with volatility strategies cannot be explained by the Fama-French three-factor model. This means that these momentum and volatility effects at the 10 Arabic market indices level needs further investigation in order to understand what is driving the inter-index momentum and momentum with volatility effects.

References

Ang, A., Hodrick, R. J., Xing, Y., & Zhang, X. (2006). The cross section of volatility and expected returns. The Journal of Finance, 61(1), 259-299.

Asness, C. S., Moskowitz, T. J., & Pedersen, L. H. (2013). Value and momentum everywhere. The Journal of Finance, 68(3), 929-985.

Balvers, R. J., & Wu, Y. (2006). Momentum and mean reversion across national equity markets. Journal of Empirical Finance, 13(1), 24-48.

Berrada, T., & Hugonnier, J. (2008). Incomplete information, idiosyncratic volatility and stock returns. Swiss Finance Institute Research Paper Series.

Blitz, D., & Van Vliet, P. (2008). Global tactical cross-asset allocation: applying value and momentum across asset classes. Journal of Portfolio Management, 35, 23-38.

Bornholt, G., & Malin, M. (2011). Using volatility to enhance momentum strategies. The Finsia Journal of Applied Finance(2), 16.

Bornholt, G. N., & Malin, M. (2013). Strong and weak momentum components: Evidence from international market indices. Available at SSRN 2315993.

Breeden, D. T., Gibbons, M. R., & Litzenberger, R. H. (1989). Empirical test of the consumption-oriented CAPM. The Journal of Finance, 44(2), 231-262.

Brockman, P., & Yan, X. S. (2008). The time-series behaviour and pricing of idiosyncratic volatility: Evidence from 1926 to 1962. under revision at Journal of Banking and Finance.

Chordia, T., Subrahmanyam, A., & Anshuman, V. R. (2001). Trading activity and expected stock returns. Journal of financial economics, 59(1), 3-32.

Ejaz, A., & Polak, P. (2014). Short Term Momentum Effect: A Case of Middle East Stock Markets. Ejaz, A, 104-112.

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds* 1. Journal of financial economics, 33(1), 3-56.

George, T. J., & Hwang, C. Y. (2010). Why Do Firms with High Idiosyncratic Volatility and High Trading Volume Volatility Have Low Returns?

Gharaibeh, O. (2015). Interaction of Size and Momentum Effects in Jordan Firms: 2005-2014. International Review of Management and Business Research 4(1), 1-16.

Gharaibeh, O. (2016). Evidence of the Momentum Effect in the Morocco Stock Market: 1995-2014 International Review of Management and Business Research, 5(1), 200-2011.

Gharaibeh, O. K., & Al-Eitan, G. N. (2015). Is the 52 Week High Strategy as Pervasive as Momentum? Evidence from Arabic Market Indices. Research Journal of Finance and Accounting.

Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. Journal of Finance, 48(1), 65-91.

Jiang, G. J., Xu, D., & Yao, T. (2007). The information content of idiosyncratic volatility. Journal of Financial and Quantitative Analysis, 44(01), 1-28.

Lamont, O. (2001). Economic tracking portfolios: National Bureau of Economic Research Cambridge, Mass., USA.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica: Journal of the Econometric Society, 48, 817-838.