Nova School of Business and Economics

Outperform the market with an ex-post return skewness strategy?!

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1 Overview

The goal of investors in the capital market has always been to achieve a return above that of the market. “We are here to make money!” *Nicholas H. Hirschey, Lecture 2021.* With the ever increasing computing power in CPUs and GPUs, it is possible to analyze an ever rising amount of historical financial data. This has led to more investors looking for opportunities in signals that depend on past price movements. [1] The financial literature contains a broad spectrum of such signals, from which the authors expect an excess return. However, the question arises whether the various signals described are actually reproducible and generate the desired success on the capital market. [2]

This paper also claims to analyze a signal-based investment strategy that generates above-market returns for investors. The strategy was presented by *Bali, Turan G and Engle, Robert F and Murray, Scott* and is reproduced. Specifically, the skewness of the returns of the past 21 days should be used as an investment signal. [3]

$$SKEW\_21d(R) = \frac{1}{21 \times \sigma_{21}(R)} \sum_{n=0}^{21-1} \left(R_{t-n} - \overline{R_{t_{21}}}\right)^3$$

$$R = r - r_{mkt}$$

Figure 1 shows the distribution of the signal over the entire period of the available data. The

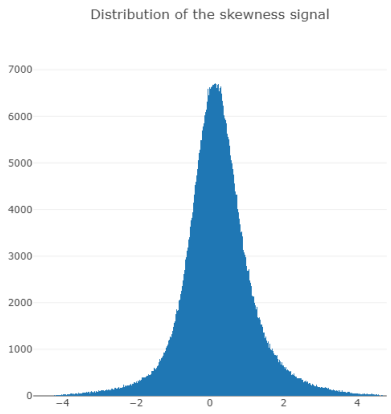
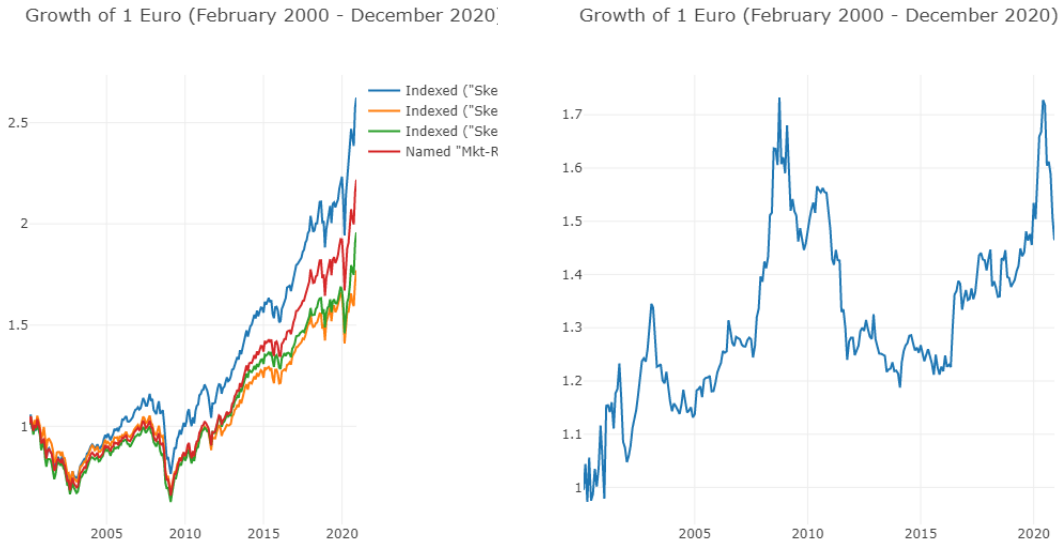


FIGURE 1: Distribution of the signal, the skewness is equally distributed

use of higher order distributions of returns as an indicator for future asset allocation is widely accepted in the literature. Be it for dynamic portfolio adjustment to wealth dependent risk aversion [4] or just to generate weekly excess return from buying stocks with a low skewness while selling those with high skewness. [5] However, there are also critics of the skewness-based investment strategy who point out that the distributional assumptions on returns make skewness

a useless tool. [6]

For this work, the dataset of *Bali, Turan G and Engle, Robert F and Murray, Scott*[2] was used. However, the analysis is limited to a maximum period from January 2000 to December 2020. To get a first impression of the skewness as a signal based investment strategy, three portfolios were formed, each consisting to one third of the strongest, medium and weakest. signals. In the respective portfolios, value-weighted investments are made in the shares contained therein. For comparison, a value weighted market portfolio was created from the same securities. 2a. Furthermore, a simple long-short strategy was implemented. 2b. The strategies described are plotted in Figure for the period 2000 to 2020. 2



(A) Formed portfolios by skewness signal against the market portfolio

(B) Long in the to 1/3 while going short in the bottom 1/3

FIGURE 2: With $\sigma = 10\%$ normalized cumulative excess returns of formed portfolios by skewness signal of an initial investment of 1 Euro

In table 1 the normalized cumulative excess returns for different time windows are listed. The danger of signal-based trading strategies is always that results can only be reproduced with specific data or for specific epochs. [7] This also applies to the analysis presented here, as can be seen in the table. None of the simple strategies beats the simple market portfolio in any period.

Period	**2000 - 2020**		**2000 - 2009**		**2010 - 2020**	
	Top 1/3	Long-Short	Top 1/3	Long-Short	Top 1/3	Long-Short
Return	162.46%	50.75%	1.94%	40.11%	167.32%	2.12%
Market return	121.84%		-14.50%		162.36%	
N	251		120		131	

[1] The time span mentioned under period refers to the beginning to the end of the year.

TABLE 1: With $\sigma = 10\%$ normalized cumulative excess returns of the different signal strategies in different periods

2 Strategy Analysis

The investment strategy is examined in more detail below. The analysis is again limited to the portfolios: Long in the strongest third and a long investment in the strongest third with simultaneous shorting of the weakest third of the value weighted portfolios.
Again, we need to be aware of why this analysis is being done. It is to make reliable profits with the described strategy, which is above those of the market. A suitable framework for this is offered by the CAPM. [8]

$$r_i - r_f = \alpha_i + \beta_i[r_{mkt} - r_f] + \epsilon_i$$

Also the Fama-French-3-Factor model as well as its usual extension by the momentum is estimated. [9]

$$r_i - r_f = \alpha_i + \beta_{mkt}[r_{mkt} - r_f] + \beta_{smb}[r_{smb} - r_f] + \beta_{hml}[r_{hml} - r_f] + \epsilon_i$$

$$r_i - r_f = \alpha_i + \beta_{mkt}[r_{mkt} - r_f] + \beta_{smb}[r_{smb} - r_f] + \beta_{hml}[r_{hml} - r_f] + \beta_m m[r_{mm} - r_f] + \epsilon_i$$

An important metric to evaluate the trading strategy is the information ratio, which measures how much additional return can be gained by the analysis.

$$IR = \frac{\alpha_i}{\sigma(\epsilon_i)}$$

The results of the portfolio analyses described above are summarized in the table 2. It can be seen that the $\alpha_{\hat{Strategy}}$ are only weakly significant. Furthermore, the difference between the $\alpha_{\hat{Strategy}}$ of the two strategies is comparatively large. This may be surprising at first, given the strongly differing cumulative returns shown in figure 1. Another significant difference can be seen in R^2. The short-long portfolio, even with the additional momentum factor, shows a maximum of $R^2 = 0.1389$ which is unusually low. In contrast, the long-only portfolio has a $R^2 = 0.9509$. However, the large difference in the various metrics that diverge in very different directions may explain why both models have a very similar $IR_{annualized}$.

Strategy	**Long upper - short lower**			**Long upper third**		
	CAPM	FF3F	FF3F + MM	CAPM	FF3F	FF3F + MM
$\hat{\alpha}_{Strategy}$	0.0020*	0.0020*	0.0017*	0.0012*	0.0012*	0.0011*
	(0.0012)	(0.0011)	(0.0010)	(0.0007)	(0.0007)	(0.0007)
$\hat{\beta}_{mkt}$	0.1216***	-0.1034***	-0.1001***	0.9702***	0.9789***	0.9413***
	(0.0251)	(0.093)	(0.081)	(0.0145)	(0.0258)	(0.241)
$\hat{\beta}_{hml}$		0.0688*	0.0424*		0.0341*	-0.226*
		(0.0352)	(0.0275)		(0.0352)	(0.0226)
$\hat{\beta}_{smb}$		-0.0860**	-0.0288*		-0.0412*	-0.0159**
		(0.0372)	(0.0198)		(0.0372)	(0.0041)
β_{mom}			0.0834**			-0.1012***
			(0.0314)			(0.0014)
N	251	251	251	251	251	251
R^2	0.0863	0.1263	0.1389	0.9470	0.9486	0.9509
R^2_{adj}	0.0826	0.1157	0.1204	0.9468	0.9480	0.9501
$IR_{annualized}$	0.3749	0.3897	0.3972	0.4005	0.4117	0.4211

[1] The standard deviation of the respective coefficients is shown in parentheses below the estimated value.

[2] *** $p-value < 0.01$, ** $p-value < 0.05$, * $p-value < 0.1$

TABLE 2: CAPM and Multi-factor model (Monthly Data, February 2000 - December 2020)

3 Strategy as part of a diversified portfolio

However, the question remains whether this strategy helps to create a better or more diverse portfolio. To address this question, this section extends the analysis to two additional financial instruments. This is to test the robustness of the strategy in preventing old data redundancy. The Vanguard Total Stock Market ETF (VTI) and the Vanguard Total Bond Market ETF (BND) are the instruments considered as proxies for the market portfolio and the risk-free interest rate, respectively. For the final analysis, the mean-variance portfolio is formed from the strategy, the market portfolio and the risk-free investment. This portfolio, when constructed, minimizes the variance while maximizing the return. It brings the highest return per unit of risk borne. The mean-variance portfolio is compared with a simple 60-40 bond to market portfolio strategy. The respective shares of the different instruments are shown in table 3. As expected, the Sharp ratio of the mean-variance portfolio is significantly higher than that of the simple 60-40 strategy. It is interesting to see that the skewness strategy is shorted in this portfolio and a very high proportion is invested in bonds. This may be due to the long time period and the relatively high returns of bonds in the early 2000s. [10]

The very small share of the past Skewness signal portfolio in the mean variance portfolio suggests that the strategy is not particularly strong and should not be used as a basis for investment. However, this does not diminish the overall strength of the mean-variance portfolio compared to

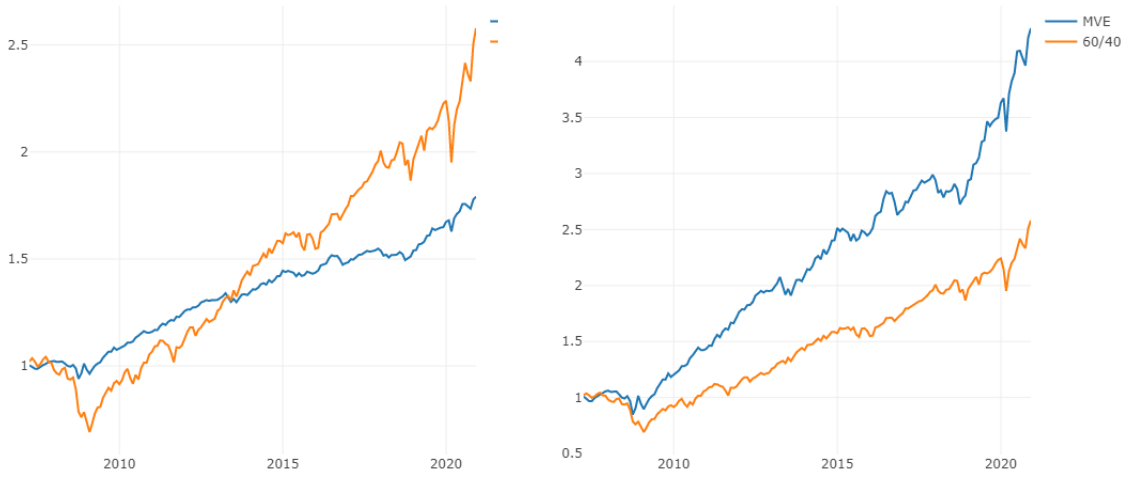
the naively constructed 60-40 portfolio. Especially the effect after risk adjustment is dramatic 3b. Shown in figure 3 The weakness of the signal based of past skewness of the returns described

Portfolio	**Mean-Variance-Portfolio**	**60%/40% Portfolio**
Weight Bonds	88.00%	60%
Weight Skewness	-5.70%	0%
Weight Market	17.70%	40%
Cumulative return[2]	329.68%	158.06%
Mean	3.98%	3.30%
Standard Derivation	3.88%	10%
Sharp Ratio	1.0402	0.1249

[1] All performance measures are annualized apart from the mean

[2] The cumulative returns are normalized with $\sigma = 10\%$

TABLE 3: Weights of investments and performance measures for different portfolios (April 2007 - December 2020)



(A) Mean-Variance Portfolio against 60-40 Portfolio

(B) Mean-Variance Portfolio against 60-40 Portfolio with standardized variance

FIGURE 3: Mean Variance portfolio against 60% in the Vanguard Total Stock Market ETF (VTI) and 40% in the Vanguard Total Bond Market ETF (BND)

here has already been discovered by Conrad, Jennifer and Dittmar, Robert F and Ghysels, Eric [11]. The authors come to similar results. They derive an alternative signal from the ex-ante skewness and thus achieve a stronger result and higher returns.

References

[1] William Leigh et al. “Trading with a stock chart heuristic”. In: *IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans* 38.1 (2007), pp. 93–104.

[2] Theis Ingerslev Jensen, Bryan T Kelly, and Lasse Heje Pedersen. *Is There A Replication Crisis In Finance?* Tech. rep. National Bureau of Economic Research, 2021.

[3] Turan G Bali, Robert F Engle, and Scott Murray. *Empirical asset pricing: The cross section of stock returns*. John Wiley & Sons, 2016.

[4] Congming Mu, Weidong Tian, and Jinqiang Yang. “Portfolio choice with skewness preference and wealth-dependent risk aversion”. In: *Quantitative Finance* 19.11 (2019), pp. 1905–1919.

[5] Diego Amaya et al. “Does realized skewness predict the cross-section of equity returns?” In: *Journal of Financial Economics* 118.1 (2015), pp. 135–167.

[6] Amado Peiro. “Skewness in financial returns”. In: *Journal of Banking & Finance* 23.6 (1999), pp. 847–862.

[7] Torben G Andersen. “Return volatility and trading volume: An information flow interpretation of stochastic volatility”. In: *The Journal of Finance* 51.1 (1996), pp. 169–204.

[8] Kent L Womack and Ying Zhang. “Understanding risk and return, the CAPM, and the Fama-French three-factor model”. In: *Available at SSRN 481881* (2003).

[9] Michael J Cooper, Roberto C Gutierrez Jr, and Allaudeen Hameed. “Market states and momentum”. In: *The journal of Finance* 59.3 (2004), pp. 1345–1365.

[10] Charlotte Christiansen. “Macroeconomic announcement effects on the covariance structure of government bond returns”. In: *Journal of Empirical Finance* 7.5 (2000), pp. 479–507.

[11] Jennifer Conrad, Robert F Dittmar, and Eric Ghysels. “Ex ante skewness and expected stock returns”. In: *The Journal of Finance* 68.1 (2013), pp. 85–124.