Making a Bet at a Right Time : Style and Volatility Timing Abilities of Korean Equity Hedge Funds

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Abstract

Korean hedge funds are institutionalized active investment strategies formed by the registered special private collective investment vehicles managed by Korean fund managers with leverage allowed up to 400% of the net asset value. Since the very first Korean equity hedge fund was launched on December 28, 2011, there are 549 different funds with varying strategies and aggregate assets under management at KRW11.5 trillion, equivalent to USD10 billion, as of July 24, 2017. Many hedge fund managers believe they are skilled at stock picking and market timing. If an active hedge fund manager is skilled in style timing, it makes sense to be particularly active in the volatile phase of the specific style factor, as the phase offers a largest risk-adjusted reward to the skill. We have investigated risk factor exposures such as size, value, and momentum in 25 survivorship bias-free individual equity hedge funds with net asset value above

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KRW50 billion out of the 549 universe to reclassify them according to their systematic style-tilting volatility, volatility-timing, and Treynor and Mazuy (1966) market timing indicators. To the best of the authors' knowledge, it is the first research of hedge fund strategies to use daily net asset value data of individual hedge funds. We then evaluated the relationship between the three market-timing indicators to the annual excess returns of reclassified quintile hedge fund groups to identify the truly talented active style and volatility timers. Identification of the talented market and volatility timer a priori will enhance the investors' expected risk-adjusted returns in the fund of hedge funds design and investment.

[1] Introduction

As some argue that well-known and heavily invested strategies that are easy to implement on a systematic basis are forms of beta rather than alpha, many also consider a static exposure to value or small capitalization stocks to be beta. Experience also tells us that in a rising risk environment, some active strategies act very much like conventional betas. One of the well-accepted definitions of the pure alpha strategies is the combination of 1) low correlations to equity, credit and other market-based risk premia, 2) low correlations to changes in volatility, and 3) being defensive in risk-off environments. Therefore, it is crucial for understanding how the strategy is likely to perform in various phases of market stress.

Recalling the past short volatility behavior of hedge fund strategies such as equity market neutral in 2008, value and small-capitalization stocks underperformed at the same time that risk aversion spiked in equity and credit markets may be a temporary phenomenon caused by an unusual demand for liquidity. However, same temporary phenomena with different degrees of risk-aversion might happen again anytime.

Market timing in hedge funds refers to the ability of hedge fund managers adjust their risk exposures by own prediction on the changes in market trends. The core capability here should be the managers' proprietary, either systematic or discretionary, prediction ability and real guts to tilt their portfolios in advance of the peers. Previous research such as Chen and Liang (2007) find a significant return and volatility timing ability for hedge funds that are self-classified as market timers. The goal of this study is to formally test this hypothesis and to determine if Korean equity hedge funds display market timing ability in KOSPI and KOSDAQ bourses.

We test for the presence of market timing ability of Korean equity hedge funds for two important reasons. First, since its first introduction on December 28, 2011, Korean hedge funds expanded its presence with 549 different hedge funds with varying strategies and aggregate assets under management at KRW11.5 trillion, equivalent to USD10 billion,

as of July 24, 2017. It is possible to build up models employing traditional style factors that will have high explanatory power for these equity hedge fund returns and is able to detect the presence of timing skills. Second, Goetzmann, Ingersoll, & Ivkovich, (2000) pointed the lack of synchronization between hedge fund managers' trading and the reporting frequencies of their performance may lead to spuriously identify the manager as if they possess some market timing ability. Generally, the monthly performance data cannot fully capture the inter-day dynamics of active equity hedge funds. Since the Korean equity hedge funds provide its net asset value transitions in a daily frequency, there should be less concern about unwanted measurement errors coming from the lack synchronization between trading and reporting frequencies.

There are multiple sources of risk besides the market risk factor, which can produce high average returns. A number of hedge fund strategies appear to be earning risk premia; they earn returns because they are performing an economic function, which involves some form of risk transfer. We first build up the risk factors such as size, value, momentum and adopt the periodic changes in the VKOSPI as the market sentiment indicator in evaluating 25 individual equity hedge fund returns. We set the guideline of net asset value above KRW50 billion among the 549 universe based on the industry-wide notion that the specific threshold may be near to the minimum efficient size of assets under management (AuM) to implement equity hedge strategies focused to Korean stock market. We then reclassified the 25 individual equity hedge funds according to their systematic style-tilting volatility (STV), volatility-timing, and Treynor and Mazuy (TM, 1966) market timing indicators.

Our study differs from to the existing literature in three ways. First, we went beyond the previous work by establishing daily Fama-French equity risk factors such as Market, SMB, and HML using the investment universe of all constituents of KOSPI and KOSDAQ and models to the historical split-adjusted prices of the selected individual Korean equity hedge funds. We constructed 1-, 3-, 6-, and 12-month momentum factors and confirm the previous work on momentum profits in some of the active market timing equity hedge funds. Second, instead of simply adopting Treynor and Mazuy (1966) model to measure the market-timing ability of each hedge fund manager, we defined the daily STV as a measure to quantify the amount of variation or dispersion of a set of individual fund's style exposures. Third, we evaluated the relationship between the three market-timing indicators; style-tilting volatility, volatility-timer, and Treynor and Mazuy market timer, to the annual excess returns and Sharpe ratios of reclassified quintile hedge fund groups to identify the truly talented active style and volatility timers. Some hedge funds employing a wider range of volatility timing behavior demonstrated an enhanced risk-adjusted returns, while some of the active style bets did not necessarily result in consistent outperformance compared to the peer managers.

[2] Data, Models, and Factors

2.1 Data Description

KOSPI, KOSDAQ, VKOSPI daily closing market price data was downloaded from Quantwise. We initially take daily net asset value, the number of outstanding shares of 28 large equity hedge funds[1] since the inception dates from a database of Korea Securities Depository ("KSD"), in-house Simone Investment Managers, and Trinity Asset Management's databases. There are two requirements of equity hedge funds to be included in our research. First, fund's AUM must be over KRW50[2] billion. Second, we include funds from the inception before March 2017. Short management terms mean not enough time series even in daily frequency to analyze and probably end up some outliers. We then excluded three hedge funds and there are total 25 equity hedge funds which meet our requirements. Due to a limited number of active equity hedge funds with qualifiable size of net asset value (NAV) threshold, our analysis mostly focused from January 2015 to the end of July 2017 period.

Hedge funds compute a NAV each day after the market close in Seoul and report to KSD. This NAVs reflects fair-value pricing including the best estimates of infrequently traded securities. In order to calculate the total returns of the historical time series data since the inception of the funds, the downloaded KSD daily net asset value ("Raw Price" or "Business NAV") needs to be modified into the historical split-adjusted price according to the following three formulas:

1) Since our hedge fund sample contains only living funds as of our sampling date with no treatment for the closing date or month, we are aware that there is a possibility of survivorship bias. According the internal data by Korea Investment & Securities Co., Ltd, one of the major prime brokerage service providers, total 22 equity hedge funds were liquidated since March 2012 with total average AuM of the last six months before the final closure were KRW 0.441 trillion (average 20bn/fund). During our sample period since January 2015, 12 equity hedge funds were liquidated with their total periodic average AuM of KRW 0.139 trillion (average 11.58bn/fund). As of the date of this article, 77% of AuMs are dedicated to equity hedge and multi-strategies, which translates around AuMs of KRW 8.86 trillion. Therefore, the six-month average total individual AuM of those closed funds of KRW 0.139 trillion is matching to our sampling period, which represents 1.19% of total equity hedge funds' AuM. Therefore, the depth and breadth of the survisorship bias during our sample period might be immaterial. Lastly, Korean hedge funds report net asset value data to Korea Securities Depository and Korea Financial Investment Association on a daily basis since the inception of the funds, there is no possibility of backfill bias in our sample.

2) Korean hedge funds are similar type of the U.S. liquid alternative mutual funds, which are subject to the restriction, outlined in Section 18(f) of the Investment Company Act of 1940, which states that mutual funds must retain a coverage ratio of at least 300%; that is, total assets divided by liabilities must be at least 300%. These hedged mutual funds are in competition with those privately placed equity-strategy focused hedge funds. According to McCarthy, David, "Hedge Funds versus Hedged Mutual Funds: An Examination of Equity Long/Short Funds", Journal of Alternative Investments, Winter 2014., the average size of 47quity long/short hedged mutual funds is U$425.9 and the median fund size is U$49mn. We choose the AuM hurdle of KRW 50bn as the minimum efficient size of Korean equity hedge funds based upon the median fund size data of U.S. hedged equity long/short mutual funds.

[Formula 1]

$$\text{Historical Split Adjusted Price}_T = \text{Daily Raw Price}_T \times \prod_{t=1}^{T} \text{Split Ratio}_t$$

[Formula 2]

$$\text{Split Ratio}_t = \frac{\textit{Closing NAV on Dividend Date + Dividend Per Share}}{\textit{Closing NAV on Dividend Date}}$$

[Formula 3]

$$\text{Fund's Daily Log Returns} = \ln\left(\frac{\textit{Today's Historical Split Adjusted Price}}{\textit{Previous Business Day's Historical Split Adjusted Price}}\right)$$

2.2 Factor description

We assume that the analyzing the daily returns of Korean equity hedge funds can be started by Fama-French-Carhart (1997) four-factor and the VKOSPI as an additional factor. We get daily share price, a book to market equity (P/B), and market capitalization data of listed companies in KOSPI and KOSDAQ markets from Quantwise database, so did SMB, HML, MOM, and △VKOSPI risk factors. We also included delisted companies during the sampling period in order to eliminate the survivorship bias. We divide stocks into three groups (High 30%, Mid 40%, and Low 30%) by market capitalization and P/B to get SMB and HML factors. We use the daily return of KIS 3-month CD rate as the proxy for the risk-free rate. Then we acquire excess return of the market portfolio.

In order to identify the hedge fund's preference of time lag and distinguish long-short strategy between momentum factors, we include 1-, 3-, 6- and, 12-month lagged momentum factors. Then, our daily hedge fund returns can be characterized by an eight-factor model expanded from Fama-French-Carhart (1997) foundation. These factors are the excess returns of the KOSPI as a proxy of the market portfolio (xKOSPI), the excess returns of small capitalization versus large capitalization stocks (SMB), the excess returns of value versus growth stocks (HML), the excess returns of high past return versus low past return stocks (MOM) in 1-, 3-, 6-, and 12-month observation windows[3]. As in Cho (2016), to account for volatility timing, the returns of the implied volatility indicator are estimated by comparing contemporaneous values of the VKOSPI to its previous 75-day time series means (σVKOSPIt-75; △VKOSPI).

In Exhibit 1, we provide the descriptive statistics of the hedge funds and market-style returns[4]. We observe that the hedge funds cannot outperform the KOSPI Index where the median hedge fund has an excess return of 7.75% per annum versus market return of 9.9%. We also observe that the most extreme

3) There is no return-overlapping problem in our periodic momentum factors since we set the non-overlapping periodic observation windows such as MOM(1) from Nov 1 to Oct 2; MOM (3) from Oct 1 to July 2; MOM (6) from July 1 to Jan 2, and so on.

4) In this exhibit, to calculate the descriptive statistics of market styles, we make a fund which invests on each factor. Then we get risk profiles of that fund. In the case of SMB style, we make a SMB Style fund by cumulative product of (daily risk premiums of SMB +1)

daily loss on a style is due to 1-month momentum (-16.5% in a single day). MDD in the Exhibit 1 represents maximum drawdown and simple beta is calculated for the xKOSPI returns. The mean and volatility are annualized returns assuming 250 trading days per year, while the MDD is a daily return. Note that for the styles we use the reduced data period from January 2015 to July 2017, while for the hedge funds we can use the returns when they are only available.

Exhibit 1. Descriptive Statistics of data and factors

		Mean	Volatility	Skewness	Kurtosis	MDD*	Beta**
Hedge Funds	Top 10%	28.93%	9.09%	0.52	4.18	-1.94%	0.28
	Median	7.75%	4.57%	-0.16	2.16	-3.34%	0.10
	Bottom 10%	1.35%	3.69%	-0.36	1.20	-11.34%	0.04
Styles	xKOSPI	9.9%	11.9%	-0.36	2.00	-17.6%	1.00
	SMB	22.6%	8.7%	-0.61	3.51	-14.9%	0.03
	HML	23.6%	10.4%	0.46	2.68	-15.6%	0.02
	MOM (1)	-6.0%	5.1%	-0.42	1.23	-16.5%	-0.04
	MOM (3)	0.5%	5.0%	0.12	1.72	-7.6%	0.00
	MOM (6)	4.2%	5.0%	0.99	5.10	-5.7%	-0.03
	MOM (12)	-4.0%	4.4%	-0.20	0.88	-14.6%	0.00
	△VKOSPI	-390.1%	258.4%	0.86	1.16	-100.0%	-3.03

2.3 Model description

In his Return-Based Style Analysis (RBSA) paper, Sharpe (1992) used major four factors such as large (medium and small) sized value (growth) stocks to distinguish funds' management style. Since we are more focused on the way hedge funds change their risk exposures to each factor according to their market and volatility timing ability, we use excess returns of each risk factors rather than stock indices classified by styles such as Value, Growth, Small, Medium, and Large.

As seeking forward-looking estimates of risk exposures to reflect future hedge fund performance more accurately, our RBSA model calculates daily risk exposure and its transitions for the optimized weights of risk factors by calibrating single hedge fund's excess returns. Since the largest correlation is 0.20 between SMB and HML factors during our data period, we can assume each factor premium is near-orthogonal to each other.

Exhibit 2 shows the pairwise correlations between our style factors. Most of the correlations tend to be below 0.2, except the correlation between SMB and HML. The highest negative correlations are between market and △VKOSPI at -0.153. Therefore, some material diversification benefits might be expected by combining multi-factors into one hedge fund of hedge funds portfolio.

Exhibit 2. Pairwise Factor Correlation Matrix

	xKOSPI	SMB	HML	MOM(1)	MOM(3)	MOM(6)	MOM(12)	△VKOSPI
xKOSPI	1.000							
SMB	0.047	1.000						
HML	0.018	0.203	1.000					
MOM (1)	-0.088	-0.006	-0.002	1.000				
MOM (3)	0.005	-0.005	0.007	0.077	1.000			
MOM (6)	-0.083	0.014	-0.037	0.047	0.050	1.000		
MOM (12)	-0.011	-0.047	-0.043	-0.009	0.002	-0.016	1.000	
△VKOSPI	-0.153	-0.003	-0.012	0.029	-0.052	0.128	-0.010	1.000

To improve the accuracy of our return-based style analysis, we adopt the concept of smoothness in Dynamic Style Analysis (DSA) in Markov (2004). With time-saving 1-month moving window-based DSA, we assume that Korean equity hedge funds keep their style at least for a month.

[Equation 1]

$$R_t = \beta_{SMB,t}X_{SMB,t} + \beta_{HML,t}X_{HML,t} + \beta_{mkt,t}X_{mkt,t} + \beta_{VKOSPI}X_{VKOSPI,t} + \beta_{MOM\ 1m}X_{MOM\ 1m} + \beta_{MOM\ 3m}X_{MOM\ 3m} + \beta_{MOM\ 6m}X_{MOM\ 6m} + \beta_{MOM\ 12m}X_{MOM\ 12m}$$

Subject to

$$-1 \le \beta_i \le 4, \quad \forall i$$

$$1 \le \sum_{i=1}^{n} \beta_{i,t} \le 4$$

$$\sum_{i=1}^{N}\sum_{t=1}^{n}(\beta_{i,t} - \beta_{i,t-1})^2 \le d \quad \text{(Smoothness Condition)}$$

R_t means daily excess return of hedge funds' NAV at time t, $\beta_{i,t}$ means daily risk exposures of style factor i at time t, $X_{i,t}$ means daily excess return of style factor i at time t, and d means the limitation on changes of each style exposures in a day.

In our 1-month window RBSA, each factor exposure can move up over 100% and below 0% because the hedge funds can use short selling as well as leveraged investing. However, we limited each factor exposures up to 400% according to the prevailing regulatory limit for the Korea-registered special private collective investment trusts. Therefore, the sum of exposures is limited from 100% to 400%. The last constraint is a smoothness condition as in Markov (2004), where the constraint can compress the responsiveness of the style drift coefficient within a pre-defined range.

We estimate the eight-factor model from Equation (1) for each hedge fund to investigate the sensitivities or exposures to each style. The estimation results are displayed in Exhibit 3, where each panel contains the estimated style exposures. The market exposures of these funds are around unity, as can be expected from equity hedge funds. We see that these hedge funds have a positive exposure to the market and 1-, 6-, and 12-month momentum factors, but have neutral exposures to value

and volatility factors, which implies that the periodic momentums are the most important styles that average hedge funds are likely to bet to momentum styles in various terms.

Exhibit 3. Estimation of Style Exposures

	xKOSPI	SMB	HML	MOM(1)	MOM(3)	MOM(6)	MOM(12)	△VKOSPI
Mean	20.22%	7.72%	2.60%	18.79%	9.98%	21.37%	21.38%	0.09%
Median	18.94%	7.73%	3.25%	19.63%	11.03%	20.93%	22.17%	0.07%
Maximum	39.37%	14.46%	10.91%	36.38%	20.57%	50.82%	31.07%	0.41%
Minimum	2.96%	-7.75%	-11.86%	6.58%	-0.71%	13.68%	13.99%	-0.48%
Std. Dev.	8.58%	4.40%	3.93%	5.67%	6.10%	7.22%	4.68%	0.16%
Skewness	0.52	-1.42	-1.65	0.61	-0.18	2.74	-0.16	-1.42
Kurtosis	0.33	5.04	6.98	2.91	-0.79	10.82	-0.79	6.41
Jarque-Bera	1.14	23.92	42.00	6.27	0.92	107.4	0.89	34.16
Probability	0.57	0.00	0.00	0.04	0.63	0.00	0.64	0.00
Sum	5.05	1.93	0.65	4.70	2.50	5.34	5.35	0.02
Sum Sq. Dev.	18.41%	4.83%	3.85%	8.03%	9.31%	13.03%	5.47%	0.01%
Observations	25	25	25	25	25	25	25	25

One of our hypothesis is that managers who change risk exposures frequently have a higher timing ability as they might know something that their peers don't. Thus, we use the standard deviation of risk exposures for each risk factors defined as STV to be a proxy for the manager's style timing behavior. After ranking the hedge funds by their size of average STVs[5], we reclassify our sample hedge funds into quintile groups by the size of their average STVs.

This leads us to the following regression model where RHFit is daily excess returns of individual hedge fund.

[Equation 2]

$$\Re_{it}^{HF} = \alpha + \sum_{i=1}^{7}\sum_{t}^{n} \beta_{it}\Re_{it}^{F} + \sum_{t}^{n} \lambda_t LN\left(\frac{\sigma_t^{VKOSPI}}{\sigma_{t-75}^{VKOSPI}}\right) + \varepsilon_{it}$$

[Equation 3]

$$\beta_{it} = \beta_{iA} + \sum_{i=1}^{7}\sum_{t}^{n} \gamma_{it} \cdot \Gamma_{it} + \eta_{it}$$

where R^{F}_{it} = xKOSPIt, SMBt, HMLt, MOM(1)t, MOM(3)t, MOM(6)t, MOM(12)t; β_{iA} is the average exposure to each style, λ_t is the volatility timing parameter at time t, γ_t is the style timing parameter at time t, Γ_t is the style return at time t and η_t is a style-specific error term. Equations (2) and (3) can be used for style timing measure on each of the seven remaining styles.

A successful equity hedge fund manager with market timing skills is able to increase exposure to the styles of higher expected returns to realize a convex relationship between the fund's return and the better-performing styles. Eq (2) is designed to examine

5) As a result of Equation 1, we get risk exposures of each factor. To get a STV of each hedge fund, we suppose that fund invest to each factor in equal weight. It means that $\sigma^{HF} = \sqrt{\sigma^2_{XKOSPI} + \cdots + \sigma^2_{VKOSPI}}$.

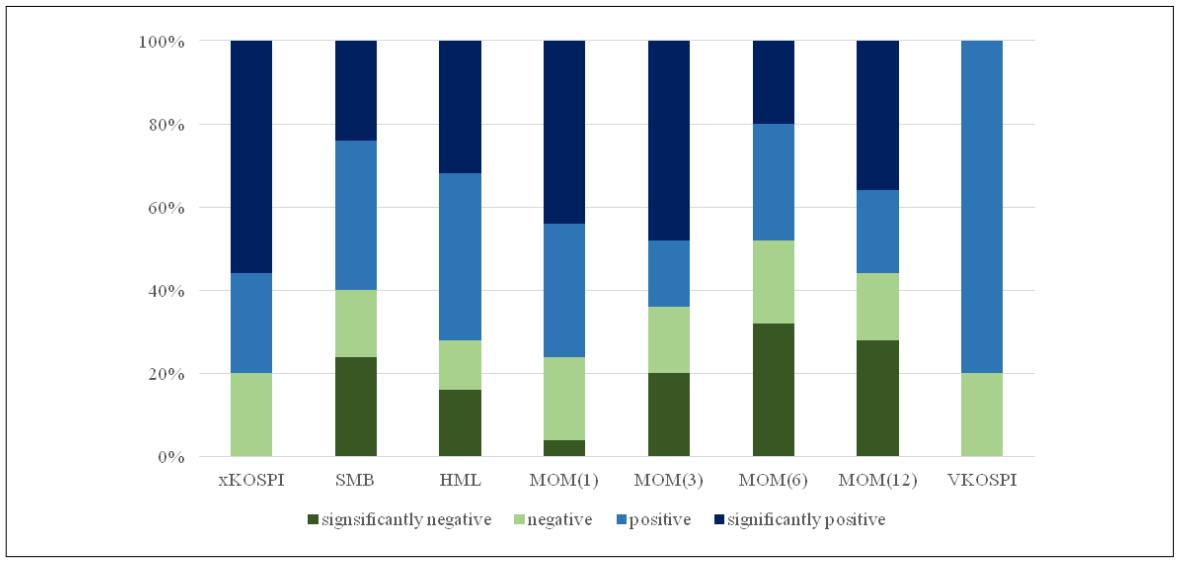
combined timing ability for the evidence of both style and volatility timing. While Chen and Lian (2007) adopted the difference between implied and realized volatilities to catch the evidence of certain hedge fund managers' ability to time the stock market volatility, λt in Eq (2) is to measure the hedge fund managers' dynamic capacity to view the stock market volatility in a more adaptive fashion. Therefore, significantly negative λt indicates Korean equity hedge fund managers' volatility timing ability with respect to the KOSPI market implied volatility.

In Eq (3), we use Treynor and Mazuy (1966) model to measure single hedge fund manager's style timing ability, which calculates the slope coefficient between daily factor exposures and the factor's risk premiums. The size of slope coefficient γ_t represents how well a manager times the style. When the actual return of the style factor is large, as a manger increases her exposure to that factor, the slope coefficient gets larger. Therefore, the larger the slope coefficient, the timely the manager catches the style opportunity. Then we can use this slope coefficient to compare style timing ability among managers.

In analyzing single manager's timing ability by style factors, we calculate the slope coefficients[6] for every hedge fund and classified them into four groups. The significantly Positive Group (Dark Blue) has the coefficient over 1, the Positive Group (Navy Blue) has coefficient between 0 and 1, the Significantly Negative Group (Heavy Green) has a coefficient below -1, the Negative Group (Yellow Green) has a coefficient between 0 and -1. Then the figure is shown as a percentage of the total samples for every risk factor.

Exhibit 4 has four implications. First, around 40% of hedge funds in our sample have significantly positive 1- and 3-month

Exhibit 4. Timing Abilities by Style Factors



6) Slope coefficient Is $\Gamma_{l,t}$ value in Equation 3 below. It means market timing ability of hedge fund manager because it measures correlation between changes in exposures and actual return in that exposure.

momentum style and more than 30% of the funds have the significantly positive value style. Second, less than 30% of the funds have the significantly positive size bet style, which is somewhat less than common beliefs of the hedge fund managers' small-cap preferences seeking the size premium. Third, the longer the momentum lags, the lower the hedge funds' momentum timing ability. Lastly, most hedge fund managers have positive VKOSPI timing abilities but the significance level is low. Any significant style factor means that the managers respond to adjust their risk exposures in a more discernable fashion than their peers. Since there are no significant positive hedge funds categorized in the VKOSPI factor, the implied volatility may not be a major risk factor for Korean equity hedge fund managers.

Exhibit 5. Annual Contribution of Significant Timing Parameters

	% of Positive (1)	Average Timing Parameter (2)	Average Daily Positive Returns (3)	Average Daily Negative Returns (4)	Annual Return Contributions (5)
xKOSPI	80%	0.97	0.53%	-0.57%	1.239%
SMB	60%	0.50	0.12%	0.05%	0.076%
HML	72%	0.59	0.10%	0.08%	0.084%
MOM (1)	80%	1.25	-0.04%	-0.01%	-0.145%
MOM (3)	64%	0.13	0.00%	0.00%	0.000%
MOM (6)	52%	0.33	0.01%	0.02%	0.003%
MOM (12)	32%	-0.65	-0.02%	-0.01%	-0.023%
△VKOSPI	80%	0.00	-2.79%	0.02%	0.000%

In Exhibit 5, we showed the estimation results from Equation (3) in more detail. The first column contains the percentage of positive estimates, the second column contains the average timing parameter value, the third column contains the average daily return for days that the market return is positive, the fourth column contains the average daily return for days that the market return is negative, and the last column is the annualized (assuming 250 trading days per annum) product of the two ((2) and (3)) columns.

We defined the daily STV as a measure to quantify the amount of variation or dispersion of a set of individual fund's factor exposures. A low STV indicates that the fund manager tends to be close to the mean (or the expected) factor exposures since the inception of the fund, while a high STV indicates that the fund manager is spread out over a wider range of factor exposures, thus employs active style timing of the portfolio management. Next, we reclassify our sample into the quintile equally weighted portfolios in the order of the magnitude of STV to evaluate the style timing ability at both specific and aggregate levels.

If hedge funds time style and volatility, then to what extent does this management activity result in better risk-adjusted returns? To answer

this question, we examine the Sharpe ratios and the significance of the eight-factor alphas.

In Exhibit 6, not only Sharpe's ratios are excellent, but the annual returns of High STV Group are also of economic significance. Due to their ability to time the best-performing styles, High STV Group of the Korean equity hedge funds were able to generate an extra return ahead of the general stock market while maintaining very low sensitivity to the KOSPI market. It is also observed that those overly active style rotating managers as well as overly inactive style timers are significantly underperforming the market.

Exhibit 6. Equity Hedge Fund Performance by Style-Tilting Volatility Classified Groups

	Lowest STV	Low STV	Medium	High STV	Highest STV
Mean Returns (p.a.)	4.47%	8.04%	6.22%	19.36%	3.11%
Standard Deviations (p.a.)	2.50%	4.06%	3.85%	5.51%	5.46%
Maximum Drawdown (day)	-2.21%	-2.93%	-3.65%	-1.85%	-5.71%
Sharpe's Ratio	1.79	1.98	1.62	3.56	0.57
Skewness	-0.15	-0.30	-0.49	0.26	0.01
Excess Kurtosis	-1.72	-1.51	-1.44	-1.98	-2.69
Beta to KOSPI	0.08	0.10	0.15	0.23	0.22
Adjusted-R2	0.15	0.12	0.25	0.23	0.22
P-Value (alpha)	0.04	0.00	0.00	0.00	0.72
P-Value (gamma)	0.59	0.10	0.02	0.11	0.21

In Exhibit 7, high and highest λ_t groups (means active implied volatility timers) demonstrate consistently higher outperformed in terms of annual mean returns and Sharpe's ratios than the low and lowest λ_t groups (means inactive implied volatility timers). Unlike the case in Exhibit 5, extremely active volatility timers outperformed the market and the peers in both absolute and risk-adjusted returns, while maintaining very low portfolio sensitivities to the KOSPI market. Furthermore, High STV group in Exhibit 6 and Highest λ_t group in Exhibit 7 demonstrated positive skewness in their return profile, which is well regarded by Mark Anson[7] (2013).

Another interesting finding in Exhibit 7 is that, in contrast to Mamaysky, Spiegel, and Zhang (2008) and others of a negative relationship between α and β due to estimation process, Korean equity hedge funds identified with the significant return and volatility timing ability (significant and positive β_t and λ_t) have also positive significant abnormal performance (significant and positive α_t). This reflects the fact that even after the portion of return explained by timing ability is accounted for, still leaves a significant amount of unexplained performance in the intercept estimate. This

7) In his interview at CFA Institute Conference, Dr. Mark Anson, the former CIO at CalPers and the current CIO at Commonfund as of this writing, mentioned that the expected quality of a hedge fund manager is a function of additional return, minimal volatility, a bias towards positive returns, and less big blowups. His comment can be expressed in formula written as: $E[U] = \alpha - \beta_1\sigma + \beta_2(Skewness) - \beta_3(kurtosis)$

positive αt should be interpreted as an existence of managers' stock selection ability as well as the combined effect of other charges including the managers' carry.

Exhibit 7. Equity Hedge Fund Performance by Volatility-Timing Classified Groups

	Lowest λ_t	Low λ_t	Medium	High λ_t	Highest λ_t
Mean Returns (p.a.)	1.91%	4.39%	10.46%	9.85%	13.93%
Standard Deviations (p.a.)	7.40%	4.06%	3.83%	7.85%	4.38%
Maximum Drawdown (day)	-13.47%	-4.02%	-1.56%	-8.20%	-1.54%
Sharpe's Ratio	0.26	1.08	2.73	1.25	3.18
Skewness	-0.46	-0.20	-0.31	-0.59	0.04
Excess Kurtosis	-0.59	-0.94	-0.91	11.62	-2.22
Beta to KOSPI	0.12	0.09	0.12	0.03	0.22
Adjusted-R2	0.06	0.10	0.15	0.01	0.30
P-Value (alpha)	0.43	0.03	0.00	0.46	0.00
P-Value (gamma)	0.54	0.25	0.05	0.06	0.23

[3] Robustness Check

While Henriksson and Merton (HM) (1981) sees the economic value of timing will be that of call option payoffs, Treynor and Mazuy (TM) (1966) sees that managers can demonstrate a convex relationship between their portfolio returns to the market by modifying their portfolio risk exposures based on their forecast of market returns. We investigate the timing ability of hedge funds by estimating market timing equation for TM adjusted for our eight-factor environment :

[Equation 4]

$$\Re_{it}^{HF} = \alpha + \sum_{i=1}^{7}\sum_{t}^{n}\beta_{it}\Re_{it}^{F} + \sum_{t}^{n}\lambda_t LN\left(\frac{\sigma_t^{VKOSPI}}{\sigma_{t-75}^{VKOSPI}}\right) + \sum_{t}^{n}\gamma_{TM}\left(\Re_t^{F}\right)^2 + \varepsilon_{it}$$

where γ_{TM} is the TM market timing parameter.

As pointed in Busse (1999), our daily hedge fund returns are highly heteroskedastic with the nature of autocorrelation, the error terms in Eq (4) are also likely to be heteroskedastic and regression estimates are inefficient but consistent. However, unlike the model suggested by Busse (1999), we are less likely subject to an errors-in-the-variables problem since the volatility timing parameter λ_t is based on returns between contemporaneous and lagged implied volatility indicator, △VKOSPI, which is basically model-free and separately observed from the KOSPI 200 Index Options market, rather than any model-driven implied volatility estimates originated from underlying equity market index returns.

Exhibit 8 shows the estimation results from our market timing model. We see that the

lowest and low γ_{TM} groups, in other words, the hedge fund groups without market timing skills according to TM coefficient demonstrate excellent Sharpe's ratios with the significant alphas.

Exhibit 8. Equity Hedge Fund Performance by TM Classified Groups

	Lowest γTM	Low γTM	Medium	High γTM	Highest γTM
Mean Returns (p.a.)	21.47%	12.95%	4.76%	4.91%	3.60%
Standard Deviations (p.a.)	4.97%	3.53%	4.97%	4.07%	4.51%
Maximum Drawdown (day)	-1.26%	-1.62%	-3.66%	-3.68%	-7.54%
Sharpe's Ratio	4.32	3.67	0.96	1.21	0.80
Skewness	0.22	-0.10	-0.37	-0.21	-0.28
Excess Kurtosis	-1.97	-2.40	-2.21	-0.88	-0.47
Beta to KOSPI	0.21	0.16	0.19	0.10	0.09
Adjusted-R^2	0.23	0.29	0.18	0.11	0.07
P-Value (alpha)	0.00	0.00	0.50	0.02	0.65
P-Value (gamma)	0.00	0.00	0.62	0.29	0.09

We estimate the timing ability by estimating the γ_{TM} of each hedge fund in daily NAV sequence by getting a variance of each style factor to add up. In Exhibit 8, lowest and low γ_{TM} groups (means inactive market timers) demonstrate consistently higher outperformed in terms of annual mean returns and Sharpe's ratios than the high and highest γ_{TM} groups (means very active market timers according to TM coefficients). Unlike the case in Exhibit 7, inactive market timers outperformed the market than the peers in both absolute and risk-adjusted returns, while maintaining very low portfolio sensitivities to the KOSPI market.

The significance of λ_t indicates the active hedge fund managers reduce their market exposure during periods of high implied volatility. This also suggests investors can use volatility timing estimates to choose equity hedge funds that will subsequently earn higher risk-adjusted returns. The successful volatility timing to predict performance might be partly due to the clustering nature of implied volatility, which makes the forecasting of the conditional volatility relatively feasible.

We confirm the robustness of our analysis by comparing the results of our volatility-timing and TM-coefficients. Some hedge funds employing a relatively wide range of market and volatility timing behavior demonstrated a consistent market timing ability from the robustness check, while some of the highly active market bets did not necessarily result in outperformance compared to peer managers.

Exhibit 9 summaries the estimation results of Equation 4. In VT V[8] portfolio, alpha is still statistically significant, while negative TM coefficient. Same phenomena can be found

8) I is lowest and V is highest in our equal-weight five-portfolio order. Therefore, STV I is lowest in STV score, while STV V is the highest STV score in our models.

Exhibit 9. Summary Statistics of Equation 4 Estimation

Groups	alpha	SMB	HML	MKT	MoM(1)	MoM(3)	MoM(6)	MoM(12)	VKOSPI	TM	Adj-R^2
STV I	**0.00**	0.00	(0.00)	**0.08**	0.01	(0.02)	0.01	0.03	0.00	(0.37)	0.13
STV II	**0.00**	0.01	**(0.04)**	**0.10**	**0.10**	(0.04)	0.01	(0.02)	(0.00)	(1.58)	0.11
STV III	**0.00**	0.01	**(0.04)**	**0.15**	**0.06**	(0.04)	(0.01)	0.01	(0.00)	**(1.90)**	0.24
STV IV	**0.00**	0.01	(0.06)	**0.25**	(0.02)	**(0.16)**	(0.02)	0.04	0.00	(4.81)	0.19
STV V	(0.00)	(0.04)	**(0.08)**	**0.22**	(0.06)	(0.06)	(0.04)	(0.05)	(0.00)	2.50	0.19
VT I	0.00	(0.06)	(0.04)	**0.11**	0.06	0.01	0.07	(0.03)	**(0.00)**	(1.09)	0.05
VT II	**0.00**	0.01	**(0.04)**	**0.09**	**0.09**	(0.03)	0.01	(0.02)	(0.00)	(1.11)	0.09
VT III	**0.00**	0.04	(0.01)	**0.12**	0.05	(0.08)	0.05	(0.00)	0.00	**(2.93)**	0.12
VT IV	0.00	(0.01)	0.02	0.03	0.08	(0.03)	0.04	(0.03)	(0.00)	3.61	0.00
VT V	**0.00**	(0.02)	(0.06)	**0.24**	(0.03)	(0.09)	(0.03)	0.09	0.00	(2.76)	0.27
TM I	**0.00**	0.02	(0.04)	**0.30**	0.03	(0.08)	(0.04)	0.06	0.00	**(14.30)**	0.18
TM II	**0.00**	0.04	(0.03)	**0.18**	0.02	**(0.10)**	(0.00)	0.01	0.00	**(5.77)**	0.25
TM III	0.00	0.00	(0.03)	**0.18**	(0.03)	(0.09)	0.06	0.04	(0.00)	(0.91)	0.15
TM IV	**0.00**	0.01	**(0.04)**	**0.10**	**0.09**	(0.03)	0.01	(0.02)	(0.00)	(1.01)	0.09
TM V	0.00	(0.04)	(0.02)	**0.10**	0.05	(0.01)	0.04	(0.03)	(0.00)	1.83	0.06

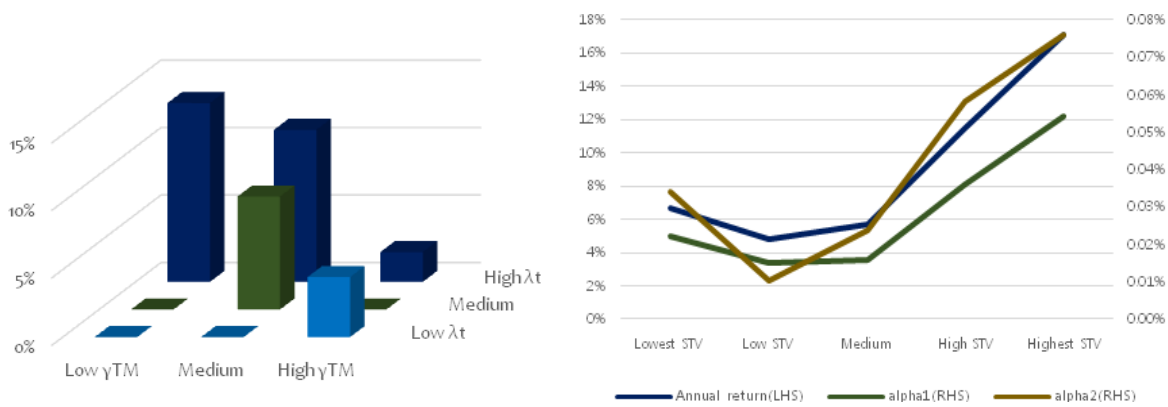
*** Bold (5% Significance)**

at portfolio STV III, IV, TM I, and TM II.

Exhibit 10 shows time variation in timing coefficients that Korean equity hedge funds' style-tilting volatility, implied volatility and TM-coefficients market timing. The timing coefficients are estimated from the combined style, return, and volatility timing specification in Eq (2~4). Alpha 1 of the Right-hand side panel of Exhibit 10 is computed from Equation 2 and Alpha 2 is from Equation 4.

The left-hand side panel of Exhibit 10 indicates annual returns are associated with hedge funds that time implied market volatility (high λ_t) to the great extent. Furthermore, the higher annual returns are achieved with hedge funds that show low market timing abilities (low γ_{TM}). The right-hand-side panel shows the consistency of our multi-factor alphas from low to high style-tilting volatilities range.

Exhibit 10 Annual Return and Alpha Variation of Style, Implied Volatility, and Market Timing Coefficients



For the robustness check, we run the same model based on weekly net asset value data by cutting every Monday, which reflects the previous Friday's closing fund performance. The suggested monthly data analysis was not practicable due to the relatively short data period from January 2015 to July 2017.

Weekly NAV data analysis demonstrates that Korean equity hedge funds identified with the significant return and volatility timing ability (significant and positive β_t and λt) continue demonstrating positive and significant Sharpe ratios which increases almost linearly with the magnitude of λ_t. On the other hand, except for low-γ_{TM} group, those lower γ_{TM} groups (inactive market timers) continue demonstrating higher mean annual returns and Sharpe's ratios than the high and highest γ_{TM} groups (very active market timers according to TM coefficients).

According to the unreported daily, weekly return-based analysis tables together with weekly return analysis after eliminating the inception and the subsequent 1-month NAV data of our sample. There is no change in the order of the risk-adjusted returns and mean annual returns even after the two-month NAV data elimination in our results, which supports our main findings of the article.

[4] Conclusion

In this article, we investigate the ability of Korean equity hedge fund managers to rotate between investment styles. In spite of their relatively short track records since their flagship equity hedge funds in the form of qualified private placement registered collective investment trust, we find empirical evidence that the equity hedge fund managers with the minimum efficient size of their AuMs are able to time the stock market. The timing results on the size and value factors are ambiguous and depend on the timing model used for performance evaluation. Our results indicate that active volatility timing Korean equity hedge funds can predict the market volatility.

Mamaysky, Spiegel, and Zhang (2008) demonstrate that a fund's alpha is composed of the contributions from the successful market timing ability and the portion due to transaction cost. Therefore, a fund's estimated alpha may become less significant in the presence of significant market timing ability. As in the discussion of mutual funds, the estimated negative alphas of equity hedge funds can also be attributed to the managers' lack of security selection skills.

As most equity hedge funds invest in individual stocks in long and short, the security selection ability does readily apply to them. The set of return-based style factors that we use in this study covers almost entire investment universe considered by most Korean equity hedge funds. While the estimated value of alpha is typically assumed to be driven by security selection ability, we speculate that in the context of equity hedge funds the esti-

mated values of the alphas are also affected by other factors such as market timing ability and transaction cost if any. We failed to confirm this with our Korean equity hedge fund sample: As relevant factors are added to the modeling process and more of the variability in hedge funds' returns is explained by positive volatility timing ability, we observe that the alpha (αt) still remains to be significant due to the existence of managers' stock selection ability as well as the combined effect of other charges including the managers' carry.

We find evidence that the active Korean equity hedge funds generate their volatility timing-based excess returns from the successful style-tilting based on their excellent predictions on style returns, audacious portfolio rebalancing well before the peers, and dynamic volatility timing with stock-selection abilities. Volatility timing has paid off in the form of higher Sharpe ratios and multi-factor-adjusted alphas, which indicate that fund performance is enhanced during the period of high implied volatility and actively managed equity hedge funds can potentially provide investors with a valuable volatility hedge. On the other hand, the traditional Treynor-Mazuy model failed to capture the market timing abilities of Korean equity hedge fund managers under our multi-factor framework.

Our results support the argument that supplementing Fama-French-Carhart four-factor with our more detailed periodic momentum and implied volatility-timing factors can improve the model explanatory power and show that the economic feasibility of the fund of hedge funds approach to the selected Korean equity hedge funds focused specifically on style and volatility timing abilities. This could lead to better asset allocation decisions and more favorable risk-return profiles.

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마켓 타이밍 투자전략: 한국 주식형 헤지펀드의 스타일 변동성 타이밍 능력

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한국형 헤지펀드는 금융위원회에 등록을 마친 사모전문투자집합기구를 통해 등록된 펀드매니저가 운용하는 기관 및 전문투자형 펀드를 의미하며 순자산의 400%까지 차입투자가 허용되는 투자기구다. 2011년 12월 28일 첫 번째 펀드가 시장에 소개된 이래 2017년 7월24일 기준으로 다양한 전략을 구사하는 549개 펀드의 총 운용자산은 11조5천억원에 달한다.

이러한 양적인 성장의 뒷면에는 헤지펀드매니저들의 종목선정과 시장 타이밍 능력에 대한 자기 확신의 역할도 있을 것으로 판단한다. 액티브한 헤지펀드 매니저가 시장 타이밍에 소질을 가지고 있다면 특정 스타일 요인의 예측되는 초과수익률 변동성 국면에 따라 예상 위험조정수익률순으로 포트폴리오를 변동시키는 것은 합리적인 판단일 것이다.

우리는 총 549개 한국형 헤지펀드 중 개별 운용자산규모가 500억원 이상인 Equity Long Bias, Equity Hedge 및 Multi-Strategy 전략형 25개 헤지펀드를 대상으로 Size, Value, Momentum 등의 스타일 요인들을 감안한 5개 그룹으로의 재분류를 실시하였다. 여기에는 Systematic Style-Tilting Volatility, Implied Volatility-Timing 및 전통적인 Treynor and Mazuy (1966) 시장 타이밍 지표가 활용되었다. 저자들이 이해하는 한 본 연구는 지수가 아닌 개별 주식형 헤지펀드의 일간 수익률 자료를 활용한 첫번째 연구로 판단된다. 위 세 가지 시장 타이밍 지표들로 순위 분류된 개별 헤지펀드군의 연간 초과수익률, Alpha 등을 통해 스타일 및 변동성 타이밍에 지속적인 재능을 시현하는 개별 헤지펀드매니저를 확인하는 과정을 통해 투자자의 위험조정 수익률을 높일 수 있는 한국형 헤지펀드를 대상으로 한 헤지펀드 재간접 투자전략의 가능성을 확인하고자 한다.

주제어: *Equity Hedge Strategy, Factor Risk Exposures, Style Timing, Volatility Timing*
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