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Market Timing with Aggregate and Idiosyncratic Stock Volatilities

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Abstract

Guo and Savickas [2005] show that aggregate stock market volatility and average idiosyncratic stock volatility jointly forecast stock returns. In this paper, we quantify the economic significance of their results from the perspective of a portfolio manager. That is, we evaluate the performance, e.g., the Sharpe ratio and Jensen's alpha, of a mean-variance manager who tries to time the market based on those two variables. We find that, over the period 1968-2004, the associated market-timing strategy outperforms the buy-and-hold strategy, and the difference is statistically and economically significant.
Keywords: Stock return predictability, CAPM, ICAPM, Idiosyncratic Volatility, Stock Market volatility.

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Economic theories, e.g., Merton's (1973) intertemporal capital asset pricing model (ICAPM), suggest that risk-averse investors require a higher excess stock market return when volatility increases.[1] Early authors (e.g., French, Schwert, and Stambaugh [1987]), however, find that realized stock market variance, MV, has negligible forecasting power for returns. In a recent study, Guo and Savickas [2005] show that the effect of MV becomes significantly positive after including realized idiosyncratic stock variance, IV, as an additional predictor. Also, IV is found to have significantly negative effects on returns, although it is positively correlated with MV. Their results suggest that early authors fail to uncover a positive risk-return tradeoff possibly because of a classic omitted variables problem: The coefficient of MV is downward biased if we do not control for IV.

IV is constructed as the value-weighted cross-sectional average of variance of stock price movements that are not explained by known systematic risk—for example, as captured by the capital asset pricing model (CAPM) or the Fama and French [1993] 3-factor model. That is, IV is a measure of average variations in stock prices that are driven only by firm-specific news. Many authors, e.g., Shalen [1993], have shown that a high level of IV could be related to a high level of dispersion of opinion about individual stocks. Therefore, as we briefly explain below, the negative relation between IV and future stock market returns is potentially consistent with the hypothesis advanced by Miller [1977].[2]

In particular, Miller [1977] argues that, as opposed to optimistic investors, the more pessimistic ones cannot express their views due to the costs and constraints of shorting individual stocks. As a result, stocks will tend to be overvalued when there is high dispersion of opinion; however, these stocks will suffer a capital loss when dispersion eventually diminishes in the future. Therefore, IV is negatively related to future returns possibly because it is a proxy for dispersion of opinion. Note that this conjecture is also supported by the cross-sectional evidence: Diether, Molloy, and Scherbina [2002], Ang, Hodrick, Xing, and Zhang [2005], and Boehme, Danielsen, and Sorescu [2006] find that stocks with higher dispersion of opinion or higher price volatility tend to have lower expected returns, especially when interacted with short sale constraints.

Guo and Savickas [2005] show that IV and MV forecast stock returns only when combined. This is because aggregate volatility tends to be higher when there is more dispersion of opinion. For example, both stock market prices and volatility increased dramatically in the late 1990s. This episode poses a challenge to Merton's ICAPM because it predicts that an increase in volatility should be associated with an increase in the equity premium and thus a decrease in stock prices [see, e.g., Guo and Whitelaw [2005]). One potential explanation is that the stock price run-up reflects a sharp increase in dispersion of opinion about technology stocks, as evidenced by a historically high level of IV during this period. This episode is admittedly somewhat unusual; however, we find that excluding it does not change our main results in any qualitative manner.

In this paper, we quantify the economic significance of Guo and Savickas' [2005] results from the perspective of a portfolio manager. That is, we evaluate the performance, e.g., the Sharpe ratio and Jensen's alpha, of a mean-variance manager who tries to time the market using MV and IV. Our analysis indicates that these two variables indeed have statistically significant market-timing abilities, which are also important economically.

For example, over the period 1968:Q4 to 2004:Q4, the annualized Sharpe ratio of the trading strategy based on MV and IV is 53 percent, compared with 33 percent for the buy-and-hold strategy. Similarly, Jensen's alpha tests show that the excess portfolio return remains significantly positive after we adjust for its loadings on systematic risk using CAPM or the Fama and French 3-factor model. These results are quite stable across time and robust to the consideration of short-sale constraints, borrowing constraints, and transaction costs. Overall, our evidence suggests that stock market returns are predictable.

Some recent authors have cast doubt on both market timing and stock return predictability. For example, Lee [1997] and Goyal and Welch [2003], among others, argue that the forecasting power of many commonly used variables—e.g., the dividend yield, the default premium, the term premium, and the short-term interest rate—have diminished substantially in the recent period. Our findings, however, suggest that their conclusion should be interpreted with caution because these authors do not use the more efficient forecasting variables, as we do in our paper.

Lettau and Ludvigson [2001] find that the consumption-wealth ratio (CAY) is a strong predictor of stock market returns; also, Guo [2006] finds that its forecasting power improves substantially when combined with MV. However, the CAY variable has some serious limitations for practitioners because these authors do not take into account the fact that macroeconomic data used in the estimation of CAY are subject to the data-release delay and periodic data revisions. To address this issue, Guo [2003] constructs the CAY variable using only information available at the time of the forecast and finds that it has negligible market-timing abilities (see also Andrade, Babenko, and Tserlukevich

[2005]). In contrast, portfolio managers can easily adopt trading strategies based on IV and MV, as investigated in this paper.

Data

We use the S&P 500 index returns, which are available at the daily frequency, as a proxy for aggregate stock market returns. The monthly risk-free rate is the yield on 3-month T-bills and we construct the daily risk-free rate by assuming that it is constant within a month. The excess stock market return is the difference between the stock market return and the risk-free rate.

As in Merton [1980] and many others, MV is the sum of squared daily excess stock market returns in a quarter:

$$(1) \qquad MV_t = \sum_{d=1}^{D_t} (R_{m,d} - R_{f,d})^2 ,$$

where $R_{m,d}$ and $R_{f,d}$ are the stock market return and the risk-free rate, respectively, for day d and D_t is the number of trading days in quarter t. The 1987 stock market crash has a confounding effect on our volatility measure; following Guo and Whitelaw [2005] and others, we replace MV for 1987:Q4 with the second-largest observation in our sample.

Similar to Campbell, Lettau, Malkiel, and Xu [2001], IV is defined as

$$(2) \qquad IV_t = \sum_{i=1}^{N_t} w_{i,t} \left[\sum_{d=1}^{D_{i,t}} e_{i,d}^2 + 2\sum_{d=1}^{D_{i,t}} e_{i,d} e_{i,d-1} \right] \text{ with } w_{i,t} = \frac{v_{i,t-1}}{\sum_{j=1}^{N_t} v_{j,t-1}} ,$$

where N_t is the number of stocks in quarter t, $e_{i,d}$ is the idiosyncratic shock to stock i in day d, $v_{i,t-1}$ is the market capitalization of stock i at the end of quarter t-1, and $w_{i,t}$ is the market share of stock *i*. We calculate the daily idiosyncratic shock using the Fama and French 3-factor model:

(3) $$e_{i,d} = \left[R_{i,d} - R_{f,d}\right] - \widehat{\alpha} - \widehat{\beta} \cdot f_d,$$

where $R_{i,d}$ is the return on stock *i*, f_d is a vector of the three Fama and French factors, and $\widehat{\alpha}$ and $\widehat{\beta}$ are ordinary least squares (OLS) estimates using daily data over the period *d*-130 to *d*-1. To obtain less-noisy estimates, we require a minimum of 45 daily observations in the OLS regression. We also exclude stocks with less than 15 return observations in a quarter and drop the autocorrelation term $2\sum_{d=1}^{D_{i,t}} e_{i,d}e_{i,d-1}$ from equation (2) if $\sum_{d=1}^{D_{i,t}} e_{i,d}^2 + 2\sum_{d=1}^{D_{i,t}} e_{i,d}e_{i,d-1}$ is less than zero. Also, as in Guo and Savickas [2005], we use only 500 stocks with the largest market capitalization measured at the end of the previous quarter. We obtain individual stock returns and market capitalization data from CRSP (the Center for Research for Security Prices) and the Fama and French factors from Kenneth French at Dartmouth College.

For comparison, in some specifications, we also include the term premium, TERM, and the stochastically detrended risk-free rate, RREL, as additional forecasting variables. TERM is the yield spread between 10-year T-bonds and 3-month T-bills, which are obtained from the Federal Reserve Board. RREL is the difference between the risk-free rate and its average in the previous 12 months. Early authors, e.g., Lee [1997], Shen [2003], and Andrade, Babenko, and Tserlukevich [2005], have investigated whether these variables have market-timing abilities. Throughout the paper, we use simple returns and our data cover the sample period 1963:Q3-2004:Q4.

Market-Timing Strategies

For simplicity, we assume that a portfolio manager can invest wealth only in the S&P 500 and 3-month T-bills. As in Guo [2006], among others, the weight of equities in the portfolio at the beginning of each quarter is

$$(4) \qquad W_{M,t} = \frac{E_t(R_{m,t+1} - R_{f,t+1})}{\gamma E_t(MV_{t+1})},$$

where $E_t(R_{m,t+1} - R_{f,t+1})$ is the expected excess stock market return, $E_t(MV_{t+1})$ is the expected stock market variance, and γ is the investor's relative risk-aversion coefficient. Thus, the weight of 3-month T-bills is $(1 - W_{M,t})$. We assume that the expected stock return is the one-quarter-ahead forecast based on a linear regression:

$$(5) \qquad E_t(R_{m,t+1} - R_{f,t+1}) = \hat{a}_t + \hat{b}_t x_t,$$

where $\hat{a}_t$ and $\hat{b}_t$ are the point estimates obtained using an expanding sample available at quarter *t* and x_t is a vector of predictive variables. We measure expected stock market variance, $E_t(MV_{t+1})$, as the average of MV from 1963:Q3 to quarter *t*.

We choose γ using two alternative methods. First, γ is set to 5, which is very close to the point estimate of 4.93, as reported by Guo and Whitelaw [2005]. Second, γ is chosen for each strategy such that the average weight of equities is equal to 1. The second method allows us to directly compare the return on the managed portfolio with the return on the buy-and-hold portfolio because the two portfolios have the same average leverage ratios. However, the other performance measures, i.e., the market-timing ability test statistic, the Sharpe ratio, and Jensen's alpha test, do not depend on γ.

We consider three specifications for expected stock returns by including (1) MV and IV; (2) MV, IV, and RREL; and (3) MV, IV, and TERM as the forecasting variables in equation (5). We estimate the initial portfolio weight, $W_{M,t}$, using the sample period 1963:Q3-1968:Q3 and use it to make the initial investment decision for 1968:Q4. We then estimate the weight recursively using an expanding sample.

Empirical Results

Chance and Hemler [2001] suggest that we can test market-timing abilities using Spearman's rank correlation between the weight of equities, $W_{M,t}$, and the excess stock return, $R_{m,t+1} - R_{f,t+1}$. We consider the two specifications for γ; however, as expected, Exhibit 1 shows that the market-timing ability test does not depend on γ. Note that, throughout the paper, ** and *** denote significance at the 5 percent and 1 percent levels, respectively. We find that the correlation is positive and highly significant for all three trading strategies, indicating that these forecasting variables have statistically significant market-timing abilities.

In Exhibit 2, we present summary statistics of *annualized* excess portfolio returns for three timing strategies as well as the buy-and-hold strategy. Again, we consider two specifications for γ: It is fixed at 5 in panel A and is chosen for each strategy such that the average weight of equities is equal to 1 in panel B. We also report the average weight of equities, $\bar{W}_M$, in panel A.

We first discuss the results in panel A of Exhibit 2. The trading strategy based on MV and IV has an annualized average excess return of 20 percent, which is substantially higher than 6 percent for the buy-and-hold strategy (row "Mean"). However, the former has an annualized standard deviation of 38 percent, which is also much higher than 17 percent for the latter (row "SD"). Overall, the strategy based on MV and IV has an annualized Sharpe ratio of 53 percent, compared with only 33 percent for the buy-and-hold strategy (row "SR"). We also investigate whether the difference between the Sharpe ratios is statistically significant using the Jobson and Korkie [1981] test with the Memmel [2003] modification; in Table 2, "$p\left(\widehat{Sh}_i - \widehat{Sh}_n\right)$" denotes the associated significance level. This test, however, needs to be interpreted with caution because, as noted by Jobson and Korkie, it has low power in small samples. With this caveat in mind, we show that the null hypothesis of no difference in the Sharpe ratios is not rejected at conventional levels. However, we bootstrap excess returns on the S&P 500 and the timing portfolio jointly and find less than a 14 percent chance of obtaining a Sharpe ratio for the buy-and-hold strategy that is higher than the MV and IV strategy. Lastly, Jensen's alpha tests show that the excess portfolio return remains significantly positive after we control for systematic risk using CAPM (row "α_{CAPM}") or the Fama and French 3-factor model (row "α_{FF}"). Also, we find that adding RREL (column "IV+MV+RREL") or TERM (column "IV+MV+TERM") to the forecasting equation tends to improve the Sharpe ratio. In particular, including TERM allows rejection of the same Sharpe ratio at the 10 percent significance level. To summarize, market-timi3ng abilities of MV and IV are both economically and statistically significant.

In panel B of Exhibit 2, we choose γ such that the average weight of equities for each strategy is equal to 1 (row "γ"). As expected, the main performance measures, e.g., the Sharpe ratio, the Jobson and Korkie [1981] test, and Jensen's alpha tests, do not change with γ. Note that the average returns differ somewhat from those reported in panel A because of the different shares in equities. For brevity, we fix γ at 5 in the remainder of the paper.

To investigate whether our results are driven by any particular event, we also examine three subsamples: 1968:Q4-1979:Q4, 1980:Q1-1989:Q4, and 1990:Q1-2004:Q4. As shown in Exhibit 3, all trading strategies produce higher excess returns and higher Sharpe ratios than the buy-and-hold strategy does in each of the subsamples. Exhibit 4 shows the accumulated wealth of one dollar invested during the three subsamples. The accumulated wealth based on the MV and IV strategy is predominantly above that for the strategy of investing only in the S&P 500 or 3-month T-bills. Therefore, in contrast with early authors, e.g., Lee [1997], we find that the superior performance of the trading strategy based on MV and IV is quite reliable across time.

Robustness Checks

We conduct a number of checks to ensure that our main results are robust. For brevity, we provide only a brief summary here but details are available upon request. (1) We conduct the market-timing ability test proposed by Cumby and Modest [1987] and find essentially the same results. (2) We consider a switching strategy: Investors hold the S&P 500 if the expected equity premium is positive and hold 3-month T-bills otherwise. Although it is very conservative, the strategy based on MV and IV generates an annualized average return and a Sharpe ratio of 6.4 percent and 47 percent, respectively, which are noticeably higher than those for the buy-and-hold strategy (as reported in panel

A of Exhibit 2). (3) We estimate conditional stock market variance using the out-of-sample forecast based on an autoregressive specification with two lags. In this case, the managed portfolio based on MV and IV has an annualized average return and a Sharpe ratio of 9.8 percent and 53 percent, respectively. (4) We consider a 25-basis-point proportional (roundtrip) transaction cost, which is in the upper range for trading the S&P 500 (e.g., Balduzzi and Lynch [1999]). The transaction cost has a relatively small effect on the results; for example, it reduces the strategy based on MV and IV by only 1.5 percent annually. (5) We use CRSP value-weighted stock market returns in place of the S&P 500 returns and find essentially the same results. To summarize, our finding that MV and IV have significant market-timing abilities appears to be quite robust.

Discussion and Conclusion

Many early authors, e.g., Samuelson [1994], have argued that stock market return predictability cannot persist, once uncovered, for at least two reasons. First, in an efficient market, investors will exploit the newly uncovered predictability until the associated profit is arbitraged away. Second, stock return predictability might simply reflect spurious data mining and thus cannot be used to form profitable trading strategies. These explanations are plausible because, as mentioned above, stock return predictability documented by early authors has indeed disappeared in the recent period.

Some recent authors (e.g., Campbell and Cochrane [1999] and Guo [2004]), however, argue that stock return predictability reflects the time-varying risk premium and thus cannot be arbitraged away. In particular, Merton's ICAPM dictates a positive relation between the conditional stock market risk and return. To exploit this relation, a portfolio manager needs to buy stocks or provide liquidity to the stock market when volatility rises—for example, as it did during the 1998 Russian default crisis—precisely the time when investors want to bail out of the market.

To summarize, our analysis indicates that the trading strategy based on MV and IV outperforms the buy-and-hold strategy, and the difference is very important economically. The proposed strategy is easy to implement and quite reliable across time; therefore, it might have important implications for portfolio management. However, investors should be cautioned that the market-timing abilities of MV and IV might not suggest an arbitrage opportunity because they could reflect time-varying systematic risk. A further investigation of this issue is warranted and we leave it for future research.

Notes

1. Strictly speaking, the positive relation between the conditional excess stock market return and variance holds only approximately because the conditional return is also affected by the hedge demand for time-varying investment opportunities. See Merton [1980] for conditions under which the effect of the hedge demand is negligible.

2. Alternatively and complementarily, Guo and Savickas [2005] also note that IV forecasts stock returns possibly because it is a measure of variance of a priced risk factor, which is omitted from standard asset pricing models (see, e.g., Lehmann [1990]).

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Exhibit 1: Chance and Hemler [2001] Market-Timing Ability Test

	MV+IV	MV+IV+RREL	MV+IV+TERM
$\gamma = 5$	0.2166 ***	0.2950 ***	0.2390 ***
$\overline{W}_M = 1$	0.2166 ***	0.2950 ***	0.2390 ***

Exhibit 2: Annualized Portfolio Excess Returns: 1968:Q4 to 2004:Q4

	Buy and Hold	MV+IV	MV+IV+RREL	MV+IV+TERM
Panel A. γ fixed at 5				
$\overline{W}_M$	1.0000	0.7160	0.8129	1.1945
Mean	0.0556	0.2007	0.3742	0.2788
SD	0.1675	0.3782	0.6231	0.4363
SR	0.3318	0.5306	0.6005	0.6390
$p\left(\widehat{Sh}_i - \widehat{Sh}_n\right)$	–	0.3153	0.1874	0.0892
α_{CAPM}	–	0.1614***	0.3173***	0.2158***
α_{FF}	–	0.1339**	0.2585***	0.1766***
Panel B. γ chosen such that the average weight is 1				
γ	–	3.5801	4.0643	5.9723
Mean	0.0556	0.2803	0.4603	0.2334
SD	0.1675	0.5282	0.7666	0.3653
SR	0.3318	0.5306	0.6005	0.6390
$p\left(\widehat{Sh}_i - \widehat{Sh}_n\right)$	–	0.3153	0.1874	0.0892
α_{CAPM}	–	0.2255***	0.3904***	0.1807***
α_{FF}	–	0.1870**	0.3180***	0.1479***

Exhibit 3: Annualized Portfolio Excess Returns: γ fixed at 5

	Buy and Hold	MV+IV	MV+IV+RREL	MV+IV+TERM
		Panel A. 1968:Q4 to 1979:Q4		
$\overline{W}_M$	1.0000	0.8617	1.2385	1.6468
Mean	-0.0017	0.1991	0.6070	0.3709
SD	0.1765	0.4918	0.9075	0.5411
SR	-0.0097	0.4050	0.6689	0.6855
		Panel B. 1980:Q1 to 1989:Q4		
$\overline{W}_M$	1.0000	0.8403	0.6976	1.3960
Mean	0.0896	0.2230	0.4111	0.3114
SD	0.1704	0.3249	0.5687	0.4726
SR	0.5257	0.6863	0.7230	0.6589
		Panel C. 1990:Q1 to 2004:Q4		
$\overline{W}_M$	1.0000	0.5239	0.5704	0.7208
Mean	0.0759	0.1870	0.1748	0.1880
SD	0.1587	0.3145	0.3148	0.3079
SR	0.4785	0.5945	0.5555	0.6106

Exhibit 4: Accumulated Wealth of $1 Invested in 1968:Q4, 1980:Q1, and 1990:Q1