Market Timing with Aggregate and Idiosyncratic Stock Volatilities

Improved performance.

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Economic theories, like Merton's [1973] intertemporal capital asset pricing model (ICAPM), suggest that risk-averse investors require a higher excess stock market return when volatility increases. Early research, however, finds that realized stock market variance, MV, has negligible forecasting power for returns (e.g., French, Schwert, and Stambaugh [1987]).

More recently, Guo and Savickas [2006] show that the effect of MV becomes significantly positive after including realized idiosyncratic stock variance, IV, as an additional predictor. IV is also found to have significantly negative effects on returns, although it is positively correlated with MV. These results suggest that early researchers may fail to uncover a positive risk-return trade-off because of a classic omitted variables problem: The coefficient of MV is downward-biased if we do not control for IV.[1]

Idiosyncratic stock variance is constructed as the value-weighted cross-sectional average of the 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] three-factor model. That is, IV is a measure of average variations in stock prices that are driven only by firm-specific news. Shalen [1993] and others have shown that a high level of IV could be related to a high level of dispersion of opinion about individual stocks. Therefore, the negative relation between IV and future stock market returns is potentially consistent with the divergence of opinion hypothesis advanced by Miller [1977].[2]

Miller [1977] argues that more pessimistic investors cannot express their views because of the costs and constraints of shorting individual stocks. As a result, stocks tend to be overvalued when there is high dispersion of opinion; stocks 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.

This conjecture is also supported by some cross-sectional evidence. Diether, Malloy, and Scherbina [2002], Ang et al. [2006], 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 in the presence of short sale constraints.

Guo and Savickas [2006] 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 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 decline in stock prices [see also Guo and Whitelaw [2006]).

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. While this result is admittedly somewhat unusual, we find that excluding it does not change our main results.

We quantify the economic significance of the results in Guo and Savickas [2006] from the perspective of a portfolio manager. We evaluate the performance (Sharpe ratio and Jensen's alpha) of a mean-variance manager who tries to time the market using MV and IV. The analysis indicates that these two variables indeed underlie statistically and economically significant market-timing abilities.

For example, from September 1968 through December 2004, the annualized Sharpe ratio of the trading strategy based on MV and IV is 53% compared with 33% for a 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 three-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 authors have cast doubt on both market-timing and stock return predictability. 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—has diminished substantially in the recent period. We suggest this conclusion should be interpreted with caution, because these authors do not use the more efficient forecasting variables as we do.

Lettau and Ludvigson [2001] find that the consumption-wealth ratio (CAY) is a strong predictor of stock market returns; Guo [2006] finds its forecasting power improves substantially when it is combined with MV. The CAY variable, however, has some serious limitations for practitioners because macroeconomic data used in the estimation of CAY are subject to 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 provides negligible market-timing abilities (see also Andrade, Babenko, and Tserlukevich [2006]). Portfolio managers can easily adopt trading strategies based on IV and MV, as investigated here.

DATA

We use the S&P 500 index returns, which are available daily, as a proxy for aggregate stock market returns. The monthly risk-free rate is the yield on three-month T-bills, and we construct the daily risk-free rate by assuming it is constant over 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, mean-variance is the sum of squared daily excess stock market returns in a quarter:

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

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 [2006] and others, we replace MV for 1987:Q4 with the second-highest observation in our sample.

Following Campbell et al. [2001], idiosyncratic variance is defined as

$$IV_t = \sum_{i=1}^{N_t} w_{i,t} \left[\sum_{d=1}^{D_{i,t}} e_{i,d}^2 + 2\sum_{d=1}^{D_{i,t}} e_{i,d} e_{i,d-1} \right] \tag{2}$$

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, $w_{i,t}$ is the market share of stock i, $e_{i,d}$ is the idiosyncratic shock to stock i in day d, and $v_{i,t-1}$ is the market capitalization of stock i at the end of quarter $t-1$.

We calculate the daily idiosyncratic shock using the Fama and French three-factor model:

$$e_{i,d} = [R_{i,d} - R_{f,d}] - \hat{\alpha} - \hat{\beta} \cdot f_d \tag{3}$$

where $R_{i,d}$ is the return on stock i, $\hat{\alpha}$ and $\hat{\beta}$ are ordinary least squares (OLS) estimates using daily data over the period $d-130$ to $d-1$, and f_d is a vector of the three Fama and French factors.

To obtain less noisy estimates, we require a minimum of 45 daily observations in the OLS regression. We also exclude stocks with fewer 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 [2006], we use only the 500 stocks with the highest market capitalization as of the end of the previous quarter. We obtain individual stock returns and market capitalization data from the Center for Research in Security Prices and the Fama and French factors from Kenneth French at the Tuck School 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 ten-year T-bonds and three-month T-bills, obtained from the Federal Reserve Board. RREL is the difference between the risk-free rate and its average in the previous 12 months. Lee [1997], Shen [2003], and Andrade, Babenko, and Tserlukevich [2006] have investigated whether these variables have market-timing abilities. Throughout this article, 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 three-month T-bills. The weight of equities in the portfolio at the beginning of each quarter is

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

where $E_t(R_{m,t+1} - R_{f,t+1})$ is the expected excess stock market return, γ is the investor's relative risk aversion coefficient, and $E_t(MV_{t+1})$ is the expected stock market variance. Thus, the weight of three-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:

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

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 reported by Guo and Whitelaw [2006]. Second, γ is chosen for each strategy so 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. 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 as the forecasting variables in Equation (5): 1) MV and IV; 2) MV, IV, and RREL; and 3) MV, IV, and TERM. We estimate the initial portfolio weight, $W_{M,t}$, for 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, $R_{m,t+1} - R_{f,t+1}$. In the two specifications for γ, Exhibit 1 shows as expected that the market-timing ability test does not depend on γ (** and *** denote significance at the 5% and 1% levels throughout). The correlation is positive and highly significant for all three trading strategies, indicating that these forecasting variables enable 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: fixed at 5 in Panel A, and chosen for each strategy so that the average weight of equities is equal to 1 in Panel B. We also report the average weight of equities, $\overline{W}_M$, in Panel A.

The trading strategy based on MV and IV in Panel A has an annualized average excess return of 20%, substantially higher than the 6% for the buy-and-hold strategy, although its annualized standard deviation of 38% is also much higher than the 17% for buy-and-hold. The strategy based on mean-variance and idiosyncratic variance has an annualized Sharpe ratio of 53%, compared to only 33% for buy-and-hold.

The fifth row in Panel A investigates whether the difference between the Sharpe ratios is statistically significant using the Jobson and Korkie [1981] test with the Memmel [2003] modification; $p(\widehat{Sh}_i - \widehat{Sh}_n)$ denotes the associated significance level. This test must be interpreted with caution because, as Jobson and Korkie note, 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. Bootstrapping excess returns on the S&P 500 and the timing portfolio jointly, we find less than a 14% chance of obtaining a Sharpe ratio for the buy-and-hold strategy that is higher than the MV and IV strategy.

Finally, Jensen's alpha tests show that the excess portfolio return remains significantly positive after we control for systematic risk using the CAPM or the Fama and French three-factor model. Adding RREL or TERM to the forecasting equation tends to improve the Sharpe ratio. Notably, including TERM allows rejection of the same Sharpe ratio at the 10% significance level.

We conclude that MV and IV enable both economically and statistically significant market-timing.

In Panel B of Exhibit 2, we choose γ so that the average weight of equities for each strategy is equal to 1 (first row). As expected, the main performance measures, whether the Sharpe ratio, the Jobson and Korkie [1981] test, or Jensen's alpha, 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. To conserve space we fix γ at 5 in the remainder of the article.

EXHIBIT 1
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***

****Significant at the 1% level.*

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
$p(\widehat{Sh}_i - \widehat{Sh}_n)$	–	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
$p(\widehat{Sh}_i - \widehat{Sh}_n)$	–	0.3153	0.1874	0.0892
α_{CAPM}	–	0.2255***	0.3904***	0.1807***
α_{FF}	–	0.1870**	0.3180***	0.1479***

***Significant at the 5% level. ***Significant at the 1% level.*

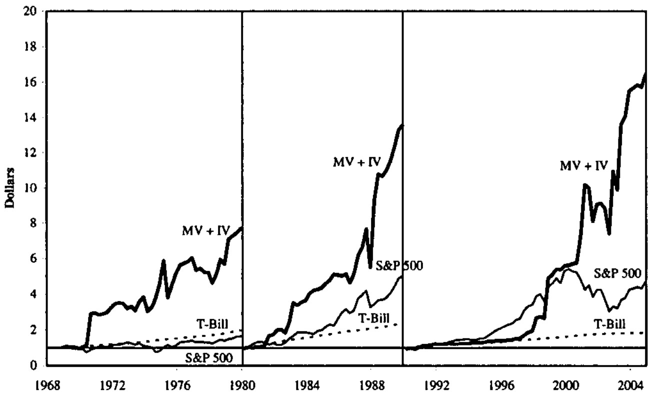
EXHIBIT 3

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



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. Exhibit 3 shows that all trading strategies produce higher excess returns and higher Sharpe ratios than the buy-and-hold strategy in each subsample.

Exhibit 4 shows the accumulated wealth of one dollar invested during the subsample periods. Wealth accumulated following the MV and IV strategy is much higher than that accumulated by investing only in the S&P 500 or three-month T-bills. We thus find that a trading strategy based on MV and IV performs reliably better over time.

ROBUSTNESS CHECKS

We conduct a number of checks to ensure that our main results are robust (details are available upon request). First we conduct a market-timing ability test proposed by Cumby and Modest [1987] and find essentially the same results.

We also consider a switching strategy. Investors hold the S&P 500 if the expected equity premium is positive and hold three-month T-bills otherwise. Although it is very conservative, the strategy based on mean-variance and idiosyncratic variance generates an annualized average return and a Sharpe ratio of 6.4% and 47%, respectively, noticeably higher than those measures for the buy-and-hold strategy (as reported in Panel A of Exhibit 2).

We estimate conditional stock market variance using an out-of-sample forecast based on an autoregressive specification with two lags. In this case, the managed portfolio based on MV and IV has annualized average return and a Sharpe ratio of 9.8% and 53%, respectively.

We consider a 25-basis point proportional (round-trip) 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 returns on the strategy based on MV and IV by only 1.5 percentage points annually.

Finally, we use CRSP value-weighted stock market returns in place of the S&P 500 returns and find essentially the same results. Our finding that MV and IV provide significant market-timing abilities appears overall to be quite robust.

DISCUSSION AND CONCLUSION

Authors including 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 we have mentioned, stock return predictability documented by early authors has indeed disappeared more recently.

Other authors including Campbell and Cochrane [1999] and Guo [2004], however, argue that stock return predictability reflects a time-varying risk premium and thus cannot be arbitraged away. Merton's ICAPM, for example, 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—such as it did during the 1998 Russian default crisis—precisely the time investors want to bail out.

Our analysis indicates that a trading strategy based on mean-variance and idiosyncratic-variance outperforms a buy-and-hold strategy, and the difference is important economically. The strategy is easy to implement and quite reliable across time; therefore, it may have important implications for portfolio management.

Yet 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. Further investigation of this issue is warranted.

ENDNOTES

The authors thank an anonymous referee for many detailed and constructive comments. The views expressed in this paper are those of the authors and do not necessarily reflect the official positions of the Federal Reserve Bank of St. Louis or the Federal Reserve System.

[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]Guo and Savickas [2006] also note that IV may forecast stock returns because it is a measure of variance of a priced risk factor that is not included in standard asset pricing models (see Lehmann [1990]).

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