Asymmetric risk premium in value and growth stocks

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Abstract

There are two competing explanations for the existence of a value premium, a rational market risk explanation, whereby value stocks are inherently more risky than growth stocks, and a market over-reaction hypothesis, where agents overstate future returns on growth stock. Using asymmetric GARCH-M models this paper tests the predictions of the two hypotheses. Specifically, examining whether returns exhibit a positive (negative) risk premium resulting from a negative (positive) shock and the relative size of any premium. The results of the paper suggest that following a shock, volatility and expected future volatility are heightened, leading to a rise in required rates of return which depresses current prices. Further, these effects are heightened for value stock over growth stock and for negative shocks over positive shocks. Thus, in support of the rational risk interpretation, with a volatility feedback explanation for predictive volatility asymmetry.

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1. Introduction

One of the most frequently used style investment strategies is value investing. Investors purchase value stocks (defined as those with a high book-to-market ratio) rather than growth stocks (defined as those with a low book-to-market ratio) in order to benefit from potential long-term over-performance of value stocks in the form of higher average returns. Moreover, there is
general recognition of the existence of such a value premium, that is, the on average greater stock market returns of high book-to-market firms over the returns of low book-to-market firms, across international stock markets (see Fama & French, 1998 for a summary of evidence).

As is well known, there is a topical debate regarding the reasons for the higher average returns of value stocks. On the one hand, papers such as Fama and French (1993, 1995, 1996), Liew and Vassalou (2000), Cooper, Gulen, and Vassalou (2001) and Vassalou (2003), argue that risk is the source of the value premium. That is, the premium arises from non-diversifiable risk inherent in high book-to-market stocks that is not captured by the standard CAPM model. However, other authors, such as Lakonishok, Shleifer, and Vishny (1994), Haugen and Baker (1996) and Daniel and Titman (1997), suggest that the source is due to market inefficiencies. That is, the premium results from investors consistently overestimating the performance of growth stock relative to value stock, by putting excessive weight on recent past history, and thus investors are making sub-optimal decisions. Further, this reasoning supports the rationale for contrarian portfolio strategies, that is, a strategy which exploits the short-run mean-reverting behaviour of stock prices, whereby an investor sells overvalued stocks and buys undervalued ones such that a current ‘loser’ portfolio outperforms a current ‘winner’. The over-reaction hypothesis is also related to the (increasing) literature on the existence of ‘noise’ traders in financial markets, that is, those traders whose actions are based on non-fundamentals, such as ‘trend-chasing’ (e.g. Black, 1986; De Long, Shleifer, Summers, & Waldmann, 1990; Kyle, 1985; Schleifer & Summers, 1990).1

Given the forgoing, examination of the time series characteristics of value and growth portfolios should yield insight as to which of the hypotheses regarding the existence of the premium provide a better explanation. It is well-known that asset returns are typically characterised by negative skewness, excess kurtosis and volatility clustering, and can be modelled by a low-order generalised autoregressive conditional heteroscedasticity (GARCH, Bollerslev, 1986; Engle, 1982) model. This basic GARCH model can then be extended in several ways. First, to allow volatility to condition returns (the GARCH-in-mean model, Engle, Lilien & Robins, 1987), such that the parameter associated with the volatility variable proxies for the risk premium, and whereby higher volatility raises the required rate of return and depresses current prices. Further, that there may be an asymmetric relationship between positive and negative shocks in the variance equation (also referred to as predictive asymmetry). More specifically, negative shocks typically increase volatility greater than positive shocks of equal magnitude. This process is typically rationalised through a leverage effect (Black, 1976; Christie, 1982), whereby a negative price shock increases the debt/equity ratio such that the stock becomes inherently riskier so increasing returns volatility. An alternative explanation for volatility asymmetry, which also implies a negative correlation between stock returns and future volatility, is offered by ‘volatility feedback’ (Campbell & Hentschel, 1992). That is, where large items of ‘news’ increase expected future volatility, so increasing the required rate of return and depressing the current asset price, thereby magnifying the negative price effects of negative news and mitigating the positive price impact of positive news. As a consequence, returns are

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1 De Long et al. (1990) and Shleifer and Vishny (1990) provide an extension of the non-rational behaviour explanation and suggest that institutional investors, who may operate over a short-run horizon, opt for growth strategies which typically pay-off within that horizon, while value portfolio strategies typically return abnormal profits over a 3–5 year horizon. Further, investors who opt for a value strategy may be risking their employment if the time horizon over which their performance is evaluated is shorter than the pay-off horizon for such a strategy, as they will appear to under-perform relative to their peers.
characterised by negative skewness with large negative returns being more common than large positive returns, and asset price movements are correlated with future volatility.\(^2\)

Overall, should the rational risk explanation of the value premium be more appropriate then we would expect to observe a greater risk premium on value stock than on growth stock. Further, support for the leverage interpretation of predictive volatility asymmetry would be garnered by a positive (negative) risk premium associated with negative (positive) shocks. Whilst, under the volatility feedback model all shocks result in a positive risk premium as expected future volatility rises. In contrast, the market over-reaction hypothesis supports a negative risk premium associated with a negative shock. That is, following a negative returns shock investors become more optimistic regarding the future and reduce their risk premium consequently increasing current prices.

The remainder of the paper continues as follows Section 2 describes the empirical models and outlines the theoretical hypotheses, Section 3 presents the data estimated results and Section 4 summarises and concludes.

2. Empirical models and theoretical hypotheses

The standard GARCH(1, 1)-M model (Engle et al., 1987) is given as follows:\(^3\):

\[ r_t = \mu + \lambda h_t + \epsilon_t \]  \hspace{1cm} (1)

\[ \epsilon_t = \zeta_t h_t \]  \hspace{1cm} (2)

\[ h_t^2 = \omega + \alpha_1 \epsilon_{t-1}^2 + \beta_1 h_{t-1}^2 \]  \hspace{1cm} (3)

where the unexpected return \( \epsilon_t = r_t - E(r_t|\Omega_{t-1}) \) is serially uncorrelated with zero mean and conditional variance \( h_t^2 = \text{Var}(r_t|\Omega_{t-1}) \) where \( \Omega_{t-1} \) represents the information set containing realised values of \( r \) up to \( t-1 \), the standardised error \( \zeta_t \) is identically and independently distributed (iid) with zero mean and unit variance.\(^4\) For the GARCH model expressed in Eq. (3) \( \alpha_1, \beta_1 \) and \( \omega \) are non-negative parameters, while it is necessary and sufficient that the \( \rho = \alpha_1 + \beta_1 < 1 \) in order for a finite unconditional variance to exist, that sum also provides a measure of the persistence of shocks to \( h_t^2 \), with half-life decay given by \( q = [\log(0.5)/\log(\rho)] \).

These measures also define the limiting integrated-GARCH (IGARCH) case under conditions \( \rho = 1, q = \infty \), such that current and past shocks persist indefinitely in conditioning future variance (Engle & Bollerslev, 1986).\(^5\)

\(^2\) However, predictive asymmetry may also reflect the role of market dynamics. In a market model comprising insiders, uninformed investors and market makers, differences in investors’ expectations may take time to be eliminated as the information held by insiders takes time to be disseminated, so accounting for volatility clustering (Kyle, 1985). In particular, as demonstrated by Sentana and Wadhwan (1992) in an extension of this model to accommodate feedback (or ‘noise’) traders possessing less information than their informed counterparts and who follow market trends and trade on price movements, responses to bad news (negative price shocks) lead to greater volatility than do responses to good news, so offering an alternative explanation for predictive asymmetry.

\(^3\) For general surveys of the (G)ARCH literature discussed in this section see Engle and Bollerslev (1986), Bollerslev, Chou, and Kroner (1992), Bera and Higgins (1993), Bollerslev, Engle, and Nelson (1994).

\(^4\) The conditional mean equation (1) could also include autoregressive or moving average terms, however, these were found to be statistically insignificant.

\(^5\) However, whilst \( \omega > 0 \) and \( \alpha_1, \beta_1 \geq 0 \) may be imposed to ensure non-negativity of the conditional variance, Nelson and Cao (1992) have shown that these inequalities need not hold to ensure a positive variance.
Following Merton (1980), the parameter $\lambda$ in Eq. (1) may be interpreted as the coefficient of relative risk aversion, and as a time-varying risk premium in the sense of the increased expected rate of return required in response to an increase in the predictable variance of the return. As such profitable trading opportunities may go unexploited due to perceived volatility risk.

In order to capture potential volatility asymmetry, we consider an alternative to Eq. (3) which permits the asymmetric response of conditional volatility to past shocks, namely the quadratic-GARCH (QGARCH) model (Engle, 1990; Engle & Ng, 1993; Sentana, 1995), the diagonal variant of which (excluding shock cross-products, see Sentana, 1995) is given by:

$$h_t^2 = \omega + \alpha_1 e_{t-1}^2 + \beta_1 h_{t-1}^2 + \theta_1 e_{t-1}$$

with shock persistence and half-life calculated as for the basic GARCH model (Sentana, 1995, p.646), whilst $\theta_1 \neq 0$ yields a direct measure of dynamic asymmetries in conditional variance with respect to past shocks, $h_t^2$ being greater for negative $e_{t-1}$ when $\theta_1 < 0$. Further, whilst the GARCH-M model formed by the conjunction of Eqs. (1) and (3) allows the conditional mean to depend on the conditional variance, that model imposes zero correlation between returns and future volatility, and therefore does not capture the mechanism underlying volatility feedback. That is, as described in the Introduction, where changes in volatility have important effects on required returns and thus on the current level of asset prices. Following Campbell and Hentschel (1992), the QGARCH-M form given by Eqs. (1) and (4) is able to capture this potential effect. That is, the QGARCH model permits a non-zero correlation between returns and future volatility through the last term in Eq. (4), and the QGARCH-M model is therefore able to capture the mechanism underlying volatility feedback. By amplifying the predictive asymmetry of the basic QGARCH model in this manner, the QGARCH-M model is also able to accommodate the negative skewness and excess kurtosis implied by volatility feedback without recourse to alternative statistical models characterised by non-normal return innovations (Nelson, 1991; Engle & González-Rivera, 1991).

Following the rational risk interpretation of the value premium, we would expect to see a positive and significant $\lambda$ for both portfolios with the risk premium, which is given by $\lambda h_t$, higher on the value portfolio to compensate investors for holding an inherently riskier portfolio. However, if this condition fails to hold this does not imply support for the market over-reaction hypothesis, such support would only be gained by a negative risk premium, but merely be evidence against the rational risk interpretation. Further, the absolute value of the asymmetric term in Eq. (4) should be greater for value portfolios than for growth portfolios. That is, we would expect a negative shock to a risky portfolio to increase volatility (risk) greater than a negative shock to a less risky portfolio.

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6 For details of more general QGARCH specifications and their interpretation, see Sentana (1995).

7 An alternative and more direct illustration of the asymmetry effect afforded by the QGARCH model is given by noting that the restricted first-order QGARCH(0,1) case may also be expressed as:

$$h_t^2 = \hat{\omega} + \psi (\hat{e}_{t-1} - c)^2.$$  

Such asymmetry may also be expressed in terms of the models ‘news impact curve’ representation, which depicts the relationship between $e_{t-1}$ and $h_t^2$ (Engle and Ng, 1993). The news impact curve is centred on $e_{t-1} = c$ with symmetric slopes for $e_{t-1} \neq c$. Further, when $\theta_1 < 0$ the derivative of $h_t^2$ with respect to $e_{t-1}$ is also greater, implying greater ‘steepness’ in the conditional variance function (Nelson, 1991; Sentana, 1995).
Finally, the model in Eq. (1) is extended to accommodate potential asymmetric influences of positive and negative shocks on the risk premium:

\[ r_t = \mu + \lambda_1 h_t I_{t-1} + \lambda_2 h_t (1 - I_{t-1}) + \epsilon_t \]  

where the indicator function takes a value of one when \( \epsilon_{t-1} > 0 \) and zero otherwise. The analytical focus of this model rests on the sign, significance and magnitude of the conditional mean parameters, that is, the risk premium parameters, \( \lambda_1 \) and \( \lambda_2 \). More specifically, the rational risk-leverage hypothesis would support a negative (positive) \( \lambda_1 \) (\( \lambda_2 \)) in Eq. (5). That is, following a negative shock, volatility is heightened, the increased volatility leads to a rise in the required rate of return due to increased risk, and so current prices are depressed. Conversely, following a positive returns shock, again volatility is heightened (although to a lesser extent due to the asymmetric nature of volatility), however, perceived risk would be lower resulting in a negative risk premium, lowering the required rate of return and increasing prices. The volatility feedback explanation for asymmetry in variance would suggest that both \( \lambda_1 \) and \( \lambda_2 \) are positive as all shocks increase expected future volatility, nevertheless, this is still consistent with a rational view of the market. Furthermore, given that the rational risk hypothesis purports that value stocks are more risky than growth stocks, we could reasonably expect first, the risk premium associated with high book-to-market stocks to be greater than the risk premium associated with low book-to-market stocks, and second, the asymmetric parameter in the variance equation to be greater (in absolute) value for high book-to-market stocks. For the market over-reaction hypothesis to hold, we would now expect a positive (negative) \( \lambda_1 \) (\( \lambda_2 \)). Thus, following a negative shock investors become optimistic about the future as so require a lower risk premium on returns, which has the effect of raising current prices.

In sum, examining Eq. (1) in connection with Eq. (4), the rational-risk interpretation of the value premium would suggest, first, that \( \lambda \) is greater than zero, second, that the risk premium, \( \lambda h_t \), for value stock is greater than the risk premium for growth stock, and finally, that the absolute value of the volatility asymmetry parameter is great for value stock. The market over-reaction hypothesis would suggest that \( \lambda_1 \) is negative. Examining Eq. (5) in connection with Eq. (4), the rational-risk-leverage hypothesis would suggest that \( \lambda_1 \) is negative, while \( \lambda_2 \) is positive, while the rational-risk-volatility feedback hypothesis would suggest that both \( \lambda_1 \) and \( \lambda_2 \) are positive. Additionally, each hypothesis would support both the risk premium, \( \lambda h_t \), and the absolute value of volatility asymmetry parameter being greater for value stock over growth stock. The market over-reaction hypothesis would suggest that \( \lambda_1 \) is positive, while \( \lambda_2 \) is negative.

3. Estimated results

The return series analysed here is monthly returns on portfolios of value and growth stock for the US over the sample period 1975: 1 to 2000: 12. Value portfolios are firms whose book-to-market ratio is among the highest 30%, while growth portfolios are firms whose book-to-market ratio is among the lower 30%. All returns are expressed in excess of the US Treasury Bill rate. This data is obtained from the website of Kenneth French. The data is derived from Morgan Stanley’s Capital International Perspective (MSCI) and includes historical data for firms that disappear, but does not include historical data for newly added firms (see Fama and French, 1998, p1976). This means that there is no survivorship bias in the data.

8 The data is available from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.
The coefficient results of estimating the above models are presented in Table 1. The first and third columns of results in Table 1 present the estimated coefficients for the first model discussed above, Eqs. (1)–(4), the QGARCH(1, 1)-M model. For both value and growth stock the GARCH parameters are significant and satisfy non-negativity, with the estimated degree of persistence following a shock to be 0.8602 and 0.9748 for value and growth stocks respectively. This corresponds to a half-life decay of just five months for value stocks and just over 27 months for growth stocks. The asymmetric variance parameter for both portfolio types is significant and negative, suggesting that a negative shock increases volatility greater than a positive shock of equal magnitude, in accordance with both the leverage and volatility feedback hypotheses. Moreover, the coefficient is larger in absolute value for value stock suggesting a negative shock has a greater impact on volatility than an equivalent negative shock on growth stock. The parameter of, perhaps, greatest significance in this model is the coefficient, $k$, which measures the degree of relative risk aversion and provides a measure of the associated risk premium, $k_h$. The results suggest that this parameter is positive and significant for both portfolio types. As such following a shock there is an increase in the required rate of return, and thus fall in the current price. Moreover, the magnitude of $\lambda$ is greater for value stocks than for growth stock, which would indicate greater returns sensitivity to risk in the value portfolio in support of the rational risk interpretation of the value premium. To further illustrate this latter point the time-varying risk premium is plotted in Fig. 1. This figure demonstrates that although the risk premium in both portfolios follows the same pattern, the extent of the premium is higher for value portfolios. Furthermore, a simple $t$-test of equality of means in the two risk premia is rejected at the 1% significance level.9

The second model of Eqs. (5) and (4) is presented in the second and fourth columns of Table 1 for the value and growth portfolios respectively. Again the GARCH parameters are statistically significant and satisfy non-negativity constraints. The estimated degrees of persistence following a shock are now 0.9461 and 0.9654 for value and growth stocks, respectively, with the corresponding half-life decays of twelve and a half months for value stocks and just under twenty months for growth stocks. The asymmetric variance parameter for both portfolio types is again negative, statistically significant and of greater absolute magnitude for the value portfolio.

Table 1
Estimated models

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Value stock</th>
<th>Growth stock</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>QGARCH(1, 1)-M</td>
<td>QGARCH(1, 1)-M with asymmetric risk premium</td>
</tr>
<tr>
<td>$\mu$</td>
<td>-0.0503* (0.01528)</td>
<td>-0.0506* (0.0212)</td>
</tr>
<tr>
<td>$\lambda_1$</td>
<td>0.7689* (0.1908)</td>
<td>0.6505* (0.2614)</td>
</tr>
<tr>
<td>$\lambda_2$</td>
<td>0.8824* (0.2707)</td>
<td>0.7294* (0.2444)</td>
</tr>
<tr>
<td>$\omega$</td>
<td>0.0013* (0.0006)</td>
<td>0.0008* (0.0004)</td>
</tr>
<tr>
<td>$x_1$</td>
<td>0.2817* (0.1382)</td>
<td>0.2105* (0.0463)</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>0.5785* (0.1191)</td>
<td>0.6958* (0.0810)</td>
</tr>
<tr>
<td>$\theta_1$</td>
<td>-0.0216* (0.0078)</td>
<td>-0.0218* (0.0072)</td>
</tr>
</tbody>
</table>

Notes: for model specification see Section 2. Figures in parentheses are Bollerslev and Wooldridge (1992) robust standard errors. Asterisk(s) denotes statistical significance at the 5% (10%) level.

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9 The respective means are 0.07 and 0.05 for value and growth stock, while the $t$-statistic for their equality is 9.38.
Finally, we can examine the sign and magnitude of the $k_i$ parameters in an attempt to distinguish between the competing hypotheses for the presence of a value premium, that is, the rational risk and market over-reaction hypotheses. Specifically, the rational risk-leverage hypothesis would be supported by a significant and negative (positive) $k_1$ ($k_2$), while the rational risk-volatility feedback hypothesis would be supported by both $k_1$, $k_2$ being positive. Support for the market over-reaction hypothesis would be gained by a positive (negative) $k_1$ ($k_2$). Examination of the estimated results presented in the second and final columns of Table 1 supports three conclusions. First, evidence of a positive and significant risk premium for both types of shock on both value and growth portfolios. That is, following either a positive or negative shock, there is
an increase in expected future volatility which leads to a rise in the required rate of return and a reduction in current prices. Second, the magnitude of the risk premium associated with a negative shock is greater than the risk premium associate with a positive shock, indicating that returns are more risk-sensitive to bad news. Third, the risk premium attached to the value portfolio is greater than the premium attached to the growth portfolio. This latter point is further illustrated in Fig. 2, where it is again evident that while the risk premium on both portfolios follow a similar pattern, the premium is greater for the value portfolio. As before, a simple $t$-test for the null of equality of mean for the two premia is rejected at the 1% level. The sum of these three results is supportive of the rational-risk-volatility feedback effect.

Overall, the results of this analysis have shown that following a shock, to either a value or growth portfolio, there is an increase in volatility, and therefore, risk, which leads, through a risk premium effect, to a rise in the required rate of return. Further, that the increase in volatility is greater for a negative shock than a positive shock of equal magnitude and that the risk premium associated with negative shocks is greater than the premium associated with positive shocks, hence returns are more sensitive to bad news. Furthermore, both the rise in volatility and the risk premium is greater for value stock suggesting that such stock is inherently riskier than growth stock. That is, a value portfolio is more sensitive than a growth portfolio to any type of shock, and such sensitivity is heightened should it be a negative shock.

4. Summary and conclusion

This paper has sought to ascertain which of the competing hypotheses regarding the presence of a value premium in stock returns, that is the observed existence of higher returns from a portfolio constructed of value or high book-to-market stocks over growth or low book-to-market stocks, is supported by an examination of the time-series characteristics of each portfolio type. More specifically, it is argued that the observed value premium results either from greater risk associated with holding value stock, and hence a higher return as compensation, or that markets over-react to news and put excessive weight on recent news and performance. Thus, according to the former hypothesis following a negative shock, volatility and expected future volatility increase (and more so than an equal positive shock), thus raising the required rate of return on stock and reducing the current price. Moreover, as value stocks are inherently more risky, the effects of this transmission mechanism should be heightened, raising their return over growth stock. Whilst, according to the latter hypothesis, following a negative shock, markets become more optimistic about the future, so reducing their risk premium and required rate of return and increasing current prices. Under this hypothesis the effect of the transmission mechanism would be heightened on growth stock, who typically were last year’s ‘winners’ and so depressing their rate of return below value stock.

Using an asymmetric GARCH-M model investigation of the risk premium characteristics associated with all shocks and then for positive and negative shocks individually is conducted on value and growth portfolios. Support for the rational risk explanation of the value premium would be obtained through a positive risk premium on negative shocks and either a negative premium on positive shocks through the leverage volatility asymmetry effect, or a positive premium through the volatility feedback effect. Support for the market over-reaction hypothesis

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10 The respective means are 0.07 and 0.06 for value and growth stock, while the $t$-statistic for their equality is 3.75.
11 In order to provide some robustness analysis of these results all models were re-estimated over the period 1980–2000. The results remain qualitatively similar and are available upon request from the authors.
would occur should the risk premium associated with a negative shock be negative and the risk premium associated with a positive shock be positive.

Initial QGARCH-M estimation reveals the existence of a positive and significant risk premium and predictive volatility asymmetry whereby a negative shock to volatility increases volatility greater than an equivalent positive shock. Moreover, the size of the risk premium and volatility asymmetry is greater for value stocks. As such, these models provide tacit support to the rational risk interpretation. Subsequently the effects of positive and negative shocks on the risk premium are separated with the results showing positive risk premiums regardless on the sign of the shock. This result unequivocally supports the rational risk-volatility feedback effect, and the Campbell and Hentschel (1992) conclusion that ‘no news is good news’, whereby all shocks increase expected future volatility, raising the required rate of return and depressing current prices. Further, the estimated risk premium associated with the value portfolio is greater than the risk premium associated with the growth portfolio. Hence, a shock increases risk associated with a risky portfolio greater than that associated with a less risky portfolio.

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References


