Total Volatility and the Cross Section of Expected Stock Returns

DEVRAJ BASU and LIONEL MARTELLINI

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* Devraj Basu is a Senior Research Engineer at the EDHEC Risk and Asset Management Centre (devraj.basu@edhec-risk.com) and Lionel Martellini is Professor of Finance at EDHEC Business School and Scientific Director of the EDHEC Risk and Asset Management Centre (lionel.martellini@edhec.edu). Daniel Mantilla provided able research assistance on the project.

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Abstract

This paper examines the explanatory power of total volatility, a model free quantity, for the cross section of stock returns. Asset pricing theory implies that expected returns should be positively related to model-implied systematic volatility, while various theoretical studies suggest that idiosyncratic volatility should be positively related to expected returns and several empirical studies suggest that idiosyncratic volatility has explanatory power for the cross section of expected returns. Taken together these findings imply that total volatility should be positively related to expected return.

We find both time series and cross sectional evidence for a positive relationship between total volatility and expected return. Portfolios of high volatility stocks achieve a higher expected return than portfolios of low volatility stocks, particularly over the 1990-2004 period. This effect is driven by both systematic volatility and idiosyncratic with respect to the Fama-French model. A cross sectional regression of individual stock returns on total volatility leads to a significant positive slope coefficient and this result is driven by idiosyncratic volatility with respect to the Fama-French model. The factor price of risk for a total volatility factor is positive and significant over the 1990-2004 period and is largely driven by idiosyncratic risk, indicating that the increase in idiosyncratic risk in the 1990s has implications for asset pricing.

1 Introduction

This paper explores the relationship between return and risk as proxied by total volatility, in the cross section of stock returns. This relationship has been widely studied at the aggregate market level[1] but not thus far in the cross section. Total volatility is the sum of systematic volatility relative to some asset pricing model and idiosyncratic volatility relative to the same model. Asset pricing theory implies that individual stock returns should be positively related to systematic volatility while several theoretical studies, both rational and behavioral, suggest that expected returns should also be positively related to idiosyncratic volatility, while several empirical studies find that idiosyncratic risk does appear to play a role in explaining the cross section of expected returns. Taken together, these studies suggest that expected returns should be positively related to total volatility and we investigate whether this relationship is indeed valid and also explores the implications for asset pricing.

Merton (1987) suggests that in an information segmented market, firms with larger firm-specific variances require higher average returns to compensate investors for holding imperfectly diversified portfolios. Malkiel and Xu (2002) show that an inability to hold the market portfolio will force investors to care about total risk to some degree in addition to the market risk. Jones and Rhodes-Kropf (2002) show that diversifiable risk can be priced in venture capital deals, even if the outside investors are fully diversified and find empirical support for their prediction. Barberis and Huang (2001) study equilibrium firm-level returns in an economy where investors are loss averse over the fluctuations of individual stocks that they own and predict that stocks with high idiosyncratic volatility should earn higher returns. There is also empirical evidence on whether firm-specific risk is priced starting from the early tests of the CAPM. In very early work on testing the CAPM using individual stocks, Douglas (1969) and Lintner (1965) found that the variance

[1]Early studies include Campbell (1987) and French, Schwert and Stambaugh (1987) foolowed by Glosten et. al (1993) and more recently Ghysels et. al. (2005).

of the residuals from a market model was strongly significant in explaining the cross-section of average stock returns[2]. More recently, Campbell, Lettau, Malkiel and Yu (CMLX) (2001) have examined the risk-return relationship at the individual stock level. CMLX (2001) find that although the market as a whole has not become more volatile, individual stock volatility has increased over a 35 year period with firm level volatility trending upwards throughout the sample, particularly in the 1990s. Other recent studies also point to an increase in total risk during the 1990s. Fama and French (2001) find a secular decrease in the survival rates of new lists over a similar period, consistent with the notion that firms became more risky in the 1990s while Pastor and Veronesi (2003) point out that the 1990s increase in idiosyncratic stock market risk has origins in the real (earnings) side. The implications for corporate finance of this rise in idiosyncratic risk in the 1990s is explored in Prabhala and Hoberg (2005) and our study is one of the first to explore the implications for asset pricing.

We first carry out a statistical analysis to ascertain the relationship between total volatility and expected return. We sort individual stocks over the 1975-2004 period into quintiles based on their total volatility and then calculate the difference in average return between the top quintile consisting of stocks with the highest total volatility and the bottom quintile of stocks with the lowest total volatility. We then compute the average difference in returns both over the entire sample period as well as both halves to assess whether stocks with high volatility earned higher returns on average. We find that the difference between the average return on the top quintile with highest volatility stocks and the bottom quintile with lowest volatility (5-1 premium) stocks is 0.74% a month over the 1980-2004 period, with a p-value

[2] Douglas (1969) and Lintner (1965). Miller and Scholes (1972), and Fama and MacBeth (1973) point out some statistical pitfalls in the analysis. However, Lehmann (1990) reaffirms the results of Douglas (1969) after conducting a careful econometric analysis. Tinic and West (1986) find that portfolio returns appear to be predicted more accurately when idiosyncratic volatility (relative to the CAPM) is added to the portfolio beta as an explanatory factor.

of 1.37%. The premium is much larger for the second half of the sample than the first, with the premium over the 1980-1990 period being 0.38% with a p-value of 20.26% while that over the 1990-2004 period is 1.10% a month with a p-value of 1.24%. This indicates that stocks with higher volatility earn significantly higher returns than stocks with lower volatility, suggesting that volatility is a good proxy for expected return. This premium is lower when we sort on Fama-French systematic volatility and appears to be driven by both systematic and idiosyncratic volatility with respect to the Fama-French model. The 5-1 premium is slightly higher when controlling for size and momentum effects and is virtually unchanged when controlling for the book-to-market effect showing that our observed relationship between volatility and expected return is not driven by the size, book-to-market or momentum effects. There appears to be an interaction between total volatility and the momentum effect with the momentum premium increasing in the total volatility quintiles, suggesting that high total volatility affects winner stocks more than loser stocks, consistent with the findings in Brooks et. al. (2006). The composition of the top quintile varies considerably over time also indicating that the 5-1 premium is not driven by specific stocks. We then carry out a cross sectional regression analysis following Fama and Macbeth (1973) to see if total volatility has explanatory power for the cross section of expected returns. The cross sectional regression slope coefficient for total volatility over the 1980-2004 period is 0.102 with a p-value of .01% showing that total volatility has explanatory power for the cross section of stock returns. The explanatory power is stronger over the 1990-2004 period with the average slope coefficient being 0.136 with a p-value of .05% while it is .052 over the 1980-1990 period which is not significant. The explanatory power of total volatility is largely driven by idiosyncratic volatility with respect to the Fama-French model.

We now investigate the implications of the findings above for asset pricing and construct a total volatility factor via the factor mimicking portfolio for total volatility. We follow Fama and French (1992) and construct the factor mimicking portfolio as the zero cost portfolio which is long the quintile of stocks with highest total volatility and short the quintile with lowest total volatility. We estimate the factor price of total volatility risk using the Fama-Macbeth (1973) procedure using individual stocks. Over the 1980-2004 period the factor price of total volatility risk is positive and it is significant at the 5% level over the 1990-2004 period. We decompose the total volatility factor into aggregate and idiosyncratic components and find that the factor price of risk for the aggregate factor is negative, consistent with Ang et. al. (2006)and Bondranenko (2004), while it is positive for the idiosyncratic component with the idiosyncratic factor price being larger in absolute value. Higher firm-specific risk could be related to higher growth in the future as suggested by Malkiel and Xu (2003) leading to a positive factor price of risk and our findings suggest that the rise in idiosyncratic volatility in the past decades has implications for asset pricing. The positive factor price of total volatility indicates that aggregate firm specific volatility is more important for asset pricing than aggregate volatility, particularly over the 1990-2004 period. We decompose the total volatility factor into systematic and idiosyncratic components and find the factor price of systematic risk is negative while that for idiosyncratic is positive and larger in magnitude. The positive price of factor risk for idiosyncratic volatility implies that increases in idiosyncratic volatility represents improvements in the investment climate for firms consistent with idiosyncratic volatility being linked to growth options (Cao, Simin and Zhang (2006)) as well as high growth (Malkiel and Yu (2003)). The relative importance of idiosyncratic volatility could be driven by time trends in financial market development, particularly the recent rise in public listings of risky firms which has led to changes in the composition of publicly traded firms. The different characteristics of these newly listed firms (Fama and French (2004)) appear to have significant implications for asset pricing and our study is a first step in analyzing these implications.

2 Statistical Evidence

We first report the time series evidence based on sorting stocks on total volatility together with various controls and then study the explanatory power of total volatility for the cross section of expected stock returns.

2.1 Data

We use data from the Center for Research in Security Prices (CRSP) over the 1975-2004 period. As we plan to sort explore the relationship between risk and return over the entire sample period we consider only stocks that survived over the entire sample period. Stocks that did not survive over the entire period eventually end up in the bottom quintile and create a downward bias in its return. We end up with a sample of 682 stocks over the entire period.

2.2 Time Series Evidence

We first consider the time series evidence for whether stocks with high volatility have higher average returns than stocks with lower volatility. We follow the procedure in Ang et. al.(2006) and sort individual stocks into quintiles based on their total volatility calculated on the basis of the previous 60 months return, hold these portfolios for 1 month and then repeat the process. We consider equally weighted rather than value weighted quintiles as value weighting focuses on stocks with higher returns. This gives us a time series of returns for the quintiles and we compute the difference in average return between the top quintile and the bottom quintile (5-1 premium) and the results are reported in Panel A of Table 1. The 5-1 premium over the 1980-2004 period is 0.74% a month with a *p*-value of 1.37% which indicates that stocks with higher volatility earn significantly higher returns than stocks with lower volatility, suggesting that volatility is a good proxy for expected return. The premium is much larger for the second half of the sample than the first, with the premium over the 1980-1990 period being 0.38% with a p-value of 20.26% while that over the 1990-2004 period is 1.10% a month with a p-value of 1.24%. The difference between the two sub-periods is clearly visible from Figure 1 as well which shows the cumulative returns on a strategy that was long the top quintile and short the bottom quintile.

When we further condition on total skewness by sorting each volatility quintile in further quintiles based on total skewness motivated by Hong, Chen and Stein (2001) and more recently Kapadia (2007), we find that the 5-1 premium is considerably higher at 1.97% per month when restricted to stocks with the highest total skewness, is virtually zero for the lowest skewness quintile and declines with decreasing total skewness. We also find that average return for stocks in the top volatility quintile are monotonic in total skewness with the difference in average return between the high volatility stocks with high skewness and high volatility stocks with low skewness being 2.11% per month.

Sorting on Systematic Volatility

We now investigate the 5-1 premium sorting on systematic volatility based on the Fama-French model rather than total volatility. From Panel B of Table 1 we see that the 5-1 premium based on systematic volatility over the 1980-2004 period is 0.68% per month with a p-value of 3.52%. While the overall premium is close to that obtained with total volatility, the results over the two sub-periods are rather different. Over the 1980-1990 period the 5-1 premium based on systematic volatility is only 0.20%, around half of that obtained with total volatility, with a a p-value of 34.77% while over the 1990-2004 period it is 1.16% with a p-value of 1.66%. Thus over the first period it appears that total volatility appears to be be a considerably better proxy for return than systematic volatility while over the second period systematic volatility performs slightly better and overall total volatility appears to be the better proxy. The results also indicate idiosyncratic risk relative to the Fama-French model commands a positive premium in the first period, a small negative premium over the second period and overall a positive premium.

If the Fama-French model is a true asset pricing then the 5-1 premium based on total and systematic volatility should be the same. The premium based on total volatility is higher suggesting that idiosyncratic volatility relative to the Fama-French model may be priced. To further analyze the relative importance of total volatility and systematic volatility we double sort stocks on total volatility and then systematic volatility and consider the difference in average returns between stocks with high systematic volatility and low total volatility and low systematic volatility and high total volatility. If the 5-1 premium is driven largely by systematic volatility then this difference should be close to the 5-1 premium with systematic volatility. We find that the difference is 0.13% a month which is considerably lower than the 0.68% a month premium for systematic volatility. Conversely the difference between average return for stocks with high total volatility and low systematic volatility and that for low total volatility and high systematic volatility is 0.48% with a p-value of 4.42%. These results suggest that the 5-1 premium is not entirely driven by systematic volatility relative to the Fama-French model and that total volatility which incudes the idiosyncratic volatility relative to this model is a better proxy for mean returns.

Controlling for Cross Sectional Effects

We now double sort our sample by first sorting stocks into quintiles based on a) firm size, b) book-to-market ratios and c) past twelve month return and then within each of these quintiles, into quintiles again based on total volatility. We then average across the attribute quintiles to obtain quintiles sorted on total volatility that contain stocks with all levels of the characteristic and then compute the 5-1 premium for each set of portfolios with the results being reported in Table 2. The 5-1 premium controlling for size is 1.00% per month with a p-value of 0.14% which strongly indicates that the effect is not just driven by small stocks. Controlling for the book-to-market effect leads to a premium of 0.79% with a p-value of 1.71% while controlling for past return leads to a premium of 1.06% per month, the highest overall, with a p-value of 0.01%. We see that in all cases the 5-1 premiums are higher when controlling for the three characteristics which demonstrates that the volatility effect is not directly related to the size, book-to-market or past returns of the individual stocks.

Interaction Between Volatility and Momentum

The 5-1 premium controlling for momentum is around 30% higher than the overall premium suggesting that momentum and total volatility are related. To further explore the issue we sort stocks by past return and total volatility and then examine the difference in average return between winners and losers with monthly re-balancing for each volatility quintile. We see from Panel A of Table 3 that the momentum premium is monotonically increasing in the total volatility quintiles with the momentum premium for the top volatility quintile being 10.51% and that for the bottom being 4.15%[3] When we replace total volatility with Fama-French systematic volatility (Panel B) we see that the premium for the top volatility quintile is lower at 9.30% but is higher for the bottom volatility quintile. This shows that the effect is driven by both Fama-French systematic volatility and idiosyncratic volatility relative to the Fama-French model and that higher total volatility has a greater positive effect on winner stocks than loser stocks. This finding is consistent with the results in Brooks at al (2006) who find that momentum profits appear to be compensation for unsystematic risk and which are common to the winner and loser stocks but affect the former more than the latter.

Further Robustness Analysis

In order to see if the 5-1 premium is driven by a "general factor" or by a few stocks or kind of stocks that are "always" on the top quintiles, we analyze the time series of volatility of the stocks that were in the highest quintile at the end of the sample period and compared it with the average volatility of

[3]The size of these premiums is driven by the monthly rebalancing.

the various quintiles. We found that the volatility of 81% and 62% of these stocks fell below the average volatility of the 4th and 3rd quintiles respectively (the comparison was done period by period) . We also analyze at the percentage of times that their volatility fell below the 4th and 3rd quintiles average volatility and we found that it fell below the 4th quintile volatility 37% of the time and below the 3rd quintile volatility 20% of the time. The findings indicate that the 5-1 premium is not driven by the presence of specific stocks. The correlation between the 5-1 premium and the level of the VIX is -0.22 indicating that 5-1 premium is not driven by aggregate volatility alone.

2.3 Cross Sectional Evidence

We now analyze whether total volatility has explanatory power for the cross section of expected returns by running a cross sectional regression. We follow Fama and Macbeth (1973) and at each point in time run a cross sectional regression of realized return on total volatility

$$R_{i,t} = \alpha_{i,t} + \gamma_t \sigma_{i,t} + \epsilon_{i,t} \tag{1}$$

Then average the slope coefficient in this regression across time ($\overline{\gamma}$) to obtain an estimate for the unconditional slope coefficient. The t-statistic for the slope coefficient is given by $t_\gamma = \frac{\sqrt{T}\overline{\gamma}}{\sigma_\gamma}$ where $\sigma_\gamma = \frac{1}{T-1}\sum(\gamma_t - \overline{\gamma})^2$. Total volatility is computed using the previous 60 months of data so that our regression begins in 1980.

The results are reported in Table 4. From Panel A of Table 4 we see that the average slope coefficient when we use total volatility as a regressor over the 1980-2004 period is 0.102 with a p-value of .01% showing that total volatility has explanatory power for the cross section of stock returns. The explanatory power is stronger over the 1990-2004 period with the average slope coefficient being 0.136 with a p-value of .05% while it is .052 over the

1980-1990 period which is not significant. To assess whether these results are driven by Fama-French systematic volatility we decompose total volatility into Fama-French systematic volatility and idiosyncratic volatility and use these as separate regressors. Panel B of Table 4 shows that over the 1980-2004 period the slope coefficient for Fama-French systematic volatility is 0.023 which is not significant while that for idiosyncratic volatility is 0.109 with a p-value of 0.01%, indicating that the explanatory power of total volatility is driven by idiosyncratic volatility with respect to the Fama-French model.

We decompose total volatility into expected and unexpected components to ascertain how much each component contributes to the explanatory power of total volatility. Following Chua, Goh and Zhang (2006) the expected component is obtained by fitting an AR(2) model to the time-series of total volatility, while the unexpected component is the residual of the AR(2) regression. When returns are regressed on the expected and unexpected components the beta coefficient for expected volatility is 0.0357 with a t-statistic of 1.7469 compared to 0.8399 with a t-statistic of 4.7781 for unexpected volatility. Thus the explanatory power of total volatility appears to be driven by the unexpected component, not the predictable component.

3 Implications for Asset Pricing

The statistical results above suggest that there may be a role for total volatility in pricing the cross section of expected stock returns. In order to investigate this issue further we follow the Fama and French (1992) procedure and construct the factor mimicking portfolio for total volatility risk. This is a zero cost portfolio which is the difference in return between the highest volatility quintile and the lowest volatility quintile. To estimate the factor price of total volatility risk we run a cross sectional Fama-Macbeth regression across individual stocks using both the market portfolio and the total volatility portfolio as factors. Each month we run the cross sectional regression

$$r_t^i = \alpha_i + \beta_{MKT}^{i,t}\lambda_{MKT}^t + \beta_{TVOL}^{i,t}\lambda_{TVOL}^t \quad (2)$$

with the betas estimated using 60 months of data. The overall price of risk for each factor is given by $\overline{\lambda}$, the time series average and the t-statistic is adjusted by a factor of $\frac{1}{1+\mu_F^2/\sigma_F^2}$ to account for the fact that the betas are generated regressors.

Our cross sectional regressions begin in 1985 as we need 60 months of initial data to construct the factor and another 60 months of data to construct the factor betas. Panel A of Table 5 shows that the market price of risk from this regression is negative and insignificant. We also see that over the 1985-2004 period the factor price of risk for total volatility is 0.68% with a t-statistic of 1.58 (p-value of 5.8%) and over the the 1990-2004 period the factor price is considerably higher at 1.42% with a t-statistic of 1.76 (p-value of 4.0%). Hence over the 1990-2004 period the factor price of total volatility risk is significant and positive, in contrast to the findings in Ang et. al. (2006) and Bondranenko (2004) who estimate a negative price of risk for aggregate volatility. When we omit the market factor and run Equation 2 with total volatility alone the factor price of risk (Panel B of Table 5) over the 1985-2004 period is 0.58% which is not significant, while it is higher (0.97%) and significant over the 1990-2004 period consistent with the earlier result.

The higher factor price of total volatility over the 1990-2004 period indicates that idiosyncratic or aggregate firm specific risk is more important for asset pricing over this period. The rise of firm specific volatility in the 1990s has been documented in a number of recent studies Campbell, Lettau, Malkiel, and Xu (2001) find that idiosyncratic risk has increased in the 1990s, while Fama and French (2001) find a secular decrease in the survival rates of new lists over a similar period, consistent with the notion that firms became more risky in the 1990s. Pastor and Veronesi (2003) point out that this increase in idiosyncratic stock market risk has origins in the real (earnings) side. In order to analyze the relative importance of aggregate and firm specific volatility we first decompose our total volatility factor into an aggregate volatility component and an idiosyncratic volatility component. The aggregate volatility factor is a zero cost portfolio long the top quintile of stocks sorted on CAPM systematic volatility and short the bottom quintile sorted on CAPM systematic volatility while the idiosyncratic volatility factor is the corresponding long short portfolio sorted on CAPM idiosyncratic volatility. We then run the counterpart of Equation 2 with aggregate volatility and idiosyncratic volatility over the 1990-2004 period and Panel B of Table 5 shows that the factor price of aggregate volatility risk is negative and insignificant while that for idiosyncratic risk is positive and larger although not significant. As a further robustness check we change the systematic component with the returns on the VIX index and find (Panel C of Table 5) that the factor price of aggregate volatility continues to be negative (-0.32%) and insignificant and the factor price of idiosyncratic risk is positive and higher (0.83%). The negative price of risk for aggregate volatility is consistent with the findings in in Ang et. al. (2006) and Bondranenko (2004), but the higher factor price of risk for idiosyncratic volatility over the 1990-2004 period indicates that firm level volatility plays a more important role in asset pricing over this period. The positive price of factor risk for idiosyncratic volatility implies that an increase in firm specific volatility represents improved prospects for firms, consistent with idiosyncratic volatility being related to growth options for firms (Cao, Simin and Zhang (2006)) as well as high growth (Malkiel and Yu (2003)) . The rise in idiosyncratic risk over the 1990s thus has asset pricing implications which could be due to time trends in financial market development in the past few decades, in particular the increasing public listing of risky firms leading to a change in the overall composition of publicly traded companies. These new listing have different fundamentals from previously listed firms as documented by Fama and French (2004), and Brown and Kapadia (2007) argue that this "new listing" effect explains the entire increase in idiosyncratic risk. Our study is a first step in quantifying the implications of these developments for asset pricing.

4 Conclusion

This paper investigates the explanatory power of total volatility for the cross section of expected stock returns. Total volatility, a model free measure, is the sum of systematic volatility with respect to an asset pricing model and idiosyncratic volatility with respect to the same model. Asset pricing theory says that expected return should be positively related to systematic volatility while several studies both theoretical an empirical suggest that idiosyncratic risk could also be positively related to expected return, thus implying a positive relation between total volatility and expected return.

We find both time series and cross sectional evidence for a positive relationship between total volatility and expected return. Portfolios of high volatility stocks achieve a higher expected return than portfolios of low volatility stocks, particularly over the 1990-2004 period. This effect is driven by both systematic volatility and idiosyncratic with respect to the Fama-French model. A cross sectional regression of individual stock returns on total volatility leads to a significant positive slope coefficient and this result is driven by idiosyncratic volatility with respect to the Fama-French model. We explore the asset pricing implications of these findings by constructing a factor mimicking portfolio for total volatility as a zero cost portfolio, long a portfolio of high volatility stocks and short a portfolio of low volatility stocks. We find a positive factor price of risk for total volatility which is large and significant over the 1990-2004 period. The positive price of total volatility risk is driven by idiosyncratic risk suggesting that the rise in idiosyncratic volatility from the 1990s, documented in several recent studies, has implications for asset pricing.

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	5-1 Premium

Panel A: Total Volatility

Overall:	0.74% (1.37%)
1980-1990:	0.38% (20.0%)
1990-2004:	1.10% (1.24%)

Panel B: Fama French Systematic Volatility

Overall:	0.68% (3.52%)
1980-1990:	0.20% (35.0%)
1990-2004:	1.16% (1.10%)

Table 1: Volatility Premiums: Overall

In this table we provide the 5-1 premium which is the difference in average return between the top and bottom equally weighted portfolio of stocks sorted on total volatility (Panel A) and Fama-French systematic volatility (Panel B). The premiums are shown for the entire period (1980-2004) and the 1980-1990 and 1990-2004 sub periods. Further details of the sorting procedure are given in Section 2.2. Returns are given in percent per month and the figures in brackets are the *p*-values.

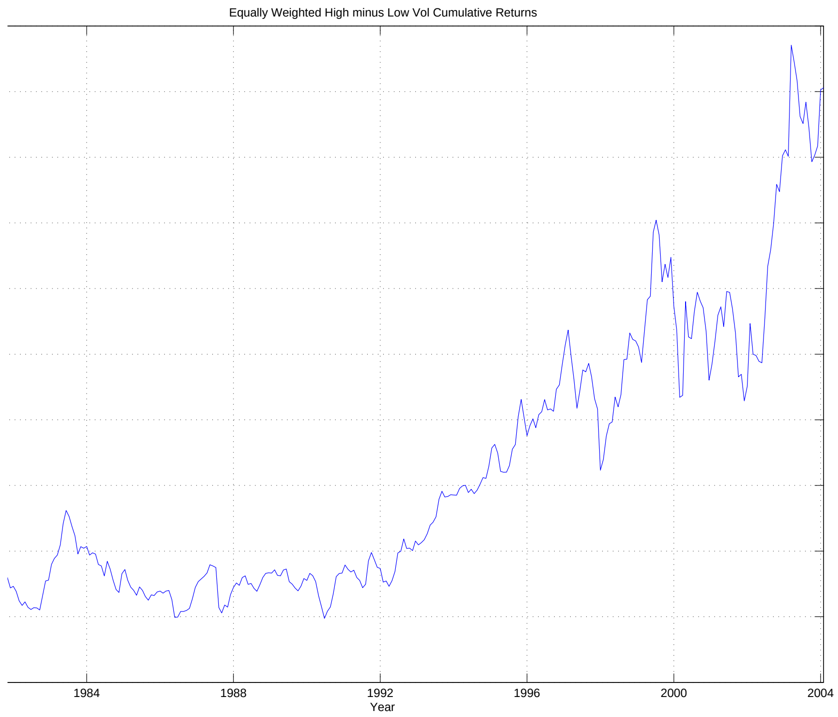

Figure 1: Returns from a Long Short Strategy

This figure shows the cumulative returns on a zero cost portfolio strategy that is long the top equally weighted quintile of stocks sorted on total volatility and short the bottom equally weighted quintile sorted on total volatility over the 1980-2004 period.

	Attribute Controlled 5-1 Premium
Size:	1.00% (0.14%)
Book-to-Market:	0.79% (1.71%)
Momentum:	1.06% (0.01%)

Table 2: Volatility Premiums: Attribute Controlled

In this table we report the attribute controlled premiums over the 1980-2004 period where stocks are double sorted on attributes (size, book-to-market and past return) and volatility and then averaged across the attribute. Further details of the sorting procedure are given in Section 2.2. Returns are given in percent per month and the figures in brackets are the p-values.

Momentum Premium	
Panel A: Total Volatility	
Q1:	10.51%
Q2:	7.42%
Q3:	6.54%
Q4:	5.22%
Q5:	4.15%
Panel B: Fama French Systematic Volatility	
Q1:	9.30%
Q2:	7.02%
Q3:	6.57%
Q4:	6.13%
Q5:	5.12%

Table 3: Momentum Premium across Volatility Quintiles

This table shows the momentum premium sorted by volatility quintiles. We first sort stocks into equally weighted quintiles based on total volatility and then on again into equally weighted quintiles based on 12 month past return. For each volatility quintile we compute the momentum premium which is the difference between the top and bottom quintiles sorted on past return. The results in Panel A are based on sorting on total volatility while those in Panel B are based on Fama-French systematic volatility.

	Slope Coefficients

Panel A: Total Volatility

Overall:	0.102 (0.01%)
1980-1990:	0.052 (12.8%)
1990-2004:	0.136 (1.05%)

Panel B: Fama French Systematic Volatility and Idiosyncratic Volatility

Overall:	0.023 (36.7%)	0.109 (0.01%)

Table 4: Cross Sectional Slope Coefficients.

In this table we provide the cross sectional slope coefficient for a cross sectional regression of individual stock returns on their total volatility (Panel A) over the 1980 -2004 period as well as the 1980-1990 and 1990-2004 sub periods. In Panel B we decompose total volatility into Fama-French systematic volatility and idiosyncratic volatility and then run the cross sectional regression over the 1980-2004 period. The figures in bracket are the p-values.

Factor Prices of Risk

Panel A: CAPM and Total Volatility

Overall:	-0.15% (34.2%)	0.68% (5.8%)
1990-2004:	-0.53% (41.5%)	1.42% (4.0%)

Panel B: Total Volatility Alone

Overall:	0.58% (7.62%)
1990-2004:	0.97% (3.12%)

Panel B: Systematic Volatility and Idiosyncratic Volatility (1990-2004)

CAPM:	-0.61% (73.3%)	1.10% (15.2%)
VIX:	-0.32% (52.9%)	0.83% (29.0%)

Table 5: Factor Prices of Risk.

In this table we provide the the factor prices of risk obtained from a cross sectional regression. In Panel A the factors are the market return and the total volatility factor, a zero cost portfolio which is long the top quintile sorted on total volatility and short the bottom quintile sorted on total volatility, and the factor prices of risk are computed over the 1985-2004 period as well as the 1990-2004 period. In Panel B the total volatility factor is considered on its own and in Panel C we decompose the total volatility factor into a systematic component which is the zero cost portfolio based on quintiles sorted on CAPM systematic volatility and an idiosyncratic component which is the zero cost portfolio based on quintiles sorted on CAPM idiosyncratic volatility. More details on the construction of the factors are given in Section 3. The figures in bracket are the p-values.