The Cross-Section of Expected Risk Exposure

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We relate fundamental firm characteristics to the cross-section of risk. We examine total, systematic and idiosyncratic risk exposure for a large sample of U.S. firms. Both volatility as well as skewness risk are examined. Our framework both provides an explanatory model of variation in risk as well as a predictive model.
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1. Introduction

A growing number of studies use firm characteristics to explain variation in the cross-section of expected returns. In terms of asset pricing theory, these characteristics are valid explanators only as much as they correlate with the underlying risk exposure. For example, in an international setting, Ferson and Harvey (1998) show that country characteristics are powerful instruments for conditional risk exposure.

We expand the scope of this analysis and focus on firm level information. We are interested in the firm characteristics that determine risk exposure. Our work analyzes the cross-section of expected risk exposure by relating fundamental characteristics to time varying risk moments.

Analysis of characteristics is integral to fundamental analysis as taught in textbooks such as *Valuation* (1994) by Copeland and *Graham and Dodd's Security Analysis* (1938).[1] For expected returns, Hamada (1969) shows the relation between beta risk and financial leverage. It makes sense that firms with higher leverage have higher equity betas that comparable firms with low leverage. Thus, risk and some characteristics can be linked as was done for example in Lev (1974) for operating leverage. A number of studies such as Ou and Penman (1989) have claimed that characteristics data can be used to predict future stock returns, either from fundamental analysis uncovering values not reflected in the stock prices (i.e. market inefficiencies) or from fundamental analysis capturing cross-sectional variations in risk (and thereby expected return) not reflected in traditional risk measures (as in Greig (1992).) The argument is that cross-sectional variation of characteristics manifests either cross-sectional variation of market inefficiency or captures cross-sectional variation in expected returns that is not captured by

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[1] Studies of characteristics can also be found in Stattman (1980), Rosenberg, Reid, and Lanstein (1985), Fama and French (1992, 1993), Brennan, Chordia and Subrahmanyam (1993) and Daniel and Titman (1997).

the traditional measures of expected returns.

We examine another facet of this argument. If the cross-sectional variation of characteristics do indeed show the cross-sectional variation of expected returns, then they should also covary with measures of risk.

We consider a number of different definitions of risk: total volatility, beta, and idiosyncratic volatility. We also look at total skewness, coskewness and idiosyncratic skewness. In examining total volatility and total skewness, we do not need an asset pricing model. However, we need to impose additional structure to divide total risk into its systematic and idiosyncratic components. We consider both a single factor Capital Asset Pricing Model (CAPM) as well as a three-factor model. Finally, our goal is both to explain variation in risk with contemporaneous characteristics and to develop a predictive model of risk exposure.

Determinants of volatility have been examined in Schwert (1990) who analyzes aggregate stock market volatility using macro-economic factors. Duffee (1995) analyzes individual firm level volatility and the impact of leverage as defined by the fall in the firm's price. However, how the various measures of risk (total, systematic, and idiosyncratic) at the level of the individual stock relate to characteristics at the firm level is an unanswered question. Recently, a number of papers have examined idiosyncratic volatility, as for example in Malkiel, Campbell, Lettau and Xu (2000). Part of our goal is to provide a single framework to examine each of these versions of risk.

Little work has been conducted on skewness. Harvey and Siddique (2000) present tests of a CAPM with coskewness that suggest this model competes favorably with the Fama and French (1992) three-factor model. This follows the seminal work of Rubinstein (1973) and Kraus and Litzenberger (1976). Stein et al. (2000) show that institutional ownership is an important determinant of total skewness. Harvey and Siddique (1999) argue that it is difficult from a time-series perspective to measure the ex ante skewness. It is important to have a cross-sectional model that tells us the ex ante risk given certain characteristics.

Ferson and Harvey (1998) argue that country risk is influenced by both local and global factors. At the firm level, we see three fundamental sources of variation: macroeconomic, industry and microeconomic. The macroeconomic factors may cause variation in risk over time but they don't really help us explain the cross-section of risk exposure at a particular point in time because the macroeconomic information is the same for all firms. Industry differences will be an important factor in explaining the cross-section of risk exposure. The industry classifications tell us something about the way cash flows, on average, in a particular industry, vary with market wide factors. After extracting industry variation, we are able to explain the cross-sectional variation in risk related to the characteristics of particular firms within an industry.

We choose characteristic measures that have been used in a number of previous studies on stock returns and earnings. For example, Lev and Thiagarajan (1993) use a set of fundamental variables (or characteristics) that capture "persistence (sometimes referred to as "quality") and growth of reported earnings."[2] We expand the list of characteristics to include both financial and operating leverage, and include a variety of growth measures.

The paper is organized as follows. The second section details the model that relates various risk measures to characteristics as well as the asset pricing frameworks that we use to separate the systematic and idiosyncratic sources of risk. The third section presents the fundamental information used to explain both cross-sectional and time-series variation in the risk measures. This section also describes the data used and presents some summary statistics. The results are presented in the fourth section. Some concluding remarks

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[2] Abarbanell and Bushee (1997) and Abarbanell and Bushee (1998) present and summarize much of this research

are offered in the final section.

2. Characteristics and the distribution of equity returns

The role of characteristics in determining risk has been viewed as important since Modigliani and Miller (1958) and Hamada (1969) show that as leverage of a firm increases, the systematic risk increases. As an illustration of the role characteristics can play in determining risk exposure for a firm, we analyze the impact of leverage on systematic and total risk.

Merton (1974) proposed the original valuation model of the equity of a firm as an equity call option. This model assumes that changes in firm value follows a geometric Brownian motion:

$$\frac{dV}{V} = \mu dt + \sigma dZ. \tag{1}$$

where μ is the instantaneous standard deviation and σ is the instantaneous standard deviation of the value process. Assuming no bankruptcy costs or tax-advantages of debt-financing, Merton (1974) (with modifications, for example, in Smith (1979)) the equity of the firm is valued as the following:

$$E(V) = VN\left(\frac{\ln\left(\frac{V}{D}\right) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}\right) - e^{-rT}DN\left(\frac{\ln\left(\frac{V}{D}\right) + (r - \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}\right) \tag{2}$$

In this model the firm has one zero-coupon bond of face-value D and maturity T, r is the riskfree interest rate and bankruptcy is determined exogenously in that bankruptcy occurs if V falls below D at maturity. With the assumption of a geometric Brownian motion for the firm value change, the distribution of logarithmic returns on the firm value is symmetric. However, if equity is determined by (2), the equity return (stock return) does not have a symmetric distribution because of the call option feature. As leverage increases (defined using either the face value or the market value of debt), value of equity falls. With falling equity value, expected stock return increases. In effect, increasing leverage in the presence of costless bankruptcy transfers wealth from bondholders to shareholders by increasing the moneyness of the option. Thus, increasing leverage in such a model of equity value, increases the skewness of the return distributions. Increases in the volatility of the underlying assets has a similar effect on the skewness.

However, assumptions that the firm has zero coupon bonds with no protection and zero bankruptcy costs are untenable. Bondholders use mechanisms such as issuing convertible bonds or including protective covenants to reduce the likelihood of the wealth-transfer problem. Additionally, the Merton (1974) model also ignores the tax-shield benefits of debt financing on the firm. Therefore, observed equity returns are unlikely to behave as the Merton (1974) model would predict.

Leland (1994) substantially modifies the Merton model to incorporate bankruptcy costs, tax advantages of debt-financing as well as endogenous determination of bankruptcy. The disadvantages are that such a model no longer has simple analytic solutions. The underlying intuition of the Leland (1994) model is that there are positive bankruptcy costs that may be offset by the tax-shield benefits of debt-financing. In this setting, distribution of equity returns is no longer guaranteed to become more skewed as leverage increases.

To analyze the impact of leverage on distribution of equity returns, we adapt the Leland (1994) model of valuation with proportional and time-independent bankruptcy costs and tax-shield value. We assume that bankruptcy is triggered if the total value of the firm's assets falls below the initial market value of the debt. This may be viewed as a protective covenant rather than an endogenous determination of bankruptcy.

In this framework, the value of the equity at any time is given by

$$E(V) \quad = \quad V + TB(V) - BC(V) - D(V) \tag{3}$$

$$\text{where, } TB(V) = \frac{\tau C}{r} - \frac{\tau C}{r}\left(\frac{V}{D_0(V_0)}\right)^{\frac{-2r}{\sigma^2}} \tag{4}$$

$$BC(V) = \alpha D_0(V_0)\left(\frac{V}{D_0(V_0)}\right)^{\frac{-2r}{\sigma^2}} \tag{5}$$

$$D(V) = \frac{C}{r} + \left[(1-\alpha)D_0(V_0) - \frac{C}{r}\right]\left(\frac{V}{D_0(V_0)}\right)^{\frac{-2r}{\sigma^2}} \tag{6}$$

$$D_0(V_0) = \frac{C}{r} + \left[(1-\alpha)D_0(V_0) - \frac{C}{r}\right]\left(\frac{V_0}{D_0(V_0)}\right)^{\frac{-2r}{\sigma^2}} \tag{7}$$

In this model, V is the total asset value of the firm that is governed by the law of motion in (1). $TB(V)$ is the value of the tax-shield that is generated from the deductibility of interest payments. $BC(V)$ is the market value of the claim to the bankruptcy costs should it occur. $D(V)$ is the value of debt. $D_0(V_0)$ is the initial market value of the debt that needs to be solved numerically in (7). Bankruptcy occurs if value of the assets falls below $D_0(V_0)$.

The parameters of the model are: α, the proportional loss in bankruptcy, τ, the tax rate, and, C, the coupon per instant of time that the firm pays as long it is solvent. The Leland (1994) model as presented in (3)-(7) suggests that changes in leverage will impact the value of equity and thereby affect equity returns.

We carry out simulations that illustrate how skewness of the equity-as-call-option returns varies as leverage is changed. We assume that the initial value of the assets of the firm is 100, use a τ of 30%, α of .04, and assume that there are 700 months of observations per firm. For the coupon, C, we use varying coupons from 0.20.

Our estimate of σ^2 is taken from the equity returns on the Dow 30 firms and we examine various σ^2 values. For r we use both a fixed rate 5% as well as r that increases with leverage (defined as $\frac{D_t}{V_t}$.)

In general, with increasing leverage equity returns become more skewed if the interest rate r is assumed to be constant. However, at very high leverage levels and with a high underlying asset volatility, σ^2, skewness can actually decrease. This can be understood as bankruptcy resulting a sample of equity returns where the negative 100% return on bankruptcy dominates the higher positive returns. The decreasing skewness is even more pronounced when the interest rate increases with leverage. Figure 1 shows the impact of changing leverage on volatility and skewness in this model.

Obviously, the impact of other characteristics can not be incorporated into this model without substantially adding to the complexity of the model.

2.1. Systematic and idiosyncratic risk

We measure total variance and skewness risk using 60 months of stock returns. Total variance at time s is given by the usual variance formula. We measure total skewness using the coefficient of skewness:

$$\frac{\frac{\sum_t^T [r_{i,t} - \bar{r}_{i,t}]^3}{60}}{\left(\sqrt{\operatorname{Var}(r_{i,t})}\right)^3}$$

where $\bar{r}_{i,t}$ is the mean return.

We use several asset pricing models to capture systematic and idiosyncratic risk. With the capital asset pricing model (CAPM) as the maintained model for expected returns, we estimate the market beta, β_{MKT}, in the market model:

$$r_{i,t} = \alpha_i + \beta_{i,\mathrm{MKT}} r_{M,t} + \epsilon_{i,t}.$$

The systematic variance risk is defined by the β_{MKT} estimated in the model. Idiosyncratic variance is defined as

$$\operatorname{Var}[r_{i,t} - \beta_{i,\mathrm{MKT}} r_{M,t}] = \operatorname{Var}(r_i) - \beta_{i,\mathrm{MKT}} r_{M,t}^2 \operatorname{Var}(r_{M,t}). \qquad (8)$$

Both the systematic and idiosyncratic risk at t is based on the time-series of returns from $t - 60$ to t. We also compute β_{MKT} using the Scholes-Williams correction where β_{MKT} is defined as

$$\frac{\mathrm{Cov}\left(r_{i,t}, \frac{r_{m,t-1}+r_{m,t}+r_{m,t+1}}{3}\right)}{\mathrm{Cov}\left(r_{m,t}, \frac{r_{m,t-1}+r_{m,t}+r_{m,t+1}}{3}\right)}.$$

We define systematic skewness risk as the directly computed skewness beta, β_{SKD} defined as

$$\hat{\beta}_{\mathrm{SKD}_i} = \frac{E[\epsilon_{i,t+1}\epsilon_{M,t+1}^2]}{\sqrt{E[\epsilon_{i,t+1}^2]}E[\epsilon_{M,t+1}^2]}$$

where $\epsilon_{i,t}$ is the residual from the market model above.

With the Fama-French three-factor model as the maintained model, the expected returns are estimated as

$$r_{i,t} = \beta_{i,\mathrm{MKT}} r_{M,t} + \beta_{i,\mathrm{SMB}} R_{SMB,t} + \beta_{\mathrm{HML}} R_{HML,t} + \varepsilon_{i,t}$$

and idiosyncratic variance and skewness are defined from the residuals of this model.

We first show that the cross-sectional variations in returns depend on the four risk measures, the Fama-French factors and directly computed skewness. Therefore, we regress non-overlapping 36-month excess returns on the risk measures computed using past information. Table 1 summarizes these results. We use both a common-intercept as well as group the firms by two-digit SIC codes. We find that coskewness with the market is a significant explanator of cross-sectional variation of returns even when industry differences are taken into account.

3. Data

We use monthly equity returns from CRSP over the 1950 to 1998. We have a total of 12,227 firms with a total of 131,347 firm-year returns. However, the availability of characteristics data reduces the sample substantially. We have a five-year-firm sample of 15,364 observations.

We measure risk using five years of returns and use June of 1953, 1958, 1963, 1968, 1973, 1978, 1983, 1988, 1993 and 1998 as our sampling dates for risk. The fundamental variables (characteristics) we use are primarily from annual COMPUSTAT (Current and the Backdata files) and also cover the years 1950 to 1998, however, with not all the variables available for all the years. Additionally, we also use historical IBES data to get expectations of EPS growth using analysts' forecasts. These are available for the cross sections 1988, 1993, and 1998. We get volume and spread data from CRSP that are available for the cross-sections from 1968 onwards.

We use a characteristic when it would be reasonable for the investors to know the information assuming that annual balance sheet and income statement are known to the investors three months after the fiscal year end. Since different data are measured at different frequencies, the date of the characteristic will also differ. As an illustration, skewness of a stock in 1993 is measured using 60 months of returns from June 1993 to June 1998. Some characteristics such as market/book, size etc. can be measured using May 1993 data using for example price as of May 1993 and average spread measured in the 12 months from May 1992 to May 1993. Assuming a fiscal year end of December (and known to investors by March 1993), characteristics such as return on assets, return on equity, fixed assets/sales ratio etc. can be measured using the financial statements dated December 1992. The growth variables such as sales growth are measured using five years of financial statements and are measured using the financial statements dated December 1987 and December 1992.

We construct a total of twenty-seven characteristics that measure the firm in various dimensions as detailed in table 2 panel A. Some of the measures (as, for example, volume) are computed using more than one definition. The risk measures are described in panel B and the fundamental variables are detailed in panel C.

These characteristics we construct are among the ten chosen by Lev and Thiagarajan (1993). Lev and Thiagarajan (1993) as well as Abarbanell and Bushee (1997) examine the abnormal growths for variables such as accounts receivable, gross margin, S&A and inventory where the abnormal growth is defined as growth in the variable relative to sales growth. We do not rely upon the abnormal growth definitions since the correlations among the abnormal growth variables are extremely high, i.e. as high as -0.99 between abnormal growth in S&A and gross margin.

We then pick a few variables in each of the dimensions for our empirical work. The ones we pick are: 1) Profitability (ROA), 2) Financial Leverage (LEV), 3) Operating Leverage (SASLS), 4) Growth (IGROWTH) and (EGROWTH), 5) Dividend Yield (DIVYLD), 6) Size (LOGSIZE) 7) Book/market (BKMKT), and 8) Volume (VOL) and (VOL2) and 9) Liquidity (TURN) and (SPREAD).

These characteristics are, however, imperfect measures and, hence, can measure the firm in more than one of these dimensions. For example, LEV (debt/equity ratio) measures financial leverage. However, IGROWTH can capture the growth in either total assets or increase in operating leverage. Similarly, a change in SASLS can come about through a change in fixed costs or in sales.

Panel D of table 2 presents the cross-correlations among the characteristics and risk measures. Some of the correlations are in fact quite large as, for example, between FASLS, RDSALES, and PM. For example, RDSALES has a correlation of -0.9778 with PM and 0.9882 with FASLS.

We analyze the principal components of the factors. Therefore, we categorize these characteristics in groups. Examining the variables that are available for every cross-section (i.e. excluding EPSGROW1, EPSGROW2, COEFFVAR, VOL2, and SPREAD), and find that the first four factors capture essentially 100% of the common variation. We call these the "raw" factors since they are extracted from the "raw" characteristics. The loadings on the four factors by the twenty characteristics are presented panel E of table 2. These factors may be "subjectively" characterized as capturing operating leverage (the first factor), growth (the second factor), profitability and size+book/market (the third and fourth factors).

However, the uniquenesses of IGROWTH, GMGROW, EGROWTH, LFGROW, DIVYLD, VOL and COV are more than 90%. It suggests that the four factors are quite independent of these characteristics. Additionally, the factor structure ignore the presence of nonlinearities in the characteristics.

Therefore, in the empirical work, we use the nine characteristics identified before. Additionally, we also augment our sample for the subsamples where VOL2 and SPREAD are available (from 1968.) and EPSGROW1, EPSGROW2 and COEFFVAR (from 1988) are available.

3.1. Industry versus firm-specific variation in characteristics

An important consideration in analyzing the impact of characteristics on firm risk measures is how much depends on what industry the firm is in versus how much firm-specific characteristic itself contributes. This also relates to how the characteristics cluster across time and industries. Thus, it may very well be that an important source of risk like operating leverage (as measured by SASLS) is a proxy for the industry rather than specific to the company. Thus, operating leverage for a company may be high because it is in a high operating leverage industry rather than arising from managerial decisions. Similarly, the characteristics may be clustered in time. Thus, a decade may see high operating leverage in an industry whereas the next decade may see lower operating leverage. In such scenario a firm's operating leverage may remain unchanged over these two decades, though, its operating leverage in relation to its industry would have increased over this period.

In fact we do find that the characteristics are very industry dependent since they depend on the line of business a firm is in. For example, in analyzing the nine characteristics, we find that for six of the characteristics we can reject the null that between group characteristics are not significant where the groups are based on the two-digit SIC code. LEV, SASLS, and IGROWTH are the three characteristics for which we fail to reject the null of significant between-group differences.

Additionally, the characteristics also vary substantially over time. For example, average financial leverage has varied substantially over the years ranging from a mean of 0.89 to 2.06.

Therefore, we also examine how the standardized characteristics relate to the risk measures. We standardize the characteristics by expressing them as the percentage deviation from the industry median for every half-decade, i.e.

$$\mathrm{STCHAR}_{i,t} = \frac{\mathrm{CHAR}_{i,t} - \mathrm{CHAR}_{industry,t}}{\mathrm{CHAR}_{industry,t}} \tag{9}$$

where $\mathrm{CHAR}_{industry,t}$ is the median characteristic computed for the two-digit SIC code and half-decade. As an example, standardized financial leverage for Abbot Labs (CUSIP 00282410) in 1955 is computed as the raw leverage (LEV) for Abbot Labs in 1955 minus the median leverage (LEV) for all firms with two-digit SIC code 28 (pharmaceuticals) divided by the median industry leverage.

4. Results

4.1. Conditional risk estimation based on fundamentals: characteristics

Our main focus is on conditional risk estimation. We also examined the contemporaneous explanation of the risk measures using the characteristics.

These results are not presented but are, however available from the authors upon request.

Table 3 presents the results of cross-sectional regressions of volatility, beta and idiosyncratic volatility on lagged characteristics and lagged values of the risk measures. The standard errors are “robust” and, hence, are adjusted for both correlation amongst the variables and autocorrelation.

Panel A shows that total volatility is most significantly predictable using past volatility and skewness with volatility being positive and skewness being negative. However, LOGSIZE and ROA are negatively related implying that larger firms with greater profitability also have lower future volatility. IGROWTH is negatively related whereas greater operating leverage (as measured by SASLS), volume (as in VOL) and turnover (as in TURN) are positively related.

Regressions of beta to the market show that greater coskewness and beta implying higher beta in the future. LOGSIZE appears positively related. ROA, IGROWTH and TURN are negatively related, implying greater profitability, growth and liquidity now imply lowering of future beta.

Panel C of table 3 presents the results of cross-sectional regressions of idiosyncratic volatility on lagged characteristics and lagged values of the risk measures. Higher idiosyncratic volatility now predicts higher idiosyncratic volatility in the future whereas idiosyncratic skewness appears negatively related. For the other characteristics, their effects on future idiosyncratic volatility appear very similar to their effects on future volatility.

Table 4 presents the results of cross-sectional regressions of skewness, coskewness and idiosyncratic skewness on the lagged characteristics data and risk measures.

Panel A shows that greater skewness now predicts greater skewness (though not with great significance.) LOGSIZE, DIVYLD and ROA are negative predictors in that smaller firms with low profitability and low dividend yields having greater skewness. Book/market, volume and turnover are positively related.

Panel B examines the predictability of coskewness. LOGSIZE, CSKEW, and EGROWTH are positively related implying that greater size, higher coskewness and earnings growth now predict higher coskewness in the future. LEV, IGROWTH, and DIVYLD are negatively related implying that greater financial leverage, inventory growth (as for example by increasing operating leverage) and dividend yield lowers future coskewness.

Finally, panel C of table 4 presents the results for idiosyncratic skewness. These results show that size (as in LOGSIZE) is the most significant predictor of future idiosyncratic skewness with smaller firms having higher idiosyncratic skewness. Higher ROA also lowers future idiosyncratic skewness. Operating leverage (as in SASLS), IGROWTH, book/market and volume are positively related.

We then also examine the impact of including other variables in the regressions in panel E1. For the subsample where SPREAD is available, we find that it is very significant as a predictor variable with increasing SPREAD associated with greater skewness. For the subsample where EPSGROW1 and COEFFVAR are available, COEFFVAR is also significant and positive.

[SHOULD WE DO IT FOR ALL THE RISK MEASURES OR JUST FOCUS ON THE CASES WHERE THERE IS A DIFFERENCE]

Finally, we examine the impact of including quadratic and interaction terms (in panels E2 and E3). In predicting future volatility, VOL^2 is significant and negative whereas VOL is positive. Thus, increase in volatility with greater volume decreases as the level of volume increases. We find increase in VOL×TURN is positive and significant in predicting future volatility. Thus, for the same increase in volume, higher turnover implies greater volatility. On the other hand LEV×VOL is negative implying that for the same increase in volume, greater leverage implies lower volatility.

In the prediction of future beta with respect to the market where quadratic and interaction terms are included, IGROWTH^2 appears as negative whereas IGROWTH is no longer significant. SASLS×LEV is positive and significant though SASLS and LEV are not individually significant. Similarly, VOL×TURN is negative and very significant implying that higher volume reduces future beta only in conjunction with an increases in future turnover.

[SHOULD WE DO IT FOR ALL THE RISK MEASURES OR JUST FOCUS ON THE CASES WHERE THERE IS A DIFFERENCE]

We finally carry out cross-sectional regressions of the risk measures on standardized characteristics. These regressions are in effect controlling for industry-specific component in the characteristics. The results are quite surprising. LOGSIZE is still significant but ROA, IGROWTH and VOL are no longer significant. On the other hand both operating leverage (SASLS) and financial leverage (LEV) are positively significant. Deviations from the industry median skewness and volatility are also significant with skewness being negative and volatility being negative. This implies that firms with skewness below the industry median and volatility above the industry median have higher skewness in the future.

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5. Conclusions

We present the first analysis of the cross-section of expected risk exposure using a variety of risk measures and find that total risk, systematic risk and idiosyncratic risk can be explained and predicted using a large number of firm-level characteristics.

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Table 1

A. Cross-sectional tests of the Fama-French model and the impact of the inclusion of coskewness

We report the results from the the cross-sectional regressions of the excess three-year equity returns for firms on the βs with respect to the market, SMB, HML portfolios and directly computed coskewness. The coefficients (excepting the intercept) have been multiplied by 100. The t-statistics are presented in the second line and significance levels in the third. The betas are computed using 60 months' prior returns ($t-60$ to t). The excess returns are computed from and t to $t+36$. The cross-sections are non-overlapping and The cross sections are over the period 1950 January to 1998 December, with a maxium of ten cross-sections per firm. In addition to the single intercept across firms (as in Group = None), we also estimate models where we permit group-specific intercepts where we group the firms by 2-digit SIC codes. We have 66 2 digit SIC codes. σ_ν is the cross-sectional variance of the group specific intercepts around the overall mean intercept and ρ is what percentage of the total variance is explained by the group specific intercepts.

Group	α	β_{SMB}	β_{HML}	β_{MKT}	β_{SKD}	σ_ν	R^2	ρ
None	0.394	6.080	-3.667	3.837			0.26	
	14.20	4.39	-2.57	1.63				
	0.000	0.000	0.010	0.104				
	0.381	5.002	-3.376	5.430	-9.666		0.29	
	13.35	3.39	-2.36	2.19	-2.12			
	0.000	0.001	0.018	0.028	0.034			
2 Digit SIC Code	0.383	5.793	-2.014	6.633		0.098	0.30	0.58
	10.49	3.72	-1.27	2.45				
	0.000	0.000	0.205	0.014				
	0.365	4.674	-1.681	8.531	-9.915	0.102	0.33	0.63
	9.64	2.82	-1.05	2.97	-1.99			
	0.000	0.005	0.293	0.003	0.047			

Table 2

A. Characteristics computed from the fundamental COMPUSTAT, CRSP and IBES data

Dimension	Mnemomic	Characteristic	Definition
Profitability	ROE	Return on Equity	$\frac{\text{EBITDA}}{\text{Equity}}$
&	ROA	Return on Assets	$\frac{\text{EBITDA}}{\text{Assets}}$
Financial Leverage	PM	Profit Margin	$\frac{\text{EBITDA}}{\text{Sales}}$
	LEV	Debt / Equity Ratio	$\frac{\text{Debt}}{\text{Equity}}$
Operating Leverage	RDSLS	R&D/Sales	$\frac{\text{Research \& Development Expense}}{\text{Sales}}$
	CAPXSLS	Cap. Exp./Sales	$\frac{\text{Capital Expenditures}}{\text{Sales}}$
	SASLS	S&A/Sales	$\frac{\text{Sales \& Administrative Expense}}{\text{Sales}}$
	FASLS	Fixed Assets/Sales	$\frac{\text{Fixed Assets}}{\text{Sales}}$
Growth	AGROWTH	Asset Growth	$\frac{\text{Asset}_t-\text{Asset}_{t-1}}{\text{Asset}_{t-1}}$
	SGROWTH	Sales Growth	$\frac{\text{Sales}_t-\text{Sales}_{t-1}}{\text{Sales}_{t-1}}$
	IGROWTH	Inventory Growth	$\frac{\text{Inventory}_t-\text{Inventory}_{t-1}}{\text{Inventory}_{t-1}}$
	LFGROW	Labor Growth	$\frac{\text{Sales per Employee}_t-\text{Sales per Employee}_{t-1}}{\text{Sales per Employee}_{t-1}}$
	ARGROW	Accounts Receivables Growth	$\frac{\text{Accounts Receivables}_t-\text{Accounts Receivables}_{t-}}{\text{Accounts Receivables}_{t-1}}$
	EGROWTH	Earnings Growth	$\frac{\text{FD EPS}_t-\text{FD EPS}_{t-1}}{\text{FD EPS}_{t-1}}$
	GMGROW	Gross Margin Growth	$\frac{\text{Gross Margin}_t-\text{Gross Margin}_{t-1}}{\text{Gross Margin}_{t-1}}$
	EPSGROW1	EPS Growth	$\frac{\text{Mean Analysts' EPS Forecast}_t-\text{EPS}_{t-1}}{\text{EPS}_{t-1}}$
	EPSGROW2	EPS Growth	$\frac{\text{Median Analysts' EPS Forecast}_t-\text{EPS}_{t-1}}{\text{EPS}_{t-1}}$
	COEFFVAR	EPS Growth Volatility	$\frac{\text{Std. Deviation of EPS Forecast}_t}{\text{Absolute Value of Median EPS Forecast}_t}$
Solvency	COV	Coverage Ratio	$\frac{\text{Interest Expense}}{\text{EBITDA}}$
	COV2	Coverage Ratio	$\frac{\text{Interest Expense}}{\text{Free Cash Flow}}$
Liquidity	SPREAD	Spread	$\frac{\text{Bid - Ask}}{\text{Price}}$
	TURN	Turnover	$\frac{\text{Shares Outstanding}}{\text{Shares Traded}}$
Volume	VOL	Volume	Shares Traded
	VOL2	Volume	Average Monthly Volume from CRSP
Dividend	DIVYLD	Dividend Yield	$\frac{\text{Dividends per Share}}{\text{Price per share}}$
Size &	LOGSIZE	LogSize	logarithm (Price per share × Shares outstandi
Book/market	BKMKT	Book/market	$\frac{\text{Equity}}{\text{Price per share}\times\text{Shares outstanding}}$

B. Risk measures computed from CRSP data

Mnemomic	Risk measure
SKEW	Total Skewness
VOLATIL	Total Variance
CSKEW	Coskewness
B2MKT	Beta to the Market
IDVOL	Idioysncratic Variance
IDSKEW	Idiosyncratic Skewness

C. Fundamental variables extracted from COMPUSTAT, CRSP and IBES

The annual Compustat data number is in parentheses.

1. earnings before interest, taxes, depreciation and amortization (EBITDA) (data18+data14)
2. gross margin (data12-data41)
3. inventory (data78 or data3)
4. sales & administrative expense (data189)
5. fully-diluted EPS (data57)
6. total assets (data6)
7. fixed assets (data7)
8. sales (data12)
9. capital expenditures (data128)
10. price per common share (data24)
11. number of common shares outstanding (data25)
12. debt (data9+data34)
13. equity (data11)
14. equity2 (data60+data35-(data56 or data10 or data130))
15. research and development expense (data46)
16. dividends per share (data26)
17. shares traded (data28)
18. interest expense (data15)
19. accounts receivable (data2)
20. labor force (data29)
21. Median primary EPS forecast for next fiscal year (IBES)
22. Mean primary EPS forecast for next fiscal year (IBES)
23. Standard deviation of primary EPS forecast for next fiscal year (IBES)
24. Monthly share volume (Monthly CRSP)
25. Bid/Ask/Price (Daily CRSP)

D. Cross-sectional correlation of characteristics and risk measures

This table presents the pairwise cross-sectional correlations of the characteristics, risk measures and lagged risk measures. The characteristics are always lagged relative to the risk measures. computed from COMPUSTAT, CRSP, and IBES data as described in panel A of table 2. Correlations significant at 5% level are denoted by an asterisk.

	SKEW	VOLATIL	B2MKT	CSKEW	IDVOL	IDSKEW	ROE	ROA	CAPXSLS	SASLS	FASLS	LEV	IGROWTH	GMGROW
SKEW	1.0000													
VOLATIL	0.2146*	1.0000												
B2MKT	0.0077	0.0186	1.0000											
CSKEW	0.1921*	-0.0112	0.1066*	1.0000										
IDVOL	0.2093*	0.9968*	-0.0140	-0.0147	1.0000									
IDSKEW	0.7712*	0.1831*	-0.0100	-0.0011	0.1836*	1.0000								
ROE	-0.0073	-0.0039	-0.0136	0.0069	-0.0035	-0.0062	1.0000							
ROA	-0.0999*	-0.0729*	-0.0275	0.0354	-0.0713*	-0.0773*	0.2760*	1.0000						
CAPXSLS	0.0064	0.0078	-0.0023	-0.0073	0.0083	0.0075	-0.0195	-0.0091	1.0000					
SASLS	0.0350	0.0352	-0.0170	-0.0005	0.0367	0.0232	-0.0066	-0.0301	0.2033*	1.0000				
FASLS	0.0122	0.0140	-0.0375	-0.0037	0.0148	0.0105	-0.0165	-0.0099	0.6311*	0.4118*	1.0000			
LEV	0.0165	0.0095	0.0084	-0.0148	0.0092	0.0168	-0.4697*	-0.0291	0.0385*	-0.0018	0.0274	1.0000		
IGROWTH	-0.0059	-0.0009	0.0036	0.0076	-0.0008	-0.0025	0.0005	0.0018	0.0037	0.0001	-0.0015	-0.0007	1.0000	
GMGROW	-0.0125	-0.0014	0.0105	-0.0200	-0.0015	-0.0002	0.0003	0.0024	0.0067	-0.0036	0.0005	0.0000	0.0014	1.0000
EGROWTH	-0.0003	0.0002	0.0061	0.0078	0.0001	-0.0022	0.0006	0.0078	-0.0006	-0.0002	-0.0002	-0.0006	-0.0003	0.0021
ARGROW	-0.0122	-0.0040	0.0756*	0.0018	-0.0053	-0.0169	-0.0002	-0.0230	0.0026	0.0073	-0.0006	-0.0007	0.0087	0.0125
LFGROW	0.0292	0.0050	0.0086	-0.0175	0.0049	0.0323	-0.0005	-0.0488*	0.0024	-0.0009	0.0004	-0.0020	0.0038	-0.0515*
AGROWTH	-0.0582*	-0.0060	0.1241*	0.0096	-0.0086	-0.0814*	0.0042	0.0099	0.0336	-0.0009	-0.0067	0.0003	0.0246	0.0013
SGROWTH	-0.0004	-0.0002	-0.0016	-0.0028	-0.0002	0.0046	-0.0001	-0.0038	0.0001	0.0042	-0.0010	0.0000	0.0140	-0.0590*
DIVYLD	-0.1703*	-0.0667*	-0.2040*	0.0309	-0.0628*	-0.0743*	0.0213	0.0251	-0.0052	-0.0153	-0.0017	0.0075	-0.0035	-0.0017
LOGSIZE	-0.3969*	-0.0970*	0.0052	0.1624*	-0.0941*	-0.3807*	0.0252	0.0472*	-0.0142	-0.0288	-0.0207	-0.0019	0.0070	0.0165
BKMKT	0.0774*	-0.0023	-0.0202	-0.0155	-0.0027	0.0975*	-0.0003	-0.0006	0.0007	-0.0019	0.0012	0.0000	-0.0006	-0.0005
VOL	-0.1105*	-0.0102	0.0631*	0.0607*	-0.0093	-0.1099*	0.0010	0.0182	-0.0007	0.0023	-0.0023	0.0030	-0.0006	0.0043
VOL2	-0.1305*	-0.0164	0.0482*	0.0521*	-0.0149	-0.1154*	-0.0011	0.0053	0.0086	0.0045	0.0054	0.0049	0.0003	0.0053
SPREAD	0.2665*	0.0898*	-0.0614*	-0.0803*	0.0928*	0.2447*	-0.0272	-0.1770*	0.0297	0.0641*	0.0400*	0.0087	0.0091	-0.0075
TURN	0.0250	-0.0016	-0.0290	0.0111	-0.0009	0.0084	0.0002	0.0028	0.0031	-0.0018	0.0073	-0.0003	-0.0007	-0.0006
COV2	0.0155	0.0159	0.0056	-0.0170	0.0154	0.0082	-0.0154	-0.0116	-0.0006	0.0015	0.0012	0.0015	0.0028	0.0002
COV	-0.0274	-0.0090	0.0018	-0.0026	-0.0091	-0.0248	0.0022	0.0020	-0.0095	-0.0009	0.0000	-0.0035	0.0006	0.0025
EPSGROW1	0.0023	0.0045	0.0621*	0.0098	0.0042	-0.0135	-0.0002	-0.0087	-0.0006	0.0001	-0.0003	-0.0007	-0.0008	0.0002
EPSGROW2	0.0190	0.0734*	0.0825*	0.0104	0.0723*	-0.0068	-0.0008	-0.0255	-0.0011	0.0023	0.0079	-0.0012	-0.0012	-0.0008
COEFFVAR	0.0596*	0.1064*	0.0394	0.0205	0.1030*	0.0287	-0.0005	-0.0095	0.0086	-0.0016	0.0097	0.0015	-0.0005	0.0006
LSKEW	0.0741*	0.0392	-0.0392	-0.0137	0.0405*	0.0517*	-0.0006	-0.0025	0.0014	0.0967*	0.0093	-0.0004	-0.0003	-0.0003
LVOLATIL	0.1965*	0.1301*	0.1107*	-0.0808*	0.1279*	0.1312*	-0.0081	-0.0115	0.0128	0.1350*	0.0245	0.0034	0.0010	-0.0041
LB2MKT	-0.0011	0.0497*	0.4488*	0.0218	0.0409*	-0.1073*	-0.0239	-0.0030	0.0248	0.0300	-0.0176	0.0119	0.0070	-0.0004
LCSKEW	-0.0171	-0.0100	0.0839*	0.1387*	-0.0115	-0.0465*	0.0059	0.0119	0.0051	-0.0050	-0.0059	-0.0035	0.0017	0.0035
LIDVOL	0.2092*	0.1270*	0.0615*	-0.0743*	0.1259*	0.1543*	-0.0072	-0.0622*	0.0127	0.1344*	0.0275	0.0031	0.0010	-0.0043
LIDSKEW	0.0690*	0.0324	-0.0381	-0.0101	0.0336	0.0511*	-0.0005	-0.0132	0.0012	0.0965*	0.0094	-0.0004	-0.0003	-0.0003

	EGROWTH	ARGROW	LFGROW	AGROWTH	SGROWTH	DIVYLD	LOGSIZE	BKMKT	VOL	VOL2	SPREAD	TURN	COV2	COV
EGROWTH	1.0000													
ARGROW	0.0006	1.0000												
LFGROW	-0.0022	0.2008*	1.0000											
AGROWTH	-0.0018	0.1555*	0.0471*	1.0000										
SGROWTH	-0.0019	0.7923*	0.2891*	0.0490*	1.0000									
DIVYLD	-0.0011	-0.0105	-0.0118	-0.0253	-0.0039	1.0000								
LOGSIZE	-0.0016	-0.0092	-0.0254	0.0876*	-0.0035	0.0753*	1.0000							
BKMKT	-0.0006	-0.0014	-0.0102	-0.0060	-0.0002	0.0123	-0.0315*	1.0000						
VOL	-0.0118	0.0053	-0.0002	0.0723*	-0.0017	-0.0222	0.3375*	-0.0033	1.0000					
VOL2	-0.0167	0.0055	-0.0013	0.0820*	-0.0020	-0.0201	0.3665*	-0.0004	0.9717*	1.0000				
SPREAD	-0.0009	0.0180	0.0235	-0.0307	-0.0023	-0.0898*	-0.4640*	-0.0033	-0.0325*	-0.0222	1.0000			
TURN	-0.0002	-0.0019	-0.0012	-0.0089	-0.0005	0.0064	0.0432*	-0.0005	-0.0113	-0.0122	0.0599*	1.0000		
COV2	0.0008	-0.0012	0.0020	-0.0165	-0.0007	-0.0093	-0.0076	0.0060	0.0043	0.0051	-0.0012	0.0029	1.0000	
COV	0.0007	-0.0076	-0.0025	0.0047	0.0016	0.0075	0.0107	0.0004	-0.0029	-0.0033	-0.0239	0.0007	-0.0057	1.0000
EPSGROW1	-0.0002	-0.0014	0.0321	0.0103	0.0067	-0.0028	0.0053	-0.0077	-0.0015	-0.0014	-0.0017	-0.0006	-0.0008	0.0012
EPSGROW2	0.0000	-0.0043	0.1159*	0.0133	0.1074*	-0.0069	-0.0160	-0.0083	-0.0065	-0.0067	0.0241	-0.0002	-0.0002	0.0023
COEFFVAR	0.0001	0.0009	0.0071	0.0021	-0.0001	-0.0043	-0.0099	-0.0002	-0.0032	-0.0035	0.0061	-0.0004	-0.0040	-0.0047
LSKEW	-0.0002	0.0005	-0.0036	0.0015	-0.0001	-0.0042	-0.0158	-0.0001	0.0002	-0.0009	0.0204	-0.0006	0.0000	-0.0005
LVOLATIL	-0.0009	0.0125	0.0122	0.0172	0.0032	-0.0344*	-0.1002*	-0.0007	-0.0059	-0.0075	0.1057*	-0.0024	-0.0019	-0.0045
LB2MKT	0.0004	0.0036	0.0201	0.0596*	0.0098	-0.0870*	0.0184	0.0025	0.0702*	0.0675*	-0.0744*	-0.0390*	0.0101	0.0242
LCSKEW	-0.0044	-0.0005	-0.0208	0.0055	-0.0067	0.0159	0.1452*	-0.0072	0.0679*	0.0665*	-0.0684*	0.0157	0.0015	0.0006
LIDVOL	-0.0008	0.0114	0.0118	0.0153	0.0026	-0.0325	-0.0966*	-0.0008	-0.0051	-0.0065	0.1057*	-0.0014	-0.0017	-0.0072
LIDSKEW	-0.0002	0.0001	-0.0036	0.0015	-0.0001	-0.0041	-0.0155	-0.0001	0.0002	-0.0009	0.0203	-0.0006	0.0000	-0.0006

	EPSGROW1	EPSGROW2	COEFFVAR	LSKEW	LVOLATIL	LB2MKT	LCSKEW	LIDVOL	LIDSKEW
EPSGROW1	1.0000								
EPSGROW2	0.9998*	1.0000							
COEFFVAR	-0.0005	-0.0008	1.0000						
LSKEW	-0.0052	0.0027	-0.0005	1.0000					
LVOLATIL	-0.0041	0.0255	-0.0009	0.9581*	1.0000				
LB2MKT	0.0186	0.0180	-0.0105	-0.0381*	0.0245	1.0000			
LCSKEW	0.0195	0.0202	0.0014	-0.0020	-0.0127	0.1031*	1.0000		
LIDVOL	-0.0045	0.0222	0.0004	0.9635*	0.9966*	-0.0075	-0.0159	1.0000	
LIDSKEW	-0.0052	0.0008	-0.0008	0.9998*	0.9578*	-0.0401*	-0.0023	0.9630*	1.0000

E. Factor loadings on the characteristic in a factor analysis with four factors

This table presents the factor loadings and the uniquenesses for twenty characteristics that are available for all the cross sections from 1958 to 1998. We exclude the characteristics that are not available for all the cross-sections.

Factors	1	2	3	4	Uniqueness
Factors	1	2	3	4	Uniqueness
ROE	-0.031	0.115	-0.240	0.570	0.603
ROA	-0.192	0.285	-0.383	0.047	0.733
CAPXSLS	0.851	0.110	-0.080	0.013	0.257
SASLS	0.770	-0.027	0.016	-0.015	0.406
PM	-0.909	0.049	0.041	0.002	0.169
FASLS	0.834	0.009	-0.119	0.021	0.290
LEV	0.016	-0.034	0.160	-0.568	0.650
IGROWTH	0.004	0.058	0.038	0.006	0.995
GMGROW	0.020	0.196	0.119	0.019	0.947
EGROWTH	-0.001	-0.019	-0.003	0.003	1.000
ARGROW	0.032	0.544	0.323	0.047	0.597
LFGROW	-0.001	0.095	0.112	0.014	0.978
AGROWTH	0.054	0.700	0.286	0.021	0.424
SGROWTH	0.000	0.637	0.297	0.048	0.503
DIVYLD	-0.070	-0.046	-0.213	0.005	0.948
LOGSIZE	-0.056	0.421	-0.578	-0.188	0.450
BKMKT	-0.002	-0.343	0.290	0.168	0.770
VOL	0.014	0.216	-0.201	-0.098	0.903
SPREAD	0.099	-0.200	0.373	0.092	0.802
COV	-0.001	-0.005	0.009	0.021	0.999

Table 3

A. Predicting volatility

We carry out cross-sectional regressions of variance, β_{MKT}, and idiosyncratic volatility computed from t to $t+60$ monthly returns on a set of twelve firm characteristics as of the year ending t. The growth variables and lagged risk measures are measured from $t-60$ to t whereas stock variables such as book/market are as of $t-1$. The coefficients (other than the intercept and the lagged values of the risk measures) have been multiplied by 100. The t-statistics are computed using robust Huber/White/Sandwich standard errors.

R^2 = 17.56 RMSE = 0.01995 Nobs=5484

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	0.020	11.81	0.000
ROA	-4.060	-6.80	0.000
LEV	0.007	0.96	0.340
SASLS	0.255	2.26	0.024
IGROWTH	0.000	-3.71	0.000
EGROWTH	0.000	1.20	0.229
DIVYLD	-2.615	-1.02	0.310
LOGSIZE	-0.178	-9.96	0.000
BKMKT	-0.035	-0.47	0.638
VOL	0.002	5.63	0.000
TURN	0.000	1.96	0.050
SKEW	-17.255	-3.58	0.000
VOLATIL	52.512	8.48	0.000

B. Predicting Beta to the market (β_{MKT})

R^2 = 13.87 RMSE = 0.44587 Nobs=5481

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	0.632	13.72	0.000
ROA	-41.426	-3.24	0.001
LEV	0.009	0.06	0.949
SASLS	-3.466	-0.70	0.487
IGROWTH	-0.007	-2.61	0.009
EGROWTH	0.004	0.36	0.718
DIVYLD	-25.929	-0.92	0.360
LOGSIZE	1.161	2.66	0.008
BKMKT	0.478	0.31	0.755
VOL	-0.018	-1.17	0.240
TURN	-0.006	-1.90	0.057
CSKEW	8.886	3.73	0.000
B2MKT	35.882	20.29	0.000

C. Predicting idiosyncratic volatility

R^2 = 17.54 RMSE = 0.01982 Nobs=5445

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	0.018	11.37	0.000
ROA	-4.056	-6.87	0.000
LEV	0.007	0.96	0.338
SASLS	0.266	2.27	0.024
IGROWTH	0.000	-2.97	0.003
EGROWTH	0.000	1.61	0.107
DIVYLD	-2.212	-0.86	0.391
LOGSIZE	-0.173	-9.77	0.000
BKMKT	-0.068	-0.98	0.328
VOL	0.003	6.89	0.000
TURN	0.000	2.19	0.029
IDSKEW	-19.216	-3.09	0.002
IDVOL	58.340	7.63	0.000

Table 4

A. Predicting skewness

We carry out cross-sectional regressions of skewness, coskewness, and idiosyncratic skewness computed from t to $t+60$ monthly returns on a set of twelve firm characteristics as of the year ending t. The growth variables and lagged risk measures are measured from $t-60$ to t whereas stock variables such as book/market are as of $t-1$. The coefficients (other than the intercept and the lagged values of the risk measures) have been multiplied by 100. The t-statistics are computed using robust Huber/White/Sandwich standard errors.

R^2 = 17.05 RMSE = 0.67986 Nobs=5481

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	1.145	17.79	0.000
ROA	-77.808	-4.56	0.000
LEV	0.403	1.30	0.192
SASLS	0.680	0.21	0.834
IGROWTH	-0.005	-3.94	0.000
EGROWTH	0.008	1.09	0.276
DIVYLD	-287.090	-4.01	0.000
LOGSIZE	-12.929	-16.92	0.000
BKMKT	10.307	4.57	0.000
VOL	0.122	5.58	0.000
TURN	0.020	2.91	0.004
SKEW	278.371	1.84	0.066
VOLATIL	-129.142	-0.77	0.444

B. Predicting coskewness (β_{SKD})

R^2 = 5.21 RMSE = 0.25154 Nobs=5481

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	-0.141	-7.91	0.000
ROA	3.682	0.68	0.495
LEV	-0.083	-2.58	0.010
SASLS	-0.842	-0.69	0.492
IGROWTH	-0.007	-20.69	0.000
EGROWTH	0.009	2.30	0.021
DIVYLD	-50.185	-3.42	0.001
LOGSIZE	2.209	9.67	0.000
BKMKT	-0.391	-0.56	0.573
VOL	-0.003	-0.42	0.677
TURN	-0.001	-0.92	0.357
CSKEW	12.120	8.80	0.000
B2MKT	-0.164	-0.23	0.821

C. Predicting idiosyncratic skewness

$R^2 = 16.02$ RMSE = 0.75531 Nobs=5445

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	1.125	16.44	0.000
ROA	-56.060	-3.01	0.003
LEV	0.321	1.30	0.193
SASLS	7.866	2.12	0.034
IGROWTH	0.004	2.72	0.006
EGROWTH	-0.001	-0.15	0.880
DIVYLD	51.664	0.89	0.372
LOGSIZE	-14.455	-17.08	0.000
BKMKT	14.562	5.80	0.000
VOL	0.147	4.92	0.000
TURN	0.011	1.45	0.148
IDSKEW	-29.114	-0.27	0.789
IDVOL	210.303	1.11	0.268

Additional Possible Tables

E1. Predicting skewness with additional variables from IBES and Spread from CRSP

We carry out cross-sectional regressions of skewness computed from t to $t+60$ monthly returns on additional variables that are available for part of our sample. The growth variables and lagged risk measures are measured from $t-60$ to t whereas stock variables such as book/market are as of $t-1$. The coefficients (other than the intercept and the lagged values of the risk measures) have been multiplied by 100. The t-statistics are computed using robust Huber/White/Sandwich standard errors.

R^2 = 17.79 RMSE = 0.69982 Nobs=5061

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	1.052	15.09	0.000
ROA	-73.132	-4.15	0.000
LEV	0.416	1.29	0.197
SASLS	-0.686	-0.20	0.840
IGROWTH	-0.005	-3.58	0.000
EGROWTH	0.008	1.28	0.202
DIVYLD	-250.026	-3.18	0.001
LOGSIZE	-12.224	-14.88	0.000
BKMKT	11.078	4.73	0.000
VOL	0.107	4.78	0.000
TURN	0.019	2.65	0.008
SKEW	287.780	2.00	0.045
VOLATIL	-226.467	-1.33	0.184
SPREAD	179.4265	3.449	0.001

R^2 = 12.70 RMSE = 0.53615 Nobs=1339

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	0.786	4.70	0.000
ROA	-77.751	-2.46	0.014
LEV	0.240	1.19	0.235
SASLS	-4.989	-0.64	0.525
IGROWTH	0.061	0.28	0.778
EGROWTH	0.008	2.08	0.038
DIVYLD	-58.706	-0.69	0.490
LOGSIZE	-9.211	-6.13	0.000
BKMKT	4.861	0.56	0.575
VOL	0.071	2.53	0.012
TURN	0.024	16.97	0.000
SKEW	370.760	1.17	0.244
VOLATIL	-333.930	-0.86	0.392
SPREAD	435.2247	1.808	0.071
EPSGROW1	0.127	1.17	0.242
COEFFVAR	1.808	2.39	0.017

E2. Predicting volatility with interaction terms

We carry out cross-sectional regressions of volatility computed from t to $t+60$ monthly returns on additional variables that are available for part of our sample. The growth variables and lagged risk measures are measured from $t-60$ to t whereas stock variables such as book/market are as of $t-1$. The coefficients (other than the intercept and the lagged values of the risk measures) have been multiplied by 100. The t-statistics are computed using robust Huber/White/Sandwich standard errors.

R^2 = 18.16 RMSE = 0.01991 Nobs=5484

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	0.020	10.59	0.000
ROA	-3.348	-4.64	0.000
LEV	0.048	1.03	0.303
SASLS	0.288	1.04	0.299
IGROWTH	-0.012	-0.48	0.631
EGROWTH	-0.003	-0.29	0.775
DIVYLD	-4.870	-1.63	0.103
LOGSIZE	-0.195	-9.32	0.000
BKMKT	0.012	0.15	0.881
VOL	0.004	3.79	0.000
TURN	0.000	0.46	0.646
SKEW	-15.786	-3.31	0.001
VOLATIL	49.365	7.45	0.000
ROA^2	2.820	1.96	0.050
LEV^2	0.000	0.39	0.696
SASLS^2	-0.029	-0.63	0.528
IGROWTH^2	0.000	-0.03	0.979
EGROWTH^2	0.000	0.28	0.778
DIVYLD^2	17.678	2.17	0.030
VOL^2	0.000	-3.47	0.001
TURN^2	0.000	-0.26	0.799
ROA*LEV	-0.528	-1.63	0.103
SASLS*LEV	0.159	1.02	0.310
VOL*TURN	0.001	3.33	0.001
ROA*EGROWTH	-0.001	-0.01	0.992
LEV*TURN	0.000	-0.81	0.417
LEV*VOL	0.000	-1.97	0.048
IGROWTH*EGROWTH	0.001	1.20	0.229
SASLS*IGROWTH	0.094	0.63	0.530

E3. Predicting B2MKT with interaction terms

R^2 = 14.84 RMSE = 0.444 Nobs=5481

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	0.588	12.33	0.000
ROA	-39.893	-2.44	0.015
LEV	-0.327	-0.56	0.578
SASLS	2.735	0.43	0.668
IGROWTH	0.237	0.60	0.552
EGROWTH	0.147	0.61	0.545
DIVYLD	-45.738	-1.20	0.230
LOGSIZE	2.161	4.25	0.000
BKMKT	1.590	1.02	0.309
VOL	0.005	0.12	0.903
TURN	-0.017	-0.89	0.372
CSKEW	9.708	4.09	0.000
B2MKT	34.642	19.29	0.000
ROA^2	-69.935	-1.21	0.228
LEV^2	-0.001	-0.71	0.480
$SASLS^2$	-1.490	-1.14	0.255
$IGROWTH^2$	0.000	-1.86	0.063
$EGROWTH^2$	0.000	0.12	0.902
$DIVYLD^2$	187.305	0.93	0.355
VOL^2	0.000	1.54	0.123
$TURN^2$	0.000	1.14	0.256
ROA*LEV	1.721	0.42	0.677
SASLS*LEV	5.367	1.82	0.068
VOL*TURN	-0.059	-3.97	0.000
ROA*EGROWTH	-1.042	-0.66	0.508
LEV*TURN	-0.002	-1.03	0.301
LEV*VOL	-0.005	-1.08	0.281
IGROWTH*EGROWTH	0.018	0.97	0.333
SASLS*IGROWTH	0.923	0.49	0.626

F1. Predicting skewness

We carry out cross-sectional regressions of skewness on a set of standardized characteristcs where a standardized characteristic is defined as the percentage deviation from the industry median of that characteristic. Skewness is computed from t to $t+60$ monthly returns. The standardized characteristic is as of the year ending t. The growth variables and lagged risk measures are measured from $t-60$ to t whereas stock variables such as book/market are as of $t-1$. The coefficients (other than the intercept and the lagged values of the risk measures) have been multiplied by 100. The t-statistics are computed using robust Huber/White/Sandwich standard errors.

R^2 = 10.77 RMSE = 0.67085 Nobs=4175

Predictive Variable	Coefficient	t-statistic	Significance level
Intercept	0.434	29.42	0.000
ROA	-1.679	-1.36	0.175
LEV	1.439	2.58	0.010
SASLS	1.867	2.01	0.044
IGROWTH	-0.012	-1.59	0.113
EGROWTH	0.004	1.27	0.204
DIVYLD	-0.785	-1.73	0.084
LOGSIZE	-36.969	-9.93	0.000
BKMKT	7.602	3.85	0.000
VOL	-0.042	-0.34	0.731
TURN	0.023	2.17	0.030
SKEW	-0.007	-8.06	0.000
VOLATIL	4.035	2.69	0.007