Related Stock Market Anomalies: Growth, Distress and Skewness

Abstract

We examine how various stock market anomalies are related, namely whether the skewness effect is related to the value/growth anomaly, the asset growth effect, the volatility effect, and the distress risk puzzle. We posit that firm growth and downsizing/reorganization options lead to more convex value payoffs and increased skewness. We find the part of expected idiosyncratic skewness that can be predicted using only measures of asset growth (in interaction with volatility), growth options and distress is negatively related to expected returns, while the other part is not priced. We conclude that the negative relations between asset growth, growth options and distress risk with stock returns can be attributed to the more positively skewed return distribution for growth-oriented and distressed firms.

JEL classification: G12

Keywords: asset growth, growth options, distress risk, volatility, skewness, returns

1. Introduction

This paper seeks to provide an explanation for the negative empirical relations among growth, distress, volatility, skewness and subsequent stock returns documented in prior studies, thus representing the first empirical study exploring the inter-linkages among various seemingly unrelated stock market anomalies: the value/growth anomaly (Fama and French (1993)), the asset growth effect (Cooper, Gulen, and Schill (2008)), the volatility effect (Haugen and Heins (1975); Ang, Hodrick, Xing, and Zhang (2006)), the distress risk puzzle (Dichev (1998)), and the skewness effect (Boyer, Mitton, and Vornik (2010)). We suggest that growth and distress proxy for real options that increase the skewness of the distribution of the firm's equity returns in volatile environments. If investors prefer stocks with embedded real options that lead to enhanced idiosyncratic skewness, then the high idiosyncratic skewness offered by levered firms with real growth and restructuring options should have lower expected returns. We add growth (in interaction with volatility) and distress proxies to a cross-sectional rolling regression framework forecasting expected idiosyncratic skewness and find that volatility-driven growth and distress option measures provide incremental explanatory power. We then forecast idiosyncratic skewness using a model that depends only on the incremental explanatory power of volatility-driven growth and distress measures, and find that expected returns are negatively related to our real options-driven estimate of expected idiosyncratic skewness. We find no significant relation between expected returns and the component of forecasted idiosyncratic skewness *unrelated* to growth and distress. The results are robust to alternative proxies for growth and distress and to alternative specifications of expected idiosyncratic skewness.

It has been documented that conditional skewness (e.g., Harvey and Siddique (2000), Boyer et al (2010)) and idiosyncratic volatility (Haugen and Heins (1975); Ang et al. (2006)) can help explain the cross-sectional variation of stock returns. It is also known that asset growth (Cooper et al. (2008), Lipman et al. (2011)) and growth options (Anderson and Garcia-Feijoo (2006), Cao et al. (2008), Trigeorgis and Lambertides (2014)), as well as distress risk (e.g., Dichev (1998), Garlappi and Yan (2011), Chava and Purnanandam (2010)) might help explain equity returns. Most of these studies have shown a *negative* relation between asset growth, growth options, distress risk, volatility, and idiosyncratic skewness (each separately) with stock returns, representing a set of unresolved "puzzles" in the empirical asset pricing literature.

Prior studies focused on explaining these anomalous relations as stand-alone, distinct phenomena. Concerning the negative growth-returns relation, for example, Anderson and Garcia-Feijoo (2006) suggest that the return predictability associated with growth opportunities is responsible for the explanatory power of the size and book-to-market factors in cross-sectional stock returns (Fama and French (1992), (1993)). Trigeorgis and Lambertides (2014) suggest that investors may rationally accept a lower required or average return from growth stocks in exchange for the growth option value and the favorably (positively) skewed risk-return profile they offer investors through active management. Grullon et al. (2012) find a stronger volatility-return relation for firms with growth options and that the sensitivity of firm value to changes in volatility declines after firms exercise their real options.

A related recent puzzle has been that of asset growth documented by Cooper et al. (2008) whereby firms with high growth in total firm assets also exhibit lower subsequent returns. Recent follow-on work (Lipson, Mortal, and Schill (2011)) shows that the ability of asset growth to explain the cross section of stock returns is closely linked to idiosyncratic volatility and that asset growth in itself is less significant when the interaction (product) of asset growth and idiosyncratic volatility is included. That the asset growth effect is concentrated in stocks with high idiosyncratic volatility is also consistent with our notion that asset growth may proxy for future growth option value creation only in high volatility (growth) environments. We extend the above line of work on asset growth and growth options, and link it with the volatility effect, suggesting that asset growth primarily represents exercise of past growth options (that may potentially also open up new future-oriented growth options in high-volatility environments); we capture residual future-oriented growth option value creation through a separate *GO* variable implied from market prices and investigate their joint complementary impact on subsequent stock returns both directly and indirectly via influencing return skewness. In line with a standard view of the firm (e.g., Berk, Green, and Naik (1999)) managing a mix of assets in place and growth options (converting the latter into the former), we use a set of complementary growth measures that capture both the impact of past (exercised) growth opportunities (proxied via asset growth (*AG*) or capital expenditure (CAPEX)) and of residual future-oriented growth option value creation (*GO*). Consider the case of Apple investing in a factory in Hong Kong to increase sales of iPhone6 vs. investing in facilities to come up with its next revolutionary product. The factory expenditure in Hong Kong represents asset growth (*AG*) that should increase cash flow (and lower volatility and skewness); but it may also provide an option to expand sales of iPhone6 in the volatile Chinese market (thus interaction of *AG* with volatility becomes significant, and may increase skewness). On the other hand, Apple's R&D and human capital expenditures to come up with its next revolutionary new product represent out-of-the-money future-oriented growth options (*GO*) that may considerably increase idiosyncratic skewness. Thus, all three value components (AG, $AG \times iv$, *GO*) play a relevant and complementary role in firm growth, both directly and through reshaping the firm's idiosyncratic skewness (in interaction with volatility).

Regarding the distress risk puzzle, most recent studies similarly document an overall negative relation between distress risk and subsequent returns.[1] Several explanations have been offered for this apparent anomaly. The first explanation focuses on *mismeasurement of returns*, suggesting there is a measurement error in the returns horizon for the analysis of bankruptcy-filing or financially distressed stocks (Chava and Purnanandam (2010)). The second explanation (Dichev (1998), Griffin and Lemmon (2002)) centers on *mispricing*, attributing the anomaly to investors' inability to price distressed firms close to the event of default (mispricing effect or post-downgrade negative drift). A third key explanation, *renegotiation*, attributes the negative relation to high shareholder renegotiation advantage that enables extracting more benefits from renegotiation near the event of default (Garlappi et al. (2008), Garlappi and Yan (2011)). With regard to the distress risk puzzle, we extend this line of reasoning suggesting that shareholders´ default option and/or reduction of fixed operating costs from reorganization

[1] Two noted exceptions are Vassalou and Xing (2004) and Chava and Purnanandam (2010). Vassalou and Xing (2004) find some evidence that distressed stocks, mainly in the small value group, earn higher returns, though this has been challenged by various studies. Chava and Purnanandam (2010) find a positive relation by using ex-ante returns proxied by implied cost of capital (ICC) calculated by analysts' 15-year forecast estimations, though this is concentrated in the pre-1980 period.

(e.g., via lower renegotiated coupon payments) may help increase skewness thereby leading to lower levered equity returns. Conrad et al. (forthcoming) suggest that firms which have a high default risk also tend to have a high probability of upside "jackpot" payoffs. Our work differs from Conrad et al. (forthcoming) in two main respects: i) we provide a combined distress risk and growth options explanation of the observed stock return anomaly providing potential rationale for classifying a distress stock as "jackpot"; ii) we attribute the increased skewness of distressed stocks mostly to their default/reorganization (downside put) options, rather than their growth (upside call) options. Thus, we emphasize the contemporaneous impact that both protective put and lottery-type call options have on stock returns via idiosyncratic skewness.[2]

Following a separate path, unrelated to the above three puzzling empirical phenomena, various studies have examined the role of idiosyncratic volatility and skewness in stock returns, also finding negative return premia. It remains an inadequately explained puzzle why high volatility stocks have lower average returns (Haugen and Heins (1975); Ang et al. (2006)), unless e.g., a linkage with embedded real options can be established. As Harvey and Siddique (2000) and Charitou et al. (2013) further suggest, certain investors might prefer portfolios that are right-skewed (e.g., due to embedded options) and, as a result, stocks with higher skewness are more desirable and should have lower expected returns. This negative skewness return premium is confirmed in other studies (e.g., Smith (2007), Yang et al. (2010)). Conrad et al.

[2] Conrad et al. (forthcoming) looks at the linkage between distress risk, the probability of an extreme positive outcome and idiosyncratic skewness. Compared to Conrad et al. (forthcoming) we argue that there are two potential sources for this enhanced skewness that drives negative returns: upside growth call options (what they call jackpot or lottery returns) and downside protection/reorganization put options. In other words while they claim it is growth options that explain the distress risk puzzle (this has partial validity of course in that a portion of their sample involves firms that are simultaneously both growth and distress firms), we distinguish between growth and protective options and show that are the protective/reorganization options that explain the distress risk puzzle. Most distressed firms do not necessarily offer jackpot returns.

(2013) find a negative premium for risk-neutral co-skewness measures. Kumar (2009) suggests individual investors prefer stocks with lottery features, where lottery stocks are identified as having high idiosyncratic volatility and skewness. Boyer et al. (2010) find that expected idiosyncratic skewness is an important priced factor commanding a negative return premium. Campbell et al. (2008) similarly suggest that distressed stocks have characteristics that appeal to certain investors, such as increased opportunities to extract private benefits of control or higher skewness of returns and that distressed stocks offer positively skewed returns.

Although these five literatures are rich and extensive on their own right, the inter-linkage between the asset growth, growth options, distress risk, idiosyncratic volatility, and idiosyncratic skewness negative return anomalies and their combined impact on stock returns remains essentially unexplored. The aim of this study is to help fill this important gap, namely to examine the combined impact of asset growth, growth options and the distress/reorganization option on stock returns through influencing expected idiosyncratic skewness and test whether the negative return premium of positively skewed stocks is driven by past asset growth (in interaction with volatility), growth options and distress risk.

We suggest that the negative overall relation between growth options and distress risk with stock returns found in the literature can be attributed to the more positively skewed return distribution of growth-oriented and distressed firms in volatile environments.[3]

[3] Rather than uncertainty being a penalty for which shareholders require a higher return, as one might expect for established value stocks, for growth or distress stocks higher uncertainty underlying their growth or default/reorganization options, combined with managerial, organizational and financial flexibility that result in more asymmetric returns, may be reflected positively ex ante in current prices and justify lower required or subsequent average returns. Active management in levered firms provides equity-holders with a set of call (expansion or growth) and put (default/reorganization) options that creates a more convex firm value payoff and

Essentially, as illustrated in Figure 1, if future demand θ increases beyond an upper demand threshold, θ^{**}, an active (flexible) firm with a strategic growth investment will exercise an expansion/growth option and lower future marginal production costs (from C to c). On the other extreme, in case of a severe negative shock in demand, below lower threshold θ^{*}, the active levered firm can exercise a put option to restructure operations or file for a Chapter 11 reorganization that enables downsizing the firm's scale and/or renegotiating debt terms and lowering fixed costs (potentially including lower coupon payments) from F to f. The active levered firm is therefore able through a strategic growth investment and reorganization/renegotiation options and restructuring to effectively alter its operating scale and cost structure depending on the future demand realization θ, exercising growth or downsizing options accordingly. The value of the active levered firm (V') can thus be viewed as the value of a passive (all-equity) firm (*V*) plus the downsize/reorganization (put) option and the upside growth/expansion (call) option. A higher level of operating and financial flexibility (through downsizing or via reorganization and debt renegotiation) of the active levered firm increases the convexity of its value payoff (*V´* is more convex than *V*) and thereby increases the skewness of its shareholder returns (e.g., see Van Zwet (1964) and Xu (2007)). This effect is more pronounced in higher volatility environments.

[INSERT Figure 1 here]

To help identify the link between asset growth, growth options, distress risk, idiosyncratic volatility, skewness and stock returns, we first isolate the part of idiosyncratic skewness generated by asset growth/growth options (in interaction with volatility) and the

leads to a more positively skewed return distribution. As a result, investors are willing to accept a lower average return from such growth or distressed stocks in exchange for the more favorable (skewed) risk-return profile.

default/reorganization option (distress risk). We refer to this as attributed or expected idiosyncratic skewness. To determine this, we first regress idiosyncratic skewness on asset growth, growth options and distress risk, controlling for other relevant variables, including idiosyncratic volatility, lag skewness, size, momentum, and turnover. We then examine the impact of this attributed or expected idiosyncratic skewness (due to volatility-driven real options alone) on stock returns in a Fama-MacBeth (1973) rolling regression framework.

Our methodological design is as follows. In the first stage of our analysis we show that growth options (as well as the interaction of asset growth with idiosyncratic volatility) and distress risk are positively related to expected idiosyncratic skewness. In the second part, expected idiosyncratic skewness specifically deriving from the firm's volatility-driven real options (growth and default/reorganization) found in the first stage is shown to be negatively related to stock returns. Expected idiosyncratic skewness predicts contemporaneous and subsequent short-run returns (up to 24 months). These predictions correspond to an annualized return differential (hedge portfolio return) of about 9.7% between low and high idiosyncratic skewness quintile portfolios, and an average monthly Sharpe ratio close to 0.37, which is substantial (Lewellen (2010)). The negative return premium associated with idiosyncratic skewness is higher for stocks with higher volatility, growth options and distress.

2. Measurement, Data and Methodology

2.1. Asset Growth and Growth Options

In line with a standard view of the firm (e.g., Berk, Green, and Naik (1999)) managing a mix of assets in place and growth options, we use a set of growth measures that capture both the impact of past (exercised) growth opportunities via asset growth (*AG*) and of residual future-oriented growth potential creation (*GO*). This dual complementary role (with a potentially mixed effect) is well accepted in the literature (e.g., Cao et al. (2008), Grullon et al. (2012), Trigeorgis and Lambertides (2014)).[4] We proxy for the impact of exercised past growth options via the asset growth (*AG*) measure. Following Cooper et al. (2008) we calculate the percent change in total assets or asset growth as:

$$AG_t = \frac{TA_t - TA_{t-1}}{TA_{t-1}}$$

where TA_t is the total asset value (Compustat data item #6) in fiscal year t. In line with the close link between growth and volatility (e.g., Grullon et al. (2012), Trigeorgis and Lambertides (2014)) and the importance of the interaction between asset growth and idiosyncratic volatility documented in Lipson et al. (2011), we additionally include an interaction term given by the product between asset growth AG_t and realized idiosyncratic volatility iv_t ($AG \times iv$).

Growth options (*GO*) represent idiosyncratic future-oriented investment opportunities. Growth options enhance the upside potential of the firm, increasing the convexity of its payoff and the skewness of its returns. Potential (yet-to-be exercised) growth options *GO* are

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[4] For example, Grullon, Lyandres, and Zhdanov (2012), when investigating how the sensitivity of firm values to changes in volatility evolves as a firm's mix of growth options and assets in place changes over time, note (p. 1501): "On the one hand, a firm develops and accumulates real options. On the other hand, it exercises these options by investing when the value of the benefits from investing is high enough to offset the value of the option to wait. Thus, the sensitivity of firm value to changes in volatility is expected to be increasing as the firm builds up its real options, and it is expected to decline when the firm exercises (part of) them." We hypothesize and find an analogous effect in that the return impact of idiosyncratic skewness is expected to be increasing as the firm creates new growth options (GO), and it is expected to decline when the firm exercises (part of them) converting them into assets in place as manifested in asset growth (AG).

calculated as the % of a firm's market value (*V*) arising from future-oriented growth opportunities (PVGO/*V*). It can be inferred by subtracting from the current market value of the firm (*V*) the perpetual discounted stream of firm operating cash flows under a no-growth policy (e.g., see Kester (1984), Cao, Simin and Zhao (2008), Trigeorgis and Lambertides (2014), Long, Wald, and Zhang (2005)):

$$V_{i,t} = \frac{CF_{i,t}}{k_i} + GO_{i,t} \qquad \text{or} \qquad GO_{i,t} = V_{i,t} - \frac{CF_{i,t}}{k_i} \tag{1}$$

Here $V_{i,t}$ is the market value of firm *i* at time t, $CF_{i,t}$ is the (perpetual) Operating Cash Flow of firm *i* at time *t,* and k_i is firm *i*'s weighted average cost of capital (WACC). *CF* is measured as free cash flow under a no-further-growth policy where capital expenditure equals depreciation. We calculate *CF* as net cash flow from operating activities (Compustat item #308) plus interest and related expenses (#15) minus depreciation and amortization (#125).[5] To estimate the cost of equity in WACC we assume the *market model* setting beta equal to 1 for all firms and estimate the market risk premium as the average premium of the S&P500 index portfolio over the one-month T-bill rate over the previous 60-month period. This simple set up avoids reliance of our results on CAPM validity. We estimate the cost of debt to be four units below the corresponding cost of equity. Effective tax rates are obtained from income taxes (#370) divided by pretax income (#365). We use the industry average if not available.

Asset growth and growth option effects are particularly important when idiosyncratic volatility is high. This set of growth variables is expected to have an impact on idiosyncratic

[5] For years prior to 1988, we follow Xie (2001) in estimating cash flow from operations as funds from operations (#110) – change in current assets (#4) + change in cash and cash equivalent (#1) + change in current liabilities (#5) – change in short-term debt (#34)].

skewness and on the way investors form their expectations regarding the firm's future growth. We thus posit that investors form their expectations regarding future idiosyncratic skewness in part by considering past asset growth (in interaction with idiosyncratic volatility) as well as residual future-oriented (or market-implied) growth potential.[6] The growth option (*GO*) variable is incremental in our regressions after controlling for asset growth and its interaction with volatility. *GO* and the interaction term ($AG \times iv$) are capturing future growth potential and increase idiosyncratic skewness, while the direct asset growth (*AG*) impact (from exercising past growth options and turning them into assets in place) may be insignificant or reduce it.

2.2. Distress Risk (Default/Reorganization Option)

Positive skewness enhancement may also result for levered firms with high distress risk facing potential default and reorganization. The negative overall relation between distress risk and stock returns found in most prior studies can be attributed to the more positively skewed distribution of levered equity returns of distressed firms that can reduce fixed operating and financial costs (e.g., coupon payments) by exercising their default/reorganization option. Effectively, the default/reorganization option held by shareholders of distressed firms provides a more positively skewed return distribution that compensates for lower average returns.

A basic way to proxy for this default/reorganization option is using Merton's (1974) option pricing model (that views equity as an option on the firms´ assets with exercise price the

[6] For robustness we used an array of measures proxying for past as well as for future growth opportunities (see also Grullon et al. (2012)). Robustness was performed using past average sales growth, capex/assets, market-to-book, and future average asset and sales growth rates.

face value of debt) to compute a distress risk (*DR*) measure for each firm. [7] Distress risk (*DR*) here is measured as the negative value of the Merton distance to default (-*D2D*), adjusted using the actual drift (μ) rather than the risk-free interest rate (*r*). This measure is highly correlated with the probability of taking advantage of the default/reorganization option that positively skews levered equity returns.[8] In this paper, distress risk is calculated analogously to Bharath and Shumway (2008) as the probability of default at the debt's maturity. The face value of the debt is current liabilities (#45) plus half of the long-term debt (#51). The market value of the firm is the sum of the market value of equity and the book value of total liabilities. The total payout by the firm (including dividends and coupon payments to debt holders) is the sum of interest expense (#15) and cash dividends (#127). Following Bharath and Shumway (2008) the debt maturity is set at one year.

For robustness we also repeat the analysis replacing the original Merton (*D2D*) distress measure *DR* with the Altman (1968) Z-score and the Ohlson (1980) O-score models. In line with Altman (1968) we proxy for distress by calculating the negative of the Z-score (*DRZ*). Due to the discriminant nature of the indicator we also proxy for distress using a binary dummy (DRZ^{DUM}) that assumes the value 1 when the Z-score is below a critical threshold of 1.88. A similar analysis is repeated using the Ohlson (1980) model; in particular, we used the Ohlson O-score

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[7] Versions of the Merton distance to default (-D2D) measure, including Moody's KMV implementations, have been used by Vassalou and Xing (2004), Campbell, Hilscher, and Szilagyi (2008), Garlappi, Shu, and Yan (2008), Chava and Purnanandam (2010), and George and Hwang (2010), among others.

[8] An advantage of using option models in calculating the distress risk is that they provide the necessary structure to infer default-related information from market prices. Option pricing models enable the construction of a measure of distress risk that contains forward-looking information (since market prices reflect investors' expectations about a firm's future performance). This is more appropriate for estimating the market´s assessment of the likelihood of a firm exercising its default/reorganization option in the future than historical estimates. Unlike accounting-based models, firm asset volatility is a key input in such option pricing models.

directly (*DRO*) or a binary dummy (DRO^{DUM}) that assumes the value 1 when the probability of default ($\Pr(Default)$) is higher than a threshold of 0.5. The probability of default is obtained by transforming the Ohlson (1980) metric in the following way:

$$\Pr(Default) = \frac{\exp(DRO)}{1 + \exp(DRO)}$$

2.3. Idiosyncratic Skewness and Volatility

We calculate idiosyncratic skewness and volatility based on daily returns for non-financial firms in the CRSP/COMPUSTAT merged file from January 1983 to December 2012. Idiosyncratic skewness and volatility are calculated each month as scaled measures of the third and second central moments of the residual obtained by fitting the market model to the daily stock returns. We first fit the market model to the daily stock returns over a year by running:

$$Re_{i,t} = \alpha + \beta_{i,t}\left(R_{m,t} - R_{f,t}\right) + u_{i,t} \tag{2}$$

where $Re_{i,t}$ is the daily excess return of stock *i* and $R_{m,t} - R_{f,t}$ is the daily market excess return at time *t*. The above equation is estimated using daily return data from January to December of each year. We then calculate the daily idiosyncratic skewness (is) and daily idiosyncratic volatility (iv) in each month as follows:

$$is_{i,t} = \frac{E_t\left[\left(\hat{u}_{i,j} - E_t[\hat{u}_i]\right)^3\right]}{\left(\sqrt{E_t\left[\left(\hat{u}_{i,j} - E_t[\hat{u}_i]\right)^2\right]}\right)^3} \frac{\sqrt{N(N-1)}}{N-2} \tag{3a}$$

$$iv_{i,t} = \frac{\sqrt{E_t\left[\left(\hat{u}_{i,j} - E_t[\hat{u}_i]\right)^2\right]}}{\sqrt{N-1}} \sqrt{N} \tag{3b}$$

$E_t[.]$ above indicates the expectation at the beginning of month t over the period $[t, t + T]$ and *N* is the number of daily observations from the first available observation of month *t* to the last available daily observation at the end of the final month of the period analyzed (*T*). As a base case, we calculated daily idiosyncratic skewness over a period of *T=12* months.[9] For our asset pricing tests we use a measure of expected idiosyncratic skewness over a horizon of *T=12* months that is generated exclusively by our real option variables, namely *AG,* $AG{\times}iv$, *GO* and *DR.*[10] We use this estimate of *expected* idiosyncratic skewness (rather than realized skewness) in an effort to isolate the impact on skewness due to *AG,* $AG{\times}iv$, *GO* and *DR* alone. The estimation of expected skewness is feasible in that it only uses information available to investors at the time the expectation is built.

To guarantee the feasibility of the measure and isolate the impact of *AG,* $AG{\times}iv$, *GO* and *DR* drivers we first estimate the below cross-sectional regressions each month *t:*

$$is_t = \alpha + \beta_{AG}AG_{t-1} + \beta_{AGIV}(AG{\times}iv)_{t-T} + \beta_{GO}GO_{t-1} + \beta_{DR}DR_{t-1} + $$

$$+ \beta_{iv}iv_{t-T} + \beta_{is}is_{t-T} + \beta_{SIZE}SIZE_{t-1} + \beta_{MOM}MOM_{t-1} + \beta_{TURN}TURN_{t-1} + \varepsilon_t \qquad (4)$$

In Eq. (4) above, the dependent variable is_t is an M X 1 vector of (M firms) cross-sectional idiosyncratic skewness in month *t*. Among the main explanatory variables, AG_{t-1} is an M X 1 vector containing the percent change in firm total assets of the previous year; $(AG{\times}iv)_{t-T}$ is an M X 1 vector containing the interactions between the percent change in total assets of the

[9] For robustness, we repeated the analysis using different horizons varying from 6 to 24 months. Results are similar. For shorter horizons (below 6 months), GO and DR lose importance once other control variables are added.
[10] Due to non-linearity in the *GO* measure, we also extended the model including a second-order term (GO^2) in the regression. The results of this extended model are contained in Table 5 Panel C2.

previous year AG_{t-1} and lagged idiosyncratic volatility iv_{t-T}; GO_{t-1} and DR_{t-1} are M X 1 vectors of cross-sectional growth option (*GO*) value and distress risk (*DR*) proxies in month *t*-1. Growth option (*GO*) intensity is calculated as in Eq. (1) of Section 2.1, while distress risk (*DR*) in our base case is the negative value of the Merton distance to default (-*D2D*). The control variables (shown on the second line of Eq. (4)) include: i) lag idiosyncratic volatility (iv_{t-T}) and lag idiosyncratic skewness (is_{t-T}); ii) $SIZE_{t-1}$, measured as the logarithm of the market value of equity (*ME*) observed at month *t*-1 (where *ME* is calculated as the product of shares outstanding and the last available closing price); iii) momentum (MOM_{t-1}), calculated as the cumulative monthly return of the previous 12 months; and iv) turnover ($TURN_{t-1}$), calculated as the ratio of trading volume to total shares outstanding in month *t*-1. Eq. (4) is cross-sectionally estimated for each month in the sample.

We then determine the expected idiosyncratic skewness specifically attributed to the real option variables above from month *t* to *t+T* (ESKEW) as:

$$E_t[is_{t+T}] = \hat{\beta}_{AG}AG_t + \hat{\beta}_{AGIV}(AG\times iv)_t + \hat{\beta}_{GO}GO_t + \hat{\beta}_{DR}DR_t \quad (5)$$

The expected idiosyncratic skewness estimated in Eq. (5) is meant to isolate the predicted skewness impact attributed to growth variables (*AG,* $AG\times iv$ and *GO*) and to distress risk (*DR*) alone. Unlike Harvey and Siddique (2000) who focus on the pricing of co-skewness, we here focus on the impact of *idiosyncratic* skewness resulting from the *AG,* $AG\times iv$, *GO* and *DR* factors. The reason we focus on idiosyncratic skewness is related to the firm-specific nature of these real options. Several prior papers have documented the pricing impact of idiosyncratic skewness (see Boyer et al. (2010), Kumar (2009)). Our focus differs from Boyer et al. (2010) in that we restrict our attention to "real options" generated expected idiosyncratic skewness. Compared to Kumar (2009), we provide a real options motivation of why investors should prefer stocks with positively skewed returns arising from growth and default options.

To test the robustness in isolating the idiosyncratic skewness impact of these real options, we also calculate the real options driven expected skewness using a different procedure. In this variant, we first calculate the expected idiosyncratic skewness generated by the *other* control variables alone (ESK_REST) as a base model (see also model (1) in Table 3):

$$(a)\ \ E_t[is_{i,t+T}] = \hat{\alpha} + \hat{\beta}_{iv} iv_t + \hat{\beta}_{is} is_t + \hat{\beta}_{SIZE} SIZE_t + \hat{\beta}_{MOM} MOM_t + \hat{\beta}_{TURN} TURN_t \qquad (6)$$

We then calculate alternative expected skewness measures using alternative model specifications that gradually incorporate (parts of) *AG*, $AG \times iv$, *GO* and/or *DR* to equation (6) (models (2), (3) and (4) in Table 3) finally leading to the below complete model:

$$(b)\ E_t[is_{i,t+T}] = \hat{\alpha} + \hat{\beta}_{AG} AG_t + \hat{\beta}_{AGIV} (AG \times iv)_t + \hat{\beta}_{GO} GO_t + \hat{\beta}_{DR} DR_t +$$

$$+ \hat{\beta}_{iv} iv_t + \hat{\beta}_{is} is_t + \hat{\beta}_{SIZE} SIZE_t + \hat{\beta}_{MOM} MOM_t + \hat{\beta}_{TURN} TURN_t \qquad (7)$$

The incremental real options driven expected idiosyncratic skewness, $\Delta E_t[is_{t+T}]$ (henceforth indicated with ESK_DIFF), is then obtained as pairwise differences between the above model (7) that includes the real options variables and base model (6) without them.

2.4. Returns Model Specification

We subsequently study the relation between expected idiosyncratic skewness ($E_t[is_{t+T}]$) specifically attributed to the volatility-driven growth and default/reorganization options and stock returns, after controlling for the 3 Fama-French factors, beta, size, book-to-market (B/M), as well as asset growth (*AG*) and interaction terms, based on the following asset pricing model:

$$\text{Stock Returns} = f\,(\beta, SIZE, B/M, AG; E_t[is_{t+T}], \text{interactions}) \quad (8)$$

Following Fama and French (1992), market risk (β) is estimated over the previous 36 months using the Sharpe-Lintner (CAPM) model: $E[R_{i,t}] = R_{f,t} + \beta_{i,t}(R_{m,t} - R_{f,t})$, where $R_{i,t}$ is the stock return of firm *i* in month t, $R_{m,t}$ is the market return in month t (a value-weighted portfolio of NYSE and AMEX stock returns), $R_{f,t}$ is the one-month U.S. T-bill rate in month *t*, and $\beta_{i,t}$ is the beta of firm *i* in month t. SIZE is alternatively measured as the log of the book value of the firms' total assets, the log of sales or as the market value of equity (ME), measured by log[fiscal year-end price per share (#199) * number of shares outstanding (#25)]. Results are similar so we report only the *ME* results. Book-to-market value of equity (B/M) ratio is measured as the book value of common equity (#60) divided by the fiscal year-end market value of equity (ME).[11] Asset growth *AG* is measured as the percent change in total assets. For robustness we also replace *AG* with CAPEX measured as the (three-year period) average capital expenditures CAPX (#128) at year end minus the beginning-of-period CAPX, deflated by total assets AT (#6), and by sales growth (SG) measured as the percentage change of sales, SALE (#12). Asset growth (AG), CAPEX and past sales growth (SG) are included as alternative proxies of past exercised growth options. Controlling for these helps isolate the impact that future un-exercised growth opportunities, captured in the real-options-driven expected skewness measure, have on equity returns. Expected idiosyncratic skewness, $E_t[is_{t+T}]$, is measured as in Eq. (5) of Section 2.3 above.

[11] Leverage, measured as the log of total liabilities LT (#81) divided by fiscal year-end firm market value *V* (ME + LT), was included for robustness as an additional control variable. Results are essentially the same (not reported).

2.5. Data and Methodology

Our sample consists of 17,530 U.S. listed firms during the 1983-2012 period with data available in the annual Compustat/CRSP Merged Database (excluding financial and utility firms with four-digit SIC codes between 6000 and 6999, and between 4900 and 4999).[12] [13] In implementing the returns model of Eq. (8) we follow the regression procedure of Fama and MacBeth (1973). For each month, we cross-sectionally regress the subsequent 12-month realised stock returns on the explanatory variables described in the model of Eq. (8).[14]

Table 1 Panel A reports summary statistics for all variables in our models. To simplify the presentation we use ESKEW, ESKEW6 and ESKEW24 to indicate the expected idiosyncratic skewness estimated over a horizon of 12 (base case), 6 and 24 months, respectively. ESK_DIFF

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[12] For robustness, we also tested our models for the extended period 1962-2012. The main results are similar. As expected, the effect of yet-unexercised growth options (*GO*) on subsequent stock returns is smaller than the corresponding coefficient found for the more recent and more volatile period (1983-2012).

[13] There are several reasons why we focus on the post-1983 period. First, many growth stocks are traded on NASDAQ. Second, market volatility and growth option value have been higher since 1983. Xu and Malkiel (2003) argue that idiosyncratic risk has become more important over time as stocks listed on the NASDAQ increased in number and importance. The start of S&P 500 index futures trading in 1983 and related computerized program trading activities have increased market volatility and the value of growth options. Chan and Lakonishok (1993) report that beta was working fine until 1982, but stopped being significant subsequently. A potential growth options factor would be more significant in the presence of increased volatility and enhanced growth opportunities which have become more pronounced since 1983. Equally important is a dramatic increase in the number of stocks with negative book equity in the post-1983 period, as documented in Brown et al. (2008), Exhibit 1. 77% of these stocks trade on NASDAQ, many being small distressed stocks, with some simultaneously being growth stocks.

[14] To ensure that the accounting and option variables are known before the returns they are used to explain, we match the accounting data for fiscal year end in calendar year t - 1 (1983-2012) with the returns from July of year t to June of year t + 1. We use a firm's market equity at the end of December of year t – 1 to compute its book-to-market ratio for t – 1. To be included in the return tests for July of year t, a firm must have Compustat/CRSP data for December of year t – 1 and June of year t. It must also have monthly returns for at least 24 of the 36 months preceding July of year t in order to calculate the option-based variables (such as the firms' volatility, *DR* and skewness) and the firm's beta. Considering the sensitivity of our results to extreme observations, we perform the analysis winsorizing the top and bottom 1 % of observations for each independent variable except size (setting them at the 1st and the 99th percentile, respectively). Many observations are lost in calculation of volatility and skewness since at least 24 monthly returns are required. Others are lost in carrying out the Fama-MacBeth (1973) procedure due to missing monthly returns. These lead to a final sample of 827,961 firm-month observations.

indicates the difference in expected idiosyncratic skewness (b) – (a) based on Eqs. (7) and (6). Finally, RSKEW indicates the realized skewness of the past 1 month. If not specifically stated, we refer to the expected skewness over a base horizon of 12 months (ESKEW). To limit the influence of outliers, we removed the extreme 1% in both tails of the estimated expected skewness measure. As expected, market beta is close to one. Mean book-to-market (*B/M*) ratio is 0.61, which is within the normal range found in other studies (e.g., Cooper et al. (2008), Anderson and Garcia-Feijoo (2006)). Capex/Assets is on average 14.37%, and it is highly volatile. The average monthly return (Return) is 1.45%. The time-series average of the cross sectional equally-weighted expected skewness (ESKEW) measure is -0.0181. This cross-sectional average is volatile, with standard deviation of 0.0844. Including the constant term to these expectations leads to a time series average of 1.631 with standard deviation of 0.684.[15]

Panel B of Table 1 reports Pearson correlation coefficients among the key variables. Expected skewness is negatively correlated with *SIZE*, *AG, CAPEX*, *SG*, and *E(+)/P*, as expected. It seems to have a low positive correlation with other variables. The correlation coefficient among the three incremental expected skewness measures ranges between 42-55%, while the correlation between these measures and realized skewness is about 0.28-0.42. The above reaffirms that our expected skewness measure properly isolates the effects of asset growth, growth options and distress risk and is different from realized skewness used in prior studies.

[15] The non real-options-driven skewness (without the constant term) generated by the control variables of Eq. (6) alone have a time-series average of -1.0823 with volatility 0.7241. Inclusion of the constant term leads the averages of expected skewness to be positive (0.5653) with volatility 0.2045.

Our empirical investigation proceeds in two stages. In the first stage we examine the relationship of idiosyncratic skewness with asset growth (*AG*) and its interaction with volatility, growth options (*GO*) and distress risk (*DR*). In the second stage we provide asset pricing tests to identify the prediction ability of expected idiosyncratic skewness specifically arising from the volatility-driven growth and default/reorganization options.

3. Empirical Findings

3.1. Relation of Skewness with Growth and Distress

In this section we examine the impact that the growth variables (*AG*, $AG{\times}iv$, *GO*) and default (*DR*) proxy have on idiosyncratic skewness. Table 2 Panel A contains the average realized skewness calculated for each decile of *AG*, $AG{\times}iv$, *GO* and *DR*. In particular, each month we divide firms in 10 equally-spaced deciles built on *AG*, $AG{\times}iv$, *GO* and *DR*. We then calculate the average realized skewness over the subsequent 12 months in each decile. *AG*, $AG{\times}iv$, *GO* and *DR* are observed at the beginning of each period in which skewness is calculated.

As can be seen in Panel A, a higher level of AG_{t-1} is associated with lower levels of idiosyncratic skewness. Past exercised growth opportunities are thus associated with lower future skewness. Including idiosyncratic volatility through the interaction term $AG{\times}iv_{t-1}$ leads to a non-linear relationship with future idiosyncratic skewness, underscoring the importance of growth opportunities in highly volatile environments. The differences between the 10th (High) and 1st (Low) deciles are -0.600 and -0.585 for AG_{t-1} and $AG{\times}iv_{t-1}$, respectively. These differences are statistically significant. Higher levels of GO_{t-1} and DR_{t-1}, separately, are associated with higher average idiosyncratic skewness. The differences between the 10th (High) and 1st (Low) deciles show an average spread of 0.461 for GO_{t-1} and 0.523 for DR_{t-1}, respectively. These differences are statistically significant at 1%. These results confirm that higher values of *GO* and *DR* (as well as $AG \times iv_{t-1}$) are associated with higher idiosyncratic skewness, as hypothesized. It is noteworthy that the relation between *GO* and idiosyncratic skewness appears curvilinear, justifying potential inclusion of a GO^2 term. Similar relations between average realized skewness with *GO* and *DR* are also observed using the two-way sorting procedure of Table 2 Panel B. To further corroborate the impact of *AG,* $AG \times iv$, *GO* and *DR* on idiosyncratic skewness we run a series of cross-sectional regressions using the full model of *is* with the set of control variables shown in Eq. (4).

Table 3 Panel A describes the time-series averages and standard errors of the cross-sectional slopes when idiosyncratic skewness is estimated over 12 months (ESKEW). As can be observed, *AG,* $AG \times iv$, *GO* and *DR* are statistically significant drivers of idiosyncratic skewness after controlling for a number of relevant covariates. High past asset growth (*AG*) seems to be associated with lower future idiosyncratic skewness, as one would expect when past growth options are exercised and turned into more cash-generating assets in place, thereby reducing the asymmetry of the return distribution. But if, following Grullon et al. (2012), one substitutes past asset growth (*AG*) with a forward-looking measure of asset growth (AG^F) (e.g., the average of the future 5 years percent chance in total asset growth), the relationship between future asset growth and idiosyncratic skewness is positive (as confirmed in Panel C model 6).[16] More importantly, the interaction between past asset growth (*AG*) and idiosyncratic volatility,

[16] However, for guaranteeing the feasibility of the skewness expectations formation, future asset growth cannot be used as a forecasting variable.

$AG \times iv$, is a positive and significant determinant of idiosyncratic skewness in all models in Table 3. This supports our assertion that asset growth generally proxies for past exercised growth opportunities and only generates future-oriented growth option value (enhancing skewness) in high-volatility (growth-option supportive) environments. It is also consistent with and reinforces the recent finding by Lipson et al. (2011) that the asset growth effect is primarily concentrated in stocks with high idiosyncratic volatility, i.e., in the absence of volatility there is no real asset growth effect. In short, as hypothesized, higher values of $AG \times iv$, *GO* and *DR* are positive and significant determinants of idiosyncratic skewness. In terms of the control variables in Eq. (4), lagged idiosyncratic volatility directly (as well as through its interaction with *AG*) and past skewness are significant positive determinants. By contrast, size, momentum and turnover have a significant negative impact. All variables in Table 3 are significant at 1% level.

Panel B provides robustness for estimation over 6 months (ESKEW6). Results for 24 month estimation (ESKEW24) are similar (these three models appear as first 3 columns in Panel C). Panel C of Table 3 presents the time-series averages and standard errors of the cross-sectional slopes of the determinants of idiosyncratic skewness that are later used to estimate the various specifications of expected skewness (contained in Panels C1, C2 and D of Table 5). Following Eq. (4), results in Panel C of Table 3 were obtained by regressing each month *t* idiosyncratic skewness (is_t) against the set of lagged explanatory variables indicated in the rows. Expected skewness (ESKEW) is then calculated in an analogous way to Eq. (5). As confirmed in Panel C of Table 3, growth and distress variables remain positive and significant determinants of idiosyncratic skewness regardless of the specification used to proxy for them. The expected skewness results are robust to the 13 different alternative specifications for our key variables

(*AG, GO, DR*) used in the main model described at the bottom of Panel C.[17] In model 11 of Panel C in Table 3 we also test the impact that a "safe firm" dummy has on idiosyncratic skewness, where the SAFE variable is a binary dummy that assumes the value 1 if the Altman Z-score is above a 2.9 cutoff and zero otherwise. As can be seen from the results, distress has a positive impact on skewness while financial soundness appears to reduce it. Results are similar if we replace asset growth (*AG*) with sales growth (*SG*), and future growth options (*GO*) with Book-to-Market (*B2M*) ratio (model 13 in Panel C of Table 3). The use of a SAFE dummy based on the Ohlson score produces qualitatively similar results (not reported).

As further robustness, we also examine the differential impact that the real option variables (*AG,* $AG\times iv$, *GO* and *DR*) have in explaining the residuals obtained by regressing idiosyncratic skewness on base model (a) of Eq. (6) containing the control variables (i.e., a constant term, lagged idiosyncratic volatility and skewness, size, momentum and turnover). *AG,* $AG\times iv$, *GO* and *DR* remain significant determinants of *residual* idiosyncratic skewness, with the previously found signs. Table 4 contains averages, along with statistical significance, of the differences in expected idiosyncratic skewness following pairwise comparisons based on

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[17] The 13 alternative specifications for expected idiosyncratic skewness are: (1) ESKEW is the base model based on Eq. (4) contained in Table 3 Panel A, model 4; (2) ESKEW6 is the base model but with skewness calculated over 6 months; (3) ESKEW24 is the base model but with skewness calculated over 24 months; (4) ESK_REST is obtained by regressing skewness against the control variables as per Eq. (6); (5) RO uses only the growth/distress variables as per Eq. (5); (6) AG^F is obtained by replacing AG with the average of the future 5 years of asset growth AG^F; (7) GO^2 is obtained by adding the square of *GO* to Eq. (5); (8) is obtained by replacing DR with the Ohlson *DRO* proxy; (9) is obtained by replacing *DR* with the negative Altman Z-score or *DRZ*; (10) is obtained by using the Ohlson distress dummy DRO^D; (11) using the Altman Z-score distress and SAFE dummies DRZ^D; (12) SG_B2M_DRZ is obtained by replacing asset growth (*AG*) with sales growth (*SG*), *GO* with Book-to-Market (*B2M*) and *DR* with the negative Altman Z-score (*DRZ*); (13) SG_B2M_DRZ^D is obtained by replacing *AG* with *SG*; *GO* with *B2M* and *DR* with DRZ^D.

models (b) - (a) of Eqs. (7) and (6). Table 4 also contains differences in expected skewness calculated by isolating the impact of growth and default options ($\mathrm{ESK\_REST_{GO}}, \mathrm{ESK\_REST_{DR}}$ and $\mathrm{ESK\_REST_{GO-DR}}$). Again we remove the 1% of observations of expected skewness in both tails. EW-$E_t[is_{t+T}]$ indicates the time-series average of equally weighted (EW) cross-sectional expected skewness, while VW-$E_t[is_{t+T}]$ is the time-series average of value weighted (VW) cross-sectional expected skewness. As noted in the table, *AG,* $AG\times iv$, *GO* and *DR* have a significant differential impact on the magnitude of expected idiosyncratic skewness in these pairwise comparisons beyond the control variables. All differences are again significant at the 1% level, confirming that $AG\times iv$, *GO* and *DR* are significant positive drivers of expected idiosyncratic skewness, w.r.t. both models (5) and (7). To ensure that *GO* and *DR* are not capturing the same phenomenon (after controlling for *AG*, $AG\times iv$ and the other control variables), we also test the significance of the difference between models of expected skewness generated by growth options and expected skewness generated by default options alone ($\mathrm{ESK\_REST_{GO-DR}}$). As confirmed in the last column of Table 4, *GO* and *DR* seem to capture different economic drivers.

3.2. Predicting Returns

If the skewness-related growth and default option explanations hold, the aforementioned option-driven expected idiosyncratic skewness measures should contain incremental power in explaining stock returns beyond standard factors. We thus use the expected idiosyncratic skewness (ESKEW) measure derived in the previous stage, isolating the part attributed only to growth variables (*AG,* $AG\times iv$ and *GO*) and distress risk (*DR*). We then proceed to analyze the relation between real options-driven expected idiosyncratic skewness (ESKEW) and equity returns, controlling for other standard factors.

As a benchmark, we first confirm the role of standard variables (e.g., beta, SIZE, B/M) in a basic Fama-French (1992) type analysis (including Earnings-to-Price ratio, E/P, and a distress dummy for negative earnings). Then we proceed with our extended analysis of the incremental role of expected idiosyncratic skewness (as determined by growth variables and the distress/reorganization option) in explaining subsequent equity returns. The use of B/M ratio rather than log of B/M (widely used in prior studies) is essential in this context to avoid excluding distressed firms (i.e., negative book equities) from the sample. To confirm consistency with prior studies as a base-line, the first model (coded LN in Table 5 Panel A1) considers only positive book equity firms using the natural logarithm of B/M instead.

As shown in Table 5 Panel A1, the results of model LN (of B/M) are largely consistent with Fama-French (1992) and prior studies that exclude negative book equity (-BE) observations. Both *SIZE* and book-to-market (B/M) appear significant in explaining subsequent returns. Consistent with the small firm effect, SIZE has a negative impact on stock returns on average. As in Fama and French (1992), ln(B/M) is positively and significantly related with stock returns.[18] When negative book equity observations are kept in the sample (as in model 1),

[18] Using log B/M as per standard Fama-French (1992) procedure automatically excludes observations with negative book value. Since the main objective of this study is to explore the impact of skewness generated jointly by distress risk and/or growth it is not appropriate to exclude candidate firms with these characteristics. Therefore we further examine our hypothesis by using the simple B/M ratio. An alternative approach is the use of B/M(+) that equals B/M for positive B/M and zero otherwise, along with a negative B/M dummy that equals 1 for negative B/M and zero otherwise. This setting is meant to capture separately a potential double role of book to market, that of a growth and a distress role (Trigeorgis and Lambertides (2014)). In our study the negative earnings-to-price dummy, E/P(DUM), takes the role of a distress variable.

book-to-market (B/M) ratio loses significance. Model 2 in Panel A1 of Table 5 confirms that asset growth (*AG*) exhibits a significant *negative* relation with subsequent stock returns: a unit increase in *AG* implies a lower average return by 0.66%.[19] This negative impact of asset growth on stock returns is consistent with prior studies (e.g., Anderson and Garcia-Feijoo (2006), Cooper et al. (2008), Lipman et al. (2011), Trigeorgis and Lambertides (2014)).

Model 3 in Panel A1 of Table 5 extends the Fama-French (1992) type analysis of model 1 by additionally considering the real options-driven expected idiosyncratic skewness measure (estimated over 12 months as base-case), ESKEW, beyond the above Fama-French type variables. Model 3 confirms that our expected idiosyncratic skewness measure that is purely driven by our growth variables and distress risk (ESKEW) is significant and *negative* in explaining subsequent stock returns, beyond all other variables: a 1% increase in expected idiosyncratic skewness arising from the real options (growth and distress) variables implies a lower average monthly return by 4.3% and a corresponding lower cost of capital. The negative impact of skewness on stock returns is consistent with evidence from other recent studies (e.g., Harvey and Siddique (2000), Smith (2007), Yang et al. (2010)).

In order to control for the possibility that our expected idiosyncratic skewness measure may capture other idiosyncratic characteristics identified in prior studies, model 4 of Panel A1 extends model 3 by adding the lag of realized idiosyncratic skewness calculated over the last available month, RSKEW. The inclusion of past realized skewness helps to control for changes in investor expectations due to unexpected realization of skewness for other reasons.

[19] AG is included to control for past exercised growth options. This helps isolate the impact that future yet-unexercised growth opportunities, reflected in real-option-driven expected skewness, have on equity returns.

Although the added past realized skewness measure is also negative and significant, as found in prior studies (e.g., Harvey and Siddique (2000)), our expected idiosyncratic skewness (ESKEW) coefficient is essentially unaffected. The expected idiosyncratic skewness measure deriving from real options has incremental explanatory power above and beyond other control variables and past realized skewness proxies. This may suggest that idiosyncratic and/or other skewness measures are not a sufficient proxy of expectations regarding future skewness. Our measure of expected idiosyncratic skewness (driven by asset growth in interaction with volatility, growth options and distress risk) seems to capture different and complementary aspects. Realized past skewness focuses more on the near-term exercise (harvesting) of mature growth opportunities and default probabilities, while our expected idiosyncratic skewness (ESKEW) measure captures incremental value from creating new (or sustaining existing) future-oriented growth option value and default/reorganization option protection over the longer term.

The significant *negative* impact of both realized and expected idiosyncratic skewness measures on stock returns is consistent with rational incorporation of growth and default/reorganization option value in current stock prices leading to lower subsequent stock returns. The above is consistent with our main hypothesis that investors may accept lower average returns in exchange for the positively skewed upside potential and downside default protection arising from corporate growth options and the shareholders´ implied default/reorganization option, particularly important in volatile environments. These results additionally confirm that our expected skewness measure reflects the part specifically attributed to asset growth/growth options and distress risk and that it differs from other skewness proxies used in prior studies (e.g., Boyer et al. (2010)). These findings confirm that asset growth (in interaction with idiosyncratic volatility), forward-looking growth options (*GO*) and distress risk (*DR*) convey important incremental information affecting investor expectations of future idiosyncratic skewness. This incremental information appears to be rationally priced according to a joint real options-skewness hypothesis.

To shed further light on the effects of real options driven expected idiosyncratic skewness on stock returns, we additionally examine the effects of idiosyncratic skewness that is not driven by our growth and distress risk variables. In Panel A2 of Table 5, we augment our main model 4 (of Table 5 Panel A1) by adding a market-wide co-skewness measure (CO-SKEW) and the non-real options part of expected skewness (ESK_REST) obtained as the fitted value from the rest or all other explanatory variables (except *AG,* $AG \times iv$, *GO* and *DR*) as per Eq. (6). These additional variables have no incremental significance, while our results are unaffected when these non-real option skewness measures are additionally considered. These findings corroborate our hypothesis and research design in isolating the effects of the volatility-driven growth and default/reorganization option variables from other factors.[20]

Panel B of Table 5 shows additional robustness results concerning the key variables used in our main model of Eq. 4. In the first two models of Panel B, involving replacement variables *CAPEX* and *SG*, we replace asset growth *AG* with alternative proxies of past (exercised) growth, specifically capital expenditures (*CAPEX*) and average past sales growth (*SG*), respectively. In the next four models, our base distress risk (*DR*) measure based on (the negative of) Merton's distance-to-default (*-D2D*) is replaced with alternative distress risk measures based on the

[20] To further control for potential non-linearities in the expected skewness regression we also tested the impact of the square of expected skewness $ESKEW^2$, obtaining insignificant results.

Ohlson O-score (*DRO*) and Altman Z-score (*DRZ*) and their dummy variants (DRO^{DUM}, DRZ^{DUM}). These are used in the formation of our main expected skewness (ESKEW) measure determined in the first stage procedure (Eq. 5) underlying our main model 4 in Panel A1 of Table 5.[21] In the last two models of Panel B, SG_B2M_DRZ and SG_B2M_DRZ^{DUM}, *AG* is replaced by sales growth (*SG*), *GO* by *B2M*, and *DR* by *DRZ* or DRZ^{DUM}, in the formation of expected skewness (ESKEW) in model 4 of Panel A1. The results remain essentially unchanged, confirming that our findings are robust regarding alternative measures for past asset growth (*AG*, *CAPEX* or *SG*), yet-unexercised growth option value (*GO*, *B2M*) or distress risk (*DR*, *DRO*, *DRZ*, DRO^{DUM}, DRZ^{DUM}).

Panel C of Table 5 shows additional robustness results to alternative expected skewness (ESKEW) specifications. The first two variants (ESKEW6 and ESKEW24) are based on 6- and 24-month estimating windows (rather than 12 months as in base-case ESKEW). The third expected skewness specification ESK_DIFF involves the difference between the fitted values of models (b) and (a) based on Eqs. (7) and (6) described in Section 2.3 above. The next specification, AG^F, is obtained by replacing past *AG* by future average asset growth (AG^F), while the last three specifications, *GO*, *DR*, and *AG_GO*, use ESKEW calculated by modifying Eq. (5) to isolate the individual impact of residual future growth options (*GO*), the combined growth variables (*AG* and *GO* including $AG \times iv$) and distress risk (*DR*), respectively. The results are similar to those of our main analysis.[22]

[21] Superscript ^{DUM} implies that a binary dummy for the high vs low corresponding distress measure is applied.
[22] Additional robustness results using expected skewness (ESKEW) measures calculated by augmenting Eq. (4) with the square term of *GO* (GO^2) to account for potential non-linearity in *GO* again are similar (unreported).

Finally, to ascertain the economic significance of the expected idiosyncratic skewness measure deriving from real options, we report portfolio level returns (and differences among extreme portfolios) in Table 6. In constructing these portfolio returns we cross-sectionally sort each stock into five equal-sized groups based on expected idiosyncratic skewness. Panel A reports portfolio returns for expected idiosyncratic skewness estimated over 12 months (ESKEW). Panels B and C report expected skewness estimated over 6 and 24 months (ESKEW6 and ESKEW24), respectively. Finally, Panel D focuses on the differential expected skewness measures (Eqs. (7) minus (6)) estimated over 12 months (ESK_DIFF). We compute the risk adjusted (value-weighted) average return over the next 6 months (across the 360 months) calculated by the Fama-French-Carhart 4-factor model. We report portfolio hedge returns as the difference in the average portfolio returns across the extreme quintiles (Low minus High expected idiosyncratic skewness). Test statistics are reported based on time series variation in these portfolio hedge returns. This approach assumes monthly rebalancing and ignores the impact of transaction costs. For robustness we also report the spreads in alphas of the hedged portfolio (regressed on Fama-French-Carhart 4-factors) along with the corresponding Newey-West t-statistics (N-W tstat). Across these alternative skewness measures, there is an economically significant predictive association between expected idiosyncratic skewness and average future returns. For example, the 0.814 monthly portfolio hedge differential between the Low and High portfolios (quintiles) sorted on expected idiosyncratic skewness over the next 12 months (ESKEW) for explaining simultaneous returns (RET0) amounts to an annualized 9.7% return differential. This is both statistically and economically significant. The Fama-MacBeth (1973) (FM) test statistic of 6.40 is equivalent to a monthly Sharpe ratio of 0.37 (see Lewellen

(2010) for a mapping of FM tstats to Sharpe ratios). Across all skewness measures with hedge portfolio returns estimated for 0-6 months ahead (RET0 - RET6) in Panels A, B and C, the monthly Sharpe ratio ranges from 0.2-0.4. These are economically significant (Lewellen, 2010).

4. Conclusion

This paper makes several contributions by establishing necessary linkages among five puzzling empirical stock anomalies, namely the value/growth anomaly, asset growth effect, the distress risk puzzle, the volatility effect and the skewness negative return premium. We contribute mainly at three levels. We show that: (i) both theoretically and empirically real growth and default/reorganization options, that are more valuable under high volatility, are strong positive drivers of idiosyncratic skewness (controlling for asset growth and its interaction with idiosyncratic volatility); (ii) the resulting real-options-induced expected idiosyncratic skewness commands a negative equity return premium; and (iii) a behaviorally rational transmission mechanism from real growth and distress/reorganization options to stock returns operates through observable idiosyncratic skewness in high volatility environments.

Specifically, we examine the combined impact of asset growth (and its interaction with idiosyncratic volatility), growth options and distress risk on expected idiosyncratic skewness and whether the negative return premium observed on positively skewed stocks is driven by the growth and distress risk embedded in these stocks. We have argued that growth options on the upside and downsizing/reorganization options in adverse scenarios lead to more convex firm value payoffs and increased skewness for active levered equity returns. The resulting enhanced idiosyncratic skewness in volatile environments has important pricing implications for the relation between stock returns and asset growth/growth options or distress risk factors. The negative relation between asset growth (when interacted with idiosyncratic volatility), growth options and distress risk with stock returns found in prior studies can thus be attributed to the more positively skewed distribution of returns for growth-oriented and distressed firms. The existence of default/reorganization and growth options truncates the left tail of the return distribution while preserving the upside growth potential increasing the right tail. The combination of these two kinds of real options increases the idiosyncratic skewness of levered firm equity returns. We posit that investors are willing to accept lower average returns from growth or distressed stocks in exchange for the more favorable (positively skewed) risk-return profile, particularly in more volatile environments.

Our empirical design proceeded in several stages. We first isolated the part of idiosyncratic skewness attributed only to asset growth and its interaction with volatility, future-oriented growth options and distress risk by regressing residual idiosyncratic skewness on asset growth, growth options and distress risk measures, after controlling for other known related factors --past idiosyncratic volatility and skewness, size, momentum, and turnover. Then we examined the impact of this expected idiosyncratic skewness on stock returns in a Fama-MacBeth (1973) rolling regression framework. Consistent with our theory and hypotheses, after confirming that the interaction of asset growth with volatility, growth options and distress risk are positively related to future idiosyncratic skewness, we showed that our expected skewness measure is negatively related to subsequent stock returns. Expected idiosyncratic skewness attributed to these real options predicts contemporaneous and subsequent returns for the next 6 months. The economic significance of these results is noticeable. There is a 9.7% annualized portfolio hedge differential between the Low and High portfolios (quintiles) sorted on expected idiosyncratic skewness over the next 6 months that is priced and explains contemporaneous returns. These predictions correspond to a monthly Sharpe ratio of 0.37.

We add to the thus far distinct empirical literatures on asset growth (e.g., Cooper et al. (2008), Lipson et al (2011)), on the value/growth effect (Fama and French (1993)) and growth options (e.g., Anderson and Garcia-Feijoo (2006), Cao et al. (2008), Trigeorgis and Lambertides (2014)), on idiosyncratic volatility (Ang et al, 2006), and on distress risk (e.g., Dichev (1998)), all impacting negatively on stock returns, by showing that the channel through which these negative impacts are carried out is by shifting the shape of the return distribution as predicted by real options theory. Our findings also reinforce and extend recent results by Boyer et al. (2010) and Conrad et al. (2013) providing further evidence that expected idiosyncratic skewness is priced and commands a negative return premium. Specifically, we show that this effect is significantly driven by real options variables (related to growth and default/reorganization options) that impact on returns via the channel of idiosyncratic skewness, i.e., that the part of expected idiosyncratic skewness that is generated by these real option variables commands an incremental negative return premium after controlling for other standard factors, including asset growth and idiosyncratic volatility. Our theory also predicts that the negative return premium from enhanced skewness should be more pronounced for more volatile stocks, with potential implications for understanding the volatility effect (Ang et al. (2006)).

Recent literature on lottery behavior also documents that certain clienteles of investors have a preference for lottery-type stocks and positive skewness (Bali et al. (2011), Kumar (2009)). Relative to this literature we add further conceptual, behavioral and statistical evidence that enhanced idiosyncratic skewness related to real options leads to a negative return premium. We contribute to this behavioral literature by demonstrating how real growth and reorganization options provide valuable flexibility for actively managed levered firms, which leads to a more convex value function and positively skewed equity returns. The resulting positively skewed returns deriving from real options resemble desirable lottery (and insurance) type features. Consistent with the above behavioral findings, we posit that actively-managed levered firms with growth and reorganization/downsizing options enable investors to obtain desirable risk-return benefits within a rational equilibrium framework.

Providing an inter-linkage between asset growth, growth options, distress, idiosyncratic volatility and skewness effects and their combined negative impact on stock returns offers a deeper understanding of these related "puzzling" phenomena. These findings suggest that more risky growth and distress investment situations may justify lower, rather than higher, expected returns in volatile environments. Thus, the fundamental relation between risk and return may need to be reconsidered. This also has profound implications for the true cost of capital related to growth and distress businesses and for conglomerate resource allocation. The resulting implications should be of value to empirical financial economists, corporate managers, financial analysts and investors alike. Improvement in forecast (and discounting) accuracy may also help reduce informational asymmetry in the marketplace. Researchers and practitioners alike may derive valuable insights regarding the economic determinants of firm performance, returns prediction, cost of capital and investing strategies.

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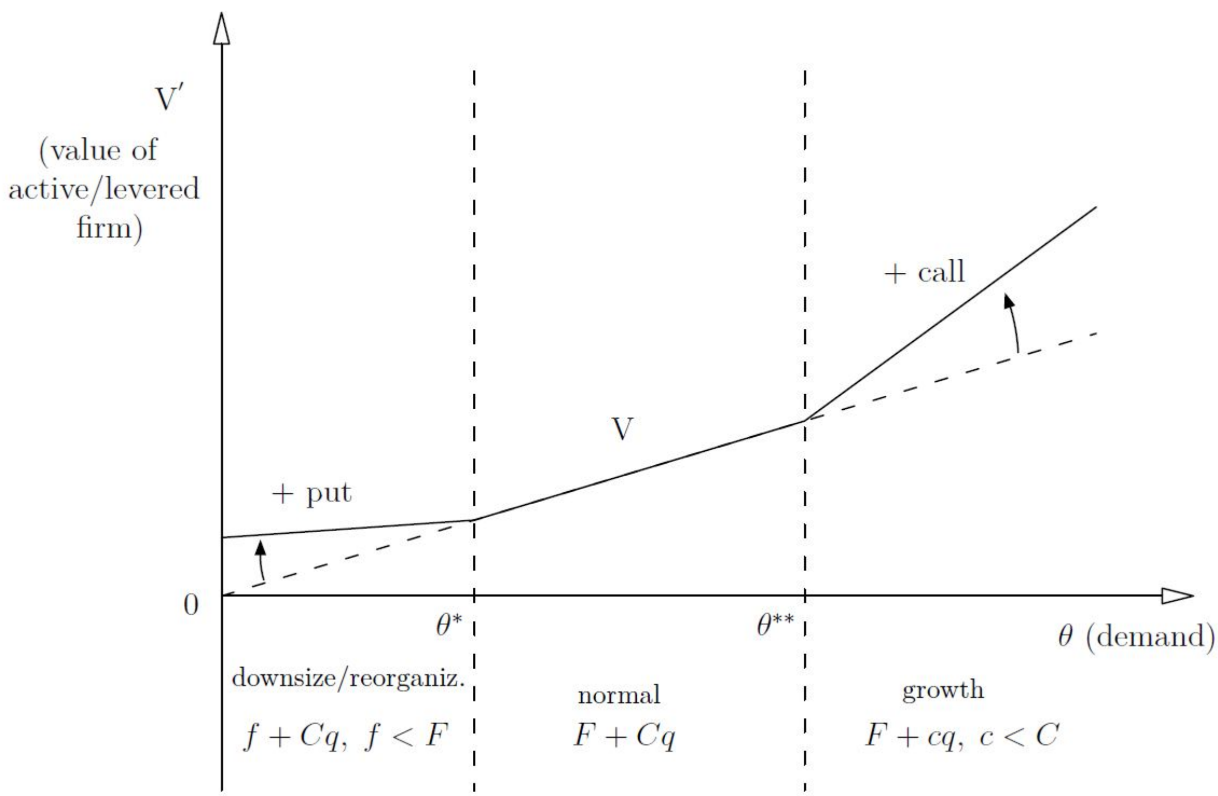

Figure 1. Graphical representation of the adaptive growth and downsize/reorganization options of an active levered firm. At an extremely low level of demand ($\theta < \theta^{*}$) the firm can pursue a downsizing/reorganization (put) option reducing fixed costs to f ($f < F$). For intermediate (normal) level of demand $\theta^{*} < \theta < \theta^{**}$ neither the downsize/reorganize or the expansion option is exercised: the firm faces the same cost function as an identical passive all-equity firm without options. For high level of demand ($\theta > \theta^{**}$) the active firm will exercise an expansion/growth option exploiting economies of scale, so the firm is able to produce at a lower marginal cost c ($c < C$). The total cost of a passive firm under normal demand is $TC = F + Cq$. The expected total adaptive costs of an active levered firm are ($f + Cq$) in case of downsizing/reorganization and ($F + cq$) under expansion/growth.

Table 1. Summary Statistics of Main Variables

This table reports summary statistics (Panel A) and correlations (Panel B) for the main variables included in the model specified in Eq. (8). Market Risk (β) is estimated over a three-year period using the Sharpe-Lintner CAPM model as in Fama and French (1992). SIZE is measured as the ln of the market value of equity (ME) (price per share x number of shares outstanding). Book-to-market (B/M) is measured as the book value of equity divided by the market value of equity (ME). CAPEX is measured as the (three-year period) average growth in capital expenditures, deflated by total assets. Asset growth (AG) is measured as percent change in total assets. SG is sales growth. ESKEW is expected skewness calculated based on Eq. (5) with coefficients estimated based on Eq. (4) over a horizon of 12 months. RSKEW is the realized idiosyncratic skewness of the past 1 month (based on Eq. (3a)). ESKEW6, ESKEW24 and ESK_DIFF are the expected skewness calculated over a horizon of 6 and 24 months and the difference in expected skewness (b) – (a) of Eqs. (7) and (6), respectively. RETURN is monthly returns.

Panel A. Summary Statistics

	Mean	Median	st. dev	min	max
RETURN	1.4527	0.2959	15.943	-86.65	437.27
BETA (β)	1.1595	1.0573	0.8776	-6.6598	11.379
SIZE	5.6422	5.5975	1.9799	-0.6117	11.320
B/M	0.6185	0.5017	0.5228	-4.6308	7.8071
AG	0.0037	0.0032	0.0294	-0.3349	0.1579
SG	0.1244	0.0714	0.2870	-0.7177	4.8195
CAPEX	0.1437	0.0936	0.3262	-0.8687	7.2350
E(+)/P	2.7624	0.5780	8.3258	0.0000	183.24
E/P DUM	0.2303	0.0000	0.4210	0.0000	1.0000
ESKEW	-0.0181	-0.0151	0.0844	-0.7559	0.5293
ESKEW6	-0.0230	-0.0176	0.0644	-0.9542	3.1057
ESKEW24	0.0237	0.0221	0.1125	-0.6580	0.9567
ESK_DIFF	0.2381	0.2102	0.6516	-2.4048	2.4821
RSKEW	0.0113	0.0027	0.1165	-0.7128	0.8870

Panel B. Pearson Correlation Coefficients

	RET	BETA	SIZE	B/M	CAPEX	AG	SG	E(+)/P	E/P D	ESKEW	ESK6	ESK24	DIFF	RSKEW
RETURN	1	0.01	-0.04	0.03	-0.02	-0.03	-0.01	-0.01	0.03	0.01	0.01	-0.01	0.01	-0.01
BETA		1	0.07	-0.09	0.01	0.04	0.06	-0.02	0.18	0.02	0.01	0.05	0.03	0.05
SIZE			1	-0.38	0.08	0.10	0.03	0.43	-0.21	-0.09	-0.07	-0.13	-0.04	-0.13
B/M				1	-0.09	-0.20	-0.18	-0.08	0.14	0.09	0.10	0.13	0.01	0.07
CAPEX					1	0.20	0.15	0.02	-0.11	-0.08	-0.06	-0.09	-0.01	-0.06
AG						1	0.44	0.00	-0.19	-0.21	-0.18	-0.19	0.00	-0.16
SG							1	-0.02	-0.07	-0.12	-0.10	-0.10	0.00	-0.06
E(+)/P								1	-0.18	-0.04	-0.01	-0.04	-0.02	-0.06
E/P DUM									1	0.21	0.17	0.19	0.04	0.21
ESKEW										1	0.55	0.42	0.03	0.42
ESKEW6											1	0.29	0.03	0.36
ESKEW24												1	0.01	0.28
ESK_DIFF													1	0.03
RSKEW														1

Table 2

Skewness by Asset Growth (*AG*), Growth Option (*GO*) and Distress Risk (*DR*) Decile

Panel A contains the average idiosyncratic skewness over the subsequent 12 months (T = 12) for each decile sorted by AG_{t-1}, $(AG \times iv)_{t-1}$, GO_{t-1} and DR_{t-1}. Panel B reports the average idiosyncratic skewness of each portfolio obtained by the intersection of 5 equally spaced quintiles calculated on GO_{t-1} and DR_{t-1}. *, ** and *** indicate 10%, 5% and 1% significance level.

Panel A. Separate Skewness by *AG*, *GO* and *DR*

AG_{t-1} decile	$Average\ is_{t+T}$	$(AG \times iv)_{t-1}$ decile	$Average\ is_{t+T}$
1 (Low)	1,037	1 (Low)	1,164
2	0,786	2	0,745
3	0,619	3	0,536
4	0,536	4	0,450
5	0,472	5	0,402
6	0,446	6	0,395
7	0,409	7	0,386
8	0,399	8	0,410
9	0,378	9	0,436
10 (High)	0,437	10 (High)	0,579
High-Low	-0.600***	High-Low	-0.585***

GO_{t-1} decile	$Average\ is_{t+T}$	DR_{t-1} decile	$Average\ is_{t+T}$
1 (Low)	0,674	1 (Low)	0,424
2	0,496	2	0,429
3	0,405	3	0,453
4	0,354	4	0,460
5	0,331	5	0,467
6	0,353	6	0,518
7	0,440	7	0,568
8	0,582	8	0,601
9	0,793	9	0,745
10 (High)	1,135	10 (High)	0,947
High-Low	0.461***	High-Low	0.523***

Panel B. Average Idiosyncratic Skewness at Intersection of *GO* and *DR Quintiles*

		DR_{t-1}				
		1 (Low)	2	3	4	5 (High)
GO_{t-1}	1 (Low)	0,525	0,475	0,525	0,604	0,774
	2	0,345	0,270	0,341	0,435	0,637
	3	0,265	0,238	0,290	0,416	0,677
	4	0,384	0,430	0,435	0,526	0,788
	5 (High)	0,788	0,938	0,963	0,898	1,142

Table 3

Time-series Average Coefficients of Cross Sectional Month-by-month Regression Slopes

This table contains the averages of cross sectional month-by-month regression slopes calculated by regressing each month idiosyncratic skewness on *AG*, $AG \times iv$ *GO, DR* and the control variables contained in Eq. (4). Panel A contains the results of our base model where the dependent variable is realized idiosyncratic skewness estimated over a period of 12 months (ESKEW). Panel B provides robustness when the dependent variable is idiosyncratic skewness calculated over 6 months (ESKEW6). For Panel A, N=311 and for Panel B, N=323. Results are similar when estimation is over 24 months (ESKEW24) (not reported). Panel C contains robustness tests of the main variables (*AG, GO, DR)* included in Eq. (4). The t-statistic is the average slope divided by its time-series Newey-West (1987) standard errors and the R-squared is the average coefficient of determination of the N=311 repeated cross-sectional regressions. All coefficients are statistically significant at 1%.

Panel A. Dependent variable: Idiosyncratic Skewness is_t over 12 Months (ESKEW) (N=311)

	(1)	(2)	(3)	(4)
Constant (α)	1.631	1.616	1.803	1.648
	(17.0)	(18.8)	(19.1)	(19.2)
AG_{t-1}	-	-0.254	-	-0.253
	-	(10.0)	-	(10.1)
$(AG \times iv)_{t-1}$	-	1.643	-	1.554
	-	(3.08)	-	(2.90)
GO_{t-1}	-	0.033	-	0.036
	-	(7.23)	-	(7.27)
DR_{t-1}	-	-	0.001	0.001
	-	-	(4.48)	(4.32)
iv_{t-T}	5.431	6.602	5.976	6.449
	(6.84)	(7.78)	(7.81)	(7.72)
is_{t-T}	0.077	0.058	0.062	0.058
	(14.9)	(14.9)	(14.7)	(14.6)
$SIZE_{t-1}$	-0.108	-0.107	-0.120	-0.108
	(15.6)	(16.5)	(17.2)	(16.8)
MOM_{t-1}	-0.208	-0.197	-0.204	-0.196
	(13.0)	(15.5)	(14.7)	(15.7)
$TURN_{t-1}$	-2.90E-4	-3.30E-4	-3.32E-4	-3.30E-4
	(4.74)	(6.86)	(6.08)	(6.80)
R^2	0.078	0.084	0.079	0.086

Panel B. Dependent variable: Idiosyncratic Skewness is_t over 6 Months (ESKEW6) (N=323)

	(1)	(2)	(3)	(4)
Constant (α)	1.122	1.213	1.276	1.245
	(15.7)	(21.6)	(20.8)	(22.4)
AG_{t-1}	-	-0.180	-	-0.183
	-	(10.6)	-	(10.4)
$(AG\times iv)_{t-1}$	-	1.346	-	1.414
	-	(3.71)	-	(3.74)
GO_{t-1}	-	0.009	-	0.009
	-	(2.38)	-	(2.41)
DR_{t-1}	-	-	0.001	0.001
	-	-	(6.01)	(8.36)
iv_{t-T}	5.054	4.912	4.737	4.755
	(7.13)	(8.41)	(8.70)	(5.76)
is_{t-T}	0.044	0.032	0.033	0.032
	(12.0)	(10.1)	(10.1)	(9.83)
$SIZE_{t-1}$	-0.072	-0.076	-0.081	-0.077
	(13.9)	(17.2)	(16.9)	(17.5)
MOM_{t-1}	-0.110	-0.112	-0.111	-0.114
	(11.2)	(12.3)	(12.2)	(12.5)
$TURN_{t-1}$	-1.83E-4	-2.10E-4	-2.29E-4	-2.14E-4
	(4.77)	(6.91)	(6.58)	(7.10)
R^2	0.054	0.059	0.055	0.060

Panel C. Robustness on Key Variables of Main Model (eq. 4)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	ESKEW	ESKEW6	ESKEW24	ESK_REST	RO	AG^F	GO^2	DRO	DRZ	DRO^D	DRZ^D	SG_B2M_DRZ	SG_B2M_DRZ^D
Constant	1.648	1.245	2.236	1.631	0.539	1.559	1.652	1.641	1.655	1.541	1.645	1.656	1.661
	(19.2)	(22.4)	(19.7)	(17.0)	(31.4)	(18.0)	(19.5)	(18.7)	(18.4)	(18.0)	(18.6)	(17.0)	(17.6)
AG_{t-1}	-0.253	-0.183	-0.214	-	-0.526	0.233	-0.252	-0.241	-0.252	-0.249	-0.244	-0.016	-0.016
	(10.1)	(10.4)	(5.87)	-	(19.9)	(4.60)	(10.0)	(9.96)	(10.3)	(10.6)	(10.1)	(4.98)	(5.14)
$(AG \times iv)_{t-1}$	1.554	1.414	-0.683	-	4.390	1.579	1.632	1.492	1.718	1.599	1.723	0.401	0.403
	(2.90)	(3.74)	(0.71)	-	(5.20)	(1.30)	(3.05)	(2.70)	(3.08)	(2.97)	(3.11)	(6.26)	(6.23)
GO_{t-1}	0.036	0.009	0.093	-	0.124	0.019	0.014	0.022	0.034	0.022	0.026	0.033	0.020
	(7.27)	(2.41)	(11.6)	-	(18.75)	(3.22)	(2.25)	(4.34)	(6.62)	(4.51)	(5.39)	(2.93)	(1.77)
$(GO_{t-1})^2$	-	-	-	-	-	-	0.008	-	-	-	-	-	-
	-	-	-	-	-	-	(6.29)	-	-	-	-	-	-
DR_{t-1}	0.001	0.001	0.002	-	0.003	0.001	0.001	0.012	0.001	0.126	0.111	0.001	0.108
	(4.32)	(8.36)	(4.31)	-	(11.0)	(2.88)	(4.34)	(7.79)	(3.09)	(12.3)	(8.38)	(2.85)	(8.51)
SAFE	-	-	-	-	-	-	-	-	-	-	-0.021	-	-0.033
	-	-	-	-	-	-	-	-	-	-	(2.43)	-	(3.95)
iv_{t-T}	6.449	4.755	7.604	5.431	-	6.011	6.343	6.422	6.587	6.312	6.250	5.924	5.570
	(7.72)	(5.76)	(7.15)	(6.84)	-	(6.75)	(7.76)	(7.64)	(7.56)	(7.63)	(7.32)	(6.82)	(6.66)
is_{t-T}	0.058	0.032	0.046	0.077	-	0.060	0.058	0.054	0.054	0.054	0.053	0.061	0.060
	(14.6)	(9.83)	(7.18)	(14.9)	-	(13.1)	(14.8)	(14.0)	(14.5)	(14.1)	(14.4)	(13.7)	(13.6)
$SIZE_{t-1}$	-0.108	-0.077	-0.152	-0.108	-	-0.105	-0.107	-0.107	-0.109	-0.102	-0.109	-0.108	-0.109
	(16.8)	(17.5)	(17.5)	(15.6)	-	(16.3)	(16.9)	(16.2)	(16.5)	(15.8)	(16.8)	(16.0)	(16.5)
MOM_{t-1}	-0.196	-0.114	-0.214	-0.208	-	-0.214	-0.194	-0.189	-0.194	-0.187	-0.181	-0.205	-0.190
	(15.7)	(12.5)	(10.6)	(13.0)	-	(13.2)	(15.6)	(15.8)	(15.6)	(15.7)	(14.4)	(15.4)	(1546)
$TURN_{t-1}$	-3.30E-4	-2.14E-4	-3.29E-4	-2.90E-4	-	-5.09E-4	-3.25E-4	-3.21E-4	-3.35E-4	-3.22E-4	-3.07E-4	-4.04E-4	-3.78E-4
	(6.80)	(7.10)	(4.48)	(4.74)	-	(8.15)	(6.67)	(6.47)	(6.61)	(6.59)	(6.33)	(6.70)	(6.53)
N	311	323	275	311	311	276	311	311	311	311	311	311	311
R^2	0.086	0.060	0.100	0.078	0.024	0.086	0.087	0.089	0.088	0.089	0.090	0.083	0.087

(1) ESKEW is the base model based on Eq. (4) contained in Table 3 Panel A, model 4; (2) ESKEW6 is the base model but with skewness calculated over 6 months; (3) ESKEW24 is the base model but with skewness calculated over 24 months; (4) ESK_REST is obtained by regressing skewness against the control variables as per Eq. (6); (5) RO uses only the growth/distress variables as per Eq. (5); (6) is obtained by replacing AG with the average of the future 5 years of asset growth AG^F; (7) is obtained by adding the square of GO to Eq. (5); (8) is obtained by replacing DR with the Ohlson DRO proxy; (9) is obtained by replacing DR with the negative Altman Z-score or DRZ; (10) is obtained by using the Ohlson distress dummy DRO^D; (11) is obtained by using the Altman Z-score distress and safe dummies DRZ^D; (12) SG_B2M_DRZ is obtained by replacing asset growth (AG) with sales growth (SG), GO with Book-to-Market (B2M) and DR with the negative Altman Z-score (DRZ); (13) SG_B2M_DRZ^D is obtained by replacing AG with SG; GO with B2M and DR with DRZ^D.

Table 4

Time-series Averages of Cross Sectional Equally Weighted (EW) and Value Weighted (VW) Expected Skewness Differentials

This table contains equally weighted (EW) and value weighted (VW) averages of the differences, in absolute value, between expected idiosyncratic skewness in pairwise comparisons based on Eqs. (6)-(7). (b) – (a) refers to the absolute value of the difference between expected skewness calculated following Eqs. (7) and (6). ESK_REST_{GO} is the absolute value of the difference between expected skewness based on (c): $E_t[is_{i,t+T}] = \hat{\alpha} + \hat{\beta}_{AG}AG_t + \hat{\beta}_{AGIV}(AG \times iv)_t + \hat{\beta}_{GO}GO_t + \hat{\beta}_{iv}iv_t + \hat{\beta}_{is}is_t + \hat{\beta}_{SIZE}SIZE_t + \hat{\beta}_{MOM}MOM_t + \hat{\beta}_{TURN}TURN_t$ and expected skewness calculated without real option variables (a) as in equation (6). ESK_REST_{DR} is the absolute value of the difference between expected skewness based on (d): $E_t[is_{i,t+T}] = \hat{\alpha} + \hat{\beta}_{AG}AG_t + \hat{\beta}_{AGIV}(AG \times iv)_t + \hat{\beta}_{DR}DR_t + \hat{\beta}_{iv}iv_t + \hat{\beta}_{is}is_t + \hat{\beta}_{SIZE}SIZE_t + \hat{\beta}_{MOM}MOM_t + \hat{\beta}_{TURN}TURN_t$ and expected skewness calculated without real option variables (a) as in equation (6). Finally ESK_REST_{GO-DR} is the absolute value of the difference between expected skewness based on the two alternative specifications just indicated ((c)-(d)). Expected skewness is calculated over a horizon of 12 months. *, ** and *** indicate 10%, 5% and 1% significance level, respectively.

	$((b)-(a))$	ESK_REST_{GO}	ESK_REST_{DR}	ESK_REST_{GO-DR}
ESK_DIFF (EW)	0.0706^{***}	0.0629^{***}	0.0627^{***}	0.0418^{***}
ESK_DIFF (VW)	0.0685^{***}	0.0609^{***}	0.0611^{***}	0.0401^{***}

Table 5

Cross Sectional Regressions

Reported coefficients are the time-series averages of month-by-month regressions over 324 months (from July 1985 to June 2012). The t-statistic is the average slope divided by its time-series Newey-West (1987) standard errors. β is the firm's beta, B/M (or B2M) is book-to-market, where B is book value of equity and M the market value of equity. Size is the logarithm of the market value of equity. If earnings are positive, E(+)/P is the ratio of total earnings to price and E/P Dummy is 0. If earnings are negative, E(+)/P is 0 and E/P DUM is 1. AG is total asset growth. CAPEX is measured as the (three-year period) average growth in capital expenditures, deflated by total assets. ESKEW is expected idiosyncratic skewness calculated as described by Eq. (5) over a horizon of 12 months. RSKEW is lag realized skewness calculated over the past month. ESKEW6, ESKEW24 and ESK_DIFF are expected skewness over a horizon of 6 and 24 months, and the difference in expected skewness (b) – (a) of Eqs. (7) and (6), respectively. ESK_DIFF is the expected skewness from non-real options variables. DR, DRO, and DRZ correspond to the distress variable based on the Merton option-based distance-to-default model, the Ohlson O-score, and Altman Z-score, respectively. Superscript DUM is for the corresponding binary dummy versions of the distress variables. AG*IV is the interaction term between AG and idiosyncratic volatility (IV) and it is present in all basic models involving AG. Panel A1 shows expected skewness (ESKEW) results for the main models. Panel A2 reports results using the non-real options expected skewness measure. Panel B shows robustness regressions using expected skewness calculated by changing key variables (*AG, GO, DR)* employed to estimate the idiosyncratic skewness. Panel C1 contains the results obtained using alternative specifications of expected skewness measure. Panel C2 presents robustness results when expected skewness specifications are extended to include the square of GO. ***, **, * represent statistical significance at the 1%, 5%, and 10% level.

Panel A1. Main Models (ESKEW as per Eq. (5))

	Constant	β	SIZE	B/M	E(+)/P	E/P DUM	AG	ESKEW	RSKEW
L	2.477***	0.134	-0.260***	0.195*	0.078***	0.435***			
	(6.28)	(0.99)	(4.36)	(1.99)	(4.29)	(2.86)			
1	2.411***	0.135	-0.269***	0.126	0.048***	0.407**			
	(5.95)	(0.95)	(4.98)	(0.91)	(4.70)	(2.51)			
2	2.492***	0.161	-0.263***	0.072	0.043***	0.325**	-0.661***		
	(6.17)	(1.15)	(4.91)	(0.53)	(4.30)	(2.07)	(4.83)		
3	2.650***	0.197	-0.282***	0.047	0.043***	0.472***	-1.245***	-4.262***	
	(6.83)	(1.44)	(5.51)	(0.35)	(4.31)	(3.21)	(5.22)	(3.32)	
4	2.698***	0.202	-0.284***	0.042	0.043***	0.481***	-1.239***	-4.215***	-0.174***
	(6.95)	(1.48)	(5.55)	(0.31)	(4.36)	(3.28)	(5.21)	(3.29)	(4.39)

Panel A2. Non-Real Option Skewness

	Constant	β	Size	B/M	E(+)/P	E/P DUM	AG	ESKEW	RSKEW	SKEW#
#CO-SKEW	2.389***	0.100	-0.212***	0.021	0.025***	0.411***	-0.964***	-4.536***	-0.150***	-0.667
	(7.59)	(0.70)	(-4.65)	(0.17)	(2.86)	(3.06)	(4.45)	(4.14)	(3.85)	(0.22)
#ESK_REST	1.719**	0.166	-0.171*	0.056	0.050***	0.406***	-1.469***	-6.211***	-0.214***	0.294
	(2.22)	(1.26)	(-1.89)	(0.41)	(4.38)	(3.04)	(6.07)	(4.65)	(5.12)	(0.50)

Panel B. Robustness on Key Variables (AG, GO, DR) of Main Model (Eq. (4))

	Constant	β	SIZE	B/M	E(+)/P	E/P Dum	#Growth	##ESKEW	RSKEW
#CAPEX	2.494***	0.162	-0.273***	0.133	0.046***	0.509***	-2.569**	-2.001**	-0.179***
	(6.36)	(1.18)	(5.33)	(0.96)	(4.74)	(3.40)	(2.07)	(2.39)	(4.69)
#SG	2.568***	0.174	-0.283***	0.113	0.047***	0.507***	-0.191*	-2.070**	-0.175***
	(6.65)	(1.27)	(5.47)	(0.87)	(4.73)	(3.53)	(1.69)	(2.35)	(4.48)
##DRO	2.869***	0.164	-0.314***	-0.058	0.048***	0.575***	-1.583***	-5.488***	-0.171***
	(7.24)	(1.22)	(6.10)	(0.41)	(4.86)	(3.51)	(7.55)	(5.29)	(4.22)
##DRZ	2.857***	0.153	-0.295***	-0.009	0.046***	0.526***	-1.643***	-4.880***	-0.174***
	(7.21)	(1.14)	(5.61)	(0.06)	(4.71)	(3.27)	(7.05)	(4.16)	(4.28)
##DRO^{DUM}	3.519***	0.139	-0.378***	-0.141	0.050***	0.741***	-0.568***	-17.92***	-0.165***
	(9.56)	(1.04)	(7.70)	(0.99)	(5.21)	(4.58)	(5.41)	(2.75)	(4.00)
##DRZ^{DUM}	2.712***	0.176	-0.292***	0.073	0.056***	0.741***	-1.323***	-5.922***	-0.168***
	(6.98)	(1.29)	(5.67)	(0.51)	(5.53)	(4.71)	(8.14)	(6.78)	(3.83)
$\#\#^{+}$SG_B2M	1.827***	0.096	-0.244***	1.045	0.046***	0.446***	-0.719***	-29.14***	-0.182***
_DRZ	(4.60)	(0.75)	(4.73)	(1.41)	(4.94)	(2.89)	(6.54)	(3.02)	(4.61)
$\#\#^{+}$SG_B2M	2.298***	0.152	-0.269***	0.279	0.050***	0.712***	-0.526***	-7.587***	-0.176***
_DRZ^{DUM}	(5.79)	(1.14)	(5.28)	(1.21)	(5.43)	(4.24)	(5.10)	(6.13)	(4.33)

Notes: #: AG replaced by CAPEX or by Sales Growth (SG); ##: In ESKEW model, DR replaced by DRO (Ohlson O-score), DRZ (Altman Z-score), or Dummy versions (DRO^{DUM} or DRZ^{DUM}); $\#\#^{+}$: AG replaced by SG, GO by B2M and DR by DRZ or DRZ^{DUM}

Panel C. Robustness Tests Using Alternative Expected Skewness (ESKEW) Measures on Main (Base) Model (Eq. 4)

	Constant	β	SIZE	B/M	E(+)/P	E/P DUM	AG	ESKEW#	RSKEW
#ESKEW6	2.750***	0.186	-0.281***	0.017	0.040***	0.433***	-0.597**	-4.327**	-0.168***
	(7.21)	(1.42)	(5.64)	(0.14)	(4.17)	(3.03)	(2.06)	(2.53)	(4.32)
#ESKEW24	3.103***	0.283*	-0.344***	0.002	0.046***	0.664***	-0.924***	-3.860***	-0.159***
	(7.58)	(1.91)	(6.33)	(0.01)	(4.71)	(4.40)	(2.59)	(3.02)	(3.82)
#ESK_DIFF	2.610***	0.199	-0.274***	0.037	0.044***	0.414***	-1.173***	-3.277***	-0.198***
	(6.38)	(1.47)	(5.00)	(0.27)	(4.28)	(2.75)	(7.58)	(3.79)	(4.81)
#AG^{F}	2.788***	0.168	-0.295***	-0.008	0.048***	0.517***	-0.632***	-4.023***	-0.173***
	(7.07)	(1.27)	(5.63)	(0.06)	(4.73)	(3.45)	(5.59)	(3.05)	(4.46)
#GO	2.408***	0.155	-0.242***	-0.036	0.037***	0.421***	-0.600***	-7.169***	-0.201***
	(5.30)	(1.20)	(4.08)	(0.26)	(3.53)	(3.09)	(5.23)	(3.42)	(5.04)
#AG_GO	2.800***	0.199	-0.271***	0.023	0.034***	0.516***	-1.426**	-5.898*	-0.173***
	(7.43)	(1.45)	(5.41)	(0.18)	(3.70)	(3.46)	(2.29)	(1.68)	(4.31)
#DR	2.501***	0.171	-0.266***	0.009	0.046***	0.432***	-0.607***	-7.632*	-0.188***
	(6.23)	(1.29)	(4.99)	(0.06)	(4.36)	(2.79)	(4.98)	(1.77)	(4.81)

Table 6

Economic Significance of Impact of Expected Idiosyncratic Skewness on Portfolio Returns

For each sample month, stocks are sorted into five equal-sized groups based on the expected idiosyncratic skewness over a horizon of 12 (6 or 24) months ESKEW (ESKEW6 and ESKEW24), and on the difference in expected skewness (b) – (a) of Eqs. (7) and (6), ESK_DIFF. RET0 to RET6 are the (value weighted) average returns within each of the groups 0-6 months ahead. The hedge portfolio return is the difference between the average portfolio return across extreme quintiles (Low minus High expected idiosyncratic skewness or portfolio 1 – 5). The Fama-MacBeth (1973) *t* statistic for hedge portfolio returns (1 – 5) is reported, along with the Sharpe ratio, calculated following Lewellen (2010).

Panel A. Portfolio Returns Using Main ESKEW estimated over 12 months

	RET0	RET1	RET2	RET3	RET4	RET5	RET6
1 (Low)	1.6397	1.6649	1.5962	1.5377	1.5408	1.5327	1.4096
2	1.2124	1.1430	1.2219	1.2060	1.2158	1.2025	1.1070
3	1.0232	0.9911	0.9850	1.0262	1.0480	0.9755	0.9853
4	0.9114	0.9084	0.9017	0.8838	0.8692	0.9066	0.9053
5 (High)	0.7988	0.7537	0.9182	0.9313	0.9692	0.9577	0.8833
Hedge (1-5)	0.8140	0.8802	0.6570	0.5560	0.5184	0.5155	0.4603
FM t-stat	6.4006	6.6970	4.9679	4.3292	4.3024	4.2255	3.9113
Sharpe ratio	0.3702	0.3867	0.2863	0.2491	0.2472	0.2424	0.2240
Alpha_Hedged	0.8629	0.8848	0.6917	0.5543	0.5065	0.4947	0.4768
N-W tstat	6.1999	6.5661	5.3878	4.1974	3.9140	3.9716	3.8882

Panel B. Portfolio Returns Using ESKEW6 (6 months)

	RET0	RET1	RET2	RET3	RET4	RET5	RET6
1 (Low)	1.6433	1.7396	1.6640	1.5802	1.6001	1.5717	1.3992
2	1.1924	1.1941	1.2703	1.2428	1.2379	1.1705	1.1112
3	1.0528	0.9966	1.0026	0.9978	1.0244	0.9881	0.9552
4	0.9463	0.8888	0.9055	0.9525	0.8978	0.8928	0.8834
5 (High)	0.9901	0.9141	0.8973	0.9018	0.9177	0.9779	0.8302
Hedge (1-5)	0.6491	0.8098	0.7908	0.6879	0.6656	0.5732	0.5113
FM t-stat	4.6454	5.9542	5.9715	5.2543	5.2593	4.4955	4.0641
Sharpe ratio	0.2687	0.3438	0.3442	0.3024	0.3021	0.2578	0.2327
Alpha_Hedged	0.5717	0.8255	0.8670	0.7026	0.6015	0.5670	0.4973
N-W tstat	4.2624	5.6148	6.6062	5.1217	4.4377	4.1472	3.5801

Panel C. Portfolio Returns Using ESKEW24 (24 months)

	RET0	RET1	RET2	RET3	RET4	RET5	RET6
1 (Low)	1.6286	1.7233	1.6597	1.5682	1.6038	1.6424	1.4659
2	1.2092	1.1941	1.1677	1.1731	1.1913	1.2115	1.1303
3	1.1300	1.1053	1.0649	1.0545	1.0655	1.0253	0.9974
4	1.0332	1.0236	1.0504	1.0837	1.0304	1.0446	1.0555
5 (High)	1.0054	0.9823	0.9886	1.0358	1.0042	0.9845	0.9662
Hedge (1-5)	0.5854	0.6984	0.6458	0.5202	0.5542	0.6408	0.4760
FM t-stat	3.9116	4.8538	4.4075	3.4627	3.6507	4.2674	3.2623
Sharpe ratio	0.2385	0.2959	0.2687	0.2111	0.2226	0.2602	0.1989
Alpha_Hedged	0.6060	0.7236	0.6237	0.5067	0.4990	0.6264	0.4313
N-W tstat	3.7131	4.3463	3.9878	2.9536	2.9057	3.7670	2.4430

Panel D. Portfolio Returns Using ESK_DIFF (12 months)

	RET0	RET1	RET2	RET3	RET4	RET5	RET6
1 (Low)	1.4235	1.3792	1.4231	1.3639	1.3539	1.3345	1.2975
2	1.1823	1.1697	1.1472	1.0449	1.1074	1.1047	0.9999
3	1.1002	1.0355	1.0773	1.0763	1.0477	1.0627	0.9667
4	1.0236	1.0175	0.9856	0.8857	0.9678	0.9691	0.8878
5 (High)	0.9935	0.9521	0.9565	0.9785	0.9386	0.9811	1.0371
Hedge (1-5)	0.3578	0.3734	0.4314	0.4038	0.3750	0.3091	0.2568
FM t-stat	2.4938	2.5668	3.0051	2.8958	2.7298	2.2179	1.7330
Sharpe ratio	0.1442	0.1482	0.1732	0.1666	0.1568	0.1272	0.0992
Alpha_Hedged	0.3638	0.4411	0.4469	0.4840	0.3613	0.3350	0.2365
N-W tstat	2.2769	2.8427	2.8567	3.3090	2.3960	2.2875	1.3784