Real Options and Idiosyncratic Skewness

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Abstract

We add to the explanatory theory of skewness showing how real options generate convexity of payoffs leading to skewness in returns. We document empirically that growth option variables are significant, positive and robust determinants of idiosyncratic skewness, over and above previously reported determinants. We further confirm that expected long-term idiosyncratic skewness deriving from growth options commands a negative return premium. These results suggest a behaviorally rational transmission mechanism from real options to stock returns through enhanced idiosyncratic skewness.

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1 Introduction

We examine active management and its effect on stock return asymmetries. Idiosyncratic or firm-specific skewness has been shown to be priced and command a negative return premium (Chen et al. (2001), Mitton and Vorkink (2007), Boyer et al. (2010)). Confirming results on the negative return premium of firm-specific skewness have been obtained in settings ranging from total skewness (Chen et al. (2001)) to skewness recovered from options prices (Conrad et al. (2013)). Given the robust evidence that firm specific skewness is both statistically important and economically relevant, an understanding of the underlying drivers causing convex value payoffs and skewed return distributions is paramount. Our focus in this paper is on the specific role of real options as important determinants of idiosyncratic skewness leading to the observed negative return premium.

Idiosyncratic skewness is presumably not priced in "symmetric" investment situations where well-diversified investors having homogeneous rational beliefs maximize expected utility over normally distributed asset returns (see Barberis and Huang (2005)). For firm-specific skewness to have extra value for investors some sort of fundamental asymmetry is needed, such as subjective beliefs (Brunnermeier and Parker (2007)), heterogenous preferences (Mitton and Vorkink (2007)) or asymmetric probability weights as in cumulative prospect theory (Barberis and Huang (2005)). Bali et al. (2011) and Kumar (2009) provide behavioral and statistical evidence on how lottery-type stocks command a negative return premium. Kumar (2009) defines lottery stocks as having high idiosyncratic skewness and volatility. Similar types of psychological and social clienteles are drawn to lottery type stocks as to lotteries. Mitton and Vorkink (2007) report an analogous clientele effect with investors.

Skewness is closely related to lottery-type features in both financial and real assets and characterizes the empirically observed distribution of stock returns and other financial time series. Several studies have shown empirically how market-related co-skewness or total skewness command a negative return premium – Kraus and Litzenberger (1976), Harvey and Siddique (2000), Chen et al. (2001), Bakshi et al. (2003), Mitton and Vorkink (2007), Bali et al. (2011), Chang et al. (2013), and Green and Hwang (2012). Asymmetry in returns manifested in the form of total skewness, co-skewness or idiosyncratic skewness is a relevant key characteristic for market investors.

Despite its obvious importance, there are surprisingly few papers addressing the issue of the determinants of skewness. In early work, Black (1976) and Christie (1982) found that changes in leverage lead to an asymmetric volatility response to stock price changes. Thus leverage and volatility differences among firms might help explain differences in skewness. Leverage has thus been a key factor in skewness models. Investor heterogeneity may also matter as a source of returns skewness differentials. Blanchard and Watson (1983) suggest that bubbles and subsequent crashes can lead to negatively skewed return distributions.

Hong and Stein (2003) argue that high trading volumes also lead to more negatively skewed returns when investors are short-sales constrained as previously suppressed market information comes out during market declines. Cao et al. (2002) present an information blockage theory of sidelined investors causing skewness after price-drops and price-runs. Chen et al. (2001) provide supporting empirical evidence that trading volume has a negative effect on skewness and that price run-ups (run-downs) are followed by more negative (positive) skewness. They also report that past average returns are negatively associated with skewness. Xu (2007) finds evidence of a positive association of skewness with trading volume (turnover) and a negative association with lagged average returns, size and institutional ownership. Epstein and Schneider (2008) argue that ambiguity in information leads to more skewness as investors react asymmetrically to good and bad news. As smaller companies are less closely followed by analysts, they may exhibit more positive skewness.

In this paper we show that, after controlling for the above drivers, real options are significant determinants of idiosyncratic skewness. Our findings contribute to the literature in several ways: (i) we show theoretically how real options lead to convex payoffs and constitute a rationally justified key determinant of idiosyncratic skewness; (ii) we confirm empirically that real growth options are strong determinants of idiosyncratic skewness; (iii) we provide empirical evidence that the growth option-induced part of long-term expected idiosyncratic skewness is associated with a negative return premium; and (iv) we uncover a behaviorally rational transmission mechanism from real options to stock returns through the channel of idiosyncratic skewness.

Growth options represent idiosyncratic, firm-specific future contingent investment opportunities. Growth options have been shown to be relevant in explaining stock returns, e.g., Anderson and Garcia-Feijóo (2006), Grullon et al. (2012), and Trigeorgis and Lambertides (2013). However, the channel through which real options influence the market place is not as clear. Cao et al. (2008) argue that real options are drivers of idiosyncratic volatility. However, the defining characteristic of real options (besides deriving more value with higher volatility) is decision flexibility leading to value convexity and return asymmetry. It is thus equally important to consider real options as determinants of idiosyncratic skewness (asymmetry), besides being viewed as determinants of idiosyncratic volatility. In this sense our results on the determinants of skewness are complementary to the study of Cao et al. (2008) on the determinants of idiosyncratic volatility. In both cases real options are seen to be important drivers of idiosyncratic characteristics of the stock return distribution that is relevant for not fully diversified investors (Mitton and Vorkink (2007)).

Our work also complements Xu (2007) who shows that asymmetric information (related to trading volume and turnover) leads to convexity in payoffs and return skewness. From our perspective, the asymmetry is caused by decision flexibility and real options. The empirical connection between real options and stock returns is strengthened and justified behaviorally by our findings on the determinants of skewness. Idiosyncratic skewness and volatility are both key measurable variables connecting hard-to-observe real growth options with stock returns. Many investors are attracted to lottery-type stocks with both high idiosyncratic skewness and high volatility. We subsequently argue that real options, by providing a more convex pay-off in the value of an actively managed firm, result in more positively skewed returns. We thus consider real options and active firm management as fundamental drivers of firm-specific skewness.

Essentially, an active firm manages an asset portfolio that includes two major categories of real options: (a) growth or expansion call options (e.g., sequential investments, excess capacity, early stage investment); and (b) protective put options (contraction, default, reorganization, abandonment and delay). As demand rises beyond an upper threshold an active firm with strategic flexibility can exercise its growth or expansion options obtaining a competitive advantage in terms of enhanced market share and higher profits. Conversely, when market demand drops below a critical level, an actively managed firm can contract the scale of operations or restructure/reorganize obtaining downside protection. This dynamic adaptation process of an active firm creates a convex value pay-off that enhances idiosyncratic skewness. Such protective put options reduce the downside risk (probability of negative returns) while expansion options preserve and enhance upside potential. Investing in active firms with such growth and contraction real options enables investors to achieve substantial diversification benefits (downside protection) while investing in a smaller number of assets and preserving the upside potential. Such investor preferences for enhanced idiosyncratic skewness lead to a less than fully diversified investment position and are associated with a negative return premium. We test and confirm our hypothesis with US stock return data during the period 1983-2011.

2 Value convexity and skewness

It may be instructive to first take an abstract view of the mathematical connection between real options, value convexity and skewness. Let V be the value of an all-equity passive firm, with no real options, under standard assumptions (following log-normal distribution). Consider next an otherwise similar but actively managed firm $V^{'}$ with real protective Put and expansion Call options attached:

$$V^{'} = V + \text{Put}(V) + \text{Call}(V) \tag{1}$$

From basic properties of call and put options (Black and Scholes, 1974) it can be verified that V' is an increasing convex function of V since $\dfrac{dV^{'}}{dV} > 0$ and $\dfrac{d^2V^{'}}{dV^2} > 0$ (see also Figure 1). According to theorem 3.1. in van Zwet (1964), an increasing and convex transformation of a random variable (V) produces a more skewed random variable ($V^{'}$). This suggests that the skewness of the value function of an active firm with real options, $V^{'}$, is higher (more positive) than that of a similar passive firm without real options, V.

We next develop a more detailed representative model to show how the dynamic adaptation process of an active firm creates a more convex value pay-off that enhances idiosyncratic skewness. Following Kulatilaka and Perotti (1998), consider a duopoly with two (all-equity) firms facing an inverse demand function of the form:

$$p(q,\, \theta) = \theta - q$$

where $p(q,\, \theta)$ is the market price as a function of total industry supply q given a uniformly distributed random demand variable θ, with support $[0,\ M]$. $\tilde{\theta}$ represents a random shock in the quantity demanded (that is unknown at time 0). Each duopolist firm faces a production cost function of the form: $C = VC + FC$, where VC and FC are the variable and fixed cost components, respectively. At time 0 the active firm has monopolistic access to an investment growth opportunity and must decide whether to make a strategic investment. Making the strategic investment will confer economies of scale (via an expansion option) which lower unit variable costs (from K to k).

Active management also allows for a more flexible production scale on the downside (a contraction option) by lowering fixed costs (from F to f). The expansion and contraction opportunities are a function of future demand realization. As illustrated in Figure 1 if future demand θ increases beyond an upper demand threshold, θ^{**}, the active firm with the strategic growth investment will exercise the expansion option and lower marginal production costs, increasing profitability. On the other hand, in case of a negative shock in demand, dropping below lower threshold θ^{*}, exercising the contraction put option enables re-sizing the firm's scale (lowering fixed costs from F to f) and reducing losses. The strategic investment effectively enables the active firm to change its operating scale and cost structure depending on the random demand shock realization, θ, exploiting growth or contraction opportunities accordingly. Under high demand ($\theta > \theta^{**}$), to satisfy the increased level of production, the active firm adopts a larger scale and faces higher fixed costs F ($F > f$). However, given the expanded scale, the firm faces lower marginal production costs k ($k < K$).Thus, its costs are $F + kq$ when $\theta > \theta^{**}$. Conversely, if quantity demanded drops below θ^{*}, the active firm can reduce size to a lower scale with less fixed costs f ($f < F$). In this case ($\theta < \theta^{*}$), the firm will not exercise expansion options and will face higher marginal cost K. Its costs will thus be $f + Kq$, for $\theta < \theta^{*}$.

Figure 1 provides a graphical representation of the above reasoning. The value of the active firm ($V^{'}$) is again seen as the value of a passive firm (V) in a normal demand range

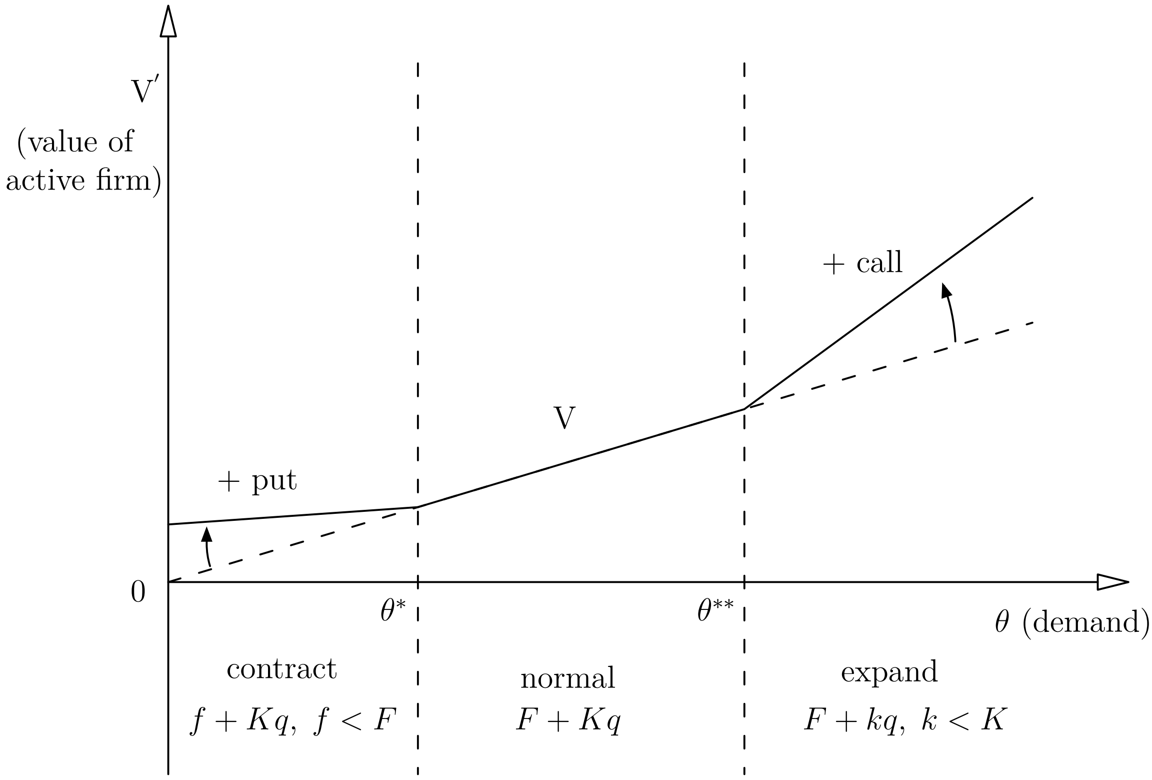


Figure 1: Graphical representation of the adaptive options of an active firm. For a low level of demand ($\theta < \theta^*$) the firm can exercise a contraction option: the scale and fixed costs will be reduced to f ($f < F$). For intermediate (normal) level of demand $\theta^* < \theta < \theta^{**}$ neither option is exercised: the firm faces the same production cost function as an identical passive firm without options. For high level of demand ($\theta > \theta^{**}$) the firm will exercise an expansion option with economies of scale, so the firm is able to produce at a lower marginal cost k ($k < K$). The cost of the passive firm under normal demand is $C = F + Kq$. The expected adaptive cost of an active firm is $(f + Kq)$ with demand scalar or probability $(1 - \frac{\theta}{M})$ of contraction and $(F + kq)$ with probability $(\frac{\theta}{M})$ of expansion.

($\theta^* < \theta < \theta^{**}$) plus the contraction (Put) and expansion (Call) options, as in equation (1) above. Without such strategic investment, a passive firm with rigid costs (of value V) faces the following total production cost:

$$C = F + Kq \tag{2}$$

with $F > f$ and $K > k$.

In the following, to simplify modeling we approximate the above piece-wise linear cost function with kinks by a smooth function. Assuming demand θ follows a uniform distribution with support [0, M], the active firm (of value V') making such strategic investment faces the following expected total (smooth) production costs:

$$C' = \underbrace{\left(1 - \frac{\theta}{M}\right)(f + Kq)}_{\text{(contract)}} + \underbrace{\frac{\theta}{M}(F + kq)}_{\text{(expand)}} \tag{2'}$$

As in Kulatilaka and Perotti (1998), an expansion (growth) option allows reduced future cost per unit ($k < K$). For an active firm, we relax here the assumption of constant production coefficients (F, K) and relate marginal and fixed costs to the actual level of the demand shock θ. Equation (2') presents the cost function as a weighted average of costs in low and high demand regions, with weights equal to the probability of observing low or high demand (θ). This adaptive cost structure is representative of an active firm with contraction (abandonment) and expansion (growth) options. Under these assumptions, the passive and actively managed firms will produce the following quantities, respectively:

$$\begin{aligned} q &= \tfrac{1}{3}\left(\theta - 2K + k\tfrac{\theta}{M} + K\left(1 - \tfrac{\theta}{M}\right)\right) \\ q' &= \tfrac{1}{3}\left(\theta - 2\left(k\tfrac{\theta}{M} + K\left(1 - \tfrac{\theta}{M}\right)\right) + K\right) \end{aligned}$$

The Cournot entry threshold points are $\theta > \theta^P \left(\equiv \frac{K}{1-1/M(K-k)}\right)$ and $\theta > \theta^A \left(\equiv \frac{K}{1+1/M(K-k)}\right)$ for the passive and active firms, respectively. The ex-post duopoly net profits (or cash flows) π and $\pi^{'}$ of the passive and active firms are, respectively, given by:

$$\pi = \begin{cases} -F & \text{if} \quad \theta < \theta^P, \\ \frac{1}{9}\left(\theta - 2K + k\frac{\theta}{M} + K\left(1-\frac{\theta}{M}\right)\right)^2 - F & \text{if} \quad \theta \geq \theta^P. \end{cases} \tag{3}$$

$$\pi^{'} = \begin{cases} -F\frac{\theta}{M} - f\left(1-\frac{\theta}{M}\right) & \text{if} \quad \theta \leq \theta^A, \\ \frac{1}{4}\left(\theta - k\frac{\theta}{M} - K\left(1-\frac{\theta}{M}\right)\right)^2 - F\frac{\theta}{M} - f\left(1-\frac{\theta}{M}\right) & \text{if} \quad \theta^A < \theta < \theta^P, \\ \frac{1}{9}\left(\theta - 2\left(k\frac{\theta}{M} + K\left(1-\frac{\theta}{M}\right)\right) + K\right)^2 - F\frac{\theta}{M} - f\left(1-\frac{\theta}{M}\right) & \text{if} \quad \theta \geq \theta^P. \end{cases} \tag{3'}$$

Equation (3') is a generalization of the Kulatilaka and Perotti (1998) model accounting for the downside contraction option, besides the upside growth option. We can isolate each specific impact produced by the expansion or contraction options by imposing restrictions on the fixed and marginal costs, as follows:

A. The case of a passive firm with no expansion or contraction options and constant production costs ($\theta/M = 1$) is obtained as a special case of equation 3 by imposing $F = f$ and $K = k$, resulting in:

$$\pi = \begin{cases} -F & \text{if} \quad \theta < K, \\ \frac{1}{9}\left(\theta - K\right)^2 - F & \text{if} \quad \theta \geq K. \end{cases}$$

This shows that even the value of a passive firm under competition is convex (quadratic) in demand θ.

B. The case of a firm with only expansion (growth) option and constant production coefficients ($\theta/M = 1$) is obtained by imposing $F = f$:

$$\pi^{'} = \begin{cases} -F & \text{if} \quad \theta < k, \\ \frac{1}{4}(\theta - k)^2 - F & \text{if} \quad k \leq \theta < 2K - k, \\ \frac{1}{9}(\theta + K - 2k)^2 - F & \text{if} \quad \theta > 2K - k. \end{cases}$$

This confirms Kulatilaka and Perotti (1998) with no fixed costs ($F = 0$).

C. The case of a firm with only contraction option is obtained by imposing $K = k$:

$$\pi^{'} = \begin{cases} -F\left(\frac{\theta}{M}\right) - f\left(1 - \frac{\theta}{M}\right) & \text{if} \quad \theta < K, \\ \frac{1}{9}(\theta - K)^2 - F\left(\frac{\theta}{M}\right) - f\left(1 - \frac{\theta}{M}\right) & \text{if} \quad \theta \geq K. \end{cases}$$

D. The more general case of an active firm with both expansion and contraction options is given by our equation (3') above.

It can be verified, following arguments in van Zwet (1964), that the expression for $\pi^{'}$ in equation (3') in case D is a more convex transformation of that in C, which is more convex than that in B, and in A. Hence the resulting random values for the active firm ($V^{'}$) with increasingly more options ($D > C > B > A$) should be more skewed. The above is illustrated graphically through simulation of demand θ in Figures 2 and 3.

Figure 2 contains plots of firm net profits (or cash flows) as function of demand θ. An active firm (case D) with such strategic investment has a competitive advantage in terms of an enhanced market share and flexible (lower) production costs, resulting in a more convex payoff (compared to the passive firm with no options in case A).[1] As shown in Figure 2, the presence of contraction (or abandonment) options reduces the size of

[1] If we assume, for simplicity, that firms enter a steady state with no further growth where capital expenditures are equal to depreciation and net working capital is constant, the indicated profits in equations (3) and (3') are equal to net cash flows; we can then make use of the present value of a perpetuity relationship and relate changes in net cash flow to changes in market equity values.

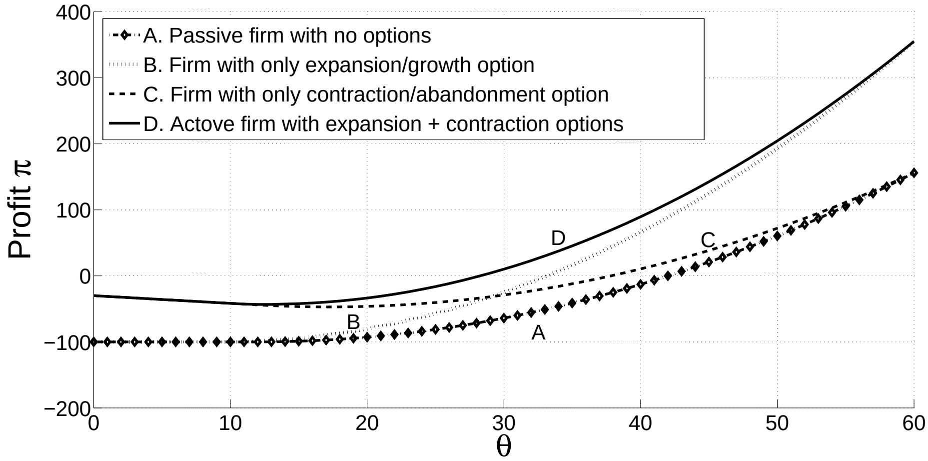


Figure 2: Firm profits (cash flows) as a function of demand shock θ. The higher continuous line (D) corresponds to an active firm with both expansion and contraction options; the thick dashed line (C) corresponds to an active firm with only contraction options, while the fine dashed line (B) corresponds to a firm with only expansion options; finally, the dashed marked line (A) corresponds to a passive firm without expansion or contraction options. The assumed parameters are $k = 4$, $K = 8$, $f = 30$, $F = 80$ and $M = 60$.

negative cash flows during low demand (C), while expansion options enhance positive cash flows during high demand states (B). These cash flow asymmetries are reflected in equity dynamics that enhance the skewness of stock returns.

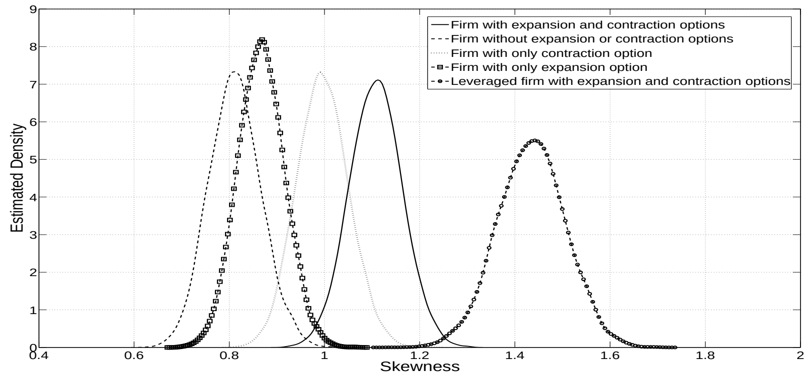
To illustrate the impact of strategic expansion and contraction options on equity return dynamics we simulate a series of demand shocks (θ) and determine the rates of equity returns for the simulated series. In particular, we simulate repeated demand shocks θ over 1,000 time intervals, first extracted from the uniform distribution underlying equation (3') (and then using an analogous log-normal process for θ) and we determine the cash flow distributions for the active and passive firms, respectively. Equity values are obtained based on the cumulation of the 1,000 realizations of cash flows (assuming an initial equity value of 50,000). The value accumulation process stops if equity becomes negative (in which case the firm is assumed to default without incurring bankruptcy costs). Equity returns are obtained from $E(t+1)/E(t) - 1$. Stock return skewness is calculated for both the active and passive firms.The base-case parameters in the simulation are $k = 4$, $K = 8$, $f = 30$, $F = 80$ and $M = 60$.

Figure 3 contains the densities of estimated skewness over 10,000 simulation paths. As hypothesized, the presence of strategic expansion and contraction options increases the skewness of equity rates of return. An increase in real options presence (intensity), measured by cost differentials of $K - k$ and $F - f$, widens the difference in skewness distributions. A different impact is caused by expansion vs. contraction options depending on the demand shock level θ. As demand θ increases, skewness is more affected by the presence of expansion options. Conversely, for low values of M, the contraction option becomes dominant. As shown in Figure 3, an expansion in demand increases average skewness (we expect skewness to be positively related with market conditions). Plot B shows estimated skewness densities when the demand shock instead comes from a log-normal distribution (with mean 40 and standard deviation 5). In this case, the ratio θ/M in equations (3') is replaced by $\mathbb{P}(\theta_t)$, where θ_t is a realization of the demand shock and $\mathbb{P}(\theta)$ is the log-normal cumulative distribution function. High (low) values of $\mathbb{P}(\theta_t)$ indicate that the quantity demanded is high (low). Again, an active firm with expansion and contraction options exhibits higher skewness. The numerical results are robust to the different demand distributional assumptions (shown here for uniform or lognormal).

The above convexity and skewness results are more pronounced if the firm is partly financed by debt (e.g., via issuance of zero-coupon debt D). Leverage and limited liability have an incremental impact on value convexity and skewness. If equity value is seen analogous to a call option on the underlying firm asset value (V') with strike price the face value of debt D, $E' = \max(V' - D, 0)$, where V' is the asset value of an active all-equity financed firm given in equation 3. The presence of leverage provides an additional layer of convexity that further enhances skewness for a levered actively-managed firm.[2]

[2]Even for a passive firm, the value function is convex in demand θ ($\pi \approx \theta^2$ from equation (3)). Growth

Plot A. Equity return skewness under uniformly distributed θ with support $[0,\, M = 60]$



Plot B. Equity return skewness under lognormally distributed $\theta \sim LN(40,\, 5)$

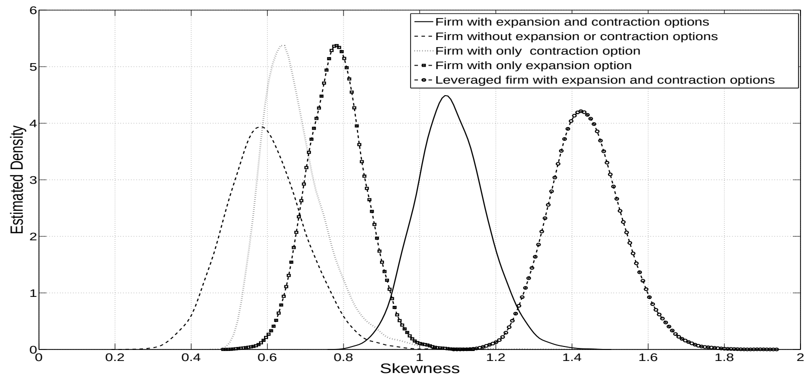


Figure 3: This graph contains plots of the equity return skewness distribution from 10,000 simulations. The base case parameters are $k = 4$, $K = 8$, $f = 30$ and $F = 80$. The case without contraction option is obtained by imposing $k = 4$, $K = 8$ and $f = F = 80$, while the case without expansion option is obtained by setting $k = K = 8$, $f = 30$ and $F = 80$. If the maximum demand shock θ increases ($M = 100$) expansion options have a stronger impact on skewness than contraction options. The reverse is true for lower values of M. Plot B contains the estimated skewness densities when θ is extracted from a log-normal distribution with mean 40 and standard deviation 5. In all plots, leverage is modelled as a call option on the underlying company value with strike price equal to the value of debt D, i.e. $E_t = \max(E_t - D,\, 0)$. As a base case we consider an equity financed firm with E_0=50,000. The density of the leveraged firm is obtained by assuming a fixed debt value of D=25,000.

The above simulation results confirm that the value of an actively managed firm is a convex function of underlying market demand, while a convex transformation through real options skews further the return distribution to the right. The market equity returns of an actively managed firm are more positively skewed than a comparable passive or rigid firm. Although, as demonstrated, both expansion as well as contraction/abandonment options contribute to increased skewness, the analysis of contraction, abandonment or default put options might be better addressed using a sample of distressed firms (or firms with government guarantees like systemic banks). Unfortunately we do not have reliable and readily observable empirical proxies for these put options in a general context. We subsequently focus our empirical analysis on the impact of expansion/growth options using the universe of active (not-defaulted) US stocks on NYSE/AMEX/NASDAQ for the period 1983-2011.

In what follows, we examine growth options as important determinants in the idiosyncratic skewness expectation model. Boyer et al. (2010) already demonstrated that expected idiosyncratic skewness is priced. Here we add more specific evidence that expected idiosyncratic skewness directly attributed to real growth options leads to lower stock returns once other previous factors are controlled for.

or expansion options on upside provide an additional level of convexity (special case ($\theta \geq \theta^P$) of equation (3') corresponding to Kulatilaka and Perotti (1998) is more convex than equation (3)). The addition of contraction option makes the value function (equation (3')) even more convex. Leverage adds a fourth level of convexity. A convex transformation (four layers) leads to more a skewed distribution (van Zwet (1964)).

3 Sample and methodology

3.1 Data description

Our sample consists of all active US firms listed in the NYSE/AMEX/NASDAQ exchanges in the period 1983-2011. We focus on the period after July 1983 when NASDAQ data is readily available and market volatility and skewness are more prevalent. There are several reasons for this focus. Firstly, many growth stocks are traded on NASDAQ. Secondly, computerized portfolio management increased after the start of S&P 500 index futures trading in 1983, enhancing volatility in the market. Growth options that might lead to more asymmetric returns and a related priced skewness factor are more significant in the presence of increased market volatility, which has become more pronounced since 1983. Xu and Malkiel (2003) argue that idiosyncratic risk has become more important over time as stocks listed on NASDAQ increased in number and importance after 1983. Chan and Lakonishok (1993) report that beta was working fine until 1982, but subsequently stopped being significant, in line with a structural break around 1983. Finally, many variables that are used to measure expansion or growth options are only available in COMPUSTAT after 1983. For these reasons, we focus our analysis on the post-1983 period.

Our basic analysis uses daily holding period equity returns downloaded from CRSP. We include ordinary common shares of firms listed on the NYSE, AMEX and NASDAQ from 1 July 1983 to 30 June 2011. Financial firms are excluded. We require each included stock to have at least 100 non-missing daily observations in a year. Data in CRSP is matched univocally with COMPUSTAT using the 8-digit CUSIP code and fiscal year. Duplicates of CUSIP-fiscal year are deleted from the sample. Tables 1 and 2 contain descriptive statistics, including correlations, for the main variables used to explain idiosyncratic skewness for the period 1983-2011.

3.2 Measuring skewness determinants

Idiosyncratic skewness is generally estimated from the residuals of time series regressions. Two approaches are commonly used to estimate the residuals: 1) Fama & French 3 factor model (e.g., Boyer et al. (2010), Green and Hwang (2012)); and 2) Market model with potential inclusion of a second-order term (Mitton and Vorkink (2007), Bali et al. (2011), Green and Hwang (2012)). In line with Harvey and Siddique (2000), we use models that rely on market information in determining market-related and firm-specific skewness components. We treat idiosyncratic or firm-specific skewness as that part of total skewness that is not related to market movements and thus measure idiosyncratic skewness from the residuals of the market model.

As real options represent firm-specific characteristics or idiosyncratic opportunities, we examine their incremental impact on idiosyncratic skewness, measured as:

$$\text{Idio-Skew}_{i,\,t} = \frac{E[\epsilon_{i,\,t}^3]}{\sqrt{E[\epsilon_{i,\,t}^2]}^3} \tag{4}$$

where $\epsilon_{i,\,t} = r_{i,\,t} - (\alpha_0 + \beta_i r_{M,\,t})$ are the residuals of the market model. We estimate idiosyncratic skewness using different horizons from 1 to 5 years, each period starting from 1 July to 30 June. The market model parameters are assumed to be constant over the horizon and expectations in equation (4) are taken on the residuals.[3] As a robustness test, we also built a skewness measure using monthly holding period returns over a period of three years (36 monthly observations).

[3]For example, the two-year horizon skewness is calculated by first fitting the market model on daily returns from 1 July in year t-2 to 30 June in year t. We then calculate the skewness as in equation (4) of the obtained daily residuals. The estimation is repeated by moving one year ahead and maintaining fixed the two-year window.

We test the impact that real option drivers have on idiosyncratic skewness using standard panel regressions with lagged regressors. We test the following models:

$$y_{i,t} = \alpha y_{i,t-j} + x'_{i,t-j}\beta + u_{i,t}, \qquad i = 1, \cdots, N;\ t = 1, \cdots, T;\ j = 1, 3. \tag{5a}$$

$$y_{i,t} = x'_{i,t-j}\beta + u_{i,t}, \qquad i = 1, \cdots, N;\ t = 1, \cdots, T;\ j = 1, 3. \tag{5b}$$

where $y_{i,t}$ represents the estimated idiosyncratic skewness for asset $i = 1, \cdots, N$ in year $t = 1, \cdots, T$, $x_{i,t-j}$ is a (K×1) vector of exogenous covariates, and β is a (K×1) vector of unknown coefficients. The subscript j denotes the length of the lag (being equal to 1 for the one year daily data and equal to 3 years for the monthly return case). Models (5a) and (5b) are estimated using standard panel methods. All accounting data is lagged one year relative to market data if the company fiscal year end is between July and December, or two years if the fiscal year end is between January and June. This ensures that all accounting variables are known by the market at the time considered. The following K exogenous firm-specific variables are used to help explain individual idiosyncratic skewness and make up the vector $x_{i,t}$. Variables are described for the base case of the skewness calculated on daily returns over a period of a year:

- Beta$_t$. This is estimated as the market loading factor calculated on daily returns from 1 July of year $t-1$ to 30 June of year t.
- Size$_t$ = $log(ME_t)$, where $ME_t = Price_t \times ShareOut_t$. Measured as the log market value of equity, size is one of the standard Fama and French (1993) factors. It can be argued that future growth opportunities are more likely to be enjoyed by smaller companies. Size might thus act as an alternative proxy for future growth options, though this may be challenged due to the possibility of also capturing leverage effects (see Black (1976) and Christie (1982)). Size is calculated as the logarithm of stock price at the end (or last non-missing available observation) of June of year t ($Price_t$)

times the number of shares outstanding at the end of June of year t ($ShareOut_t$). The main results hold if size is alternatively proxied by the logarithm of total assets or sales.

- $\mathrm{B/M}_t = ceq_{t-fy}/(ME_t)$. Book to market is included as a basic Fama and French (1993) factor potentially proxying for the existence of future growth options or for distress (see Fama and French (1993)). Book to market is calculated as the ratio of book value of equity in fiscal year $t-fy$ (ceq_{t-fy}) to the market value of equity at the end of June of year t. The subscript fy assumes the values 1 or 2 if the fiscal year end month is between 1 July - 31 December or 1 January - 30 June, respectively. Chen et al. (2001) find that this variable is positively related with skewness, probably because glamour stocks are more crash-prone.

- GO_t, the growth option intensity, represents the percentage of firm market value (MV_t) that stems from future growth opportunities (GO_t). It is typically estimated by subtracting from the current market value of the firm (MV_t) the perpetual discounted stream (at the w.a.c.c.) of the firm's operating cash flows under a no-further-growth policy (e.g. see Cao et al. (2008), Trigeorgis and Lambertides (2013)):
$$\mathrm{GO}_t = \frac{MV_t - \frac{FCF_{t-fy}(ng)}{w.a.c.c._{t-fy}}}{MV_t} \tag{6}$$
where $MV_t = ME_t + lt_{t-fy}$. The weighted average cost of capital ($w.a.c.c._{t-fy}$) is calculated as $CostEquity \times (1 - Lev_{t-fy}) + CostDebt \times Lev_{t-fy}$, where the cost of equity is estimated from the market model (or CAPM assuming a market beta equal to 1 for all firms). Market equity premium is estimated as the average market excess return (roughly 6%) over the treasury bill rate. The cost of debt is estimated by applying an annual spread of 2% to the 10-year treasury bond rate. The results are qualitatively insensitive to different spreads. $FCF_{t-fy}(ng)$ is the free cash flow under

no-further-growth, i.e. firm “as is” policy. In most previous literature (Long et al. (forthcoming), Cao et al. (2008), Trigeorgis and Lambertides (2013)) $oancf$ from COMPUSTAT has been used as an estimate of $FCF(ng)$. We here adhere to a more precise definition of free cash flow used in company valuation, adding back to $oancf$ the interest and assuming that under a no-growth policy capital expenditures roughly equal depreciation. This leads to estimating $FCF_{t-fy}(ng)$ as $oancf_{t-fy} + xint_{t-fy} - dpc_{t-fy}$. To enable direct comparisons with previous literature we also estimate the model with the commonly used definition of $FCF(ng)$ as $oancf$ in our robustness checks. To reduce errors and the impact of year-specific contingencies we use an average $oancf$ over the past three years.

- $\text{CAPFIX}_t = capx_{t-fy}/ppent_{t-fy}$. CAPFIX might be seen as a proxy for exercising growth options and turning them into assets in place. If capital expenditures capture past exercised growth options, the relationship between capital expenditures and the value of future investment options may not be linear (see Goyal et al. (2002) and Cao et al. (2008)). Capital expenditure intensity is measured as the ratio of capital expenditures in fiscal year $t - fy$ ($capx_{t-fy}$) over the net value of property, plant and equipment in the same fiscal year ($ppent_{t-fy}$).
- $\text{RD}_t = xrd_{t-fy}/at_{t-fy}$. Research and development (R&D) intensity is a typical real option measure that captures systematic firm efforts to cultivate or develop new multi-stage growth options. R&D intensity is measured as R&D expenses in fiscal year $t-fy$ (xrd_{t-fy}) over total assets in the same fiscal year (at_{t-fy}). Missing values in xrd_{t-fy} are replaced by zeros to save observations; relaxing this assumption does not substantially change the main results.
- Turnover_t. Used as a measure of investor heterogeneity (Chen et al. (2001)), turnover is given by the ratio of average daily volume from 1 July of year $t-1$ to 30 June of year t, divided by average shares outstanding from 1 July of year $t-1$ to 30 June

of year t.

- $\bar{r}_t$ and σ_t, the average daily firm (asset) return and volatility from 1 July of year $t-1$ to 30 June in year t. Campbell and Hentschel (1992) and Harvey and Siddique (1999) have shown that skewness is a time-varying firm characteristic that can be modeled by auto-regressive processes. Blanchard and Watson (1983) suggested that bubbles and subsequent crashes may lead to negatively skewed return distributions. These results suggest that in modeling the determinants of skewness one should control for endogenous market-based variables, especially lagged average returns, volatility, and past skewness.

- $\text{Lev}_t = lt_{t-fy}/MV_t$, where $MV_t = (Price_t \times ShareOut_t + lt_{t-fy})$. Leverage captures the financial flexibility of the firm while it may also proxy for distress. It is calculated as the ratio of total liabilities at fiscal year $t-fy$ (lt_{t-fy}) to the market value of the firm MV_t. The market value of equity is given by stock price times number of shares outstanding at the end of June of year t ($Price_t \times ShareOut_t$). The value of debt is approximated by total liabilities lt_{t-fy}.

- Concentration_t, measured by the Herfindahl - Hirschman Index (HHI) calculated at the two-digit SIC industry level using sales ($sale_{t-fy}$). HHI is used as a proxy for the level of competition in an industry and captures how well protected is the firm's strategic advantage. For firm i in year $t-fy$ we calculate:

$$\text{Concentration}_{i,t} = \left(\frac{sale_{i,t-fy}}{\sum_{i=1}^{N_{SIC}} sale_{i,t-fy}}\right)^2 \times 100$$

  where N_{SIC} is the total number of firms in the same 2-digit industry.

- $\text{ROA}_t = ni_{t-fy}/at_{t-fy}$. ROA_t is the return on assets in fiscal year t, where ni_t is the net income in fiscal year t and at_t is total asset value at the beginning of fiscal year t. ROA is the measure of the firm's past performance.

- $\text{MktSent}_t = \overline{Rm}_t/\sigma_{m,t}$ proxies for market up/downs or market sentiment (e.g., pessimism or optimism) in year t. It is given by the ratio of the average return on the market over a period of one year to the standard deviation of market returns from July of year $t-1$ to June of year t. During downmarket or pessimism periods the measure declines as lower (or even negative) market rates of return are realized along with higher volatility. This variable captures general economic conditions that impact the firm production level and proxies for demand shocks.

To avoid excessive influence of outliers for B/M, GO, CAPFIX, ROA and RD, we remove the extreme 0.1% of observations in both tails. For comparability, the horizon used to calculate beta_t, turnover_t, average firm return and volatility of the daily asset return $\bar{r}_t$ and σ_t, and MktSent_t, are analogously extended when skewness is calculated over 2, 3, 4 and 5 years. When skewness is calculated on monthly returns we consider 36 monthly observations (rolled each year) from 1 July of year $t-3$ to 30 June of year t. To allow for more observations and enable direct comparison with previous literature (see Chen et al. (2001)) we use daily skewness calculated over one year as our base case. In the robustness section we include the results obtained for skewness calculated over longer horizons. Table 1 contains the main descriptive statistics on these explanatory variables. Table 2 gives the correlation coefficients of the variables included in the regression analysis.

To complete our analysis and corroborate the importance of our previous discussion we also test whether real-options-induced *expected* idiosyncratic skewness is negatively related to returns. As in Boyer et al. (2010) we here focus on the long-term expectation of idiosyncratic skewness and specifically test whether the real-options-induced expected idiosyncratic skewness leads to lower returns. We estimate expected idiosyncratic skewness (IS_t) using the following series of cross sectional regressions:

$$IS_t = \alpha_0 + \beta_1 IS_{t-T} + \beta_2 \mathrm{GO}_{t-T} + \beta_3 \mathrm{RD}_{t-T} + \beta_4 \mathrm{CAPFIX}_{t-T} + \beta_5 IV(1Y)_{t-T} + \epsilon_t \quad (7)$$

We include as explanatory variables the three main real option determinants plus idiosyncratic volatility. IV is included in the expectations for two reasons: (1) it is a key driver of the value of real growth options, and (2) idiosyncratic volatility and skewness are co-determined as high firm-specific volatility attracts more active management which influences the shape of the return distribution while active management simultaneously influences idiosyncratic volatility. As in Boyer et al. (2010) the analysis is affected by the choice of the horizon used for the skewness expectation. For robustness we estimate expected idiosyncratic skewness using different lengths of the time window. In particular, IS_t is the idiosyncratic skewness calculated from 1 July in year $t-T$ to 30 June in year t where $T = 2$, 3, 4 years is the analyzed horizon; GO_{t-T}, RD_{t-T}, CAPFIX_{t-T} and IV_{t-T} are observed at 30 June of time $t-T$; and IS_{t-T} is past (lagged) idiosyncratic skewness calculated from 1 July in $t-2T$ to 30 June in $t-T$. Expected idiosyncratic skewness (at year t) over future horizon $t+T$ is estimated as:

$$E_t[IS_{t+T}] = \hat{\alpha}_0 + \hat{\beta}_1 IS_t + \hat{\beta}_2 \mathrm{GO}_t + \hat{\beta}_3 \mathrm{RD}_t + \hat{\beta}_4 \mathrm{CAPFIX}_t + \hat{\beta}_5 \mathrm{IV(1Y)}_t \quad (8)$$

Once expected idiosyncratic skewness over future horizons (T) is calculated as above, we test its market impact on returns by running:

$$r_{t+1} = \gamma_0 + \gamma_1 E_t[IS_{t+T}] + \Gamma Z_t + \epsilon_{t+1} \quad (9)$$

The matrix Z_t contains related firm characteristics such as market beta, size, book-to-market ratio, idiosyncratic volatility, a dummy for negative book-to-market values (distress) and turnover observed at 30 June in year t. Equation (9) is estimated at the individual asset level using a series of cross-sectional and pooled regressions for each year.

4 Main empirical results

We first present basic descriptive statistics for our explanatory variables by skewness deciles. Table 3 presents averages of the explanatory variables in each skewness decile. We divide idiosyncratic skewness in year t in 10 deciles and calculate the cross-sectional average of idiosyncratic skewness in each decile. Explanatory variables are observed in the previous period and are then cross sectionally averaged depending on their skewness classification in year t. From Table 3 it can be noted that when positive, skewness rises almost linearly with GO and RD, but shows potential non-linearity in CAPFIX. Non-linearity of skewness with GO and RD is also observed when skewness turns to negative values.[4]

Tables 4 and 5 contain the results of the panel estimations for our daily and monthly models at individual level (equations 5b and 5a). Standard errors are corrected for heteroskedasticity and cluster effects. In line with Chen et al. (2001) and Xu (2007), we find that current skewness is negatively related to past average returns and size, but positively associated with past volatility and book to market. In line with a real options view, the positive association between volatility and skewness might stem from the positive relation between volatility and growth options (see Cao et al. (2008), Grullon et al. (2012)). As in Cao et al. (2008), we also find that our real option proxies are positively related to idiosyncratic volatility. Financial leverage, by providing a second layer of flexibility and convexity, has an enhancing impact on idiosyncratic skewness. In line with previous

[4] The relation between GO, RD and skewness is weaker in this case – but Table 3 raises an interesting issue on the determinants of negative skewness. Negatively skewed assets become lottery stocks if short-sold.

studies, we find mixed evidence of the impact of turnover on skewness (see Chen et al. (2001); Xu (2007)). The impact of size (-), volatility (+) and financial leverage (+) are also consistent with the leverage effect noted by Black (1976) and Christie (1982) and the volatility feedback mechanisms of Campbell and Hentschel (1992). Higher market sentiment (+MktSent), given by the ratio of past average market return over market volatility, is positively associated with skewness, in line with Blanchard and Watson (1983). Past profitability measured by ROA is inversely related to skewness.

After controlling for all the above factors, the main real option variables GO and RD are found positively and significantly related to skewness. Tables 4 and 5 confirm that higher growth options (GO) lead to more positively skewed returns, in line with our real options-skewness hypothesis. These results are valid in both daily and monthly return data, with the latter exhibiting a higher explanatory power ($R^2 = 19.4\%$). The results are also robust to different estimation methodologies and time horizons. Capital expenditure intensity (CAPFIX), related to the exercise of past growth options, has an inconclusive sign, potentially due to non-linearities (see Goyal et al. (2002) and Cao et al. (2008)). Our findings indicate that growth options are not only important determinants of idiosyncratic volatility (see also Cao et al. (2008)), but their presence significantly affects the shape (skewness) of the return distribution. Tables 6 contains the results of pooled panel regressions at the portfolio level (using daily data). The real option variables, GO, RD and CAPFIX explain a significant portion (about 35%) of average portfolio idiosyncratic skewness. The overall model explanatory power is high ($R^2 = 56\%$).

Regarding the relation between expected idiosyncratic skewness and equity returns, Table 7 shows that, after controlling for firm-specific characteristics such as market beta, size, book-to-market, idiosyncratic volatility, distress (negative book-to-market dummy) and turnover, the real-options-induced expected idiosyncratic skewness, $E_t[IS_{t+T}]$, is significantly negatively related with returns. In base case cross-sectional regression (model

(1) in Table 7) we use a 3 years expectation period and measure returns as the geometric average of the next 12 months holding period returns. We also test a similar model using a pooled regression with returns measured monthly (model (2) in Table 7). Reinforcing and extending results in Boyer et al. (2010), we find that real-options-induced expected idiosyncratic skewness commands a negative return premium. Our overall results indicate that real growth options are not only important determinants of skewness, but have an important impact on returns.

5 Robustness results and discussion

Table 8 shows results from rerunning our statistical tests using portfolios built on deciles based on our idiosyncratic skewness measure. We divided our idiosyncratic skewness measure in year t in 10 equally-spaced deciles and calculated the cross-sectional average of daily idiosyncratic skewness in each decile. Explanatory variables are observed in the previous period and are then cross-sectionally averaged depending on their skewness classification in year t. Table 8 contains the results of pooled panel regressions for each individual variable. Along with past ROA, past idiosyncratic skewness, idiosyncratic volatility, size, B/M and leverage, our real option proxies GO and RD are highly effective in explaining average skewness in each skewness decile (with R^2 0.37 and 0.30, respectively). Collectively, these results suggest that our real option variables explain an important portion of average portfolio idiosyncratic skewness.

Table 9 confirms that our main results of Table 4 (column 4) are robust to different time horizons. While GO loses some power as the horizon increases, RD intensity becomes more important. There are several reasons for RD intensity having more influence over longer horizons: i) RD investments are long term; ii) RD can generate preemptive or first-mover advantages which translate into more convex pay-offs that enhance skewness;

and iii) investment in RD generates future follow-on growth options.

Table 10 presents various additional robustness test results. We specifically examine how the results are affected by the estimation methodology and the construction of real option variables. We run different panel estimation methods and used alternative proxies for the main variables in our regression models. Table 10 shows (in column 2) that fixed effect (FE), (column 3) random effect (RE), and (column 4) dynamic panel procedures based on Arellano and Bond (1991) (AB) produce qualitatively similar results as the pooled regressions (column 1) concerning the main real option variables GO and RD. To account for the time dynamics of the estimated coefficients, column (5) reports the time-series average coefficients of year-by-year cross-sectional regression slopes. The results again indicate that growth option proxies are significant positive determinants of idiosyncratic skewness.

Further, robustness tests employing alternative definitions of the GO variable, namely setting negative GO values to zero (GO1) in column (6), using the Cao et al. (2008) measurement approach (GO2) in column (7), or using the standard cash flow definition based on $oancf$ alone as in Long et al. (forthcoming), Cao et al. (2008) and Trigeorgis and Lambertides (2013) (GO3) in column (8) – produce similar results as in our base case. Overall, over and above all other variables considered in previous literature, our main real option variables (GO and RD) are significant and robust determinants of idiosyncratic skewness.

Table 11 provides robustness checks for the expectation periods of idiosyncratic skewness (2 and 4 years around base case 3 years) and return estimation period (6 months vs. base case 12 months). The negative return premium remains significant with all these variations.

6 Conclusions

This paper had several objectives. First, it has shown theoretically (and via simulation) how active management of firm real options results in value convexity and enhanced skewness in equity returns. Second, it has confirmed empirically that real option variables (GO and R&D) are key determinants of idiosyncratic skewness after controlling for other known factors. Third, long-term forecasts of skewness induced by real options commands a negative return premium in individual stocks and portfolios. Our findings are consistent with the hypothesis that less-than-fully diversified investors, having a preference for entrepreneurial or lottery-type investment opportunities, may be willing to accept lower short-run average returns in exchange for more positive skewness or asymmetric lottery-type bets. Finally, we add to the literature on growth options impacting negatively on stock returns by showing that the channel through which this negative impact is carried out is by shifting the shape of the return distribution as predicted by real options theory.

Firm-specific skewness has been shown to be priced and command a negative return premium. Empirically the results have been obtained using idiosyncratic skewness (Mitton and Vorkink (2007)), expected idiosyncratic skewness (Boyer et al. (2010)), total skewness (Chen et al. (2001)) and (risk-neutral) implied skewness recovered from options (Conrad et al. (2013)). This paper focused on the question, what drives this economically important asymmetry in stock returns? What are the important determinants of idiosyncratic skewness? Our main finding is that active management of real options is a key source and driver of firm-specific skewness. Firm-specific skewness is particularly relevant for under-diversified investors and clienteles drawn to lottery-type stocks (Bali et al. (2011), Kumar (2009)).

The importance of real options to the market place is not new. Recent asset pricing studies show that real options are priced and have a statistical connection to both stock returns (Anderson and Garcia-Feijóo (2006), Trigeorgis and Lambertides (2013)) and to idiosyncratic volatility (Cao et al. (2008), Grullon et al. (2012)). In this paper, we add a new theoretical perspective and empirical link that reveals how real options are essential drivers of idiosyncratic skewness and through enhancing skewness command a negative return premium.

Our analysis of real options as skewness determinants provides an important new addition to previous explanatory theories of skewness. In prior literature skewness was linked to leverage and volatility feedback mechanisms (Black (1976), Christie (1982), and Campbell and Hentschel (1992)), investor heterogeneity (Hong and Stein (2003), Chen et al. (2001) and Xu (2007)), information blockage (Cao et al. (2002)) and information ambiguity (Epstein and Schneider (2008)).

In establishing a theoretical link between real options and idiosyncratic or firm-specific skewness, we follow several lines of argumentation. We provide a general mathematical argument on how real options increase convexity of the value function that leads to increased skewness based on a fundamental result by van Zwet (1964). We also develop an economic duopoly model extending Kulatilaka and Perotti (1998) demonstrating how active management of real options for expansion and contraction increase firm value convexity and the skewness of equity returns. The effective creation and exercising of real options is therefore at the heart of transforming random exogenous events into asymmetric business opportunities and competitive advantage.

Building on these conceptual notions, we proceed to provide robust empirical evidence on how real option variables, specifically R&D and growth option intensity, are strong economic determinants of idiosyncratic skewness, over and above other determinants previously reported. Our empirical results confirm our real-options-to-skewness hypothesis while corroborating earlier findings on other determinants of skewness. Our main findings of real options variables being significant determinants of idiosyncratic skewness are robust, being subjected to numerous checks: decile tables and regression models, daily or monthly returns, individual asset and portfolio tests, different time horizons, alternative estimation methods and definitions of variables.

A couple of related findings are worth noting. Capital expenditure intensity, more closely linked to the exercise of real options (rather than their creation), exhibits a nonlinear relation to skewness, corroborating earlier findings by Goyal et al. (2002) and Cao et al. (2008). A time horizon of three years gives strong results in determinants-of-skewness and in skewness-returns association, corroborating the long term relationship between expected idiosyncratic skewness and stock returns found by Boyer et al. (2010). R&D intensity is more significant in longer time horizons in line with R&D proxying for multi-stage, long-term optional investments.

Our main findings reinforce and extend the results by Boyer et al. (2010) and Conrad et al. (2013) providing further evidence that expected idiosyncratic skewness commands a negative return premium. Specifically we show that this effect is significantly driven by real options variables that impact on returns via the channel of skewness, i.e., we show that the part of expected idiosyncratic skewness that is generated by real options variables commands an incremental negative return premium, after controlling for other standard factors.

Recent literature on lottery behavior documents that certain clienteles of investors have a preference for lottery type stocks (Bali et al. (2011), Kumar (2009)). Relative to this literature we add further behavioral and statistical evidence that positive idiosyncratic skewness and tail effects related to real options lead to a negative return premium. We contribute to this behavioral literature by demonstrating how real options provide valuable flexibility for actively managed firms, which leads to a more convex value function and positively skewed returns. The resulting positively skewed returns deriving from real options resemble lottery type features which through lottery-type investor preferences are priced producing a negative return premium.

Consistent with the above behavioral findings we posit that actively-managed firms with expansion and/or contraction options enable investors to obtain similar benefits as well-diversified portfolios but with a smaller number of assets. In addition to providing downside protection, strategic investment by an active firm preserves upside potential via expansion/growth options. If investors have a preference for the enhanced skewness of actively managed firms (with more upside potential during economic expansion and enhanced downside risk protection during downturns), they might be willing to accept lower average returns in the short term justifying a negative return premium.

In conclusion, we contribute by establishing necessary linkages at three levels. We show that: (i) both theoretically and empirically real growth options are strong and positive determinants of idiosyncratic skewness, over and above previously reported skewness determinants; (ii) the resulting growth-options-induced expected idiosyncratic skewness commands a negative return premium; and (iii) a behaviorally rational transmission mechanism from real options to stock returns operates through observable idiosyncratic skewness and lottery type features.

Table 1: **Descriptive statistics of the idiosyncratic skewness determinants (1983 - 2011).** This table contains descriptive statistics of the variables used as determinants of skewness (equations (5a) and (5b)). The sample period covers 1 July 1983 to 30 June 2011. The number of observations changes depending on data availability. We report the idiosyncratic skewness measure ("Idio-Skew") calculated from daily data over a year. Firm-specific volatility "σ", average rate of return "$\bar{r}$", "turnover", "beta" and market sentiment "MktSent" are calculated from daily data over a time period of a year. Missing values in research and development expenses (xrd) are replaced by zeros. Details on the variable definition and construction are contained in Section 3.2.

Variable	Obs	Mean	Std. Dev.	Min	Max
Idio-Skew	112,867	0.6181	1.5722	-15.8109	15.7753
Beta	112,867	0.7610	0.6661	-9.5937	10.0938
Size	111,963	11.816	2.1387	4.6571	20.0777
B/M	97,353	0.6770	0.8492	-8.3035	10.9562
GO	68,238	0.8703	0.8043	-2.8192	11.4752
RD	97,461	0.0494	0.1108	0	1.5323
CAPFIX	95,698	0.2818	0.2174	0	2.6829
IV	112,867	0.0394	0.0295	2.28e-5	1.3156
Turnover	112,865	0.0559	0.0769	3.21e-6	4.5726
$\bar{r}$	112,867	0.0008	0.0030	-0.0257	0.1938
Lev	97,373	0.3484	0.2406	0	0.9986
Concentration	97,433	0.3621	3.7725	0	100
ROA	85,816	-0.0140	0.2415	-3.2889	0.9075
MktSent	112,867	0.0447	0.0644	-0.1841	0.2709

Table 2: **Correlation coefficients among skewness determinants (1983 - 2011).** This table contains the correlation coefficients among the variables used in equations (5a) and (5b) as skewness determinants. The variables are built using daily data from July 1983 to June 2011. Idiosyncratic skewness "Idio-Skew$_t$", lagged firm-specific volatility "σ_{t-1}", average rate of return "$\bar{r}_{t-1}$", "turnover$_{t-1}$", "beta$_{t-1}$" and market sentiment "MktSent$_{t-1}$" are calculated from daily data over a period of a year. Details on the variable definition and construction are contained in Section 3.2. Missing values in research and development expenses (xrd) are replaced by zeros.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1)	IdioSkew	1														
(2)	IdioSkew$_{t-1}$	0.082	1													
(3)	Beta$_{t-1}$	-0.073	-0.053	1												
(4)	Size$_{t-1}$	-0.204	-0.180	0.389	1											
(5)	B/M$_{t-1}$	0.080	-0.031	-0.171	-0.271	1										
(6)	GO$_{t-1}$	0.110	0.113	0.045	-0.216	-0.084	1									
(7)	RD$_{t-1}$	0.068	0.076	0.152	-0.077	-0.150	0.391	1								
(8)	CAPFIX$_{t-1}$	-0.007	-0.026	0.154	-0.026	-0.125	0.123	0.198	1							
(9)	IVi_{t-1}	0.163	0.316	-0.071	-0.526	0.088	0.316	0.212	0.092	1						
(10)	Turnover$_{t-1}$	-0.033	0.019	0.433	0.249	-0.126	0.047	0.128	0.179	0.085	1					
(11)	$\bar{r}_{i_{t-1}}$	-0.011	0.308	-0.028	-0.066	-0.173	0.050	0.063	-0.036	0.071	0.526	1				
(12)	Lev$_{t-1}$	0.084	-0.010	-0.195	-0.181	0.390	-0.161	-0.298	-0.287	-0.178	0.061	-0.151	1			
(13)	Concentration$_{t-1}$	-0.023	-0.024	0.018	0.127	-0.008	-0.036	-0.038	-0.026	-0.008	-0.051	-0.011	0.025	1		
(14)	ROA$_{t-1}$	-0.122	-0.143	-0.021	0.220	0.045	-0.418	-0.486	-0.061	-0.031	-0.322	-0.055	-0.001	0.027	1	
(15)	MktSent$_{t-1}$	0.006	0.028	-0.021	-0.014	-0.108	-0.001	-0.012	-0.016	-0.050	-0.095	0.114	-0.083	-0.006	0.026	1

Table 3: **Basic desccriptive statistics of explanatory variables by idiosyncratic skewness deciles.** This table contains the time-series averages of each portfolio built by dividing idiosyncratic skewness in 10 equally spaced deciles. The variables are built using daily data from July 1983 to June 2011. Idiosyncratic skewness "Idio-Skew$_t$", lagged firm-specific volatility "σ_{t-1}", average rate of return "$\bar{r}_{t-1}$", "turnover$_{t-1}$", "beta$_{t-1}$" and market sentiment "MktSent$_{t-1}$" are calculated from daily data over a period of a year. Each year skewness is reclassified in 10 equally-spaced deciles and the lagged values of the covariates are cross-sectionally averaged. RD$^*_{t-1}$ indicates that missing values of the research and development expenses (*xrd*) are dropped. RD$_{t-1}$ has been calculated with missing values in *xrd* replaced by zeros. Details on the variable definition and construction are contained in Section 3.2.

Decile	$\overline{\text{Idio-Skew}}$	$\overline{\text{Idio-Skew}}_{t-1}$	$\overline{\text{Beta}}_{t-1}$	$\overline{\text{Size}}_{t-1}$	$\overline{\text{B/M}}_{t-1}$	$\overline{\text{GO}}_{t-1}$	$\overline{\text{RD}}_{t-1}$	$\overline{\text{RD}^*}_{t-1}$
1	-1.695	0.346	0.899	12.688	0.513	0.786	0.049	0.079
2	-0.280	0.347	0.837	12.703	0.585	0.732	0.037	0.066
3	0.021	0.347	0.803	12.501	0.633	0.722	0.037	0.071
4	0.204	0.427	0.782	12.250	0.657	0.770	0.038	0.073
5	0.364	0.462	0.789	12.095	0.671	0.806	0.045	0.081
6	0.529	0.508	0.788	11.884	0.684	0.843	0.051	0.087
7	0.725	0.560	0.794	11.695	0.704	0.913	0.054	0.092
8	0.999	0.625	0.779	11.510	0.704	0.959	0.060	0.099
9	1.496	0.758	0.768	11.259	0.739	1.020	0.064	0.105
10	3.753	0.835	0.685	10.899	0.841	1.101	0.071	0.118

Decile	$\overline{\text{Idio-Skew}}$	$\overline{\text{CAPFIX}}_{t-1}$	$\overline{\text{IV}}_{t-1}$	$\overline{\text{Turnover}}_{t-1}$	$\overline{\bar{r}}_{t-1}(\times 100)$	$\overline{\text{Lev}}_{t-1}$	$\overline{\text{Conc.}}_{t-1}$	$\overline{\text{ROA}}_{t-1}$
1	-1.695	0.301	0.029	0.073	0.083	0.295	0.459	0.031
2	-0.280	0.268	0.030	0.063	0.083	0.331	0.508	0.036
3	0.021	0.262	0.032	0.058	0.084	0.343	0.426	0.027
4	0.204	0.264	0.035	0.056	0.088	0.345	0.434	0.015
5	0.364	0.271	0.037	0.055	0.082	0.348	0.416	-0.001
6	0.529	0.277	0.039	0.057	0.081	0.344	0.342	-0.014
7	0.725	0.284	0.042	0.056	0.077	0.353	0.259	-0.028
8	0.999	0.290	0.044	0.060	0.082	0.358	0.310	-0.052
9	1.496	0.294	0.047	0.058	0.071	0.365	0.245	-0.073
10	3.753	0.284	0.048	0.057	0.066	0.385	0.247	-0.094

Table 4: **Panel regressions of idiosyncratic skewness determinants (daily data).** This table contains the results of the panel regressions of equations (5a) and (5b) on individual daily idiosyncratic skewness. The dependent variable is daily idiosyncratic skewness (IdioSkew$_{t-1}$) calculated from July 1st to June 30th each year. The sample period in column (1) covers July 1983 to June 2011. The columns contain the results from standard pooled regressions with heteroskedastic and cluster robust standard errors. Missing values in research and development expenses (xrd) are replaced by zeros. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

	(1)	(2)	(3)	(4)
Constant	2.128***	0.448***	0.208***	1.123***
	(53.1)	(31.1)	(16.6)	(14.9)
IdioSkew$_{t-1}$	0.076***		0.092***	0.049***
	(12.0)		(13.0)	(5.91)
Beta$_{t-1}$	0.021**			-0.043***
	(2.56)			-(3.87)
Size$_{t-1}$	-0.135***			-0.078***
	-(42.9)			-(15.7)
B/M$_{t-1}$	0.070***			0.031***
	(8.94)			(2.88)
GO$_{t-1}$		0.200***		0.075***
		(16.7)		(6.36)
RD$_{t-1}$		0.483***		0.443***
		(5.63)		(5.01)
CAPFIX$_{t-1}$		-0.217***		-0.132***
		-(5.93)		-(3.57)
IV$_{i_{t-1}}$			12.64***	6.375***
			(43.5)	(12.8)
Turnover$_{t-1}$			-0.935***	0.134
			-(9.08)	(1.48)
$\bar{r}_{i_{t-1}}$			-81.41***	-48.99***
			-(15.1)	-(6.64)
Lev$_{t-1}$				0.334***
				(9.66)
Concentration$_{t-1}$				-0.001
				-(0.30)
ROA$_{t-1}$				-0.239***
				-(6.44)
MktSent$_{t-1}$				0.828***
				(7.95)
Number of obs	97,338	67,151	99,579	66,919
F	719	143	663	220
Prob > F	0	0	0	0
R-squared	0.0467	0.0136	0.0483	0.0615
Root MSE	1.5393	1.5657	1.5408	1.5245

Table 5: **Panel regressions of idiosyncratic skewness determinants (monthly data).** This table contains the results of the panel regressions of equations (5a) and (5b) on individual monthly idiosyncratic skewness. The dependent variable is monthly idiosyncratic skewness calculated from July 1^{st} of year t-3 to June 30^{th} of year t. The sample period covers July 1983 to June 2011. The columns contain the results from standard pooled regressions with heteroskedastic and cluster robust standard errors. Missing values in the research and development expenses (xrd) are replaced by zeros. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

	(1)	(2)	(3)	(4)
Constant	1.938***	0.277***	0.142***	1.196***
	(40.3)	(16.7)	(11.2)	(18.0)
IdioSkew$_{t-3}$	0.097***		0.092***	0.039***
	(13.0)		(10.5)	(4.23)
Beta$_{t-3}$	0.057***			0.005
	(8.86)			(0.60)
Size$_{t-3}$	-0.126***			-0.090***
	-(37.2)			-(21.4)
B/M$_{t-3}$	0.023**			0.026**
	(2.43)			(2.13)
GO$_{t-3}$		0.183***		0.042***
		(11.2)		(3.11)
RD$_{t-3}$		0.734***		0.249***
		(6.69)		(2.61)
CAPFIX$_{t-3}$		0.079*		0.075**
		(1.78)		(1.96)
IV$_{i_{t-3}}$			3.426***	2.047***
			(31.4)	(14.5)
Turnover$_{t-3}$			-0.021***	0.010*
			-(5.09)	(1.89)
$\bar{r}_{i_{t-3}}$			-8.068***	-4.454***
			-(33.0)	-(13.3)
Lev$_{t-3}$				0.084**
				(2.32)
Concentration$_{t-3}$				0.002*
				(1.69)
ROA$_{t-3}$				-0.224***
				-(4.67)
MktSent$_{t-3}$				0.474***
				(16.1)
Number of obs	45,715	31,455	51,185	31,383
F	608.8	92.5	715.5	201.0
Prob > F	0.0000	0.0000	0.0000	0.0000
R-squared	0.1577	0.0324	0.1410	0.1936
Root MSE	0.7369	0.7859	0.7569	0.7168

Table 6: **Pooled panel regressions of skewness determinants (skewness portfolios - daily data).** This table contains the results of the panel regressions of equations (5a) and (5b) on 20 portfolios built with daily idiosyncratic skewness. The dependent variable is the cross-sectional average in each quantile of the daily idiosyncratic skewness calculated from July 1^{st} to June 30^{th} each year. The sample period is 1986 - 2011. All columns contain standard pooled regressions with robust standard errors. Missing values in research and development expenses (xrd) are dropped before calculating the averages. The explanatory variable market sentiment (MktSent) has been dropped being cross-sectionally constant.

	(1)	(2)	(3)	(4)
Constant	1.853*	-1.423***	-1.809***	3.703
	(1.79)	-(2.91)	-(3.32)	(0.94)
IdioSkew_{t-1}	2.603***		2.919***	1.551***
	(3.52)		(3.45)	(2.73)
Beta_{t-1}	0.607***			-0.922
	(2.81)			-(1.33)
Size_{t-1}	-0.331***			-0.156
	-(5.20)			-(0.49)
B/M_{t-1}	1.315**			-1.812*
	(2.44)			-(1.86)
GO_{t-1}		3.711***		1.284***
		(4.06)		(3.20)
RD_{t-1}		12.41**		6.254
		(2.40)		(1.10)
CAPFIX_{t-1}		-8.150**		-12.214**
		-(2.02)		-(2.56)
$\text{IV}_{i_{t-1}}$			34.50***	33.19
			(3.27)	(1.12)
Turnover_{t-1}			-1.430	5.018
			-(0.73)	(0.49)
$\bar{r}_{i_{t-1}}$			-432.4***	-584.7***
			-(2.93)	-(2.75)
Lev_{t-1}				1.606
				(0.76)
$\text{Concentration}_{t-1}$				-0.213
				-(1.20)
ROA_{t-1}				-5.238***
				-(2.80)
Number of obs	480	480	480	480
F(4, 45710)	28	13	5	14
Prob > F	0	0	0	0
R-squared	0.4018	0.3530	0.4235	0.5643
Root MSE	1.1408	1.1852	1.1199	0.9829

Table 7: **Returns based on expected idiosyncratic skewness (1983 - 2011).** This table reports the coefficients as averages of the time series slopes (Fama and MacBeth (1973)) and pooled regressions at individual asset level explaining returns (r_{t+1}) using expected idiosyncratic skewness and a set of firm-specific characteristics according to equation (9): $r_{t+1} = \gamma_0 + \gamma_1 E_t[IS_{t+T}] + \Gamma Z_t + \epsilon_{t+1}$ where $E_t[IS_{t+T}] = \hat{\alpha}_0 + \hat{\beta}_1 IS_t + \hat{\beta}_2 \mathrm{GO}_t + \hat{\beta}_3 \mathrm{CAPFIX}_t + \hat{\beta}_4 \mathrm{RD}_t + \hat{\beta}_5 \mathrm{IV(1Y)}_t$ is from equation (8). The matrix Z_t contains control variables for market beta, size, book to market (B/M) ratio, idiosyncratic volatility (IV), a dummy for negative book to market and and turnover. Model (1) contains the averages of the time series slopes obtained by cross sectionally regressing $r_{t+1} = \gamma_0 + \gamma_1 E_t[IS_{t+T}] + \Gamma Z_t + \epsilon_{t+1}$ every month, with prediction period $T = 3$ years and r_{t+1} estimated as the geometric average of the next 12 month returns. Model (2) contains the coefficients obtained from standard pooled regression with prediction period $T = 3$ years and r_{t+1} estimated as next month return. The results are estimated using all non-financial firms annual stock returns from CRSP over the period July 1986 - June 2011. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

	(1) $T = 3Y$ cross-section (1Y)	(2) $T = 3Y$ pooled (1M)
Const	1.560***	2.708***
	(6.69)	(9.99)
$E_t[IS_{t+T}]$	-0.367**	-1.201***
	-(2.26)	-(11.2)
Market beta	0.118	0.473***
	(0.95)	(7.45)
Size	-0.078***	-0.192***
	-(4.31)	-(11.1)
B/M	0.424***	0.570***
	(16.9)	(7.37)
IV(1Y)	10.571***	0.478***
	(5.00)	(17.9)
Neg B/M	0.742***	1.172***
	(10.5)	(5.46)
Turnover	-4.320***	-3.271***
	-(9.90)	-(5.92)
R-squared	0.085	0.004
N	186	392,665

Table 8: **Pooled panel regressions of skewness determinants (skewness portfolios using daily data).** This table contains the results of pooled panel regressions for each individual covariate in 10 decile portfolios built using daily idiosyncratic skewness. The dependent variable is the cross-sectional average (in each decile) of the daily idiosyncratic skewness (calculated from July 1^{st} to June 30^{th} each year). The sample period is 1986 - 2011. All columns contain standard pooled regressions with heteroskedastic and cluster robust standard errors. Missing values in research and development expenses (xrd) are dropped before calculating the averages. The explanatory variable market sentiment (MktSent) has been dropped as being cross-sectionally constant. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

	Constant	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	R-squared	N
(1) IdioSkew$_{t-1}$	-1.366***	3.781***													0.409	240
	-(2.68)	(3.43)														
(2) Beta$_{t-1}$	1.951**		-1.697**												0.061	240
	(2.46)		-(2.16)													
(3) Size$_{t-1}$	8.467***			-0.657***											0.241	250
	(3.30)			-(3.29)												
(4) B/M$_{t-1}$	-1.710*				3.448***										0.200	250
	-(1.88)				(2.74)											
(5) GO$_{t-1}$	-3.574***					4.831***									0.370	240
	-(3.48)					(3.81)										
(7) RD$_{t-1}$	-2.011***						30.12***								0.300	250
	-(3.03)						(3.35)									
(6) CAPFIX$_{t-1}$	0.258							1.264							0.001	250
	(0.27)							(0.30)								
(9) IV$_{i_{t-1}}$	-2.004**								68.16***						0.272	240
	-(2.25)								(2.96)							
(8) Turnover$_{t-1}$	0.888***									-4.756					0.009	240
	(2.89)									-(0.90)						
(10) $\bar{r}_{i_{t-1}}$	0.794										-236.5**				0.013	240
	(1.57)										-(2.06)					
(11) Lev$_{t-1}$	-3.213**											11.03**			0.161	250
	-(2.05)											(2.50)				
(12) Concentration$_{t-1}$	1.383**												-2.114**		0.108	250
	(2.15)												-(2.37)			
(13) ROA$_{t-1}$	0.325													-18.73***	0.511	250
	(1.45)													-(3.79)		

Table 9: **Robustness of idiosyncratic skewness determinants to various horizons (daily data).** This table contains robustness results of the panel regressions of equations (5a) and (5b) on individual daily idiosyncratic skewness, calculated over different horizons from 1 (1Y) to 5 years (5Y). The dependent variable is daily idiosyncratic skewness calculated from 1 July to 30 June. The sample period covers July 1983 to June 2011. The columns contain results from standard pooled regressions with heteroskedastic and cluster robust standard errors. Missing values in research and development expenses (*xrd*) are replaced by zeros. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

	1Y	2Y	3Y	4Y	5Y
Constant	1.123***	1.612***	1.891***	2.030***	2.115***
	(14.9)	(16.4)	(15.4)	(14.8)	(12.7)
IdioSkew_{t-1}	0.049***	0.063***	0.064***	0.061***	0.059***
	(5.91)	(6.41)	(6.45)	(5.77)	(4.17)
Beta_{t-1}	-0.043***	-0.067***	-0.031	-0.042	-0.107**
	-(3.87)	-(3.60)	-(1.17)	-(1.20)	-(2.27)
Size_{t-1}	-0.078***	-0.113***	-0.139***	-0.146***	-0.141***
	-(15.7)	-(17.1)	-(17.1)	-(16.1)	-(12.7)
B/M_{t-1}	0.031***	0.032**	0.044**	0.045*	0.055*
	(2.88)	(2.08)	(2.25)	(1.89)	(1.84)
GO_{t-1}	0.075***	0.091***	0.087***	0.060**	0.038
	(6.36)	(5.52)	(4.29)	(2.36)	(1.18)
RD_{t-1}	0.443***	0.526***	0.629***	0.764***	0.982***
	(5.01)	(3.95)	(3.31)	(3.19)	(3.11)
CAPFIX_{t-1}	-0.132***	-0.042	-0.014	0.029	-0.025
	-(3.57)	-(0.84)	-(0.24)	(0.41)	-(0.29)
$\text{IV}_{i_{t-1}}$	6.375***	5.991***	5.979***	7.296***	10.265***
	(12.8)	(6.35)	(4.81)	(5.92)	(6.29)
Turnover_{t-1}	0.134	0.453***	0.533**	0.352	0.040
	(1.48)	(2.86)	(2.37)	(1.31)	(0.12)
$\bar{r}_{i_{t-1}}$	-48.99***	-67.93***	-72.69***	-69.19***	-76.13***
	-(6.64)	-(3.42)	-(3.05)	-(4.22)	-(3.63)
Lev_{t-1}	0.334***	0.425***	0.404***	0.381***	0.280***
	(9.66)	(7.91)	(6.36)	(5.18)	(3.17)
$\text{Concentration}_{t-1}$	-0.001	-0.001	0.001	0.001	0.002
	-(0.30)	-(0.26)	(0.27)	(0.38)	(0.56)
ROA_{t-1}	-0.239***	-0.338***	-0.472***	-0.546***	-0.524***
	-(6.44)	-(6.53)	-(7.34)	-(6.76)	-(5.12)
MktSent_{t-1}	0.828***	1.678***	2.723***	1.872***	-1.218**
	(7.95)	(8.62)	(9.7)	(5.04)	-(2.42)
Number of obs	66,919	62,391	55,081	45,808	36,786
F	220	174	145	106	76
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.0615	0.0732	0.0861	0.0877	0.0933
Root MSE	1.5245	1.7143	1.7307	1.7723	1.8068

Table 10: **Robustness tests of idiosyncratic skewness determinants (daily).** This table contains robustness results of panel regressions of equations (5a) and (5b) on daily idiosyncratic skewness. The dependent variable is the daily idiosyncratic skewness calculated from 1 July to 30 June each year. The sample period covers July 1983 to June 2011. Standard errors are corrected for heteroskedasticity and cluster effects. The first column of the table contains the base case shown in Table 4 where GO is defined as in equation (6). The second and third columns contain the results of the panel estimation with fixed (FE) and random (RE) effects, respectively. The fourth column contains the results using the Arellano and Bond (1991) estimation for dynamic panels (AB), while the fifth column contains the coefficients as time-series averages of cross sectional year-by-year regression slopes. The sixth column (GO1) contains the results of the pooled regression with GO values bounded below at zero. The seventh column (GO2) contains results using the definition of GO as in Cao et al. (2008). Finally, the last column (GO3), contains the results of the pooled regression when GO is directly calculated using the standard cash flow from operations ($oancf$). Missing values in research and development (xrd) expenses are replaced by zeros. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

	(1) Pooled	(2) FE	(3) RE	(4) AB	(5) CS	(6) GO1	(7) GO2	(8) GO3
Constant	1.123***	1.931***	1.468***	7.325***	2.107*	1.108***	1.245***	1.152***
	(14.9)	(11.8)	(15.9)	(19.5)	(1.68)	(14.7)	(13.9)	(15.2)
IdioSkew$_{t-1}$	0.049***	-0.086***	-0.040***	0.015	0.041***	0.049***	0.056***	0.050***
	(5.91)	-(11.1)	-(5.52)	(1.38)	(4.56)	(5.89)	(5.37)	(5.99)
Beta$_{t-1}$	-0.043***	-0.018	-0.027**	-0.046***	-0.040*	-0.044***	-0.042***	-0.042***
	-(3.87)	-(1.30)	-(2.27)	-(2.78)	-(1.86)	-(3.91)	-(3.09)	-(3.72)
Size$_{t-1}$	-0.078***	-0.147***	-0.105***	-0.571***	-0.080***	-0.077***	-0.084***	-0.078***
	-(15.7)	-(12.3)	-(16.6)	-(20.0)	-(8.56)	-(15.6)	-(14.8)	-(15.7)
B/M$_{t-1}$	0.031***	0.067***	0.054***	0.092***	0.010	0.030***	0.034**	0.032***
	(2.88)	(4.62)	(4.60)	(4.66)	(1.12)	(2.82)	(2.30)	(2.94)
GO$_{t-1}$	0.075***	0.062***	0.075***	0.066***	0.041**	0.086***	0.013**	0.050***
	(6.36)	(4.17)	(6.02)	(3.01)	(2.23)	(6.82)	(2.26)	(4.09)
RD$_{t-1}$	0.443***	0.734***	0.716***	0.972***	0.235**	0.430***	0.552***	0.480***
	(5.01)	(4.72)	(6.85)	(4.71)	(2.40)	(4.86)	(4.74)	(5.42)
CAPFIX$_{t-1}$	-0.132***	-0.193***	-0.162***	-0.071	-0.133***	-0.132***	-0.111**	-0.133***
	-(3.57)	-(4.03)	-(4.06)	-(1.24)	-(3.76)	-(3.57)	-(2.22)	-(3.59)
IV$_{i_{t-1}}$	6.375***	2.261***	4.258***	-10.323***	7.939***	6.293***	6.770***	6.667***
	(12.8)	(4.06)	(8.88)	-(9.30)	(7.40)	(12.6)	(11.8)	(13.3)
Turnover$_{t-1}$	0.134	0.349**	0.257***	0.499***	-0.463***	0.134	0.212*	0.116
	(1.48)	(2.56)	(2.64)	(2.69)	-(2.68)	(1.47)	(1.65)	(1.28)
$\bar{r}_{i_{t-1}}$	-48.99***	-21.37***	-34.45***	-16.65***	-55.74***	-48.64***	-52.86***	-50.30***
	-(6.64)	-(5.27)	-(7.33)	-(2.76)	-(7.45)	-(6.60)	-(4.60)	-(6.81)
Lev$_{t-1}$	0.334***	0.859***	0.599***	1.283***	0.315***	0.335***	0.308***	0.320***
	(9.66)	(11.9)	(13.6)	(10.5)	(6.89)	(9.72)	(6.94)	(9.32)
Concentration$_{t-1}$	-0.001	-0.002	-0.002	-0.006	0.000	-0.001	-0.001	-0.001
	-(0.30)	-(0.98)	-(1.33)	-(1.54)	(0.16)	-(0.32)	-(0.25)	-(0.34)
ROA$_{t-1}$	-0.239***	-0.076	-0.188***	-0.005	-0.261***	-0.230***	-0.301***	-0.262***
	-(6.44)	-(1.64)	-(4.83)	-(0.10)	-(5.12)	-(6.19)	-(6.57)	-(7.13)
MktSent$_{t-1}$	0.828***	1.025***	0.949***	0.891***	-14.41	0.827***	0.913***	0.828***
	(7.95)	(9.15)	(9.30)	(6.99)	-(1.12)	(7.94)	(7.51)	(7.93)
Number of obs	66,919	66,919	66,919	58,363	24	66,919	47,244	66,917
F	220.360	110.520				220.470	164.310	218.840
Prob > F	0.000	0.000				0.000	0.000	0.000
R-squared	0.062	0.248	0.0538		0.0806	0.062	0.061	0.061
Root MSE	1.525	0.146				1.524	1.520	1.525

Table 11: **Returns based on expected idiosyncratic skewness (1983 - 2011).** This table reports the coefficients as averages of the time series slopes (Fama and MacBeth (1973)) at individual asset level explaining returns (r_{t+1}) using expected idiosyncratic skewness and a set of firm-specific characteristics according to equation (9): $r_{t+1} = \gamma_0 + \gamma_1 E_t[IS_{t+T}] + \Gamma Z_t + \epsilon_{t+1}$ where $E_t[IS_{t+T}] = \hat{\alpha}_0 + \hat{\beta}_1 IS_t + \hat{\beta}_2 \text{GO}_t + \hat{\beta}_3 \text{CAPFIX}_t + \hat{\beta}_4 \text{RD}_t + \hat{\beta}_5 \text{IV(1Y)}_t$ is from equation (8). The matrix Z_t contains control variables for market beta, size, book to market (B/M) ratio, idiosyncratic volatility (IV), a dummy for negative book to market and and turnover. Model (1) and (2) contain averages of the time series slopes obtained by cross sectionally regressing $r_{t+1} = \gamma_0 + \gamma_1 E_t[IS_{t+T}] + \Gamma Z_t + \epsilon_{t+1}$ every month, with prediction period $T = 2$ and $T = 4$ years, respectively, and r_{t+1} estimated as the geometric average of the next 12 month returns. Models (3) and (4) contain the averages of the time series slopes obtained by cross sectionally regressing $r_{t+1} = \gamma_0 + \gamma_1 E_t[IS_{t+T}] + \Gamma Z_t + \epsilon_{t+1}$ every month with prediction period $T = 2$ and $T = 4$ years, respectively, and r_{t+1} estimated as the geometric average of the next 6 month returns. The results are estimated using all non-financial firms annual stock returns from CRSP over the period July 1986 - June 2011. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

	(1) $T = 2Y$ cross-section (1Y)	(2) $T = 4Y$ cross-section (1Y)	(3) $T = 2Y$ cross-section (6M)	(4) $T = 4Y$ cross-section (6M)
Const	0.991***	1.720***	0.996***	1.781***
	(4.09)	(6.86)	(2.74)	(5.06)
$E_t[IS_{t+T}]$	-0.786***	-1.076***	-0.581**	-0.968***
	-(5.37)	-(6.44)	-(2.37)	-(3.91)
Market beta	0.002	0.092	0.024	0.134
	(0.02)	(0.66)	(0.18)	(0.73)
Size	-0.049***	-0.080***	-0.057**	-0.090***
	-(2.80)	-(4.21)	-(2.15)	-(3.25)
B/M	0.371***	0.447***	0.399***	0.491***
	(13.9)	(20.8)	(9.4)	(11.6)
IV(1Y)	18.85***	17.815***	17.399***	18.730***
	(6.73)	(6.14)	(3.78)	(4.49)
Neg B/M	0.692***	0.811***	0.788***	0.917***
	(10.9)	(10.9)	(8.53)	(9.62)
Turnover	-4.185***	-4.250***	-4.725***	-4.677***
	-(9.55)	-(10.10)	-(6.93)	-(6.88)
R-squared	0.080	0.087	0.067	0.071
N	198	174	205	181

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