A Comprehensive Look at the Option-Implied Predictors of Stock Returns

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Abstract

Theory suggests that ex-ante dividend yield is positively related to the future stock returns. This result is extensively confirmed in the empirical literature at market level. We compute ex-ante measure of dividend yield from equity options at firm-level and show that it is negatively related to the subsequent monthly stock returns. The main driver of this puzzling empirical finding is the deviations from put-call parity caused by information asymmetry between traders in options and equity markets. Our panel data analysis reveals that the normal relationship between the dividend yield and the future returns recovers after information asymmetry dissipates within a few months. We further find that the existence of information asymmetry contaminates ex-ante option-implied skewness measures as well, which explains why existing literature finds both positive and negative relationship between option-implied skewness and expected returns in the cross-section. Finally, we reconcile such mixed evidence by showing that the normal negative relationship between option-implied skewness and expected returns appears regardless of choice of option-implied skewness measures after the false positive relationship due to information asymmetry vanishes in the panel data analysis.

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1 Introduction

Stock return predictability is not necessarily evidence against efficient markets, as opposed to conventional wisdom. At the aggregate level, market return predictability can be viewed as a result of time-varying equity premium. At the individual firm or portfolio level, the cross-sectional variations of expected stock returns can be attributed to different exposures to risk factors. However, evidence on return predictability is subject to statistical biases, poor out-of-sample return predictability, and difficulty in identifying risk factors.[1] As a result, literature has provided mixed evidence on the nature of stock return predictability, in particular, at the individual firm or portfolio level.

First of all, we examine whether ex-ante measures of firm-level dividend yields forecasts future stock returns. Theory suggests that the ex-ante dividend yield is positively related to future stock returns. This is due to the time-varying equity premium and the present value relation as described in Fama and French (1988) and Campbell and Shiller (1988). Consistent with this theoretical argument, numerous papers including Cochrane (2011) find positive relation between the dividend yield and future market returns. Golez (2014) refines the well-known return predictor dividend-price ratio by extracting the expected dividend growth from options data and finds stronger predictability of market returns. His results provide further support to the view that the market return predictability is due to time-varying equity premium. At the firm-level, we compute ex-ante measures of dividend yields using equity options data. We sort individual stocks based on their implied dividend yields every month, the subsequent monthly return difference between the top and bottom decile is -1.17% per month with t-stat 6.0. This cross-sectional variation in the expected return is puzzling in that the firm-level implied dividend yield is negatively related to the subsequent stock return as opposed to the positive relation theoretically expected.

We argue that the main driver of this puzzling empirical fact is contamination of firm-level

[1]See Stambaugh (1999) and Ferson, Sarkissian, and Simin (2003) for statistical biases and see Welch and Goyal (2008) for out-of-sample return predictability.

option-implied dividend yields. For example, information asymmetry between traders in options and equity markets can severely distort measurements of option-implied dividend yields based on no-arbitrage principle. The intuition is simple. When the traders in options market have superior information than the traders in equity market, the underlying stock price temporarily deviates from what option prices in the put-call parity imply. Such deviation is captured by the expected dividend when we extract the expected dividends from the put-call parity. Therefore, the measure of expected dividend is contaminated, and so are the measures of implied dividend yield and the corrected dividend-price ratio. We develop a hypothesis that the effect of information asymmetry will disappear within a few months, and thereafter the normal relationship between the implied divided yield and the expected return will recover. We test this hypothesis by both cross-sectional and panel data analyses. In cross-sectional analysis, when we sort individual stocks based on their implied dividend yields every month, the future return difference between the top and bottom decile persists over 12 months against our hypothesis. In panel analysis with firm fixed effects, we find the return predictability pattern consistent with our hypothesis. Our results are robust to the use of an alternative valuation ratio, the corrected dividend-price ratio by (Golez 2014).

The reason why the cross-sectional analysis fails to find the same return-predictability pattern as the panel analysis is as follows. First, the dividend yield can represent the expected return based on the present-value relation which is originally defined in the time-series environment in Campbell and Shiller (1988). In the cross-sectional setting, the dividend yields will be difficult to capture variations in the expected return due to excessive variations in the expected dividend growth across firms. Second, the cross-sectional analysis ignores the effect of the common time-variation in firm-level implied dividend yields. As a result, how the expected return varies with the dividend yield within a given firm is ignored in estimation. Third, a cross-sectional analysis is not suitable for the data with short sample period, that is, when conditional information matters, in general. Fourth, most importantly, cross-sectional variations in expected returns can be driven by unidentified risk factors. We include the firm fixed effects to circumvent the issue of unidentified risk factors.

Our findings shed light on the existing mixed evidence on the relationship between risk-neutral skewness and expected return. Xing, Zhang, and Zhao (2010) show that high (low) slope of the volatility smirk predicts low (high) stock returns while implying the traders in the options market have superior information than the equity traders. Since high slope of the volatility smirk is often assumed to imply negative risk-neutral skewness of stock returns, their finding implies the positive relationship between risk-neutral skewness and the expected return, as opposed to Conrad, Dittmar, and Ghysels (2013) and the asset pricing models with idiosyncratic skewness developed in Brunnermeier, Gollier, and Parker (2007) and Barberis and Huang (2008).

We examine if information asymmetry can explain the existing mixed evidence on the relationship between risk-neutral skewness and the expected return. We find that option-implied measures such as the slope of the volatility smirk (Xing, Zhang, and Zhao 2010), and the model-free risk-neutral skewness (Conrad, Dittmar, and Ghysels 2013) also suffer from the same issue of contamination.[2] With such option-implied measures, we confirm that the effect of information asymmetry disappears within a few months, and thereafter the normal negative relationship between risk-neutral skewness and the expected return recovers. To summarize, the issues in option-implied measures and cross-sectional analysis cause such mixed evidence on the relationship between option-impled skewness and the expected return, and we reconcile the mixed evidence using a panel analysis with varying forecasting horizons.[3]

The remainder of the paper is organized as follows. Section 2 introduces different option-implied measures and explains why they are potentially contaminated by nature. Section 3 describes the

[2]The contamination issue exists also in other option-implied measures used in Ofek, Richardson, and Whitelaw (2004), Yan (2011), Cremers and Weinbaum (2010), and Kalay, Karakaş, and Pant (2014).

[3]Yan (2011) shows that the relationship between risk-neutral skewness and the expected return can be either positive or negative depending on the parameter values in a model with jumps and argues that it is purely an empirical question and introducing information asymmetry is not necessary. However, we explain why it is difficult to reject the existence of information asymmetry in Section 2.5.

data sources and data treatments. Section 4 provides empirical results to support our hypothesis. Section 5 concludes.

2 Option-Implied Predictors for Stock Returns

2.1 Implied Dividend Yield

There are two ways to extract implied dividend yields from index derivatives. The first one is to use put-call parity of options introduced in Binsbergen and Koijen (2010). The second method is to use both options and futures data described in Golez (2014). Apart form estimating implied dividend yields, the second method also simultaneously estimates interest rates from futures prices. However, the estimates of interest rates could be different from the interest rates inferred from bond markets data. Besides, the estimated interest rates could contain measurement errors. Therefore, in this paper, we only use options data to derive dynamics of implied dividend yields.

To compute implied dividends from options data, we require only the absence of arbitrage opportunities. Under this condition, put-call parity for European options holds:

$$c_{t,T} + Ke^{-r_{t,T}(T-t)} = p_{t,T} + S_t - D_{t,T}$$

where $c_{t,T}$ and $p_{t,T}$ are prices of call and put options at time t, with maturity T and strike price K.[4] $r_{t,T}$ is the interest rate between time t and T. $D_{t,T}$ is the expected dividends paid between time t and T under the risk-neutral probability defined as

$$D_{t,T} = \sum_{i=1}^{T} E_t(M_{t:t+i} d_{t+i})$$

[4] Since individual firm options are American options, the put-call parity becomes a band with inequality. Therefore, we acknowledge that the firm-level option-implied measures based on strict put-call parity are still noisy proxies at best even without information asymmetry.

Here, $M_{t:t+i}$ is a stochastic discount factor to discount future dividends d_{t+i}. Equity price is given by the sum of discounted dividend values:

$$S_t = \sum_{i=1}^{\infty} E_t(M_{t:t+i} d_{t+i})$$

Thus, the implied dividend yield is $IDY = D_{t,T}/S_t$. We use pairs of call option and put option with same strike price and same time to maturity to estimate implied dividend yield. We will interpolate the term structure of interest rate to get an appropriate discount rate.

The dividend yield can be a predictor stock returns because of the present value relation explained in Fama and French (1988) and Campbell and Shiller (1988). From a simple dividend growth model of stock prices, we have

$$S_{t-1} = \frac{D_t}{r-g}$$

Therefore, the historical dividend yield $D_t/S_{t-1} = r - g$ includes information about the discount rate which is the expected return. The option-implied dividend yield $IDY = D_{t,T}/S_t$ we construct is an ex-ante version of this the historical dividend yield.

2.2 Corrected Dividend-Price Ratio

The corrected dividend price ratio measure comes from the model in Campbell and Shiller (1988) and Golez (2014) with time-series property of expected returns. We first define log return r_{t+1}, log dividend growth rate Δd_{t+1}, and log dividend-price ratio dp_t as follows:

$$r_{t+1} = log[\frac{P_{t+1} + D_{t+1}}{P_t}], \Delta d_{t+1} = log[\frac{D_{t+1}}{D_t}], dp_t = log[\frac{D_t}{P_t}]$$

where P_t is the price at time t and D_t is the dividend paid from $t-1$ to t. Then, use taylor expansion around the average of dividend-price radio $\bar{dp}$,

$$r_{t+1} = \kappa + dp_t + \Delta d_{t+1} - \rho dp_{t+1}$$

where $\kappa = log[1 + exp(-\bar{dp})] + \rho\bar{dp}$ and $\rho = \frac{exp(-\bar{dp})}{1+exp(-\bar{dp})}$ After iterations, we obtain the Campbell and Shiller (1988) present value identity

$$dp_t = -\frac{\kappa}{1-\rho} + E_t\sum_{j=0}^{\infty}\rho^j(r_{t+1+j}) - E_t\sum_{j=0}^{\infty}\rho^j(\Delta d_{t+1+j})$$

Denote $\mu_t = E_t(r_{t+1})$. Assume μ_t follows AR(1) processes:

$$\mu_{t+1} = \delta_0 + \delta_1\mu_t + \epsilon_{t+1}^{\mu}$$

By plugging in the AR(1) assumption of expected return, we find the dividend price ratio as follows.

$$dp_t = \phi + (\frac{1}{1-\rho\delta_1})\mu_t - E_t\sum_{j=0}^{\infty}\rho^j(\Delta d_{t+1+j})$$

Finally, we derive a return forecasting equation:

$$\mu_t = E(r_{t+1}) = \psi + (1-\rho\delta_1)dp_t + (1-\rho\delta_1)E_t\sum_{j=0}^{\infty}\rho^j(\Delta d_{t+1+j}) + v_{t+1}^r \tag{1}$$

where $\Delta d_{t+1+j} = log[\frac{D_{t+1+j}}{D_{t+j}}] = log(D_{t+1+j}) - log(D_{t+1})$. We can also write the return forecasting equation with a single factor as

$$E(r_{t+1}) = \psi + (1-\rho\delta_1)dp_t^{CorrTS} + v_{t+1}^r \tag{2}$$

where $dp_t^{CorrTS} = dp_t + E_t \sum_{j=0}^{\infty} \rho^j (\Delta d_{t+1+j})$ is the dividend-price ratio corrected for term structure of implied dividend growth rates.

According to Equation (1), the future expected return is a function of historical dividend-price ratio and the expected forward dividend growth rates. In Equation (2), expected return can be more accurately measured by the dividend-price ratio after subtracting the term structure of implied dividend growth rates. We will use options with different maturities to estimate implied forward dividends. Golez (2014) assume AR(1) process for implied dividend growth and derive the dividend-price ratio corrected for single implied dividend growth rates estimated from implied dividends with six month to maturity. The dividend-price ratio derived in Golez (2014) is

$$dp_t^{Corr} = dp_t + g_t(\frac{1}{1 - \rho\gamma_1})$$

where g_t is conditional expected dividend growth rate and γ_1 is AR(1) coefficient of the process of expected dividend growth rate.

2.3 Model-Free Risk-Neutral Skewness

We calculate individual firms' risk-neutral skewness following the results in Bakshi and Madan (2000) and Bakshi, Kapadia, and Madan (2003). They show that the payoff to any security can be replicated and priced using a set of options with different strike prices on that security. Bakshi and Madan (2000) define quadratic contract, cubic contract, and quadratic contracts as having payoffs

$$H[S] = \begin{cases} R(t,\tau)^2 & \text{volatility contract} \\ R(t,\tau)^3 & \text{cubic contract} \\ R(t,\tau)^4 & \text{quartic contract} \end{cases}$$

where $R(t,\tau) \equiv \ln[S(t+\tau)] - \ln[S(t)]$ is the log-return of the stock. Using the prices of these contracts, model-free risk-neutral moments may be computed as

$$\mathrm{VAR}(t,\tau) = e^{r\tau}V(t,\tau) - \mu(t,\tau)^2$$

$$\mathrm{SKEW}(t,\tau) = \frac{e^{r\tau}W(t,\tau) - 3\mu(t,\tau)e^{r\tau}V(t,\tau) + 2\mu(t,\tau)^3}{[e^{r\tau}V(t,\tau) - \mu(t,\tau)^2)]^{2/3}}$$

$$\mathrm{KURT}(t,\tau) = \frac{e^{r\tau}X(t,\tau) - 4\mu(t,\tau)e^{r\tau}W(t,\tau) + 6e^{r\tau}\mu(t,\tau)^2V(t,\tau) - 3\mu(t,\tau)^4}{[e^{r\tau}V(t,\tau) - \mu(t,\tau)^2)]^2}$$

where V, W and X represent the fair values of the volatility, cubic and quadratic contract, respectively. These prices are computed integrating over the strike prices, as

$$\begin{aligned} V(t,\tau) &= \int_{S(t)}^{\infty} \frac{2(1 - \ln[K/S(t)])}{K^2} C(t,\tau;K)dK \\ &+ \int_0^{S(t)} \frac{2(1 + \ln[S(t)/K])}{K^2} P(t,\tau;K)dK \end{aligned}$$

$$\begin{aligned} W(t,\tau) &= \int_{S(t)}^{\infty} \frac{6\ln[K/S(t)] - 3(\ln[K/S(t)])^2}{K^2} C(t,\tau;K)dK \\ &- \int_0^{S(t)} \frac{6\ln[S(t)/K] + 3(\ln[S(t)/K])^2}{K^2} P(t,\tau;K)dK \end{aligned}$$

$$\begin{aligned} X(t,\tau) &= \int_{S(t)}^{\infty} \frac{12(\ln[K/S(t)])^2 - 4(\ln[K/S(t)])^3}{K^2} C(t,\tau;K)dK \\ &+ \int_0^{S(t)} \frac{12(\ln[S(t)/K])^2 + 4(\ln[S(t)/K])^3}{K^2} P(t,\tau;K)dK \end{aligned}$$

In the above equations, $C(t, \tau; K)$ and $P(t, \tau; K)$ are the prices of European calls and puts written on the underlying stock with strike price K and expiration τ periods from time t. As shown in the equation, we use a weighted sum of out of the money options across different strike prices to construct the ex-ante risk-neutral skewness of stock returns. Following Conrad, Dittmar, and Ghysels (2013), we set apart four maturity buckets. Each time to maturity is assigned to one of 1-month, 3-month, 6-month, and 12-month maturity. We calculate the risk-neutral skewness from options with time to maturity closest to 3 month.

2.4 Volatility Skew

Xing, Zhang, and Zhao (2010) define volatility skew (the slope of volatility smirk) as the difference between the implied volatilities of out-of-the-money puts and at-the-money calls.

$$Vol\_skew_{i,t} = VOL_{i,t}^{OTM,P} - VOL_{i,t}^{ATM,C}$$

where $VOL_{i,t}^{OTM,P}$ is the implied volatility of an out-of-the-money put option with the ratio of the strike price to the stock price lower than 0.95 (but higher than 0.80), and $VOL_{i,t}^{ATM,C}$ is the implied volatility of an at-the-money call option with the ratio of the strike price to the stock price between 0.95 and 1.05. We follow Xing, Zhang, and Zhao (2010) to restrict our attention to options with time to maturity between 10 and 60 days. When there are more than one pair of out-of-the-money put option and at-the-money call option, we weight all available options with positive volume equally.

2.5 Contamination of Option-Implied Measures

Option-implied measures are supposed to be contaminated by information asymmetry between traders in options and equity markets. The intuition is simple. When the implied dividend yield is constructed from options data, the main assumption is the absence of arbitrage opportunities. Under this condition, the present (expected) value of dividend before maturity is extracted from the put-call parity:

$$c_{t,T} + Ke^{-r_{t,T}(T-t)} = p_{t,T} + S_t - D_{t,T}$$

where $c_{t,T}$ and $p_{t,T}$ are prices of call and put options at time t, with maturity T and strike price K. $r_{t,T}$ is the interest rate between time t and T. $D_{t,T}$ is the expected dividends paid between time t and T.

When the traders in options market have superior information than the traders in equity market as argued in Xing, Zhang, and Zhao (2010) and Cremers and Weinbaum (2010), the underlying stock price S_t temporarily deviates from what option prices in the put-call parity imply. Such deviation is captured by the expected dividend when we extract the expected dividends from the put-call parity. Therefore, the measure of expected dividend is contaminated, and so are the measures of implied dividend yield and the corrected dividend-price ratio.

When the volatility skew is computed following Xing, Zhang, and Zhao (2010), deviations of underlying stock price S_t from the fair price will affect implied-volatility calculations. For example, if some negative news is available only in options market, then the observed stock price will be higher than the full-information price. The out-of-the-money put option price will be seen too high to equity traders, and the calculated implied volatility will be higher than the true implied volatility. Therefore, the measure of the volatility skew will be contaminated by information asymmetry. In fact, Xing, Zhang, and Zhao (2010) acknowledge the existence of information asymmetry and interpret the contaminated volatility skew as a proxy for information asymmetry. However, if we view the volatility skew as a proxy for negative ex-ante risk-neutral skewness, their findings contradict Conrad, Dittmar, and Ghysels (2013) and the asset pricing models with skewness developed in Brunnermeier, Gollier, and Parker (2007) and Barberis and Huang (2008). Our view is that the measured volatility skew captures both information asymmetry and negative skewness.

When the model-free risk-neutral skewness is computed following Bakshi, Kapadia, and Madan (2003), deviations of underlying stock price S_t from the fair prices also play a role since the stock price S_t is used in calculation. Similar to the case of volatility skew, the measure of model-free risk-neutral skewness will be contaminated by information asymmetry and will represent both information asymmetry and risk-neutral skewness.[5]

Based on potential contamination of option-implied measures, we develop a hypothesis that the effect of information asymmetry will disappear within a few months, and thereafter the normal relationship between the option-implied measures and the expected return will recover. Here, the normal relationship means a positive association with expected returns in case of the implied dividend yield, the corrected dividend price ratio, and volatility skew while negative in case of the risk-neutral skewness. Contamination of option-implied measures by information asymmetry can even revert the sign of the relationship if contamination is severe. However, if traders in equity market resolve information asymmetry in a few months, the normal relationship can appear thereafter. We empirically test this hypothesis in the rest of the paper in order to reconcile the well-known mixed evidence on the relationship between option-impled skewness and expected returns: Xing, Zhang, and Zhao (2010) and Yan (2011) vs. Conrad, Dittmar, and Ghysels (2013).

In fact, the positive relationship between risk-neutral skewness and expected return is not necessarily abnormal. Yan (2011) shows that such relationship can be either positive or negative depending on the parameter values in a model with jumps and argues that it is purely an empirical question and introducing information asymmetry is not necessary. However, we do not rule out existence of information asymmetry for three reasons. First, the model cannot explain why the

[5] Although we do not study in this paper, measures for historical (realized) skewness such as Amaya, Christoffersen, Jacobs, and Vasquez (2013) are potentially contaminated as well since the realized return due to information asymmetry will be included when realized skewness is calculated.

relationship between risk-neutral skewness and expected return changes from "positive" to "negative" over forecasting horizons. Second, it is very difficult to find parameter values in the model that can explain the negative relationship at the market level while positive at the firm-level even though we focus on only short-term expected returns. Third, the evidence about information asymmetry in literature is quite strong. Xing, Zhang, and Zhao (2010) show information asymmetry is linked to the subsequent earning surprises, and Cremers and Weinbaum (2010) find the short sale constraint cannot explain the put-call parity deviation and its return predictability as opposed to Ofek, Richardson, and Whitelaw (2004).

3 Data

Our sample period is from January 1996 to December 2013. Options data are from Optionmetrics (provided through Wharton Research Data Services). Closing price are calculated as the average of closing bid and ask prices. Data on stock returns are obtained from Center for Research in Security Prices. We use monthly returns from 1996 to 2013 for all individual securities with positive common shares outstanding. Balance sheet data for the computation of book-to-market ratios and leverage ratios are from Compustat. Interest rates are obtained from a collection of continuously compounded zero-coupon interest rates at different maturities from OptionMetrics.

To calculate risk-neutral skewness, we follow the procedure as in Bakshi, Kapadia, and Madan (2003) using out-of-the-money puts and calls. We employ options with time to maturity close to 3 month and with positive open interest. For each day, we require at least two OTM puts and two OTM calls to calculate risk-neutral skewness. If there are more puts than calls, then we use the puts that have the most similar strike to price ratio as the calls, vice versa if there are more calls than puts. For each month, we average the risk-neutral skewness for each day in this month to get a monthly measure of risk-neutral skewness. The sample consists of 70,095 firm-month observations of risk-neutral skewness with mean of -0.48 and standard deviation 0.33 over the time period January 1996 to December 2013.

When calculating the volatility skew, we apply the following filters to daily options data as in Xing, Zhang, and Zhao (2010): including options with positive volume for underlying stock, implied volatility between 3% and 200%, price larger than $0.125, positive open interest and nonmissing volume, and maturity between 10 to 60 days. We use ATM call options with moneyness between 0.95 and 1.05 and OTM put options with moneyness between 0.80 and 0.95. We first calculate daily volatility skew by using the differences between implied volatilities between OTM puts and ATM calls. Then we average the daily volatility skew to get monthly measures for each firm. We end up with 151,771 firm-month observations of volatility skew with mean 4.08 and standard deviation 4.91.

In estimating the implied dividend yield from options, we follow the procedure described in Binsbergen, Brandt, and Koijen (2012). Options with positive volume or open interest greater than 200 contracts are considered. Each day, we find paris of call and put with same strike price and same time to maturity and calculate implied dividend yields for this pair from put-call parity. For each day, we compute the mean of implied dividend yield to get the daily measure. For each month, we aggregate all daily estimates of implied dividend yields and calculate the mean of daily estimates. The sample has 392,725 firm-month observations of implied dividend yields with mean of 0.02 and standard deviation of 0.05. We also calculated dividend price ratio corrected for implied dividend growth for firms paying dividends. We have 38,656 firm-month measures of log corrected dividend price ratio with mean -3.24 and standard deviation of 1.07.

Table 1 provides the summary statistics of monthly firm-level option-implied measures and control variables used in the paper. IDY is the ex-ante option-implied dividend yield from put-call parity. log DP^c is the corrected dividend-price ratio from Golez (2014). RNSKEW is the model-free risk-neutral skewness from Bakshi, Kapadia, and Madan (2003). HSKEW and HVOL are the monthly historical return skewness and volatility calculated using daily returns, respectively. log Size, log BM, and log LEV are firm market capitalization, the book-to-market ratio, and the leverage in a log scale, respectively.

4 Empirical Results

4.1 Option-implied Measures

Figure 1 shows how the distribution of firm-level implied dividend yield evolves over time. The cross-sectional mean and the median of implied dividend yield change over time significantly, implying there are substantial common time-variations of firm-level implied dividend yield.

Table 2 shows the correlation matrix of monthly firm-level option-implied measures and control variables. The ex-ante option-implied dividend yield (IDY) and the corrected dividend-price ratio (DP^c) from Golez (2014) are positively correlated and the correlation coefficient is 0.746. They are, in fact, very similar measures. The only difference is that the implied dividend yield (IDY) captures both the expected return and expected dividend growth by construction while the corrected dividend-price ratio (DP^c) represents only the expected return by subtracting the expected dividend growth term from the historical dividend price ratio. Thus, the implied dividend yield is still a noisy proxy for the expected return. However, we consider the implied dividend yield, hoping that it can be cleaner measure than the historical dividend yield in that the historical dividend yield includes the realized dividend which is noisy by nature. On the other hand, the corrected dividend-price ratio (DP^c) is still a noisy proxy for the expected return because measuring the dividend growth term is subject to estimation errors and model mis-specification embedded in the procedure by Golez (2014). Therefore, we consider both the implied dividend yield (IDY) and the corrected dividend-price ratio (DP^c) in our analysis.

Volatility skew (VOLSKEW) from Xing, Zhang, and Zhao (2010), which is the slope of volatility smirk, is positively correlated with the implied dividend yield (IDY) and the corrected dividend-price ratio (DP^c). This positive correlation represents two different aspects of these measures. First, high implied dividend yield or high corrected dividend-price ratio implies high expected return. High volatility skew generally translates into more negative skewness which means high expected returns as shown in Brunnermeier, Gollier, and Parker (2007) and Barberis and Huang (2008). Therefore, they are supposed to be positively correlated. Second, as explained in Section 2.5, these option-implied measures are potentially contaminated by information asymmetry between options and equity markets to the same direction. Therefore, these option-implied measures are supposed to be positively correlated for this reason as well. Note the model-free risk-neutral skewness (RNSKEW) from Bakshi, Kapadia, and Madan (2003) is negatively correlated with the implied dividend yield (IDY), the corrected dividend-price ratio (DP^c), and the volatility skew (VOLSKEW) since high risk-neutral skewness generally translates into low volatility skew (the slope of volatility smirk).

Figure 2 shows the time-series of the cross-sectional medians of four option-implied measures: IDY, log DP^c, RNSKEW, and VOLSKEW. All variables are standardized by their sample means and standard deviations for better visualization. Note we draw $-$RNSKEW instead of RNSKEW so that all four option-implied measures in the plot are associated with expected returns in the same way. In time-series, the implied dividend yield (IDY) and the corrected dividend-price ratio (DP^c) are highly correlated as expected from their definition. The negative model-free risk-neutral skewness ($-$RNSKEW) and the volatility skew (VOLSKEW) are also highly correlated, confirming that they both measure negative skewness. All four measures are highly correlated after 2006 suggesting skewness becomes a dominant factor in equity valuations.

Table 3 reports the average firm-characteristics of each decile portfolio sorted by the implied dividend yield every month. Although the correlations between the implied dividend yield and firm characteristics in Table 2 are not very high, the average firm-characteristics except Sharpe ratio have monotonic relationship with the implied dividend yield. Since the implied dividend yield is a valuation ratio, it is supposed to be related to firm-characteristics. By definition, the implied dividend yield does not compete with firm-characteristics. Rather, it summarize all information contained in firm-characteristics related to firm valuation. Roughly speaking, low implied dividend yield firms are small, growth, low-leveraged, more volatile, more positively skewed firms with higher kurtosis.

4.2 Cross-sectional Analysis

Table 4 shows raw and risk-adjusted average returns of ten equal-weighted decile portfolio sorted by the ex-ante option-implied divided yield (IDY). We find that high implied dividend yield is associated with lower subsequent returns. Panel A shows that the top implied-dividend-yield decile portfolio has the subsequent monthly return significantly lower than the bottom implied-dividend-yield decile portfolio. The subsequent monthly return difference between top and bottom decile is -1.17% per month with t-stat 6.0 computed using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. This difference remains robust after we adjust risk by CAPM, Fama-French 3-factor model, and Carhart 4-factor model. Therefore, this sorting exercise implies that high implied dividend yield means low expected return as opposed to the well-known market level evidence and what the present-value relation in Fama and French (1988) and Campbell and Shiller (1988) implies. We repeat this analysis with different holding periods up to twelve months and find the same pattern persists.

We perform a conventional cross-sectional analysis on stock returns with option-implied measures. Table 5 shows Fama-Macbeth regressions with monthly stock returns. For each month t, we run the following cross-sectional regression:

$$r_{i,t+1} = \alpha_t + \beta_t X_{i,t} + \gamma_t^\top Z_{i,t} + e_{i,t+1}$$

where $r_{i,t+1}$ is the monthly stock return (%), $X_{i,t}$ is either the implied dividend yield $IDY_{i,t}$ or the corrected dividend-price ratio $\log DP^c_{i,t}$, and $Z_{i,t}$ is control variables. Then we compute the time-average of β_t and γ_t to find the point estimates and report their t-statistics in parentheses using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The coefficient on the implied dividend yield is negative and its t-statistics is about 5 with or without control variables including size, book-to-market, leverage, historical volatility, and historical skewness. Again, this result is counter intuitive since the present vale relation which is a simple accounting identity implies a positive coefficient. One potential explanation is that implied dividend yield $IDY_{i,t}$ and the corrected dividend-price ratio $\log DP^c_{i,t}$ are dominated by the effect of put-call parity deviations caused by information asymmetry between traders in options and equity markets. In that case, negative coefficients should be observed as Table 5.

In fact, if the implied dividend yield and the corrected dividend-price ratio are not contaminated by put-call parity deviations, the control variables should be excluded in the regression since the dividend yield and the dividend-price ratio are a valuation ratio and so already include information in control variables related to the expected returns. However, we include the control variables because what we observe in the regression is mostly the effect of put-call parity deviations caused by information asymmetry.

Table 6 repeats Table 4 with other option-impled measures such as model-free risk-neutral skewness (RNSKEW) and volatility skew (VOLSKEW) which is the slope of volatility smirk. Table 6 shows exactly the same pattern as Table 4. The coefficient on volatility skew is negative and significant with or without control variables. In case of risk-neutral skewness, the opposite sign on the coefficient is actually the same pattern as Table 4 because of its definition. The coefficient on risk-neutral skewness is positive and significant with or without control variables. Therefore, we suspect that we have counter-intuitive results here since all four option-implied measures are potentially contaminated by deviations from put-call parity caused by information asymmetry between traders in options and equity markets. The next section further investigates this hypothesis with panel data analysis.

4.3 Panel Data Analysis

Previous section shows that high implied dividend yield is associated with lower subsequent returns in the cross-section as opposed to exiting theories and market level evidence. In case of the subsequent monthly return, it is consistent with contamination of the option-implied measures by deviations from put-call parity caused by information asymmetry between traders in options and equity markets.

However, more puzzling fact is that such pattern persists for twelve months since information asymmetry is difficult to explain why such pattern persists for such a long period. Here, we argue that the conventional cross-sectional analysis is not suitable to reveal the true relationship between the implied dividend yield and the expected returns. First, the dividend yield represents the expected return based on the present-value relation which is originally defined in the time-series environment in Campbell and Shiller (1988). In the cross-sectional setting, the dividend yield will be difficult to capture variations in the expected return due to excessive variations in the expected dividend growth across firms. Second, the cross-sectional analysis ignores the effect of the common time-variation in firm-level implied dividend yields as shown in Figure 1. As a result, how the expected return varies with the dividend yield within a given firm is not considered at all in cross-sectional estimation. Third, a cross-sectional analysis is not suitable for the data with short sample period, that is, when conditional information matters, in general. Fourth, most importantly, cross-sectional variations in expected returns might be due to unidentified risk factors. We resolve these issue by performing a panel data analysis. In particular, we circumvent the issue of unidentified risk factors by including firm fixed effects. After all, we focus on how the expected return varies with the dividend yield within a given firm.

Table 7 show the time-series predictability of monthly S&P500 index returns. We compare five different option-implied measures: the implied dividend yield (IDY), the corrected dividend-price ratio (log DP^c), the model-free risk-neutral skewness (RNSKEW), the volatility skew (VOLSKEW), and the corrected dividend-price ratio using information in the term structure of the expected dividend growth from Bilson, Kang, and Luo (2015). All these predictor variables are computed using the index options. Due to the short sample period from January 1996 to December 2013, evidence on predictability is somewhat weak, yet the signs of coefficients are all consistent with theories. High dividend yield and low skewness are associated with high expected return.

Table 8 shows the pooled time-series predictability of individual stock returns. We run the following panel regression:

$$r_{i,t+1} = \alpha_i + \beta \, IDY_{i,t} + \gamma^\top Z_{i,t} + e_{i,t+1}$$

where $r_{i,t+1}$ is the monthly stock return (%), α_i is the firm fixed effect, IDY is the ex-ante option-implied dividend yield from put-call parity, and $Z_{i,t}$ is control variables. The table shows that the coefficient on the implied dividend yield is negative and highly significant as t-stat is around 10, consistent with the cross-sectional result. One interesting result here is that control variables become relatively less significant when the firm fixed effects are included whilst the implied dividend yield does not. If firm fixed effects capture all risk premium associated with identified and unidentified risk factors, remaining significant coefficients represent time-variation of risk premium. Since the coefficients on the implied dividend yield remain the same even after the firm fixed effects are included, we conclude the time-series relationship between the implied dividend yield and the expected return is more important or more dominant in the data than the cross-sectional relationship.

Table 9 extends Table 9 using different forecasting horizons up to twelve months. We run the following panel regression with each of forecasting horizon $h = 1, 2, 3, ..., 12$:

$$r_{i,t+h} = \alpha_i + \beta\ X_{i,t} + e_{i,t+1}$$

where $r_{i,t+h}$ is the h-months ahead non-overlapping monthly stock return (%), α_i is the firm fixed effect, and $X_{i,t}$ is either implied dividend yield $IDY_{i,t}$ in Panel A or the corrected dividend-price ratio $\log DP^c_{i,t}$ in Panel B. Here, including firm fixed effects is important since it eliminates all cross-sectional variations in expected returns due to risk factors. In Panel A, the coefficient on the implied dividend yield starts from a strongly negative value but gradually increases and becomes significantly positive after three month. We interpret this coefficient pattern as the information asymmetry disappears within a few months and the normal relationship between the implied dividend yield and the expected return recovers. The same pattern is discovered when the corrected dividend price ratio is used as a predictor variable since two measures are constructed in a very similar way. Here, the control variables should be excluded in the regression since the dividend yield and the dividend-price ratio are a valuation ratio and so already include information in control variables related to the expected returns.

Table 10 repeats Table 9 with the model-free risk-neutral skewness (RNSKEW) and the volatility skew (VOLSKEW), which is the slope of volatility smirk) as a predictor variable. We find the exactly the same pattern as Table 9. In the first few months, information asymmetry dominates and so the coefficient is the opposite of what theory implies, yet the normal relationship between the skewness measures and the expected return recovers thereafter. Note the signs of the coefficients on the model-free risk-neutral skewness (RNSKEW) should be the opposite of the volatility skew (VOLSKEW) because of their definitions. In case of the model-free risk-neutral skewness and the volatility skew, control variables should be included because skewness is just one determinant of the expected return. Accordingly, we have stronger results when control variables are included as expected. Table 11 repeats Table 9 and 10 with overlapping holding period returns. After six month, the normal relationship with all option-implied measures and the expected return dominates the overall return predictability.

To confirm the validity of the option-implied measures, we test whether the option-implied dividend actually include information about future dividend. This is an important fundamental question since the option-implied dividend from put-call parity is a main building block of the implied dividend yield and the corrected dividend-price ratio. The first two rows of Table 12 show that the option-implied dividend actually include information about future dividend, and so two option-implied measures are not pure noises. The remaining part of Table 12 shows how the implied dividend yield predicts the dividend growth. The result is consistent with information asymmetry in the short term and existing literature in the long term.

5 Conclusion

As Fama and French (1988) and Campbell and Shiller (1988) explain, the dividend yield should be positively related to the future stock returns. We construct the option-implied measure of dividend yield from equity options at firm-level and find that it is negatively related to the subsequent monthly stock returns, as opposed to the market level evidence and what theory suggests. This puzzling empirical finding is mainly driven by the deviations from put-call parity caused by information asymmetry between traders in options and equity markets. Our panel data analysis reveals that the normal relationship between the dividend yield and the future returns recovers after information asymmetry dissipates within a few months. The biggest problem with the cross-sectional analysis is that the cross-sectional variations in expected returns can be driven by unidentified risk factors. We include the firm fixed effects to circumvent the issue of unidentified risk factors. We further investigates whether the existence of information asymmetry contaminates ex-ante option-implied skewness measures as well, which explains why existing literature finds both positive and negative relationship between option-implied skewness and expected returns in the cross-section. Finally, we reconcile such mixed evidence by showing that the normal negative relationship between option-implied skewness and expected returns appears regardless of choice of option-implied skewness measures after the false positive relationship due to information asymmetry vanishes in the panel data analysis. To conclude, the issues in option-implied measures and cross-sectional analysis cause such mixed evidence on the relationship between option-impled skewness and the expected return, and we reconcile the mixed evidence using a panel analysis with varying forecasting horizons.

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Table 1: **Summary Statistics**

The table presents the summary statistics of monthly firm-level option-implied measures and control variables used in the paper. IDY is the ex-ante option-implied dividend yield from put-call parity. log DP^c is the corrected dividend-price ratio from Golez (2014). RNSKEW is the model-free risk-neutral skewness from Bakshi, Kapadia, and Madan (2003). VOLSKEW is volatility skew (VOLSKEW), which is the slope of volatility smirk, from Xing, Zhang, and Zhao (2010). HSKEW and HVOL are the monthly historical return skewness and volatility calculated using daily returns, respectively. log Size, log BM, and LEV are firm market capitalization, the book-to-market ratio, and the leverage, respectively. The sample period is from January 1996 to December 2013.

Variable	Mean	Percentile				
		5%	25%	50%	75%	95%
IDY	0.022	-0.020	0.004	0.014	0.031	0.089
log DP^c	-3.247	-4.971	-3.799	-3.226	-2.613	-1.611
RNSKEW	-0.428	-0.909	-0.568	-0.398	-0.253	-0.060
VOLSKEW	4.084	-0.181	2.046	3.217	4.985	10.872
HSKEW	0.171	-1.291	-0.303	0.155	0.640	1.707
HVOL	0.099	0.032	0.055	0.081	0.122	0.225
log Size	0.099	0.032	0.055	0.081	0.122	0.225
log BM	-1.077	-2.871	-1.672	-1.054	-0.483	0.561
LEV	0.320	0.020	0.100	0.251	0.480	0.870

Table 2: **Correlation Matrix**

The table presents the correlation matrix of monthly firm-level option-implied measures and control variables used in the paper. IDY is the ex-ante option-implied dividend yield from put-call parity. log DP^c is the corrected dividend-price ratio from Golez (2014). RNSKEW is the model-free risk-neutral skewness from Bakshi, Kapadia, and Madan (2003). VOLSKEW is volatility skew (VOLSKEW), which is the slope of volatility smirk, from Xing, Zhang, and Zhao (2010). HSKEW and HVOL are the monthly historical return skewness and volatility calculated using daily returns, respectively. log Size, log BM, and LEV are firm market capitalization, the book-to-market ratio, and the leverage, respectively. The sample period is from January 1996 to December 2013.

	IDY	DP^c	RN−SKEW	VOL−SKEW	HSKEW	HVOL	log Size	log BM	LEV
IDY	1								
log DP^c	0.726	1							
RNSKEW	-0.175	-0.134	1						
VOLSKEW	0.544	0.384	-0.517	1					
HSKEW	0.010	0.010	0.006	0.010	1				
HVOL	0.249	0.197	0.021	0.438	0.031	1			
log Size	-0.231	-0.136	-0.145	-0.238	0.001	-0.353	1		
log BM	0.096	0.054	-0.049	0.113	-0.002	0.136	-0.242	1	
LEV	0.142	0.139	-0.135	0.147	-0.003	0.114	-0.097	0.665	1

Table 3: . **Implied Dividend Yield and Firm Characteristics**

The table presents the average firm-characteristics of each decile portfolio sorted by the implied dividend yield every month. IDY is the ex-ante option-implied dividend yield from put-call parity. log DP^c is the corrected dividend-price ratio from Golez (2014). RNSKEW is the model-free risk-neutral skewness from Bakshi, Kapadia, and Madan (2003). HSKEW and HVOL are the monthly historical return skewness and volatility calculated using daily returns, respectively. log Size, log BM, and LEV are firm market capitalization, the book-to-market ratio, and the leverage, respectively. HKURT is the monthly historical return kurtosis calculated using daily returns. Sharpe Ratio is calculated using monthly return and volatility. The sample period is from January 1996 to December 2013.

	Low 1	2	3	4	5	6	7	8	9	High 10	High-Low (t-stat.)
log Size	6.45	7.22	7.71	7.78	7.82	7.89	7.90	7.88	7.61	7.04	0.60
											(26.87)
log BM	-1.04	-1.15	-1.28	-1.23	-1.16	-1.10	-1.03	-0.96	-0.89	-0.93	0.11
											(4.16)
LEV	0.26	0.26	0.25	0.27	0.30	0.32	0.35	0.37	0.40	0.38	0.12
											(22.86)
HVOL	3.53	3.18	3.03	2.97	2.85	2.73	2.65	2.58	2.65	2.99	-0.54
											(-11.69)
HSKEW	0.27	0.21	0.19	0.18	0.17	0.17	0.16	0.15	0.16	0.15	-0.12
											(-11.57)
HKURT	1.63	1.42	1.29	1.23	1.16	1.14	1.15	1.13	1.13	1.28	-0.34
											(-10.22)
Sharpe Ratio	0.72	0.57	0.52	0.56	0.57	0.61	0.62	0.63	0.68	0.62	-0.10
											(-1.63)

Table 4: **Average Returns of Deciles Portfolios Sorted by the Implied Dividend Yield**
The table presents raw and risk-adjusted average returns of ten equal-weighted decile portfolio sorted by the ex-ante option-implied divided yield. Panel A, B, C, and D show one-, three-, six-, and twelve-month holding period overlapping returns, respectively. Avg. return is the raw sample average of returns. CAPM α is the CAPM alpha of each portfolio return. FF3 α is the Fama-French three-factor model alpha of each portfolio return. Carhart4 α is the Carhart four-factor model alpha of each portfolio return. The last two columns show the difference between the top and the bottom decile portfolio returns and their t-statistics computed using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The sample period is from January 1996 to December 2013.

Panel A: 1-month Holding Period Return (%)

	Low 1	2	3	4	5	6	7	8	9	High 10	H-L	t(H-L)
Avg. return	2.21	1.42	1.06	1.05	1.34	1.10	1.01	1.23	1.21	1.04	-1.17	-5.99
CAPM α	1.23	0.52	0.13	0.16	0.49	0.25	0.19	0.40	0.40	0.16	-1.29	-6.87
FF3 α	1.12	0.45	0.10	0.13	0.42	0.12	0.07	0.27	0.27	0.00	-1.34	-8.29
Carhart4 α	1.27	0.57	0.20	0.17	0.45	0.17	0.14	0.33	0.38	0.16	-1.34	-7.96

Panel B: 3-month Holding Period Return (%)

	Low 1	2	3	4	5	6	7	8	9	High 10	H-L	t(H-L)
Avg. return	7.03	4.12	3.35	3.46	3.79	3.34	3.58	3.78	4.24	4.09	-2.94	-6.06
CAPM α	6.04	3.20	2.42	2.53	2.90	2.45	2.73	2.91	3.38	3.11	-3.15	-6.40
FF3 α	6.12	3.38	2.59	2.71	3.03	2.50	2.73	2.91	3.41	3.11	-3.23	-6.67
Carhart4 α	6.31	3.49	2.69	2.76	3.09	2.60	2.84	3.05	3.57	3.30	-3.24	-6.51

Panel C: 6-month Holding Period Return (%)

	Low 1	2	3	4	5	6	7	8	9	High 10	H-L	t(H-L)
Avg. return	13.32	8.76	6.81	7.05	6.89	6.95	7.14	7.81	8.18	8.62	-4.70	-6.51
CAPM α	12.38	7.94	5.92	6.19	6.02	6.07	6.32	6.93	7.33	7.73	-4.88	-6.74
FF3 α	12.76	8.42	6.46	6.74	6.43	6.40	6.56	7.16	7.59	7.99	-5.00	-6.77
Carhart4 α	13.23	8.71	6.78	6.97	6.70	6.70	6.90	7.52	7.95	8.43	-5.03	-6.64

Panel D: 12-month Holding Period Return (%)

	Low 1	2	3	4	5	6	7	8	9	High 10	H-L	t(H-L)
Avg. return	28.75	19.16	15.38	14.64	14.44	14.58	14.62	15.70	16.82	20.10	-8.65	-7.73
CAPM α	27.81	18.40	14.52	13.78	13.68	13.78	13.86	14.90	16.07	19.27	-8.78	-7.91
FF3 α	28.41	19.00	15.26	14.55	14.11	14.20	14.27	15.31	16.39	19.77	-8.87	-7.84
Carhart4 α	28.97	19.48	15.62	14.90	14.48	14.60	14.71	15.85	16.86	20.27	-8.94	-7.67

Table 5: **Fama Macbeth Regression on the Implied Divided Yield and the Corrected Dividend-Price Ratio**

The table presents Fama-Macbeth regressions with monthly stock returns. For each month t, we run the following cross-sectional regression:

$$r_{i,t+1} = \alpha_t + \beta_t X_{i,t} + \gamma_t^\top Z_{i,t} + e_{i,t+1}$$

where $r_{i,t+1}$ is the monthly stock return (%), $X_{i,t}$ is either the implied dividend yield $IDY_{i,t}$ or the corrected dividend-price ratio $\log DP^c_{i,t}$, and $Z_{i,t}$ is control variables. HSKEW and HVOL are the monthly historical return skewness and volatility calculated using daily returns, respectively. log Size, log BM, and LEV are firm market capitalization, the book-to-market ratio, and the leverage, respectively. Then we compute the time-average of β_t and γ_t to find the point estimates and report their t-statistics in parentheses using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The last column shows the time-average of adjusted R^2 of each cross-sectional regression. The sample period is from January 1996 to December 2013.

Model	IDY	log DP^c	log Size	log BM	LEV	HVOL	HSKEW	Adj. R^2 (%)
I	-6.060							0.3
	(-4.73)							
II	-5.894		-0.384	0.135	0.322	2.812	-0.011	5.8
	(-5.18)		(-4.89)	(1.50)	(0.69)	(1.01)	(-0.22)	
III		-0.035						0.5
		(-0.48)						
IV		-0.122	-0.140	-0.019	0.229	-1.195	-0.089	6.5
		(-1.59)	(-1.92)	(-0.19)	(1.87)	(-0.35)	(-1.11)	

Table 6: **Fama Macbeth Regression on Risk-Neutral Skewness and the Slope of Volatility Smirk.**

The table presents Fama-Macbeth regressions with monthly stock returns. For each month t, we run the following cross-sectional regression:

$$r_{i,t+1} = \alpha_t + \beta_t X_{i,t} + \gamma_t^\top Z_{i,t} + e_{i,t+1}$$

where $r_{i,t+1}$ is the monthly stock return (%), $X_{i,t}$ is either model-free risk-neutral skewness $RNSKEW$ or volatility skew $VOLSKEW$ (the slope of volatility smirk), and $Z_{i,t}$ is control variables. HSKEW and HVOL are the monthly historical return skewness and volatility calculated using daily returns, respectively. log Size, log BM, and LEV are firm market capitalization, the book-to-market ratio, and the leverage, respectively. Then we compute the time-average of β_t and γ_t to find the point estimates and report their t-statistics in parentheses using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The last column shows the time-average of adjusted R^2 of each cross-sectional regression. The sample period is from January 1996 to December 2013.

Model	RN−SKEW	VOL−SKEW	log Size	log BM	LEV	HVOL	HSKEW	Adj. R^2 (%)
I	0.915							0.7
	(1.77)							
II	1.360		0.016	-0.036	0.083	-2.232	0.067	7.8
	(2.99)		(0.17)	(-0.31)	(0.75)	(-0.65)	(0.81)	
III		-0.060						0.8
		(-2.66)						
IV		-0.062	-0.038	-0.006	0.037	-1.245	0.004	7.2
		(-2.87)	(-0.49)	(-0.07)	(0.34)	(-0.42)	(0.06)	

Table 7: **Time-series Predictability of Market Returns**

The table presents time-series predictability of market returns. Each column shows the result of the time-series predictive regression:

$$r_{m,t+1} = \alpha + \beta X_t + e_{t+1}$$

where $r_{m,t+1}$ is the monthly S&P500 index return (%) and X_t is a single predictor variable. IDY is the ex-ante option-implied dividend yield from put-call parity. log DP^c is the corrected dividend-price ratio from Golez (2014). log DP^{c,ts} is the corrected dividend-price ratio using information in the term structure of the expected dividend growth from Bilson, Kang, and Luo (2015). RNSKEW is the model-free risk-neutral skewness from Bakshi, Kapadia, and Madan (2003). VOLSKEW is volatility skew, which is the slope of volatility smirk, from Xing, Zhang, and Zhao (2010). All these predictor variables are computed using the index options. Numbers in parentheses are their t-statistics using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The sample period is from January 1996 to December 2013.

Single Predictor	IDY	log DP^c	log DP^{c,ts}	RNSKEW	VOLSKEW
Coefficient β	0.0057	0.0043	0.0080	-0.0001	0.7295
(t-statistics)	(1.56)	(1.24)	(2.31)	(-0.29)	(1.67)
In-sample R^2 (%)	1.56	0.89	2.60	0.01	1.59
Pseudo Out-of-sample R^2 (%)	0.17	-0.35	2.46	-2.80	0.19

Table 8: **Panel Regression of Monthly Stock Returns on the Lagged Implied Dividend Yield**

The table presents the pooled time-series predictability of individual stock returns. We run the following panel regression:

$$r_{i,t+1} = \alpha_i + \beta\ IDY_{i,t} + \gamma^\top Z_{i,t} + e_{i,t+1}$$

where $r_{i,t+1}$ is the monthly stock return (%), α_i is the firm fixed effect, IDY is the ex-ante option-implied dividend yield from put-call parity, and $Z_{i,t}$ is control variables. HSKEW and HVOL are the monthly historical return skewness and volatility calculated using daily returns, respectively. log Size, log BM, and LEV are firm market capitalization, the book-to-market ratio, and the leverage, respectively. All explanatory variables are standardized by their sample means and standard deviations. Numbers in parentheses are t-statistics calculated using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The sample period is from January 1996 to December 2013.

Model	IDY	log Size	log BM	LEV	HVOL	HSKEW	Fixed Effect	Adj R^2 (%)
I	-0.32						Yes	0.03
	(-8.55)							
II	-0.44	-5.56	0.44				Yes	2.06
	(-11.02)	(-56.56)	(7.04)					
III	-0.41	-5.69	0.28	0.41	-0.41	0.04	Yes	2.12
	(-10.22)	(-54.41)	(3.91)	(3.69)	(-10.02)	(1.36)		
IV	-0.33						No	0.04
	(-10.05)							
V	-0.33	-0.44	0.34				No	0.19
	(-9.38)	(-13.36)	(10.35)					
VI	-0.34	-0.52	0.21	0.17	-0.12	0.05	No	0.21
	(-9.53)	(-14.20)	(4.73)	(4.03)	(-3.46)	(1.56)		

Table 9: **Panel Regression of Monthly Stock Returns with Varying Forecasting Horizon**

The table presents the pooled time-series predictability of individual stock returns with different forecasting horizons up to twelve months. We run the following panel regression with each of forecasting horizon $h = 1, 2, 3, ..., 12$:

$$r_{i,t+h} = \alpha_i + \beta\ X_{i,t} + e_{i,t+1}$$

where $r_{i,t+h}$ is the h-months ahead non-overlapping monthly stock return (%), α_i is the firm fixed effect, and $X_{i,t}$ is either implied dividend yield $IDY_{i,t}$ or the corrected dividend-price ratio log $DP^c_{i,t}$. All explanatory variables are standardized by their sample means and standard deviations. Under the coefficient estimates, we report t-statistics calculated using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The sample period is from January 1996 to December 2013.

Panel A: Regression on IDY

h^{th} month	1	2	3	4	5	6	7	8	9	10	11	12
1. Without Firm Fixed Effects												
β	-0.33	-0.18	-0.06	0.03	0.05	0.11	0.03	0.02	0.04	0.01	0.07	0.13
t-stat.	-10.05	-5.09	-1.77	0.83	1.45	2.82	1.38	0.53	1.17	0.26	1.67	3.09
2. With Firm Fixed Effects												
β	-0.32	-0.13	-0.02	0.13	0.18	0.26	0.12	0.13	0.16	0.10	0.15	0.25
t-stat.	-8.55	-3.24	-0.48	3.09	4.10	5.84	2.64	2.84	3.62	2.15	3.26	5.07

Panel B: Regression on log DP^c

h^{th} month	1	2	3	4	5	6	7	8	9	10	11	12
1. With Firm Fixed Effects												
β	0.05	-0.13	0.21	0.24	0.20	0.23	0.24	0.31	0.29	-0.04	0.17	0.30
t-stat.	0.76	-1.73	2.81	3.05	2.56	3.12	3.02	3.82	3.80	-0.50	1.92	3.75

Table 10: **Panel Regression of Monthly Stock Returns on the Lagged Option-implied Skewness Measures with Varying Forecasting Horizon**

The table presents the pooled time-series predictability of individual stock returns with different forecasting horizons up to twelve months. We run the following panel regression with each of forecasting horizon $h = 1, 2, 3, ..., 12$:

$$r_{i,t+h} = \alpha_i + \beta\, X_{i,t} + \gamma^\top Z_{i,t} + e_{i,t+1}$$

where $r_{i,t+h}$ is the h-months ahead non-overlapping monthly stock return (%), α_i is the firm fixed effect, $X_{i,t}$ is either model-free risk-neutral skewness $RNSKEW$ or volatility skew $VOLSKEW$ (the slope of volatility smirk), and $Z_{i,t}$ is control variables: HSKEW, HVOL, log Size, log BM, and LEV as defined in Table 1. All explanatory variables are standardized by their sample means and standard deviations. Under the coefficient estimates, we report t-statistics calculated using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The sample period is from January 1996 to December 2013.

Panel A: Regression on VOLSKEW

h^{th} month	1	2	3	4	5	6	7	8	9	10	11	12
1. With Firm Fixed Effects												
β	-0.39	-0.11	0.02	0.21	0.36	0.55	0.37	0.28	0.19	0.33	0.53	0.57
t-stat.	-7.39	-1.99	0.43	3.57	5.99	8.92	6.08	4.43	2.93	5.16	8.07	8.61
2. With Firm Fixed Effects, log Size, and log BM												
β	-0.62	-0.33	-0.21	0.01	0.17	0.39	0.21	0.08	-0.11	0.14	0.39	0.37
t-stat.	-10.34	-5.52	-3.47	0.08	2.75	5.96	3.26	1.33	-0.17	2.08	5.67	5.21
3. With Firm Fixed Effects and All Control Variables												
β	-0.42	-0.25	-0.23	0.13	0.07	0.2	0.21	0.08	-0.11	0.13	0.37	0.23
t-stat.	-6.97	-5.47	-3.58	-0.23	1.04	2.94	3.03	1.18	-1.51	1.87	5.14	3.04

Panel B: Regression on RNSKEW

h^{th} month	1	2	3	4	5	6	7	8	9	10	11	12
1. With Firm Fixed Effects												
β	0.55	0.23	0.09	0.10	0.06	0.07	-0.03	0.01	0.29	0.07	-0.07	0.08
t-stat.	7.62	3.23	1.23	1.23	1.37	0.87	-0.45	0.11	3.78	0.93	-0.94	1.05
2. With Firm Fixed Effects, log Size, and log BM												
β	0.19	-0.09	-0.28	-0.28	-0.26	-0.34	-0.40	-0.24	0.04	-0.23	-0.34	-0.25
t-stat.	2.38	-1.23	-3.48	-3.39	-3.21	-4.07	-4.75	-2.86	0.42	-2.65	-3.97	-2.92
3. With Firm Fixed Effects and All Control Variables												
β	0.16	-0.07	-0.23	-0.22	-0.15	-0.22	-0.33	-0.22	0.07	-0.21	-0.33	-0.24
t-stat.	3.04	-0.85	-2.84	-2.68	-1.89	-2.69	-3.92	-2.60	0.82	-2.44	-3.84	-2.73

Table 11: **Panel Regression of Stock Returns with Varying Holding Period**

The table presents the pooled time-series predictability of individual stock returns with different holding periods up to twelve months. We run the following panel regression with each of holding periods $n = 1$, 3, 6, and 12:

$$r_{i,t+n} = \alpha_i + \beta\, X_{i,t} + \gamma^\top Z_{i,t} + e_{i,t+1}$$

where $r_{i,t+n}$ is the overlapping n-month holding period stock return (%), α_i is the firm fixed effect, $X_{i,t}$ is implied dividend yield $IDY_{i,t}$, the corrected dividend-price ratio $\log DP^c_{i,t}$, model-free risk-neutral skewness $RNSKEW$, or volatility skew $VOLSKEW$ (the slope of volatility smirk), and $Z_{i,t}$ is control variables: HSKEW, HVOL, log Size, log BM, and LEV as defined in Table 1. All explanatory variables are standardized by their sample means and standard deviations. Under the coefficient estimates, we report t-statistics calculated using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The sample period is from January 1996 to December 2013.

Predictor	Control Variables		Holding Period (month)			
			1	3	6	12
IDY	Firm Fixed Effects	β	-0.32	-0.30	0.77	3.05
		t-stat.	-8.55	-3.40	4.81	10.67
log DP^c	Firm Fixed Effects	β	0.05	0.17	0.84	2.30
		t-stat.	0.76	1.21	3.82	6.83
VOLSKEW	Firm Fixed Effects	β	-0.39	-0.34	1.26	4.98
		t-stat.	-7.39	-2.98	6.50	15.30
	Firm Fixed Effects	β	-0.62	-1.05	-0.10	2.28
	+ log Size + log BM	t-stat.	-10.34	-8.50	-0.49	7.16
	Firm Fixed Effects	β	-0.42	-0.88	-0.26	1.73
	+ All Control Variables	t-stat.	-6.97	-7.06	-1.29	5.46
RNSKEW	Firm Fixed Effects	β	0.55	0.86	0.99	0.77
		t-stat.	7.62	5.51	3.92	1.92
	Firm Fixed Effects	β	0.19	-0.26	-1.42	-3.79
	+ log Size + log BM	t-stat.	2.38	-1.52	-5.26	-9.54
	Firm Fixed Effects	β	0.16	-0.21	-1.09	-3.28
	+ All Control Variables	t-stat.	3.04	-1.21	-3.99	-8.23

Table 12: **Panel Regression of Dividend Growth with Varying Horizon**

The table presents the pooled time-series predictability of individual dividend growth with different dividend horizons up to twelve months. We run the following panel regression with each of dividend horizons $n = 1$, 3, 6, and 12:

$$\log D_{i,t+n}^{(12)} - \log D_{i,t}^{(12)} = \alpha_i + \beta X_{i,t} + e_{i,t+1}$$

where $D_{i,t}$ is the overlapping twelve-month trailing sum of dividends, α_i is the firm fixed effect, and $X_{i,t}$ is either option-implied dividend growth $IDG_{i,t}$ or option-implied dividend yield $IDY_{i,t}$. Under the coefficient estimates, we report t-statistics calculated using Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The sample period is from January 1996 to December 2013.

Predictor	Firm Fixed Effects		Dividend Growth Horizon (month)			
			1	3	6	12
IDG	Yes	β	0.696	0.108	0.198	0.379
		t-stat.	2.55	3.57	6.93	7.60
	No	β	0.078	0.104	0.165	0.351
		t-stat.	3.89	4.63	7.28	7.93
IDY	Yes	β	0.037	0.035	0.238	-0.114
		t-stat.	2.93	1.23	0.49	-1.57
	No	β	0.085	-0.028	0.093	-0.272
		t-stat.	0.84	-1.08	-1.94	-3.29

Figure 1: **Evolution of the Cross-sectional Distribution of Implied Dividend Yield**
The plot shows the cross-sectional distribution of monthly option-implied dividend yield. Each line represents the cross-sectional mean, median, 10^{th} percentile, and 90^{th} percentile calculated every month, respectively.

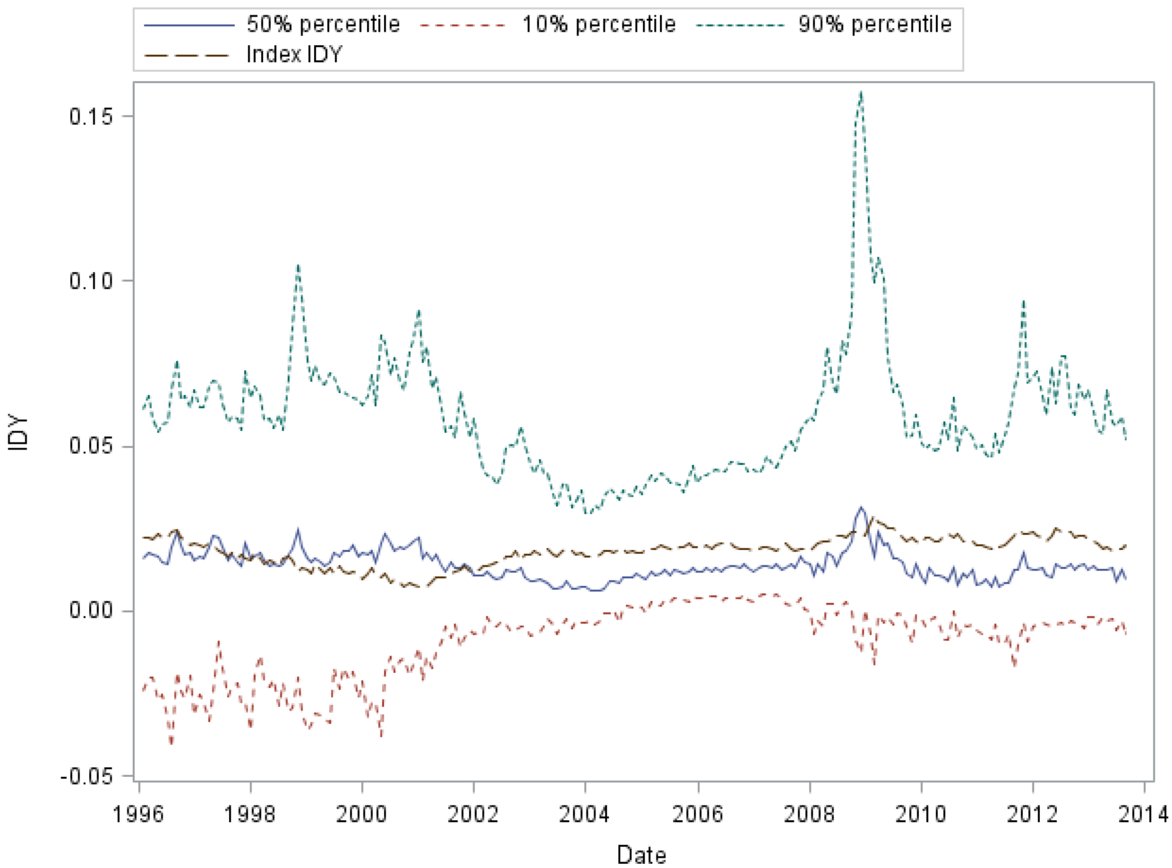

Figure 2: **Cross-sectional Medians of Option-implied Predictors for Stock Returns**
The plot shows the time-series of the cross-sectional median of four monthly option-implied predictors for stock returns: IDY, log DP^c, RNSKEW, and VOLSKEW where IDY is the implied dividend yield, log DP^c is the corrected dividend-price ratio, RNSKEW is the model-free risk-neutral skewness, and VOLSKEW is the volatility skew (the slope of volatility smirk). All variables are standardized by their sample means and standard deviations for better visualization. We draw −RNSKEW instead of RNSKEW so that all four option-implied measures in the plot are associated with expected returns in the same way. The sample period is from January 1996 to December 2013.