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**What Do Financial Asset Prices Say About  
the Housing Market?**

**J. Benson Durham**

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## What Do Financial Asset Prices Say About the Housing Market?

J. Benson Durham\*  
Division of Monetary Affairs  
Board of Governors of the Federal Reserve System  
Washington, DC 20551  
(202) 452-2896  
j.benson.durham@frb.gov

### **Abstract**

This paper examines the first three moments of investors' expectations for the housing sector. That is, first, what do financial markets imply about expected future home prices? Second, how much confidence do investors have in their forecast? And, third, do market participants see more downside than upside risk? Housing futures and options, which trade on the Chicago Mercantile Exchange (CME), are not yet deep and liquid, and derivatives on homebuilders' shares reflect considerable idiosyncratic information and are therefore an imperfect proxy. Nonetheless, prices suggest that investors currently expect some mild depreciation in home values within the next year. Also, uncertainty has increased, but, generally inconsistent with the perception of a "bubble," the implied risks do not seem particularly tilted to the downside. Probability density functions derived from options on homebuilders' stocks are not appreciably skewed to the left in general, vis-à-vis the broader market, or with respect to recent history.

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## Introduction

The controversial question of whether or not there is a “bubble” in home prices aside (Case and Shiller, 2003; McCarthy and Peach, 2004; Himmelberg et al., 2005), this paper addresses the first three moments of investors’ expectations for home prices in particular and the broader housing sector in general. In other words, first, what is the mean expectation for the path of home prices? Second, how uncertain are investors about that mean projection? And, third, do investors see the risks to the outlook for housing as considerably skewed to the downside as opposed to the upside, which might be consistent with the perception of a bubble?

We can readily assess the moments of investors’ expectations for other financial variables,<sup>1</sup> but deep and liquid markets that signal perceptions about future home prices do not yet exist. However, Chicago Mercantile Exchange (CME) housing futures and options—which began trading on May 22, 2006, and have limited open interest to date—as well as derivatives on the financial assets of firms whose prospects are broadly tied to home prices, nonetheless contain some key information about investors’ views of the sector. Indeed, CME housing futures currently suggest that market participants expect home prices to decelerate sharply or actually decline a little within the next year, although the anticipated drop is mild compared to some estimates of the purported overvaluation of the housing market. In addition, market participants seem more uncertain about the trajectory of home prices, as implied volatilities on the few CME options that have traded thus far are generally greater than the realized historical volatilities on the underlying indexes. Finally, probability density functions (PDFs) implied by options on select homebuilders’ shares are only marginally negatively skewed at the present time.

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<sup>1</sup> For example, we can use federal funds and Eurodollar futures and options, which are highly liquid, to extract an expected path for monetary policy as well as the uncertainty and skew around such a projection. Also, investors routinely track the implied volatility and higher moments with respect to the stock market using liquid options on the S&P 500.

Moreover, the current skew of these densities is broadly comparable to that of the equity market as a whole, and skewness has not noticeably increased over time for these firms. Caveats about this proxy notwithstanding, this suggests that market participants do not in fact view the risks to home prices or, perhaps more accurately, to the broader housing sector as especially tilted to the downside.

The remainder of this paper is organized as follows. The first, second, and third sections cover the first three moments of investors' expectations derived from the CME contracts and derivatives on homebuilders' shares. Section 4 concludes.

## **1. The First Moment: The Expected Path for Home Prices**

CME housing futures and options are a potentially useful indicator of investors' expectations for home prices over the horizon of these instruments. This section outlines some of the details of these contracts and describes the predicted change in future home values implied by current market prices.

### *1.1. Market Mechanics and Liquidity*

CME housing futures and options are written on the S&P/Case-Shiller Indexes (CSI) for ten metropolitan areas as well as a (market-capitalization weighted) composite based on the regional indexes.<sup>2</sup> For each of these, the exchange lists four cash-settled futures contracts that expire in the quarterly cycle of February, May, August, and November. The February "tradable" CSI index reflects data collected through the middle of that month regarding activity in October,

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<sup>2</sup> The indexes are established at 100 for the base year of 2000. Similar to the OFHEO indexes, the CSI indexes match sales on the same property ("repeat sales" methodology), but unlike the OFHEO indexes, the CSI is not confined to Fannie Mae and Freddie Mac conforming mortgages. The underlying data for the calculation of the CSI is collected by Fiserv CSI Inc. (Fiserv), which uses property data vendors and multiple listing service providers.

November, and December—commonly characterized as a two-month “look back.”<sup>3</sup> Contracts currently expire near the end of August 2006, November 2006, February 2007, and May 2007, which cover activity over 2006:Q2, 2006:Q3, 2006:Q4, and 2007:Q1, respectively.<sup>4</sup>

Table 1 lists a few indicators of liquidity in the futures market as of July 10, 2006. As noted in Column 4, open interest across the eleven indexes and the four outstanding expiries totaled 636 contracts. To put this figure in perspective, an individual contract size is given by \$250 multiplied by the relevant CSI index (Column 3). Therefore, as noted in Column 5, the total notional value of all outstanding contracts is only about \$38.7 million.<sup>5</sup> The contracts for Miami and Los Angeles are the most popular.

### *1.2. Current Market Prices and the Central Tendency of Expectations*

Although these futures markets are very small, we can nonetheless glean some information from current futures prices, perhaps particularly with respect to the first moment of investors’ expectations. This is different from futures on other financial instruments, such as stocks, for which a simple arbitrage relation links the spot, futures, and the risk-free rate. The standard futures arbitrage relation implies that

(1)

$$F = Se^{r\tau}$$

where  $F$  is the futures price,  $S$  is the spot price of the underlying stock,  $r$  is the risk-free rate, and  $\tau$  is the time to maturity. But, this argument would not seem to hold in the housing market.

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<sup>3</sup> “Tradable” CSI indexes differ from the “standard” CSI indexes in that the latter are updated quarterly with a three-month, instead of a two-month, “look-back.” (So, for the standard index, the June update released on the last business day of the month reflects data over the first quarter.) The standard indexes are never released before the tradable indexes.

<sup>4</sup> Trading in an expiring contract ends at 12:00 p.m. (CST) on the last Tuesday of the contract month, and the underlying CSI index is then published at 1:15 p.m. that day. For additional information, see [www.cme.com/housing](http://www.cme.com/housing).

<sup>5</sup> This compares with the \$21.6 trillion estimated value of the national housing market at the end of 2005.

Simply, the transactions costs associated with purchasing the underlying CSI index and taking the requisite position in cash are prohibitive. Also, the “spot” price is not directly observable, because the (tradable) CSI is released with a two-month lag.

Given the four expiries from August 2006 through May 2007, we can construct an expected path for home prices through the 2006:Q1 – 2007:Q1 period. For the near term, the front futures contract that expires in August,  $CME_{AUG06}$ , settles based on activity observed during the second quarter of this year. The CSI “tradable” index published in August 2005,  $CSI_{AUG05}$ , refers to activity during the second quarter of 2005. Therefore, we can calculate the simple futures-implied year-over-year percentage change in home prices over the 2005:Q2 to 2006:Q2 period,  $g$ , as

(2)

$$g = \frac{CME_{AUG06(2006:Q2)} - CSI_{AUG05(2005:Q2)}}{CSI_{AUG05(2005:Q2)}} \times 100 .$$

Table 2 summarizes the futures-implied year-over-year price change for each index and expiry as of July 10, 2006. Perhaps of particular interest, futures contracts on the composite suggest that, on a year-over-year basis, home prices ending in 2006:Q2 will increase around 6.3 percent, decelerate further to 3.2 percent by 2006:Q3, and decline by about -3.7 percent for the year ending in 2007:Q1. The regional indexes generally imply a similar pattern, and current quotes suggest some price depreciation in each of the ten metropolitan areas over the 2006:Q1 – 2007:Q1 period.

To put these projections in more historical perspective, the top panel of Figure 1 shows the growth rates in the composite, Miami, and Los Angeles indexes from January 1987 through March 2006 and the CME futures-implied trajectory thereafter. Also, the bottom panel shows

how futures-implied growth in home prices has evolved since trading began on May 22 for the same contracts. As a caveat, market conditions were particularly illiquid in the early days of trading, and the most pronounced downward adjustments to prices came shortly after May 22, 2006. Prices have been somewhat more stable since then, but the general downward trend in implied growth rates for the most distant horizon is perhaps noteworthy and consistent with some weaker-than-expected incoming housing data. For example, the implied appreciation in the composite for the 2006:Q1 – 2007:Q1 period declined from about 2.1 percent on June 5 to -1.7 percent on June 16, and to -3.7 percent for the most recent observation. In addition to the particular signal regarding future home prices, these movements and the steady increase in open interest broadly suggest that, although these markets are very small, they are not inert.

## **2. The Second Moment: Implied Volatility**

To go beyond mean expectations to higher moments, options are of course necessary. Unfortunately, only a small number of CME housing options have traded to date. Nonetheless, to get a sense of the relative uncertainty surrounding the expected trajectory of the housing market, we can compute implied volatilities from these contracts and compare them with the historical variance of the underlying series.

Table 3 lists all seventeen put and call options that currently trade. Column 5 indicates the current implied volatility on each contract, and Column 6 denotes the standard deviation of CSI-implied year-over-year prices changes from 1987:Q1 through 2006:Q1. In short, with only

one exception, implied volatilities are greater than the historical volatilities, which suggests that investors see more risks to home prices going forward.<sup>6</sup>

### **3. The Third Moment: Skewness**

The second moment alone does not distinguish perceived downside risk from upside potential. To do so, we might consider calculating implied PDFs using the CME housing options. But with few liquid strikes per contract-expiry, we cannot yet compute full distributions of investors' expectations and thereby ascertain the degree of skewness (or other higher moments for that matter).

However, financial asset prices of firms whose fortunes are broadly tied to the housing sector might shed some light on the moments of investors' expectations, not only about home prices, but also more generally regarding the prospects for the broader sector. Indeed, housing sector stocks, as proxied by the S&P 500 Homebuilders Sub-index, significantly underperformed the overall market during the first half of 2006—consistent with some recent deterioration in the outlook for housing.

The remainder of this section outlines the use of derivatives on homebuilders' stocks to extract information about higher moments. Returns on some of these firms' shares may be positively correlated with changes in existing home prices and other relevant incoming news, conditioned on overall market returns.<sup>7</sup> If so, with due regard for idiosyncratic factors, if

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<sup>6</sup> No more than two strikes per contract-expiry currently trade. In the case of the two put options on the Miami futures that expire next February, the implied volatilities are indicative of a smile, as the deeper out-of-the-money put is the more expensive.

<sup>7</sup> The markets for new as opposed to existing homes potentially behave differently. Homebuilders' stocks are obviously more closely related to new home sales, but the regressions nonetheless test for exposure to the existing market.



investors see more downside than upside risk to either home prices or the general housing sector, the PDFs of homebuilders' stocks should be skewed to the left, all else equal.

### *3.1. A Note on Sample Selection*

In order to estimate the PDFs, we obviously can only consider those firms for which options sufficiently trade. As indicated in Table 4, a leading Wall Street analyst covers seventeen homebuilders, and there are sufficiently liquid strikes for seven of these firms—Beazer Homes (BZH), DR Horton (DHI), KB Home (KBH), Lennar (LEN), Pulte Homes (PHM), Ryland Group (RYL), and Toll Brothers (TOL).<sup>8</sup> Table 4 also ranks these companies according to total assets, stock market capitalization, and sales, and the sample contains the four largest firms in terms of total assets.

### *3.2. How Reasonable is the Proxy?*

Apart from specific firm characteristics, again, the key assumption underlying this analysis is that the stock prices of companies that build homes are closely tied to the perceived prospects for residential real estate. The more returns on these stocks empirically exhibit sensitivity to changes in home prices and other related news, conditioned on their market exposure, the more confidence we can have in extrapolating inferences about investors' perceptions from the individual PDFs. But sensitivity to home prices per se aside, we can still draw some conclusions about investors' perceptions regarding the wider sector.

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<sup>8</sup> More specifically, the sample is limited to firms with options that expire in January 2007 with a minimum of nine strikes. (Options are also listed for expiry in January 2008 and January 2009, but liquidity declines with time to maturity.) January 2007 options do not trade for five homebuilders—NVR, Meritage Homes, M/I Homes, Orleans Homebuilders, and Levitt—and there are an insufficient number of strikes for the remainder of firms listed in Table 4.

To test this notion, Tables 5-12 summarizes regression results with quarterly excess price returns on these seven stocks as well as an equally weighted homebuilders index as the dependent variable. The independent variables include excess returns on a market proxy, the S&P 500; the contemporaneous quarterly change in the CSI composite or, to capture particular regional exposures, the CSI indexes for Chicago, Denver, Las Vegas, Los Angeles, Miami, and New York; and the cumulative surprise component of housing starts and new home sales over the quarter, measured by the difference between the released value and the median prediction from the MMS survey.<sup>9</sup> For the equally weighted index and each individual firm, the regression samples, include 1994:Q2 – 2006:Q1, the period over which data on all series are available, and another period, if applicable, using all information for each particular case.

Before examining the results for each individual firm, consider the results for the equally weighted index of the seven homebuilders, listed in Table 5. As Regression 1 indicates, the coefficient for the market return is positive and statistically significant, at least at the 10 percent level, while the contemporaneous change in the composite CSI also enters the regression positively as expected and is safely significant. This finding is consistent with the view that returns on these firms indeed have some significant exposure to changes in home prices, conditioned on overall market performance. Other news about the sector, however, does not seem to have an impact, as the surprise component of housing starts and new home sales are statistically insignificant. Regression 2 suggests that returns on the index of homebuilders do not correlate significantly with contemporaneous changes in any particular metropolitan CSI, as none of the coefficients are statistically significant.

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<sup>9</sup> Contemporaneous values of the CSI indexes are of course not available to investors in real time, but the underlying assumption is that market participants perceive conditions contemporaneously. These metropolitan areas are chosen given that they produce a correlation matrix with no element greater than 0.58, approximately the correlation between the New York and Los Angeles indexes.

Tables 6-12 examine the seven firms individually. Data for two firms generally do not corroborate the findings for the equally weighted index. For example, price returns for DR Horton (Table 7) over both the 1988:Q1 – 2006:Q1 and 1994:Q2 – 2006:Q1 periods correlate positively and significantly with the S&P 500, but the coefficients for the CSI measures, housing starts surprises, and new home sales surprises are statistically insignificant in each regression. Also, although the coefficients for the Miami and Los Angeles indexes are significant with the expected sign in the 1988:Q1 – 2006:Q1 and 1994:Q2 – 2006:Q1 samples (Regressions 2 and 4 in Table 8), respectively, returns for KB Home are uncorrelated with the composite index and are actually negatively correlated with the Las Vegas index in both samples (Regressions 1 and 3). In addition, returns are curiously negatively correlated with housing starts surprises in the 1994:Q2 – 2006:Q1 sample, at least with 10 percent confidence (Regression 4).

The remaining cases lend some support to the overall finding. Although none of the results using data prior to 1994 are statistically significant, quarterly excess returns during the 1994:Q2 – 2006:Q1 period for the remaining five firms—Beazer (Table 6), Lennar (Table 9), Pulte Homes (Table 10), Ryland (Table 11), and Toll Brothers (Table 12)—correlate with contemporaneous changes in the composite CSI with at least 10 percent confidence. In addition, returns for Lennar and Ryland exhibit some positive sensitivity to housing starts surprises in the 1988:Q1 – 2006:Q1 sample (Regressions 1 and 2 in Table 9, and Regression 1 in Table 11). But, curiously with respect to incoming data, returns on Pulte Homes are negatively correlated with new home sales surprises in the 1994:Q2 – 2006:Q1 sample, at least with 10 percent confidence (Regression 3 in Table 10). Also, some of the regressions that include individual metropolitan CSI measures produce somewhat perverse results. For example, returns for Lennar and Ryland during the 1994:Q2 – 2006:Q1 sample correlate negatively with the Las Vegas index with 10

percent confidence (Regression 4 in Tables 9 and 11), and although returns on Toll Brothers correlate positively with the Miami index in the 1988:Q1 – 2006:Q1 period, the correlation with the Los Angeles index is negative (Regression 1 in Table 12).

All in all, although the proxy is far from perfect, the regressions summarized in Tables 5-12 imply that homebuilders' shares, and by extension derivatives on those claims, might contain useful forward-looking information regarding expected home prices in particular, in addition to the housing sector in general. The discussion now turns to options on the shares of these seven firms.

### 3.3. Some details on the Calculation of the PDFs

This paper makes no innovations with respect to methods of extracting PDFs from options prices, but a review of the methodology used here is instructive. Briefly, following Breeden and Litzenberger (1978), the value of an option can be expressed as its discounted expected value under the risk-neutral measure, as in

(3)

$$C(S, t; K, T) = \underbrace{e^{-r(T-t)}}_{\text{discount}} \int_K^{\infty} \underbrace{p(S, t; S', T)}_{\text{density}} \underbrace{(S' - K)}_{\text{payoff}} dS'$$

where  $C$  is the value of a call option on stock  $S$  with strike  $K$ ,  $t$  is the current date,  $T$  is the maturity date,  $r$  is the risk-free rate, and  $p$  is the (risk-neutral) density. Differentiating twice under the integral sign recovers the desired density, following

(4)

$$p(S, t; K, T) = e^{r(T-t)} \frac{\partial^2}{\partial K^2} C(S, t; K, T)$$

Without continuously quoted strikes, we must interpolate between prices or implied volatilities.

The analysis in this paper closely follows Shimko (1993) and estimates a quadratic relation between implied volatility and strike, as in

(5)

$$\hat{\sigma}(K) = \alpha + \beta_1 K + \beta_2 K^2 + \varepsilon$$

where  $\hat{\sigma}$  is the implied volatility associated with  $K$ . The resulting (smooth, twice differentiable) function is substituted for  $\sigma$  in the Black-Scholes formula and differentiated twice to obtain the density for prices at expiration. Finally, a simple transformation produces a distribution in terms of log price returns. As a caveat, there are a number of other possible interpolation methods and therefore ways to extract implied densities (Bliss and Panigirtzoglou, 2002). Also, as discussed further below, I only estimate a given density over the range of quoted strikes and therefore depart from Shimko (1993) in that the estimation imposes no parametric form whatsoever.<sup>10</sup>

With a complete expression for a given density, we can compute all the moments, and this paper mainly concerns skewness and refers to two methods. Perhaps the most standard calculation,  $S$ , follows

(6)

$$S = \frac{\mu_3}{\sqrt{\mu_2^3}},$$

where  $\mu_2$  and  $\mu_3$  are the second and third moments of the distribution, respectively, centered around the mean. The second measure, octile skewness,  $OS$ , follows

(7)

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<sup>10</sup> In addition, I make no adjustment for the fact that the option is American rather than European, but one might exploit the formulae in Barone-Adesi and Whaley (1987). Also, with about six months to expiry, I make no adjustment to the option pricing formulae for those stocks which pay dividends.

$$OS = \frac{[Q(.875) - Q(.5)] - [Q(.5) - Q(.125)]}{Q(.875) - Q(.125)}$$

where  $Q(.5)$ , for example, denotes the median of expected returns. Both measures have their advantages, but octile skewness is usefully bounded between +1 and -1.<sup>11</sup>

### 3.4. Current Skewness among Homebuilders PDFs

Figure 2 shows the implied risk-neutral distributions for the seven homebuilders stocks as of July 10, 2006 for options that expire on January 19, 2007. PDFs for five firms—DR Horton, KB Homes, Lennar, Pulte Homes, and Toll Brothers—exhibit negative skewness according to both measures. Skewness measures for the remaining two homebuilders—Beazer and Ryland—are either mixed or unambiguously positive. In general, the degree of skewness in any case seems to be mild, as the most negative octile skewness is -0.19 (Lennar), and the average across all cases is only -0.08.<sup>12</sup> Therefore, these densities do not suggest that investors see considerably more downside risk than upside potential in the sector.

One issue, again given that the estimation is completely non-parametric and only covers the range of quoted strikes, is that some of the densities are notably truncated. In particular, the distributions for Beazer and Ryland are truncated to the left, and the density for Lennar is truncated to the right. Those for DR Horton and Pulte seem truncated roughly equally in both directions. On the one hand, any remedy would involve some parametric assumption about the form of the distribution outside the range of quoted strikes. On the other hand, the precise degree of skewness is somewhat biased, albeit in both directions, across these cases. Cross-sectional and time-series comparisons might be particularly relevant in this regard.

<sup>11</sup> Octile skewness is similar to quartile skewness. See Hinkley (1975).

<sup>12</sup> Estimation of a single joint returns density for the seven firms as a whole would require strong assumptions about the covariance matrix of returns for this set of homebuilders.

### *3.5. Cross-sectional Comparisons of Skewness*

Whatever the general degree of current skewness for the seven homebuilders, cross-sectional comparisons are additionally useful. In particular, the question remains as to whether skewness for expected returns on homebuilders' shares is more or less pronounced than that currently observed for the broader stock market. Toward such an assessment, consider Figure 3, which shows the PDFs for each of the four current outstanding expiries for options on the S&P 500, calculated by precisely the same methods as in Figure 2.

These S&P 500 densities present a mild negative skewness through the first three horizons. In fact, the distribution for S&P 500 options that expire on December 16, 2006, which is closest to the January 19, 2007 expiry of options on the homebuilders stocks, is more skewed than the average skewness with respect to (6) or (7) among the homebuilder densities in Figure 2. Therefore, the current snapshot does not suggest that investors perceive comparatively more pronounced downside than upside risks for individual homebuilders than for the market as a whole. Put somewhat differently, housing sector risk does not seem to drive the current degree of skewness in the overall market.<sup>13</sup>

### *3.6. Time-series Comparisons of Skewness*

Comparisons over time among the same set of firms also help put the shape of the current distributions into perspective. Toward that end, Table 13 lists relevant measures from the PDFs of KB Home, Pulte Homes, and Toll Brothers for selected historical dates as far back as June 28,

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<sup>13</sup> The degree of truncation in the S&P 500 densities is similar to that which besets the distributions in Figure 2, especially for contracts that expire in 2007.

2002.<sup>14</sup> In general, these data suggest that recent negative skewness has certainly not been noticeably more pronounced compared to previous years. Both indicators of skewness (Columns 4 and 5) for Pulte Homes and Toll Brothers stand at their lowest levels compared to second-quarter-end estimates for 2002, 2003, 2004, and 2005. In addition, the standard skewness measure for KB Home PDF for 2006 is the lowest in the sample, and octile skewness is certainly within its historical range. This analysis is not definitive, but the data hardly suggest that investors now see more downside relative to upside risk in the sector, notably during the sustained run-up in home prices over the last few years.

A comment on the second moment given these historical PDFs may also be useful. Although skewness does not seem to have increased over time, some evidence suggests that general uncertainty is greater than previously observed. Column 6 lists the 90 percent confidence interval, taken as  $Q(.95) - Q(.05)$  and expressed in percentage log price returns, for the same three firms. The width of the confidence interval is highest for the most current observation for Toll Brothers and KB Home, and the latest observation Pulte Homes is near the sample peak. These results are broadly consistent with those in Table 3, which again indicates that the implied volatilities from CME housing options are generally greater than the historical volatilities on the underlying indexes.

#### **4. Conclusions**

Although imperfect gauges, market prices of CME housing futures and derivatives on homebuilders' shares provide some useful information about investors' expectations for the housing market. In general, current prices are consistent with a mean expectation that home

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<sup>14</sup> Historical data on options for individual firms are somewhat limited. In particular, data often do not cover a sufficient range of strikes on both sides of the price of the underlying, and therefore implied densities are frequency severely truncated.



prices will decline a little before the end of 2006, although the extent of the anticipated contraction is modest compared to some estimates of overvaluation in the housing market. Also, whatever the expectation for average home values, investors seem to be more uncertain about that projection. Current implied volatilities on CME housing options are large vis-à-vis historical volatilities in the CSI indexes, and the current widths of the implied densities from options on homebuilders' stocks now stand at comparatively high historical levels. Finally, if market participants entertain the notion of a housing bubble, those PDFs should, all else equal, be skewed notably to the left. However, idiosyncratic factors aside, current equity derivatives suggest that the degree of skew is modest, especially compared to the implied distribution of the overall stock market as well as to historical densities.

Some additional analysis of these issues might be instructive, particularly with respect to the third moment. For example, an examination of the extent to which financial markets price skewness risk might usefully supplement this inquiry. That is, just as we can think of implied volatility as the sum of expected volatility and a volatility risk premium, implied skewness from these distributions might be composed of expected skewness and a risk premium for the third moment. Even so, the relevant distributions vis-à-vis the market and historical data still suggest that skewness is modest, whatever the trends in its components. If such a risk factor commands a higher (lower) price in the current environment, then the expected component of skewness would concomitantly be lower (higher) nonetheless.

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**Table 1: CME Housing Futures Liquidity: July 10, 2006**

(1)	(2)	(3)	(4)	(5)
<u>Metropolitan Area</u>	<u>Ticker</u>	April 2006 CSI <u>Index Value</u>	<u>Open Interest</u>	<u>Notional Value</u>
Composite	CUS	224.62	61	\$3,425,455
Boston	BOS	177.61	46	\$2,042,515
Chicago	CHI	165.62	29	\$1,200,745
Denver	DEN	137.28	13	\$446,160
Las Vegas	LAV	266.78	22	\$1,467,290
Los Angeles	LAX	270.44	114	\$7,707,540
Miami	MIA	276.41	184	\$12,714,860
New York	NYM	213.53	36	\$1,921,770
San Diego	SDG	249.35	58	\$3,615,575
San Francisco	SFR	217.52	45	\$2,447,100
<u>Washington</u>	<u>WDC</u>	<u>250.39</u>	<u>28</u>	<u>\$1,752,730</u>
TOTAL			636	\$38,741,740

**Table 2: CME Housing Futures-Implied Year-Over-Year Percent Changes:  
July 10, 2006**

	Period:			
	<u>2005:Q2-</u> <u>2006:Q2</u>	<u>2005:Q3-</u> <u>2006:Q3</u>	<u>2005:Q4-</u> <u>2006:Q4</u>	<u>2006:Q1-</u> <u>2007:Q1</u>
Composite	6.2	3.2	-1.7	-3.7
Boston	-2.5	-3.6	-3.4	-3.8
Chicago	5.1	2.4	-1.1	-2.9
Denver	0.6	-0.9	-2.0	-2.0
Las Vegas	5.1	1.6	-0.8	-0.9
Los Angeles	10.1	5.6	1.0	-1.9
Miami	15.5	8.0	0.4	-5.8
New York	7.1	4.3	-0.6	-3.5
San Diego	0.8	-0.5	-1.2	-1.4
San Francisco	2.9	0.6	-3.0	-4.8
Washington	4.8	2.3	-1.4	-2.8

**Table 3: Implied Volatility: Options on CME Futures:  
July 10, 2006**

(1)	(2)	(3)	(4)	(5)	(6)
<u>Ticker</u>	<u>Strike</u>	<u>Expiry</u>	<u>Option</u>	<u>Implied Volatility</u>	<u>Historical Volatility*</u>
BOS	160	27-Feb-07	Put	19%	7%
BOS	150	29-May-07	Put	21%	7%
CUS	215	29-May-07	Call	17%	7%
CUS	215	29-May-07	Put	17%	7%
LAV	185	27-Feb-07	Put	22%	9%
LAX	215	27-Feb-07	Put	22%	12%
LAX	282	29-May-07	Put	5%	12%
MIA	240	28-Nov-06	Put	14%	8%
MIA	215	27-Feb-07	Put	21%	8%
MIA	250	27-Feb-07	Put	11%	8%
NYM	210	29-May-07	Put	23%	7%
NYM	210	29-May-07	Call	23%	7%
NYM	215	29-May-07	Put	24%	7%
NYM	215	29-May-07	Call	24%	7%
SDG	200	27-Feb-07	Put	20%	10%
SDG	240	29-May-07	Put	17%	10%
SFR	175	27-Feb-07	Put	20%	10%

\*Standard deviation of CSI-implied year-over-year price changes, 1987:Q1 – 2006:Q1.

**Table 4: 2006:Q1 Rankings of Homebuilders by Total Assets, Stock Market Capitalization, and Sales**

Rank	Total Assets		Stock Market Capitalization		Sales	
1	<i>LEN</i>	<i>Lennar Corp</i>	NVR	NVR Inc	NVR	NVR Inc
2	<i>PHM</i>	<i>Pulte Homes Inc</i>	<i>LEN</i>	<i>Lennar Corp</i>	<i>KBH</i>	<i>KB Home</i>
3	<i>DHI</i>	<i>D R Horton Inc</i>	<i>KBH</i>	<i>KB Home</i>	MDC	MDC Holdings Inc
4	<i>KBH</i>	<i>KB Home</i>	<i>PHM</i>	<i>Pulte Homes Inc</i>	<i>RYL</i>	<i>Ryland Group Inc</i>
5	NVR	NVR Inc	MDC	MDC Holdings Inc	MTH	Meritage Homes Corp
6	MDC	MDC Holdings Inc	<i>RYL</i>	<i>Ryland Group Inc</i>	<i>LEN</i>	<i>Lennar Corp</i>
7	<i>TOL</i>	<i>Toll Brothers Inc</i>	<i>DHI</i>	<i>D R Horton Inc</i>	<i>BZH</i>	<i>Beazer Homes USA Inc</i>
8	<i>RYL</i>	<i>Ryland Group Inc</i>	<i>BZH</i>	<i>Beazer Homes USA Inc</i>	HOV	Hovnanian Enterprises
9	SPF	Standard Pacific Cp	MTH	Meritage Homes Corp	MHO	M/I Homes Inc
10	MTH	Meritage Homes Corp	SPF	Standard Pacific Cp	SPF	Standard Pacific Cp
11	<i>BZH</i>	<i>Beazer Homes USA Inc</i>	<i>TOL</i>	<i>Toll Brothers Inc</i>	<i>PHM</i>	<i>Pulte Homes Inc</i>
12	HOV	Hovnanian Enterprises	HOV	Hovnanian Enterprises	<i>TOL</i>	<i>Toll Brothers Inc</i>
13	TOA	Technical Olympic USA Inc	MHO	M/I Homes Inc	<i>DHI</i>	<i>D R Horton Inc</i>
14	WCI	WCI Communities Inc	TOA	Technical Olympic USA Inc	WCI	WCI Communities Inc
15	MHO	M/I Homes Inc	WCI	WCI Communities Inc	TOA	Technical Olympic USA Inc
16	OHB	Orleans Homebuilders Inc	OHB	Orleans Homebuilders Inc	OHB	Orleans Homebuilders Inc
17	LEV	Levitt Corp	LEV	Levitt Corp	LEV	Levitt Corp

\* Source: Compustat (Italics denote firms for which sufficient options data are available.)

**Table 5: Homebuilders Index (Equally weighted)  
(BZH, DHI, KBH, LEN, PHM, RYL, TOL)**

Sample:	1994:Q2 – 2006:Q1	
	(1)	(2)
S&P 500	0.7876 (0.068)+	0.8527 (0.082)+
CSI: Composite Index	2.2065 (0.016)*	
Housing Starts Surprise	0.1897 (0.608)	-0.0374 (0.922)
New Home Sales Surprise	-0.0006 (0.444)	-0.0004 (0.568)
CSI: Chicago		-1.4412 (0.646)
CSI: Denver		-0.6570 (0.790)
CSI: Las Vegas		-0.9687 (0.120)
CSI: Los Angeles		1.5764 (0.262)
CSI: Miami		1.3134 (0.377)
CSI: New York		0.6582 (0.790)
Constant	-0.0007 (0.983)	0.0125 (0.764)
Observations	48	48
Adjusted R-squared	0.064	-0.002
Durbin-Watson	1.048	1.161

p values in parentheses

+ significant at 10%; \* significant at 5%; \*\* significant at 1%

**Table 6: Beazer Homes USA, Inc. (BZH)**

Sample:	1994:Q2 – 2006:Q1	
	(1)	(2)
S&P 500	0.5743 (0.311)	0.8084 (0.209)
CSI: Composite Index	1.6804 (0.084)+	
Housing Starts Surprise	0.3579 (0.359)	0.3577 (0.433)
New Home Sales Surprise	-0.0004 (0.654)	-0.0002 (0.847)
CSI: Chicago		-0.4744 (0.895)
CSI: Denver		1.0476 (0.698)
CSI: Las Vegas		-0.7775 (0.231)
CSI: Los Angeles		-0.1980 (0.900)
CSI: Miami		2.3261 (0.195)
CSI: New York		0.9047 (0.752)
Constant	0.0121 (0.750)	-0.0201 (0.698)
Observations	48	48
Adjusted R-squared	-0.014	-0.084
Durbin-Watson	1.299	1.435

p values in parentheses

+ significant at 10%; \* significant at 5%; \*\* significant at 1%



**Table 7: DR Horton (DHI)**

Sample:	1992:Q3 – 2006:Q1		1994:Q2 – 2006:Q1	
	(1)	(2)	(3)	(4)
S&P 500	0.9485 (0.021)*	1.0526 (0.028)*	0.9739 (0.026)*	1.0009 (0.043)*
CSI: Composite Index	1.0779 (0.270)		1.7181 (0.121)	
Housing Starts Surprise	0.1026 (0.814)	-0.0716 (0.875)	0.1333 (0.761)	-0.2688 (0.529)
New Home Sales Surprise	-0.0001 (0.931)	0.0000 (0.965)	-0.0003 (0.741)	-0.0002 (0.798)
CSI: Chicago		-0.7394 (0.805)		-1.4003 (0.678)
CSI: Denver		-0.4417 (0.836)		-1.9754 (0.434)
CSI: Las Vegas		-0.1659 (0.842)		-0.5944 (0.494)
CSI: Los Angeles		0.0470 (0.977)		1.4256 (0.444)
CSI: Miami		1.4783 (0.174)		1.2193 (0.386)
CSI: New York		0.3757 (0.899)		0.3086 (0.921)
Constant	0.0250 (0.421)	0.0229 (0.645)	0.0062 (0.871)	0.0361 (0.475)
Observations	55	55	48	48
Adjusted R-squared	0.025	-0.052	0.033	-0.018
Durbin-Watson	1.238	1.326	1.231	1.292

p values in parentheses

+ significant at 10%; \* significant at 5%; \*\* significant at 1%

**Table 8: KB Home (KBH)**

Sample:	1988:Q1 – 2006:Q1		1994:Q2 – 2006:Q1	
	(1)	(2)	(3)	(4)
S&P 500	1.7683 (0.004)**	1.6523 (0.005)**	0.6467 (0.147)	0.7597 (0.107)
CSI: Composite Index	0.8770 (0.508)		1.7865 (0.124)	
Housing Starts Surprise	0.5853 (0.164)	0.4183 (0.383)	-0.0338 (0.934)	-0.6049 (0.093)+
New Home Sales Surprise	0.0002 (0.777)	0.0002 (0.717)	-0.0006 (0.380)	-0.0005 (0.470)
CSI: Chicago		1.4504 (0.398)		-3.6480 (0.189)
CSI: Denver		0.8665 (0.699)		-2.9276 (0.201)
CSI: Las Vegas		-1.9892 (0.013)*		-1.5025 (0.009)**
CSI: Los Angeles		2.0432 (0.260)		2.3214 (0.079)+
CSI: Miami		2.9978 (0.017)*		1.8285 (0.215)
CSI: New York		-4.6161 (0.104)		1.0514 (0.631)
Constant	0.0278 (0.376)	0.0090 (0.787)	-0.0005 (0.988)	0.0437 (0.282)
Observations	73	73	48	48
Adjusted R-squared	0.126	0.177	0.008	0.190
Durbin-Watson	1.281	1.386	1.235	1.463

p values in parentheses

+ significant at 10%; \* significant at 5%; \*\* significant at 1%

**Table 9: Lennar (LEN)**

Sample:	1988:Q1 – 2006:Q1		1994:Q2 – 2006:Q1	
	(1)	(2)	(3)	(4)
S&P 500	1.3710 (0.001)**	1.3862 (0.001)**	1.0605 (0.013)*	0.9747 (0.047)*
CSI: Composite Index	0.3853 (0.675)		1.8467 (0.068)+	
Housing Starts Surprise	0.5054 (0.088)+	0.5831 (0.072)+	0.3087 (0.360)	0.1911 (0.565)
New Home Sales Surprise	0.0000 (0.927)	-0.0001 (0.922)	-0.0007 (0.347)	-0.0007 (0.370)
CSI: Chicago		1.5611 (0.171)		-0.7797 (0.847)
CSI: Denver		0.2452 (0.881)		-0.9975 (0.700)
CSI: Las Vegas		-0.6424 (0.117)		-1.2096 (0.072)+
CSI: Los Angeles		-0.0566 (0.924)		2.7065 (0.158)
CSI: Miami		-0.8156 (0.418)		-0.7929 (0.603)
CSI: New York		1.1791 (0.448)		0.5985 (0.839)
Constant	0.0369 (0.146)	0.0311 (0.206)	0.0129 (0.729)	0.0455 (0.401)
Observations	73	73	48	48
Adjusted R-squared	0.155	0.139	0.087	0.025
Durbin-Watson	1.174	1.182	0.941	1.008

p values in parentheses

+ significant at 10%; \* significant at 5%; \*\* significant at 1%

**Table 10: Pulte Homes Inc. (PHM)**

Sample:	1988:Q1 – 2006:Q1		1994:Q2 – 2006:Q1	
	(1)	(2)	(3)	(4)
S&P 500	1.3798 (0.002)**	1.3538 (0.005)**	0.8482 (0.040)*	0.8272 (0.076)+
CSI: Composite Index	0.5441 (0.650)		2.9892 (0.003)**	
Housing Starts Surprise	0.3052 (0.415)	0.3288 (0.456)	-0.0390 (0.919)	-0.2229 (0.603)
New Home Sales Surprise	-0.0000 (0.963)	0.0000 (0.958)	-0.0011 (0.084)+	-0.0010 (0.140)
CSI: Chicago		0.0939 (0.950)		-2.3145 (0.530)
CSI: Denver		1.7732 (0.374)		0.5954 (0.806)
CSI: Las Vegas		-0.6071 (0.328)		-0.4047 (0.529)
CSI: Los Angeles		0.6116 (0.514)		1.9991 (0.149)
CSI: Miami		1.7745 (0.116)		1.4345 (0.330)
CSI: New York		-1.8514 (0.357)		0.2561 (0.912)
Constant	0.0313 (0.317)	0.0029 (0.927)	-0.0152 (0.636)	-0.0069 (0.859)
Observations	73	73	48	48
Adjusted R-squared	0.109	0.066	0.124	0.037
Durbin-Watson	1.492	1.467	1.443	1.590

p values in parentheses

+ significant at 10%; \* significant at 5%; \*\* significant at 1%

**Table 11: Ryland Group Inc. (RYL)**

Sample:	1988:Q1 – 2006:Q1		1994:Q2 – 2006:Q1	
	(1)	(2)	(3)	(4)
S&P 500	0.8825 (0.076)+	0.9611 (0.057)+	0.4473 (0.469)	0.4616 (0.490)
CSI: Composite Index	1.3213 (0.217)		2.2960 (0.059)+	
Housing Starts Surprise	0.6246 (0.063)+	0.5359 (0.138)	0.4167 (0.299)	0.2432 (0.603)
New Home Sales Surprise	0.0005 (0.460)	0.0006 (0.444)	-0.0001 (0.936)	0.0001 (0.961)
CSI: Chicago		0.8256 (0.449)		0.2800 (0.932)
CSI: Denver		0.3434 (0.838)		-0.7479 (0.815)
CSI: Las Vegas		-1.4545 (0.025)*		-1.6570 (0.083)+
CSI: Los Angeles		0.7305 (0.384)		2.1701 (0.274)
CSI: Miami		1.9985 (0.083)+		1.1409 (0.578)
CSI: New York		-0.7644 (0.672)		-0.3285 (0.914)
Constant	0.0163 (0.530)	0.0035 (0.889)	0.0063 (0.875)	0.0216 (0.687)
Observations	73	73	48	48
Adjusted R-squared	0.076	0.065	-0.012	-0.087
Durbin-Watson	1.442	1.445	1.279	1.365

p values in parentheses

+ significant at 10%; \* significant at 5%; \*\* significant at 1%

**Table 12: Toll Brothers Inc. (TOL)**

Sample:	1988:Q1 – 2006:Q1		1994:Q2 – 2006:Q1	
	(1)	(2)	(3)	(4)
S&P 500	1.4815 (0.003)**	1.6419 (0.001)**	0.9621 (0.038)*	1.1366 (0.057)+
CSI: Composite Index	-0.2286 (0.876)		3.1288 (0.017)*	
Housing Starts Surprise	0.5285 (0.336)	0.5139 (0.331)	0.1839 (0.755)	0.0431 (0.947)
New Home Sales Surprise	0.0007 (0.386)	0.0006 (0.390)	-0.0008 (0.349)	-0.0006 (0.557)
CSI: Chicago		1.9594 (0.169)		-1.7516 (0.642)
CSI: Denver		1.5424 (0.461)		0.4065 (0.900)
CSI: Las Vegas		-0.3062 (0.647)		-0.6354 (0.456)
CSI: Los Angeles		-1.7499 (0.052)+		0.6097 (0.729)
CSI: Miami		2.3423 (0.073)+		2.0372 (0.259)
CSI: New York		-0.5361 (0.792)		1.8170 (0.565)
Constant	0.0298 (0.370)	-0.0225 (0.414)	-0.0266 (0.469)	-0.0324 (0.564)
Observations	73	73	48	48
Adjusted R-squared	0.103	0.118	0.080	-0.033
Durbin-Watson	1.303	1.387	1.129	1.197

p values in parentheses

+ significant at 10%; \* significant at 5%; \*\* significant at 1%

**Table 13: Selected Moments of Probability Density Functions from Options on Homebuilders' Shares**

(1)	(2)	(3)	(4)	(5)	(6)
<u>Homebuilder</u>	<u>Date</u>	<u>Expiry</u>	<u>Skewness</u>	<u>Octile Skewness</u>	<u>90 Percent Confidence Interval*</u>
KB Home	6/28/2002	1/18/2003	-0.60	-0.25	72.76
KB Home	6/30/2003	1/17/2004	-0.53	-0.17	80.25
KB Home	6/30/2004	1/22/2005	-0.55	-0.10	77.16
KB Home	6/30/2005	1/21/2006	-0.69	-0.19	67.37
<i>KB Home</i>	<i>7/10/2006</i>	<i>1/19/2007</i>	<i>-0.44</i>	<i>-0.17</i>	<i>95.89</i>
Pulte Homes	6/30/2003	1/17/2004	-0.64	-0.22	72.14
Pulte Homes	6/30/2004	1/22/2005	-0.86	-0.21	77.59
Pulte Homes	6/30/2005	1/21/2006	-1.08	-0.25	95.84
<i>Pulte Homes</i>	<i>7/10/2006</i>	<i>1/19/2007</i>	<i>-0.28</i>	<i>-0.11</i>	<i>87.65</i>
Toll Brothers	6/28/2002	1/18/2003	-0.72	-0.26	82.80
Toll Brothers	6/30/2003	1/17/2004	-0.87	-0.27	101.90
Toll Brothers	6/30/2004	1/22/2005	-1.69	-0.28	84.54
Toll Brothers	6/30/2005	1/21/2006	-1.14	-0.29	87.26
<i>Toll Brothers</i>	<i>7/10/2006</i>	<i>1/19/2007</i>	<i>-0.31</i>	<i>-0.08</i>	<i>102.51</i>

\*Measured by  $Q(.95) - Q(.05)$  and expressed in terms of percentage log returns.

Figure 1: CME Housing Futures

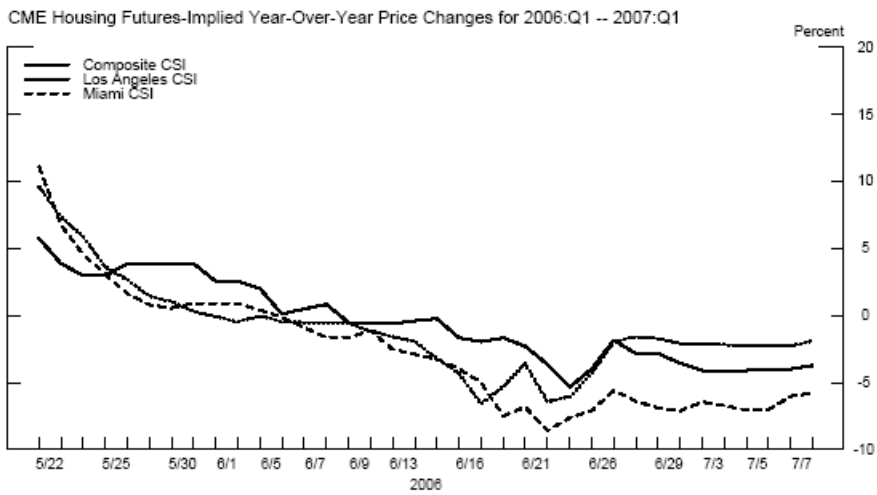
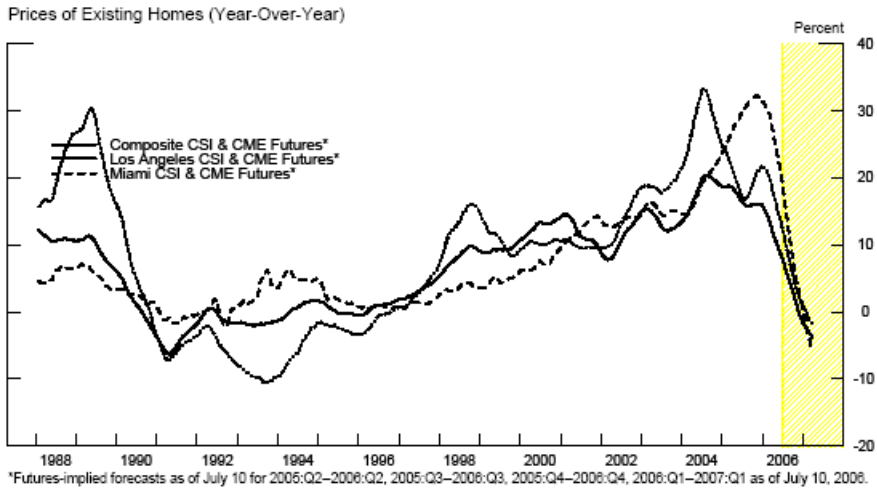




Figure 2: Implied PDFs of (Log) Price Returns from Options on HomeBuilders' Stocks  
July 10, 2006 (Expiry: January 19, 2007)

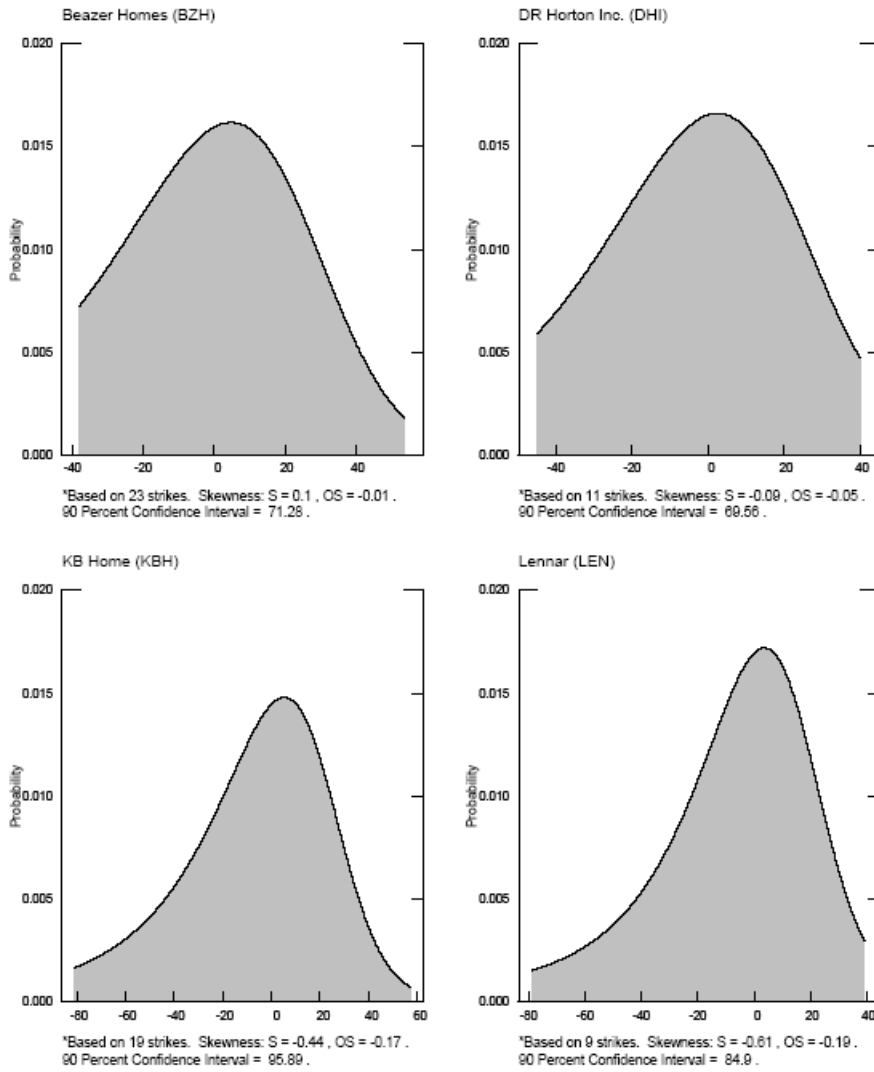


Exhibit 2 (Continued): Implied PDFs of (Log) Price Returns from Options on Homebuilders' Stocks  
July 10, 2006 (Expiry: January 19, 2007)

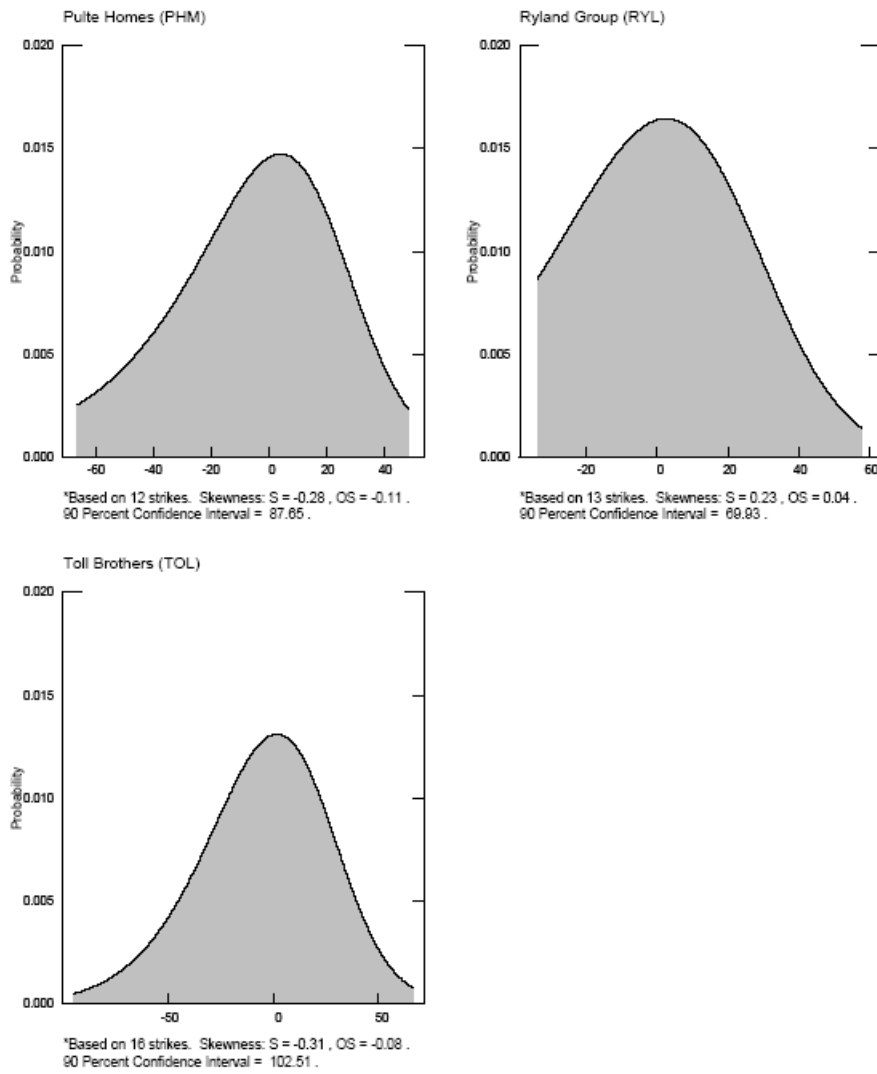


Figure 3: Implied PDFs of (Log) Price Returns from Options on the S&amp;P 500

