WP 2009-22
June 2009

Working Paper

Department of Applied Economics and Management
Cornell University, Ithaca, New York 14853-7801 USA

Conditional Skewness of Aggregate Market Returns

Anchada Charoenrook and Hazem Daouk

Conditional Skewness of Aggregate Market Returns

Anchada Charoenrook* and Hazem Daouk+

March 2004
This version: May 2008

Abstract:
The skewness of the conditional return distribution plays a significant role in financial theory and practice. This paper examines whether conditional skewness of daily aggregate market returns is predictable and investigates the economic mechanisms underlying this predictability. In both developed and emerging markets, there is strong evidence that lagged returns predict skewness; returns are more negatively skewed following an increase in stock prices and returns are more positively skewed following a decrease in stock prices. The empirical evidence shows that the traditional explanations such as the leverage effect, the volatility feedback effect, the stock bubble model (Blanchard and Watson, 1982), and the fluctuating uncertainty theory (Veronesi, 1999) are not driving the predictability of conditional skewness at the market level. The relation between skewness and lagged returns is more consistent with the Cao, Coval, and Hirshleifer (2002) model. Our findings have implications for future theoretical and empirical models of time-varying market return distributions, optimal asset allocation, and risk management.

JEL classification code: G12, C1
Keywords: Conditional skewness, Conditional Volatility, Predicting Skewness, Aggregate market returns, International finance

* The Owen Graduate School of Management, Vanderbilt University, 401 21st. Avenue South, Nashville, TN 37203. Email: anchada.charoenrook@owen.vanderbilt.edu

+ Department of Applied Economics & Management, Cornell University, 446 Warren Hall, Ithaca, NY 14853. Email: hd35@cornell.edu

Introduction

The characteristics of the distribution of security returns, such as skewness, play a significant role in financial theory and practice. Many asset pricing models, such as the CAPM, assume multivariate normal distributions of stock returns. If stock return distributions are skewed, then asset pricing models that account for the presence of higher moments should produce more accurate valuations.[1] In a study of stock portfolio returns, Harvey and Siddique (2000) find that coskewness of portfolio returns with the aggregate market returns is a determinant of expected returns.[2] Patton (2002) shows that accounting for skewness improves performance of optimal asset allocation. Furthermore, accurate prediction of the conditional return distribution, especially at the higher moments (volatility and skewness), significantly improves the valuation of contingent claims and the effectiveness of risk management. Thus, investigating asymmetry in stock return distributions and what causes it is important for multiple facets of finance.

Some theories posit that conditional skewness may be predictable by lagged returns and trend-adjusted turnover. At the firm level, there is some empirical evidence of this predictability. Harvey and Siddique (2000) document that skewness varies among portfolios of different size and book-to-market levels. Chen, Hong, and Stein (2001) report that trend-adjusted turnover and lagged returns predict skewness of daily returns of individual stocks in the U.S. stock market. At the market level, while time variation in skewness has been documented, there are no studies of the predictability of skewness.[3]

This paper examines whether the conditional skewness of aggregate market returns is predictable by lagged returns and trend-adjusted turnover, and we investigate what economic mechanisms are responsible for the predictability of skewness. We analyze aggregate market returns in 57 countries. We present new evidence that conditional skewness of aggregate market returns is predictable. Lagged one-month returns predict conditional skewness of daily returns during the following month. This relation between skewness and lagged returns

---

[1] For example, Harvey and Siddique (2000) and Dittmar (2002) develop asset pricing models which include higher moments like skewness and kurtosis.

[2] Harvey and Siddique (2000) define coskewness as a measure of the comovement of the second moments of the portfolio returns and the second moment of aggregate market returns.

[3] Harvey and Siddique (1999) document time variation in the skewness of the S&P500 index returns and four other international market returns.

is economically and statistically strong across both developed and emerging countries. We find similar results using lagged returns over 3 months, 6 months, and 12 months. In contrast, we find that trend-adjusted turnover does not predict market returns.

Why should conditional skewness be predictable? We categorize the theories that address this question into three groups. We discuss them in detail in the next section[4]. The first group of theories shows that more negative skewness should follow stock price declines. The earliest theory is the leverage effect (Black, 1976; Christie, 1982). A drop in stock price raises financial and operating leverage, which increases volatility of subsequent stock returns. An increase in stock price reduces leverage, which reduces volatility of subsequent stock returns. This relation between time-varying volatility and returns can generate what appears to be non-zero skewness because stock returns measured over an extended period of time consist of a mixture of conditional return distributions. When the mean of these conditional distributions are declining at the same time as their volatilities are increasing, the return over a period of changing conditional distributions will have negative skewness. Consequently, the leverage effect can create a negative relation between lagged return and skewness.

The second theory in this group is the volatility feedback effect (Pindyck, 1984; French et al., 1987; and Campbell and Hentschel, 1992). Releases of major bad news decrease stock price and increase volatility. The increase in volatility increases expected returns, which exacerbates the stock price decline. On the other hand, releases of major good news increase stock price and also increase volatility; the second effect dampens the former. Thus, given the same amount of information, stock price declines are larger than stock price increases. This generates a negative relation between lagged return and conditional skewness. The third theory is one of fluctuation in the level of uncertainty (David, 1997; Veronesi, 1999). This theory is akin to the volatility feedback effect, but it is more specific on how volatility level changes with unexpected news.

The second group of theories predicts more negative skewness following price increases or high levels of trend-adjusted turnover. The stochastic bubble model of Blanchard and Watson (1982) predicts larger negative skewness following a period of sustained stock price

---

[4] Veronesi (2002) offers a concise but comprehensive review of well know theories that can cause path dependent conditional skewness.

increase. The asymmetry here is caused by a stock bubble bursting – a low probability of very large negative returns. Hong and Stein (2003) propose a model in which lagged trend-adjusted turnover is negatively related to skewness. This relation arises because investors have heterogeneous beliefs and they cannot short sell stocks.

In the last group is the theory proposed by Cao, Coval, and Hirshleifer (2002) (hereafter CCH). Their model is based on information blockage due to trading costs. The model predicts negative skewness following a price run up and positive skewness following a price run down. CCH also predict increase in volatility following large price changes.

We adopt a simple, yet effective method to disentangle the effects of these theories. We note that the relation between lagged returns and conditional volatility or skewness implied by these theories depends on the sign of lagged returns. Therefore, we test the relation between lagged returns and conditional skewness based on signed lagged returns. Existing empirical studies do not distinguish whether this relation is symmetric with respected to the direction of lagged returns.

Our results are able to distinguish between the competing theories. Specifically, we find that stock returns become more negatively skewed following a positive return month and become more positively skewed following a negative return month. The result that negative lagged returns predict more positive skewness is contrary to the predictions of the leverage effect, the volatility feedback effect, and the fluctuation uncertainty theory. The stochastic stock bubble model does not predict any relation between negative lagged returns and skewness. In contrast, the economic mechanism proposed in CCH appears to be more consistent with our findings.

The findings in this study contribute to the existing literature in various aspects. First, they suggest the inclusion of predictable skewness in models of contingent claims and risk management. Employing more accurate predictions of conditional skewness should improve the valuation of contingent claims on the stock market and the effectiveness of risk management. Second, they suggest that future theoretical and empirical models of stock market returns should allow for predictable conditional skewness. Third, the predictability of conditional skewness of market returns is relevant to the optimal dynamic asset allocation among stocks, bonds, and other assets, of risk-averse investors. Lastly, the finding that positive lagged returns predict more negative skewness and negative lagged returns predict more positive skewness suggests that the economic mechanism driving this relation affects both buying and selling of stocks. In CCH, trading costs causes the conditional return distribution to be asymmetric even when the arrival of information is symmetric ex ante.

The remainder of this paper is organized as follows. Section I presents the theories related to the predictability of skewness. Section II describes the data employed in our tests. Section III reports the test results. We discuss robustness issues in Section IV, and offer concluding remarks in Section V.

I. Background theories

This section describes existing theories that have implications for conditional skewness. Their effects are summarized in Table I.

A. The leverage effect, volatility feedback effect, and the fluctuation of uncertainty effect

When a firm has leverage, a drop in stock price raises financial and operating leverage (when debt is constant), which increases its volatility. An increase in stock price reduces leverage, which reduces its volatility. The leverage effect can generate what appears to be negative skewness because the stock return, which is measured over an extended period of time, picks up a mixture of conditional return distributions whose mean are declining at the same time as their volatilities are increasing. Because leverage is higher after stock prices decline, the leverage effect cause a negative relation between lagged return and conditional skewness.

The volatility feedback effect hinges on the empirical observation that in a period of significant news, good or bad, stock prices become more volatile for a period of time. Increased volatility increases the expected return on the stock, which further exacerbates a stock decline, but dampens a stock price increase. The volatility feedback effect predicts larger stock price declines than increases given the same amount of information ex ante. This causes returns to be more negatively skewed when stock prices decline.

Veronesi (1999) proposes a theory in which there is fluctuation in the level of uncertainty of the state of the economy. Veronesi (1999) models the dividend process as a Markov switching process between a good and a bad economic state. When investors receive a stream of good news, they become more certain that the economy is in the good state. If bad news arrives following a stream of good news, it causes a price decline and also makes investors more uncertain as to what state the economy is in. On the other hand, the arrival of good news when investors believe that the economy is in the bad state, increases price, but it also increases the uncertainty about what state the economy is in. Veronesi shows that in equilibrium, the willingness of investors to hedge against a change in their own uncertainty on the true state of the economy makes stock price overreact to bad news and underreact to good news. Consequently, returns are more negatively skewed when prices decline.

B. Cao, Coval, and Hirshleifer (2002)

In the Cao, Coval, and Hirshleifer (2002) model there are informed investors, uninformed noise traders, and an uninformed market maker. All market participants are fully rational. Investors incur heterogeneous trading costs. There is a probability that a set of investors received a common noisy informative signal about the valuation of a security.

The following chain of events illustrates the main idea of this model. There is private good news about a security, and a set of investors receive favorable signals about this security. Despite receiving a private signal, some investors are "sidelined" and do not trade because of high trading costs. Others with lower trading costs buy the security. After observing a stock price increase due to buy trades, a favorably informed sidelined investor weighs two effects. On the one hand, the accuracy of his signal is confirmed, but on the other hand the stock price is more expensive to buy. The price increase may not outweigh the net gain from trading because the price is revised by an uninformed market maker. That is, the revised price set by the market maker remains less than the full information price; the market maker does not know for certain that there is a private signal. Therefore, the market maker places a higher probability that the last trade was from a liquidity trader than the informed sidelined investor who has received a signal himself. Consequently, more informed investors who were previously sidelined buy stocks because the confirmation of their signals by other buyers outweighs their trading costs. Overall, significant price rise can trigger trading of a favorable informed investor previously sidelined. Conversely, an informed investor with negative information becomes less confident that he has received the correct signal, and therefore sits out and does not trade.

This sidelining of investors causes conditional changes in skewness as a function of past returns. After an upward price trend, it is likely that there are a few sidelined investors with favorable signals so that prices will rise moderately higher. However, it is likely that there are a large number of sidelined investors with adverse signals. The eventual entry of sidelined investors with adverse signals will cause a major correction. The market maker is aware of these sidelined investors and adjusts prices accordingly when he sees a sell trade. Thus, returns become more negatively skewed following price rises, even when returns are ex ante symmetric. The opposite chain of events occurs when private news is negative. In this case, prices decline and sidelined investors are more likely to be the ones that have favorable signals. Thus, returns are more positively skewed following a price decline. This mechanism also gives rise to high conditional volatility following either a large price increase or decline.

C. Hong and Stein (2003)

Hong and Stein (2003) (hereafter HS) propose a model that generates a relation between lagged turnover and skewness. The asymmetric property of returns arises because investors have heterogeneous beliefs, and they cannot short sell. In their model, there are three traders in the market: investor A, investor B, and arbitrageurs. Investors A and B cannot short sell stocks. Arbitrageurs can short sell any amount of stocks at no cost. These three traders trade one stock which may be thought of as the market portfolio.

Investors A and B are assumed to be overconfident and therefore use their private information in valuing the stock, but neither use the other's signal even when it is revealed. This assumption keeps the differences of opinion between the two investors from converging. Arbitrageurs are fully rational, risk-neutral, and uninformed. Arbitrageurs realize that the best estimate of the stock value is the average of signals of A and B. Sometimes, however, the arbitrageurs do not observe the signal of A or B because A or B may not trade due to short-sale constraints.

To see how the model generates asymmetric conditional skewness, consider an example. At time 1, investor A receives a pessimistic signal such that A's valuation is lower than that of

B. Investor A sits out of the market since he is not allowed to short sell, but B trades. Arbitrageurs observe this and realize that A's valuation is lower than that of B, but do not know by how much. Thus, the stock price at time 1 does not fully reflect information of A.

At date 2, if B's signal is positive then B trades with the arbitrageurs, and A does not trade. The stock price still does not reflect A's time 1 information. If however, at time 2, B receives a pessimistic signal that is lower than the current market valuation, then B will sell his stocks which lowers price. At this point arbitrageurs learn something by observing if and at what price A steps in and starts buying. That is, arbitrageurs learn about A's information by observing how A reacts to reduced demand by B. Thus, more information of pessimistic investors is revealed as stock price declines. This mechanism generates a higher variance as the stock price declines causing negative skewness in stock returns at time 2.

The logic above, however, is not sufficient to establish that the return distribution over time 1 and time 2 is negatively skewed. There is a counter effect of positive skewness at time 1 because the negative draws are the ones hidden from the market at time 1. Hong and Stein show that when A's and B's beliefs are sufficiently different, time-2 effect dominates leading to negative skewness in returns. Hong and Stein suggest that the level of divergence of opinion can be measured by turnover. Thus, the model predicts that returns will be more negatively skewed following an increase in turnover.

II. Data

This section describes the data set employed in the empirical tests which includes measures of conditional skewness and conditional volatility, as well as other control variables. The daily returns and monthly returns of equity indices, trading volume, and market capitalization are obtained from Datastream database for the period of January 1973 through December 2002 for 23 developed and 34 emerging markets. The results presented here are for gross aggregate market returns. We also test aggregate market returns in excess of the risk free rate and find the same results.

A. Market return variables

The conditional skewness in daily returns, $sk_{i,t}$,is computed each month as

$$sk_{i,t} = \frac{n}{(n-1)(n-2)} \sum_{\tau=1}^{n} \left(\frac{r_{i,\tau,t} - \bar{r}_{i,t}}{\hat{\sigma}_{i,t}} \right)^3 , \qquad (1)$$

where $\hat{\sigma}^2{}_{i,t} = \frac{1}{(n-1)} \sum_{\tau=1}^{n} (r_{i,\tau,t} - \bar{r}_{i,t})^2$.

$r_{i,\tau,t}$ is the index return of country *i* on day τ in month *t*, $\bar{r}_{i,t}$ is the average daily return for returns of month *t*, and *n* is the number of daily observations in month *t*. Scaling the raw central third moment by the standard deviation is a standard normalization employed for skewness statistics that allows for a comparison across returns with different variances (Greene, 1993).

The conditional volatility of *daily* market returns is the standard deviation of daily returns in a month given as

$$\hat{\sigma}_{i,t} = \sqrt{\frac{1}{(n-1)} \sum_{\tau=1}^{n} (r_{i,\tau,t} - \bar{r}_{i,t})^2} \ . \qquad (2)$$

We also test the standard deviation estimates of daily returns that corrects for non-synchronous trading as in French, Schwert, and Stambaugh (1987) and find similar results (not reported here).

We examine the volatility of *monthly* returns estimated using the following ARCH model:

$$\begin{aligned}
r_{i,t} &= c_1 + \varepsilon_{i,t}, \\
r_{w,t} &= c_2 + \varepsilon_{w,t}, \\
h_{i,t} &= b_1 + a_1\left(\frac{1}{2}\varepsilon^2_{i,t-1} + \frac{1}{3}\varepsilon^2_{i,t-2} + \frac{1}{6}\varepsilon^2_{i,t-3}\right), \\
h_{w,t} &= b_2 + a_2\left(\frac{1}{2}\varepsilon^2_{w,t-1} + \frac{1}{3}\varepsilon^2_{w,t-2} + \frac{1}{6}\varepsilon^2_{w,t-3}\right), \\
h_{i,w,t} &= b_3 + a_3\left(\frac{1}{2}\varepsilon_{i,t-1}\varepsilon_{w,t-1} + \frac{1}{3}\varepsilon_{i,t-2}\varepsilon_{w,t-2} + \frac{1}{6}\varepsilon_{i,t-3}\varepsilon_{w,t-3}\right), \\
\varepsilon_{i,t}, \varepsilon_{w,t} &\sim N\left(\begin{bmatrix}0\\0\end{bmatrix}, \begin{bmatrix}h_{i,t} & h_{i,w,t}\\ h_{i,w,t} & h_{w,t}\end{bmatrix}\right).
\end{aligned} \qquad (3)$$

$r_{w,t}$ is the monthly return of the world market index at month *t*.

$\varepsilon_{i,t}$ is the innovation in monthly return of the stock market index of country *i* at month *t*.

$h_{w,t}$ is the conditional variance of the world index at time *t*.

$h_{i,t,}$ is the conditional variance of the monthly return of the stock market index of country *i* at month *t*. The conditional volatility of monthly returns is the square root of $h_{i,t}$.

$h_{i,w,t}$ is the conditional covariance of the monthly returns of the stock market index of country *i* with the monthly return of the world index at time *t*.

The weights of the lagged residual vectors of the model in (3) are taken to be 1/2, 1/3, and 1/6, as in as in Engle, Lilien, and Robins (1987). The constants a_2, b_2, and c_2 are constrained to be identical for every country-world pair. We use the Morgan Stanley Capital International Inc. (MSCI) value-weighted world index as proxy for the world market portfolio.[5] We estimate the model in (3) using the maximum likelihood estimate.

Turnover is defined as the ratio of volume of dollar trade per month to dollar market capitalization at the end of the month. To mitigate the effect of outliers, which occur because the denominator is small in some countries, we take the natural logarithm of this ratio. As in Chen, Hong, and Stein (2001), we use trend-adjusted turnover to test the predictions of Hong and Stein (2003). The adjustment eliminates any component of turnover that is related to a fixed country characteristic. Here, the adjustment is done by subtracting from turnover the average of turnover during the previous six months.[6]

B. Data on the legality and feasibility of short selling and existence of put options

We construct a measure of short-sale constraints using survey data on the feasibility of short selling and put option trading from Charoenrook and Daouk (2003). Charoenrook and Daouk (2003) report survey data on legality and feasibility of short selling and practice of put option trading of 111 countries. We use feasibility rather than legality of short selling because, as reported in Charoenrook and Daouk (2003), some countries do not have rules

[5] The MSCI World Index is actually an index of only developed countries. It begins in December 1969. In principal, the choice of MSCI All-Country World Index, which includes more countries, may be better. In practice, however, since the MSCI All-Country World Index is available only from December 1987, and because it has a correlation of 0.9968 with the MSCI World Index, MSCI World Index is a better choice.

[6] Our results are not sensitive to how we adjust for the trend. We adjust turnover using the average turnover over a 6 month period, 12 month period, and 18 month period and find the same results.

prohibiting short selling and at the same time no short selling takes place because of lack of institutional facilities. On the other hand, some countries prohibit short selling, but short selling routinely takes place via off-shore markets.

Columns 2 and 3 of Table II report the feasibility of short selling and put option trading in each of the 57 countries in our sample data. The measure of short-sale constraints variable *SSPO feasibility* equals 1 if either short selling or put options trading is feasible, and it equals 0 otherwise. For example, Chile started put option trading in 1994 and short selling in 2001, thus the variable *SSPO feasibility* for Chile equals 1 in January 1995 and thereafter.

[Insert Table II here]

C. Control Variables

Bekaert and Harvey (2000) and Henry (2000) empirically show that liberalization has an effect on liquidity and volatility. We control for the confounding effects of liberalization in all our tests. The indicator variable "liberalization" in Bekaert and Harvey (2000), and Henry (2000) changes from zero to one in the month after the official liberalization. Official liberalization dates used here are obtained from Table I in Bekaert and Harvey (2000) for countries reported. For some of the countries not reported in Bekaert and Harvey (2000), we use the liberalization dates from Bae, Bailey and Mao (2003). In addition to liberalization, in regression specifications of tests of conditional volatility we include lagged volatility to control for autocorrelation in volatility.

III. Empirical evidence

We are interested in examining the patterns of conditional skewness in the aggregate market returns of the U.S and other international markets and finding out what economic mechanisms drive these patterns. We examine both time series regressions of individual countries and pooled cross-section and time series panel regressions. All the regressions are corrected for autocorrelation and heteroskedasticity in the residual term. All panel regressions include a country-fixed-effect dummy, which is not reported.

A. Predictability of conditional skewness: individual countries

Table II presents individual country test results. The unconditional skewness and volatility are estimated as in Equations (1) and (2), except that each country's sample data is employed to calculate a single skewness or volatility estimate rather than monthly estimates. Like previous studies, we find that the unconditional skewness of the U.S market portfolio is negative. Negative skewness is common in developed markets; eighteen out of twenty three developed markets have negative skewness. This is not the case in emerging markets; only fourteen out of thirty four emerging markets exhibit negative skewness.

Table II also presents results from regressions of conditional skewness on lagged trend-adjusted turnover and lagged return, and on lagged return alone, controlling for liberalization (not reported). The coefficients that are significant at approximately 10% or lower are highlighted. In individual country regressions when the regression coefficients of skewness are significant, they are all negative except for 1 regression. Thus, there appears to be a negative relation between skewness and lagged returns.

B. Predictability of conditional skewness: Panel regression analysis

The summary statistics for the variables employed in the panel regressions are presented in Table III. Table IV reports regressions of conditional skewness on lagged trend-adjusted turnover and lagged one-month returns, controlling for liberalization and fixed-country effects. Lagged trend-adjusted turnover does not predict skewness, but lagged return does.

[Insert Tables III and IV here]

Lagged return is negatively related to conditional skewness. The slope estimates of lagged returns are between -0.66 to -0.52 in all equation specifications and country groupings. All coefficients are statistically significant at lower than the 1% level. The relation of lagged returns and skewness is also economically significant. From regression (3), a one standard deviation change in lagged return predicts a 0.64 change in skewness of returns, which equals 85% of the standard deviation in the dispersion of conditional skewness in our sample (0.79 in Table III).

[Insert Table V here]

Next we test the relation between skewness and lagged returns conditioned on the sign of lagged returns. We sort the sample data by lagged returns into deciles of equal observations. We use the daily returns in each decile to compute a single skewness estimate and the standard error for the estimate. The skewness is computed using Equation (1). The skewness estimates that are more than twice the standard error are highlighted in bold. Results in Table V indicate that when lagged returns are negative and become more negative, conditional skewness becomes more positive, and when lagged returns are positive and become more positive, skewness becomes more negative. The last row of table V reports the skewness of decile 10 minus the skewness of decile 1. The difference between the skewness of the two deciles is statistically significant at the 5% level.

[Insert Table VI here]

Table VI reports panel regressions of skewness on lagged one month returns, controlling for detrended turnover, liberalization, and country-fixed-effects for the sample that includes positive and negative lagged returns separately. In the regressions that include only positive lagged returns, the coefficient of lagged returns are negative and significant at the 5% level. In the regressions that include only negative lagged returns, the coefficient of lagged returns are also negative and are all significant at the 1% level.

These results confirm that the negative relation between skewness and lagged returns are due to both negative skewness following a positive return month, and positive skewness following a negative return month. These relations are inconsistent with the leverage effect, the volatility feedback, and the fluctuation uncertainty model, all of which predicts more negative skewness following negative returns. The bubble theory does not predict any relation between lagged negative returns and skewness. Among the theories we consider here, CCH is the most consistent with the relation found in the test results.

The difference in the magnitudes of the coefficient estimates of lagged returns in developed markets and emerging markets further supports CCH. In CCH, investors are sidelined due to trading costs. Since trading costs are higher in emerging markets, we should observe a stronger relation between lagged returns and skewness in emerging markets. After a market decline, sidelined investors are more likely to have favorable information. When they enter the market, they buy stocks. Panel B of Table VI shows that the coefficient estimates of lagged returns in emerging countries are higher than in developed countries. The difference is statistically significant at the 5% level.

After a market run up, sidelined investors are more likely to have adverse information. When these investors enter the market, they sell stocks. In countries where short selling is not possible, sidelined investors who do not already own stocks, never enter the market even when their adverse information is confirmed by observing other sell trades. Table I reports that 7 out of 34 emerging countries allow short sales compared to 20 out of 23 developed countries. This explains the weaker relation between lagged positive return and conditional skewness in emerging countries compared to developed countries even when trading cost is higher in emerging markets (reported in Panel B of Table VI).

C. Conditional volatility and lagged returns

The empirical evidence on skewness may be interpreted two ways: (1) the leverage effect, the volatility feedback effect, and the fluctuation uncertainty are empirically insignificant in our data sample, or (2) the empirical impact of these effects is subsumed by other effects in predicting skewness. To distinguish between these two interpretations we examine the relation between conditional volatility and lagged returns. We examine both the volatility of daily returns and volatility of monthly returns of the ARCH model described in Section II.

[Insert Table VII here]

Table VII reports panel regressions of conditional volatility on lagged returns, controlling for lagged volatility, liberalization, and country-fixed-effects. Panel A reports test results for the sample of positive lagged returns, and Panel B reports test results for the sample of negative lagged returns. The results in Panels A and B of Table VII show higher volatility follows higher lagged returns when lagged returns are negative and when lagged returns are positive. We further examine the hypothesis that the regression coefficients of lagged absolute return are the same when lagged returns are negative or positive. The t-statistics corresponding to the test of this hypothesis is reported in italics in Panel B of Table VII. We find that volatility increases more following a stock price decline than a stock price increase, which is consistent with the leverage effect, the volatility feedback effect, and the fluctuation uncertainty theory. Thus, we conclude that these effects are present in our data, but the relation between skewness and lagged return is subsumed by other economic mechanisms such as the CCH model.

E. Conditional skewness and lagged trend-adjusted turnover

The HS model predicts a negative relation between lagged trend-adjusted turnover and conditional skewness. In the HS model, a regular investor cannot short sell, but arbitragers can. The arbitragers need to be able to short sell to absorb the buying demand of the regular investors who cannot short sell because one of the simplifying assumptions of the model is that the net supply of the stock is zero. When we apply the HS model to our empirical setting, we think about arbitragers as a large group of arbitragers who have a large inventory of the stock and therefore can buy or sell from their inventory but not actually short sell. In other words, the arbitragers would not have to borrow the stocks and sell them, but just take them from their inventory and sell them. Moreover, when we classify a market as not allowing short selling, in most markets an internal borrowing of securities with a financial institution may still be possible. In this sense, the HS model still applies when countries prohibit short-selling.

In HS, the interaction between short-selling constraint of investors and their heterogeneous beliefs causes the negative relation between lagged trend-adjusted turnover and skewness. To understand the role of short-selling constraints, we estimate the regression of conditional skewness on trend-adjusted turnover, an interaction term of lagged trend-adjusted turnover multiplied by SSPO feasibility, SSPO feasibility, liberalization, and country-fixed-effects.

[Insert Table VIII here]

The results reported in Table VIII show that trend-adjusted turnover does not predict the skewness of returns. In the all countries sample, the regression coefficient on lagged trend-adjusted turnover multiplied by SSPO feasibility term is -0.905 and it is significant at the 10% level. A negative coefficient means that higher trend-adjusted turnover predict more negative skewness in countries where short selling is feasible (when SSPO is 1) compared to countries where short selling is not feasible. This finding is contrary to our interpretation of what HS model predicts. Overall, our test results do not support Hong and Stein (2003).

IV. Robustness

In this section, we review three issues related to our empirical analysis: (1) the robustness of the results given different specifications of lagged returns and trend-adjusted turnover, (2) measurement error in the skewness estimates, and (3) the effect of outliers.

Table IX reports regressions of skewness on lagged returns and trend-adjusted turnover for different specifications of lagged returns and trend-adjusted turnover. Tests using lagged returns constructed using the previous 1 month, 3 months, 6 months, and 12 months are reported. Trend-adjusted turnover is constructed by subtracting the trend over the previous 6 months, 18 months, and 30 months. The results in all regression specifications are qualitatively the same as our main results.

[Insert Table IX here]

The skewness variable is estimated each month from daily returns, thus it is measured with noise. In the case that the measurement error is correlated with a regressor, the point estimate of the regression coefficient on that regressor is positively biased if the measurement error is positively correlated with the regressor. The regression coefficient is negatively biased if the measurement error is negatively correlated with the regressor.

To assess whether our measurement error is related to lagged return, we sort monthly skewness estimates by their corresponding lagged returns into 10 deciles, and then calculate the standard deviation of monthly skewness in each decile. We then examine if there is any detectable relation between the standard deviation number and the average lagged return among the deciles. Table X reports the standard deviation and average lagged returns for the 10 groupings of monthly skewness for the sample that includes all markets, emerging markets, and developed markets separately. The results show that there is no relation between the standard deviation of monthly skewness estimates and lagged returns, thus assuring that the regression coefficient estimates in our analysis are unbiased.

[Insert Table X here]

When measurement error is independent of the regressors in the regression analysis, the point estimates of the regression coefficients are unbiased but the standard error estimates are inflated. In this case, the regression is tilted against finding significance. We find strong statistical significance that lagged return predicts skewness despite measurement error.

We also examine if our main results are driven by a few outliers. We rank the data based on skewness. We eliminated the data points in the highest 2.5 percentile and the data points in the lowest 2.5 percentile, and test the relation between lagged positive return and lagged negative return with skewness. The results remain statistically significant.

V. Conclusions

This paper examines whether conditional skewness of aggregate market returns are predictable. Existing theories suggest that skewness may be related to lagged returns and lagged trend-adjusted turnover. We find a strong negative relation between conditional skewness and lagged returns. We find no relation between skewness and lagged trend-adjusted turnover.

This paper further investigates what economic mechanisms drive the relation between lagged returns and skewness. A number of theories explain this relation. We note that some of these theories differ in their predictions of this relation with respect to the sign of lagged returns. They also differ in their predictions of the relation between lagged returns and volatility. Thus, to assess the empirical validity of these theories, we examine the relation between lagged returns and skewness or volatility conditional on the sign of lagged returns.

We find that stock returns become more negatively skewed following a positive return month and become more positively skewed following a negative return month. The relation between lagged returns and skewness is slightly stronger for negative lagged returns. We also find that higher volatility follows a large price change in either direction. The increase in volatility is higher following a stock price decline than following a price increase.

Our volatility findings are consistent with the leverage effect, the volatility feedback effect, and fluctuation uncertainty effect. In particular, the leverage effect and the volatility feedback effect are so closely tied to fundamental finance theories that it would be surprising if we did not find it in the data. On the other hand, our empirical evidence concerning conditional skewness appears to contradict these theories. Our findings indicate that there are stronger economic mechanisms which drive the predictability of conditional skewness of aggregate market returns. These mechanisms seem to economically dominate the leverage effect and the volatility feedback effect. The economic mechanism proposed in CCH appears to be the most consistent with all our empirical findings, especially with our findings on conditional skewness.

Our findings have a number of implications for future research. First, since skewness of aggregate market returns are predictable, future econometric modeling of aggregate market returns should be flexible enough to allow conditional skewness to be affected by lagged returns and other variables such as turnover. Second, future theories of the stock return generating process should account for the predictability of conditional skewness at a market-wide level. In particular, they should account for both negative skewness following price increases, as well as positive skewness following price declines. This should improve future stock market contingent claims valuation models. Lastly, the predictability of conditional skewness of market returns is relevant to the optimal asset allocation between stocks, bonds, and other assets.

Reference:

Bae, Kee-Hong, Warren Bailey, and Connie X. Mao, 2003, "Stock Market Liberalization and the Information Environment," working paper, Cornell University.

Bekaert, G., and C. Harvey, 2000, "Foreign Speculators and Emerging Equity Markets," *Journal of Finance,* 55, 565–613.

Black, F., 1976, "Studies of Stock Price Volatility Changes," *Proceedings of the 1976 Meeting of American Statistical Association, Business and Economical Statistics Section*, 177-181.

Blanchard, O. J., and Watson, M. W., 1982, "Bubbles, Rational Expectaions, and Financial Markets," *In: Wachtel, P. (Ed.), Crises in Economic and Financial Structure,* Lexington Books, Lexington, MA, 295-315.

Campbell, J. Y., and R. Hentschell, 1992, "No News is Good News: An Asymmetric Model of Changing Volatility in Stock Returns." *Journal of Financial Economics* 31, 281-318

Cao, H. Henry, Joshua D. Coval, and David Hirshleifer, 2002, "Sidelined Investors, Trading-Generated News, and Security Returns," *Review of Financial Studies* 15, 651-648.

Charoenrook, Anchada, and Hazem Daouk, 2003, "The World Price of Short Selling," working paper, Vanderbilt University.

Chen, Joseph, H. Hong, J. C. Stein, 2001, "Forecasting Crashes: Trading Volume, Past Returns, and Conditional Skewness in Stock Prices," *Journal of Financial Economics* 61, 345–381.

Christie, A. A., 1982, "The Stochastic Behavior of Common Stock Variances – Value, Leverage, and Volatility in Stock Returns," *Journal of Financial Economics* 10, 407-432.

David, A., 1997, "Fluctuating Confidence in Stock Markets: Implications for Returns and Volatility," *Journal of Financial and Quantitative Analysis* 32, 427-462.

Dittmar, Robert F., 2002, "Non-linear Pricing Kernels, Kurtosis Preference, and Evidence from the Cross Section of Equity Returns, *Journal of Finance* 57, 369-403.

Engle, R., D. Lilien, and R. Robins, 1987, "Estimating Time Varying Risk Premia in the Term Structure: The ARCH-M Model," *Econometrica,* 55, 391–407.

French, K., W. Schwert, and R. Stambaugh, 1987, "Expected Stock Returns and Volatility," *Journal of Financial Economics,* 19, 3-29.

Greene, W. H., 1993, *Econometric Analysis*, Macmillan, New York.

Harvey, Campbell R. and Akhtar Siddique, 1999, "Autoregressive Conditional Skewness," *Journal of Financial and Quantitative Analysis* 34, 465-487.

Harvey, Campbell R, and Akhtar Siddique, 2000, "Conditional Skewness in Asset Pricing Tests," *Journal of Finance* 55, 1263–1295.

Henry, P., 2000, "Stock Market Liberalization, Economic Reform, and Emerging Market Equity Prices," *Journal of Finance*, 55, 529–564.

Hong, Harrison, and Jeremy C. Stein, 2003, "Differences of Opinion, Short-Sales Constraints and Market Crashes," *Review of Financial Studies* 16, 487-525.

Patton, Andrew J., 2004, "On the Out-of-Sample Importance of Skewness and Asymmetric Dependence for Asset Allocation," *Journal of Financial Econometrics* 2, 130-168.

Pindyck, Robert S., 1984, "Risk, Inflation, and the Stock Market," *American Economic Review* 74, 335-352.

Veronesi, P., 1999, "Stock Market Overreaction to Bad News in Good Times: A Rational Equilibrium Model," *Review of Financial Studies* 12, 975-1007.

Veronesi, P., 2002, "Discussion of Sidelined Investors, Trading-Generated News, and Security Returns," *Review of Financial Studies* 15, 649-654.

Table I: The different effects on conditional volatility and skewness

Theory	Conditional volatility	Conditional skewness
Leverage	Volatility increases (decline) when stock price declines (increases)	Lower or more negatively skewed returns follows a stock price decline
Volatility feedback And Veronesi (1999)	Volatility increases with large price increase or decrease	Lower or more negatively skewed returns follows a stock price decline
Stock Bubble	—	Lower or more negatively skewed returns follows a period of stock price increase
Cao Coval and Hirshliefer (2002)	Volatility increases with large price increase or decrease	Lower or more negatively (positively) skewed returns follows a period of stock price increase (decline)
Hong and Stein (2003)	—	Lower or more negatively skewed returns follows high trend-adjusted turnover

Table II: Individual countries

This table reports the feasibility of short selling and put option trading, and properties of the return distribution of 57 individual country indices. Columns 3 and 4 report the unconditional skewness and unconditional volatility of returns. Unconditional skewness is computed as in Equation (1) employing all observations for each country. Unconditional volatility is the standard deviation of daily returns computed using all observations for each country. Regression I reports regressions of conditional skewness of daily returns on lagged trend-adjusted turnover and lagged one month return. Regression II report regression of skewness on lagged one month returns. We control for liberalization in both regressions. "NA" denotes not available due to the unavailability of volume data.

Country	Feasibility of short sale	Existence of put options	Unconditional skewness	Unconditional volatility	Regression I Dep. variable: skewness			Regression II Dep. variable: skewness	
					Intercept	lagged trend-adjusted turnover	lagged return	Intercept	lagged return
column no.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Emerging countries									
ARGENTINA	No	1991	-0.862	0.02129	0.0722	**-39.5291**	-0.2255	0.0658	-0.3858
					(0.3798)	(0.0185)	(0.7302)	(0.4303)	(0.5319)
BAHRAIN	No	No	-0.029	0.00611	NA	NA	NA	**0.4175**	3.8114
					NA	NA	NA	(0.0846)	(0.4556)
BRAZIL	No	1984	0.141	0.02121	**0.1396**	**-5.7420**	-0.8307	0.0538	**-1.1881**
					(0.0608)	(0.0000)	(0.1824)	(0.4722)	(0.0128)
CHILE	2001	1994	0.226	0.01189	**0.0959**	21.7311	-0.8307	**0.0893**	-0.7416
					(0.0443)	(0.2197)	(0.1709)	(0.0642)	(0.2316)
CHINA	No	No	3.136	0.02410	0.0736	**-1.0521**	-0.8690	0.0765	-0.9456
					(0.5039)	(0.0723)	(0.2309)	(0.4973)	(0.1883)
COLOMBIA	No	No	0.322	0.01137	0.0367	**25.1970**	-0.7501	0.0374	-0.7025
					(0.6429)	(0.0000)	(0.3599)	(0.6240)	(0.4393)
CZECH	Yes	No	-0.171	0.01370	-0.0073	6.4838	-1.1650	0.0025	-1.0538
					(0.9155)	(0.2234)	(0.1290)	(0.9715)	(0.1497)
EGYPT	No	No	0.217	0.01251	NA	NA	NA	0.0522	-0.7879
					NA	NA	NA	(0.6494)	(0.5746)
GREECE	No	2000	0.395	0.01913	**0.2216**	**-10.9119**	-0.2985	**0.2234**	-0.7571
					(0.0009)	(0.0547)	(0.5706)	(0.0010)	(0.1760)
HUNGARY	No	2000	-0.361	0.02010	**0.1424**	**0.3358**	0.0142	**0.1447**	-0.1810
					(0.0391)	(0.0033)	(0.9826)	(0.0347)	(0.7898)
INDIA	No	2001	0.113	0.01585	**0.1613**	2.2232	-0.0128	**0.1647**	0.0867
					(0.0139)	(0.2475)	(0.9783)	(0.0127)	(0.8629)
INDONESIA	No	2004	3.023	0.03183	0.0604	2.1588	-0.4618	0.0803	-0.3254
					(0.3755)	(0.7137)	(0.3682)	(0.2457)	(0.5330)
ISRAEL	No	1995	-0.244	0.01542	**0.1723**	**-28.0166**	-0.9249	**0.1471**	-1.0828
					(0.0069)	(0.0311)	(0.3044)	(0.0262)	(0.2416)
JORDAN	No	No	-0.139	0.00728	NA	NA	NA	0.2100	5.7096
					NA	NA	NA	(0.1640)	(0.1225)
SOUTH KOREA	No	1997	0.816	0.02979	**0.1385**	**2.3430**	**-1.2405**	**0.1483**	**-1.0197**
					(0.0730)	(0.1054)	(0.0015)	(0.0593)	(0.0019)
MALAYSIA	Started in 1996, stopped in 1997	2000	-0.091	0.01869	**0.1714**	-11.5940	**-1.4120**	**0.1719**	**-1.6057**
					(0.0060)	(0.1591)	(0.0728)	(0.0059)	(0.0427)

Country	Feasibility of short sale	Existence of put options	Unconditional skewness	Unconditional volatility	Regression I Dep. variable: skewness			Regression II Dep. variable: skewness	
					Intercept	lagged trend-adjusted turnover	lagged return	Intercept	lagged return
column no.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Emerging countries									
MEXICO	Yes	2004	-0.220	0.01857	0.0756	-1.5266	**-1.0386**	0.0749	**-0.9594**
					(0.1988)	(0.4366)	(0.0202)	(0.2077)	(0.0224)
MOROCCO	No	No	0.500	0.00768	NA	NA	NA	**0.1967**	-2.8287
					NA	NA	NA	(0.0209)	(0.1791)
NIGERIA	No	No	0.200	0.01056	NA	NA	NA	0.0444	-1.6608
					NA	NA	NA	(0.6766)	(0.2038)
OMAN	No	No	1.808	0.00802	NA	NA	NA	-0.1959	-0.0027
					NA	NA	NA	(0.5005)	(0.9998)
PAKISTAN	No	No	-0.159	0.01985	0.0019	-1.0104	**-1.2270**	-0.0106	**-1.1757**
					(0.9826)	(0.2540)	(0.0228)	(0.9058)	(0.0283)
PERU	No	No	-0.156	0.01128	0.1379	-0.1126	0.2741	0.1380	0.2751
					(0.1970)	(0.9654)	(0.8329)	(0.1956)	(0.8325)
PHILIPPINES	No	No	1.133	0.01775	**0.1217**	-1.5270	**-1.1019**	**0.1648**	-0.9183
					(0.0646)	(0.7099)	(0.1046)	(0.0160)	(0.1596)
POLAND	No	2000	0.155	0.02222	**0.0924**	**-8.4099**	**0.7305**	**0.1197**	0.1453
					(0.0851)	(0.0264)	(0.0986)	(0.0256)	(0.7465)
RUSSIA	Yes	2001	1.406	0.03126	0.1187	11.3679	-0.0589	0.1192	-0.0565
					(0.1684)	(0.5235)	(0.8255)	(0.1708)	(0.8331)
SAUDI ARABIA	No	No	0.740	0.00856	NA	NA	NA	0.1506	-0.4623
					NA	NA	NA	(0.4024)	(0.8794)
SLOVAKIA	No	No	-0.003	0.01823	NA	NA	NA	-0.1792	1.2243
					NA	NA	NA	(0.1381)	(0.2333)
SOUTH AFRICA	Yes	1992	-0.279	0.01567	0.0430	-1.3011	-0.6612	0.0414	-0.6423
					(0.5147)	(0.8890)	(0.3529)	(0.5224)	(0.3577)
SRI LANKA	No	No	5.413	0.01373	NA	NA	NA	0.1340	0.4771
					NA	NA	NA	(0.1714)	(0.5343)
TAIWAN	1998	No	0.149	0.02201	**0.1880**	-1.1897	-0.4656	**0.1820**	**-0.6054**
					(0.0006)	(0.1284)	(0.4094)	(0.0001)	(0.0666)
THAILAND	1998	No	0.556	0.02131	**0.2322**	-2.8547	**-0.8816**	**0.2302**	**-0.9868**
					(0.0000)	(0.2590)	(0.0563)	(0.0000)	(0.0279)
TURKEY	1995	No	0.244	0.03419	**0.1004**	-1.6870	-0.4025	0.0947	-0.4791
					(0.1009)	(0.3763)	(0.2819)	(0.1303)	(0.1845)
VENEZUELA	No	No	-1.302	0.02731	NA	NA	NA	0.0997	-0.0453
					NA	NA	NA	(0.2341)	(0.9440)
ZIMBABWE	No	No	-1.247	0.02121	NA	NA	NA	0.0934	-0.2077
					NA	NA	NA	(0.4510)	(0.6941)

Country	Feasibility of short sale	Existence of put options	Unconditional skewness	Unconditional volatility	Regression I Dep. variable: skewness			Regression II Dep. variable: skewness	
					Intercept	lagged trend-adjusted turnover	lagged return	Intercept	lagged return
column no.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Developed contries									
AUSTRALIA	Yes	1982	-1.394	0.01266	0.0060	2.6089	**-1.0386**	0.0445	-0.4387
					(0.8853)	(0.6630)	(0.0445)	(0.2206)	(0.2772)
AUSTRIA	Yes	1991	0.104	0.01011	-0.0750	1.1145	0.4411	-0.0203	0.3407
					(0.1066)	(0.7348)	(0.4041)	(0.6673)	(0.5854)
BELGIUM	Yes	1993	-0.073	0.01038	0.0702	12.7301	**-1.4014**	**0.0749**	-1.0343
					(0.1287)	(0.2744)	(0.1032)	(0.0349)	(0.1568)
CANADA	Yes	1975	-0.611	0.00910	-0.0319	-5.6716	-0.6312	-0.0361	-0.5535
					(0.4004)	(0.1146)	(0.2512)	(0.3342)	(0.3100)
DENMARK	Yes	1990	0.613	0.01173	0.0420	-0.5392	0.0355	0.0377	1.5853
					(0.4216)	(0.9477)	(0.9666)	(0.7058)	(0.2399)
FINLAND	No	1988	-0.088	0.03150	-0.0345	9.9433	-0.1259	0.0100	-0.3529
					(0.7457)	(0.2193)	(0.8534)	(0.9192)	(0.5184)
FRANCE	Yes	1987	-0.185	0.01245	-0.0128	1.5505	-0.0164	0.0013	-0.0399
					(0.7807)	(0.8125)	(0.9812)	(0.9698)	(0.9167)
GERMANY	Yes	1990	-0.247	0.01125	-0.0194	**-2.0487**	-0.7704	-0.0048	**-0.9714**
					(0.6693)	(0.0135)	(0.1958)	(0.8766)	(0.0633)
HONG KONG	1994	1993	-0.966	0.01896	0.0863	-4.7414	**-1.2816**	0.0622	**-1.0617**
					(0.1373)	(0.4203)	(0.1005)	(0.1194)	(0.0022)
IRELAND	Yes	No	-0.053	0.01202	-0.1511	-0.9651	-0.1314	0.0214	-0.5095
					(0.3872)	(0.8971)	(0.9214)	(0.6757)	(0.6072)
ITALY	Yes	1995	-0.133	0.01466	0.0558	1.5145	0.6535	**0.0809**	0.0949
					(0.1397)	(0.5472)	(0.2340)	(0.0107)	(0.8017)
JAPAN	Yes	1989	0.090	0.01242	**0.1358**	0.5308	-0.5770	**0.1627**	**-1.0302**
					(0.0053)	(0.5651)	(0.3753)	(0.0000)	(0.0586)
LUXEMBURG	1991	No	0.304	0.01028	0.1151	90.7614	0.3593	0.0820	1.3863
					(0.4023)	(0.1194)	(0.7817)	(0.3103)	(0.2279)
NETHERLANDS	Yes	1978	-0.188	0.01071	0.0176	-1.8128	-0.8299	0.0399	-0.2005
					(0.6250)	(0.3081)	(0.2215)	(0.1880)	(0.7149)
NEW ZEALAND	No	No	0.016	0.01303	0.0736	4.1875	-0.8917	0.0563	-0.2637
					(0.1620)	(0.4432)	(0.1199)	(0.2261)	(0.6791)
NORWAY	1999	1990	-0.429	0.01467	**0.0915**	-3.1910	**-1.0445**	**0.0932**	**-1.1088**
					(0.0309)	(0.2275)	(0.0209)	(0.0289)	(0.0145)
PORTUGAL	Yes	1999	-0.024	0.01074	0.0811	-5.3465	0.4861	0.0833	0.2083
					(0.1421)	(0.2892)	(0.5704)	(0.1299)	(0.7948)
SINGAPORE	Yes	1993	-0.161	0.01490	**0.1517**	-1.7909	-0.6233	**0.1885**	**-0.7018**
					(0.0020)	(0.7744)	(0.2361)	(0.0000)	(0.0657)
SPAIN	No	1992	-0.189	0.01261	-0.0431	**-6.5796**	-0.1413	-0.0495	-0.8374
					(0.4565)	(0.1064)	(0.8571)	(0.3183)	(0.2793)
SWEDEN	1991	1987	-0.156	0.01477	0.0700	**4.8440**	**-1.1275**	0.0669	**-1.0984**
					(0.1167)	(0.0943)	(0.0807)	(0.1380)	(0.0843)
SWITZERLAND	Yes	1988	-0.301	0.01042	0.0138	5.5211	**-1.6765**	0.0454	-0.6515
					(0.7624)	(0.3622)	(0.0378)	(0.1634)	(0.2094)
UK	Yes	1984	-0.112	0.01186	-0.0589	1.0791	-0.9276	-0.0246	**-0.7070**
					(0.2009)	(0.7569)	(0.1771)	(0.4448)	(0.1091)
US	Yes	1973	-0.834	0.00998	**0.0620**	0.1397	**-1.4161**	**0.0616**	**-1.4335**
					(0.1071)	(0.9599)	(0.0495)	(0.1022)	(0.0469)

Table III: Summary statistics

This table presents summary statistics for variables employed in the regressions. Skewness is the conditional skewness calculated as in Equation (1) using daily market returns for each month. Turnover is the logarithm of the ratio of volume of dollar trade per month to dollar market capitalization at the end of the month. Trend-adjusted turnover is turnover minus the average of turnover during the previous six months. SSPO feasibility is a binary variable that equals one if either short-selling or put option trading is feasible in that country during that month (in practice). The indicator variable liberalization changes from zero to one in the month after the official liberalization date, which was obtained from Bekaert and Harvey (2000). Volatility is the standard deviation of daily return during a month.

Variable name	Mean	Standard deviation	Maximum	Minimum
Skewness	0.0662	0.7918	4.6471	-4.5862
Lagged trend-adjusted turnover	-0.0081	0.5298	16.5629	-12.6573
SSPO feasibility	0.4279	0.4948	1.0000	0.0000
Monthly Return	0.0076	0.0950	1.0229	-1.2114
Liberalization	0.5816	0.4933	1.0000	0.0000
Volatility	0.0170	0.0243	0.4467	0.0019

Table IV: Conditional skewness

This table reports panel regressions of conditional skewness of daily returns on lagged trend-adjusted turnover, lagged one-month returns, controlling for lagged skewness, lagged volatility, liberalization, and a country-fixed-effect dummy (not reported). Turnover is the logarithm of the ratio of volume of dollar trade per month to dollar market capitalization at the end of the month. Trend-adjusted turnover is turnover minus the average of turnover during the previous six months. Lagged return is the index return during the previous month. Lagged skewness is the skewness during the previous month. Lagged volatility is the standard deviation of daily returns during the previous month. The indicator variable liberalization changes from zero to one in the month after the official liberalization date, which was obtained from Bekaert and Harvey (2000). All regression coefficient estimates are corrected for autocorrelation and heteroskedasticity in the residual term. P-value is reported in parenthesis.

	All countries				Developed countries				Emerging countries			
Regression specification	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Independent variables												
Lagged trend-adjusted turnover	0.1440 (0.2651)		0.1517 (0.2217)	0.1433 (0.2631)	-0.8296 (0.2038)		-0.8407 (0.1922)	-1.0574 (0.0966)	0.1642 (0.1885)		0.1723 (0.1517)	0.1661 (0.1774)
Lagged return		-0.5611 (0.0000)	-0.6393 (0.0000)	-0.6602 (0.0000)		-0.5283 (0.0000)	-0.6345 (0.0000)	-0.6063 (0.0001)		-0.5837 (0.0000)	-0.6421 (0.0000)	-0.6638 (0.0000)
Lagged skewness				0.0277 (0.0369)				0.0306 (0.0516)				0.0025 (0.2650)
Lagged volatility				1.4656 (0.0384)				3.7039 (0.0664)				1.2942 (0.0857)
Liberalization	0.0078 (0.7240)	0.0046 (0.8293)	0.0027 (0.9021)	0.0033 (0.8804)	-0.0072 (0.9155)	0.0020 (0.9705)	-0.0113 (0.8675)	-0.0147 (0.8240)	0.0089 (0.7020)	0.0047 (0.8370)	0.0037 (0.8734)	0.0042 (0.8549)

Table V: The relation between lagged return and skewness

We sort the sample data according to lagged returns into deciles of equal number of observations. We use the daily returns in each decile to compute a skewness estimate and the standard error for each estimate. The skewness is computed using Equation (1). The corresponding standard error = $\sqrt{6/n}$, where n is the number of observations. The conditional skewness estimate that is more than twice the standard error is highlighted in bold.

	Developed countries			Emerging countries		
Decile	**Lagged return**	**Conditional skewness**	**Standard error**	**Lagged return**	**Conditional skewness**	**Standard error**
1	-0.1119	0.0184	0.0199	-0.1780	**0.7697**	0.0263
2	-0.0509	0.0298	0.0199	-0.0833	**0.7914**	0.0263
3	-0.0272	**-1.0638**	0.0199	-0.0494	**-0.2112**	0.0263
4	-0.0101	**-0.1539**	0.0199	-0.0258	**0.0259**	0.0263
5	0.0036	**-0.0585**	0.0199	-0.0048	**-0.3244**	0.0263
6	0.01744	**-0.64922**	0.0199	0.0157	**1.62218**	0.0263
7	0.03094	**-0.80443**	0.0199	0.0369	**0.87641**	0.0263
8	0.04708	**-0.87794**	0.0199	0.0620	**1.06610**	0.0263
9	0.07056	**-0.15976**	0.0199	0.0998	-0.01106	0.0263
10	0.13288	**-0.77211**	0.0199	0.2253	**-0.75586**	0.0263
10-1	0.24478	**-0.79051**	0.0199	0.4033	**-1.52556**	0.0263

Table VI: Conditional skewness and lagged returns

This table reports panel regressions of conditional skewness of daily returns on lagged trend-adjusted turnover, lagged one-month returns, controlling for liberalization, and a country-fixed-effect dummy (not reported). Turnover is the logarithm of the ratio of volume of dollar trade per month to dollar market capitalization at the end of the month. Trend-adjusted turnover is turnover subtracted by the average of turnover during the previous six months. Lagged return is the index return during the previous month. The indicator variable liberalization changes from zero to one in the month after the official liberalization date, which was obtained from Bekaert and Harvey (2000). All regression coefficient estimates are corrected for autocorrelation and heteroskedasticity in the residual term. P-value is reported in parenthesis. Panels A and B report regressions that employ data when lagged returns are positive and negative, respectively.

Panel A: Data sample includes only positive lagged returns

	All countries			Developed countries			Emerging countries		
Regression specification	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Independent variables									
Lagged trend-adjusted turnover	-0.2426 (0.3847)		-0.1756 (0.5207)	-0.2258 (0.7820)		0.1160 (0.8900)	-0.2450 (0.4005)		-0.2087 (0.4725)
Lagged return		-0.3591 (0.0163)	-0.3840 (0.0318)		-0.4439 (0.0138)	-0.6568 (0.0059)		-0.2746 (0.2513)	-0.1985 (0.4320)
Liberalization	-0.0828 (0.0073)	-0.0276 (0.3830)	-0.0415 (0.2301)	-0.1093 (0.2307)	-0.0411 (0.5890)	-0.0341 (0.7206)	-0.0804 (0.0138)	-0.0337 (0.3711)	-0.0590 (0.1375)

Panel B: Data sample includes only negative lagged returns

	All countries			Developed countries			Emerging countries		
Regression specification	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Independent variables									
Lagged trend-adjusted turnover	0.2153 (0.0591)		0.2082 (0.0763)	-1.5964 (0.0999)		-1.9219 (0.0402)	0.2411 (0.0317)		0.2383 (0.0382)
Lagged return		-0.6723 (0.0000)	-0.7296 (0.0000)		-0.5763 (0.0009)	-0.6421 (0.0016)		-0.7830 (0.0001)	-0.8440 (0.0002)
Liberalization	0.0993 (0.0014)	0.0027 (0.9361)	0.0033 (0.9307)	0.1118 (0.2487)	0.0473 (0.5521)	0.0194 (0.8482)	0.0977 (0.0029)	-0.0144 (0.7258)	-0.0131 (0.7740)

Table VII: Conditional volatility

This table reports panel regressions of conditional volatility of daily returns and monthly returns on lagged one-month absolute returns, controlling for lagged volatility, liberalization, and a country-fixed-effect dummy (not reported). Volatility of daily returns is calculated as the standard deviation of daily return using daily return observations in each month. The volatility of monthly returns is calculated from a multivariate ARCH model in Equation (3). Lagged return is the index return during the previous month. The indicator variable liberalization changes from zero to one in the month after the official liberalization date, which was obtained from Bekaert and Harvey (2000). All regression coefficient estimates are corrected for autocorrelation and heteroskedasticity in the residual term. P-value is reported in parenthesis. Panels A and B report regressions that employ data when lagged returns are positive and negative, respectively. Panel B also reports the t-statistics (in italics) for the test of the hypothesis that the coefficients of absolute lagged returns are equal when lagged returns are negative and when lagged returns are positive.

Panel A: Data sample includes only positive lagged returns

	All countries		Developed countries		Emerging countries	
Dependent variable	Volatility of Daily returns	Volatility of monthly returns	Volatility of Daily returns	Volatility of monthly returns	Volatility of Daily returns	Volatility of monthly returns
Independent variables						
Lagged absolute return	0.0218 (0.0000)	0.1952 (0.0000)	0.0151 (0.0000)	0.1109 (0.0000)	0.0255 (0.0010)	0.2260 (0.0000)
Lagged volatility	0.3513 (0.0000)	0.0683 (0.0004)	0.4155 (0.0000)	0.0580 (0.0160)	0.3396 (0.0000)	0.0599 (0.0020)
Liberalization	-0.0016 (0.0025)	-0.0009 (0.0180)	0.0004 (0.3192)	-0.0005 (0.0549)	-0.0019 (0.0018)	-0.0007 (0.1236)

Panel B: Data sample includes only negative lagged returns

	All countries		Developed countries		Emerging countries	
Dependent variable	Volatility of Daily returns	Volatility of monthly returns	Volatility of Daily returns	Volatility of monthly returns	Volatility of Daily returns	Volatility of monthly returns
Independent variables						
Lagged absolute return	0.0405 (0.0000) *3.82*	0.2099 (0.0000) *1.95*	0.0203 (0.0000) *2.55*	0.1414 (0.0000) *3.39*	0.0562 (0.0000) *3.54*	0.2334 (0.0000) *1.14*
Lagged volatility	0.4481 (0.0000)	0.1343 (0.0008)	0.3862 (0.0000)	0.0815 (0.1232)	0.4438 (0.0000)	0.1278 (0.0021)
Liberalization	0.0006 (0.3832)	0.0009 (0.0630)	0.0017 (0.0013)	0.0001 (0.9219)	0.0005 (0.4400)	0.0011 (0.0425)

Table VIII: Conditional skewness and short-sale constraints

This table reports panel regressions of conditional skewness of daily returns on SSPO feasibility, lagged trend-adjusted turnover, lagged one-month returns, the interaction term SSPO feasibility × trend-adjusted turnover, controlling for liberalization, and a country-fixed-effect dummy (not reported). SSPO feasibility is a measure of short-sale constraints. SSPO feasibility is a binary variable that equals one if either short-selling or put option trading is possible in that country during that month (in practice). Turnover is the logarithm of the ratio of volume of dollar trade per month to dollar market capitalization at the end of the month. Trend-adjusted turnover is turnover minus the average of turnover during the previous six months. Lagged return is the index return during the previous month. The indicator variable liberalization changes from zero to one in the month after the official liberalization date, which was obtained from Bekaert and Harvey (2000). All regression coefficient estimates are corrected for autocorrelation and heteroskedasticity in the residual term. P-value is reported in parenthesis.

	All countries	Developed countries	Emerging countries
Independent variables			
SSPO feasibility	0.0293 (0.2919)	-0.0126 (0.7549)	0.0642 (0.0935)
Lagged trend-adjusted turnover	0.1772 (0.1491)	-4.5237 (0.2907)	0.1852 (0.1262)
SSPO feasibility × Lagged trend-adjusted turnover	-0.9052 (0.0900)	3.8994 (0.3681)	-1.0405 (0.2208)
Liberalization	-0.0001 (0.9967)	-0.0049 (0.9430)	-0.0085 (0.7517)

Table IX: Conditional skewness and different specification for lagged returns and trend-adjusted turnover

This table reports panel regressions of conditional skewness of daily returns on lagged trend-adjusted turnover, lagged returns, controlling for liberalization, and a country-fixed-effect dummy (not reported). Turnover is the logarithm of the ratio of volume of dollar trade per month to dollar market capitalization at the end of the month. The indicator variable liberalization changes from zero to one in the month after the official liberalization date, which was obtained from Bekaert and Harvey (2000). The 6 regression specifications differ in how the trend-adjusted turnover and lagged return variables were constructed. For regression (1), trend-adjusted turnover is turnover minus the average of turnover during the previous six months. Lagged return is the index return during the previous month. For regression (2), trend-adjusted turnover is turnover minus the average of turnover during the previous six months. Lagged return is the index return during the previous 3 months. For regression (3), trend-adjusted turnover is turnover minus the average of turnover during the previous six months. Lagged return is the index return during the previous 6 months. For regression (4), trend-adjusted turnover is turnover minus the average of turnover during the previous six months. Lagged return is the index return during the previous 12 months. For regression (5), trend-adjusted turnover is turnover minus the average of turnover during the previous 18 months. Lagged return is the index return during the previous month. For regression (6), trend-adjusted turnover is turnover subtracted the average of turnover during the previous 30 months. Lagged return is the index return during the previous month. All regression coefficient estimates are corrected for autocorrelation and heteroskedasticity in the residual term. P-value is reported in parenthesis.

Panel A

Regression specification	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables	Conditional skewness					
Lagged return	-0.5611	-1.0668	-1.2708	-1.7657	-0.5611	-0.5611
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Liberalization	0.0046	0.0010	-0.0009	-0.0049	0.0046	0.0046
	(0.8293)	(0.9644)	(0.9669)	(0.8174)	(0.8293)	(0.8293)

Panel B

Regression specification	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables	Conditional skewness					
Lagged trend-adjusted turnover	0.1517	0.1755	0.1643	0.1483	0.0474	0.0272
	(0.2217)	(0.1381)	(0.1804)	(0.2400)	(0.3536)	(0.4252)
Lagged return	-0.6393	-1.2816	-1.5989	-2.4095	-0.6387	-0.6387
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Liberalization	0.0027	-0.0044	-0.0075	-0.0151	0.0042	0.0047
	(0.9021)	(0.8448)	(0.7371)	(0.4957)	(0.8494)	(0.5666)

Table X: The variation in monthly skewness measure and lagged returns

We calculate a monthly skewness in Equation (1) using daily returns. We then sort this data into deciles of equal number of observations based on lagged returns. We calculate the variation in the monthly skewness estimate for each decile as the standard deviation of the monthly skewness estimate in each decile. This table reports the average lagged returns and standard deviation of the monthly skewness estimate for each decile for the sample of all countries, developed countries, and emerging countries respectively.

	All countries		Developed countries		Emerging countries	
Decile	Average lagged return	Standard deviation of skewness estimates	Average lagged return	Standard deviation of skewness estimates	Average lagged return	Standard deviation of skewness estimates
1	-0.1397	0.7807	-0.1119	0.7362	-0.1779	0.7706
2	-0.0617	0.7780	-0.0508	0.7521	-0.0831	0.8174
3	-0.0343	0.7503	-0.0271	0.6951	-0.0493	0.8159
4	- 0.0147	0.7964	-0.0101	0.7436	-0.0257	0.9225
5	0.0013	0.8032	0.0036	0.7307	-0.0047	0.9437
6	0.0170	0.8044	0.0175	0.7767	0.0158	0.8849
7	0.0327	0.7516	0.0310	0.7493	0.0370	0.8375
8	0.0516	0.8032	0.0472	0.7416	0.0621	0.8500
9	0.0794	0.8163	0.0708	0.7923	0.0999	0.8839
10	0.1706	0.7803	0.1335	0.7113	0.2258	0.8388

OTHER A.E.M. WORKING PAPERS

WP No	Title	Fee (if applicable)	Author(s)
2009-21	A Study of Market-Wide Short-Selling Restrictions		Charoenrook, A. and H. Daouk
2009-20	The Impact of Age on the Ability to Perform under Pressure: Golfers on the PGA Tour		Fried, H. and L. Tauer
2009-18	Beyond the Tipping Point: A Multidisciplinary Perspective on Urbanization and Development		Beal, J., Guha-Khasnobis, B. and R. Kanbur
2009-17	Economic Impacts of Soybean Rust on the US Soybean Sector		Gomez, M., Nunez, H. and H. Onal
2009-16	Detecting Technological Heterogeneity in New York Dairy Farms		del Corral, J., Alvarez, A. and L. Tauer
2009-15	Altering Milk Components Produced by the Dairy Cow: Estimation by a Multiple Output Distance Function		Cho, J., Nakane, M. and L. Tauer
2009-14	Evaluating Marketing Channel Options for Small-Scale Fruit and Vegetable Producer		LeRoux, M., Schmit, T.M., Roth, M. and D.H. Streeter
2009-13	An Empirical Evaluation of New Socialist Countryside Development in China		Guo, X., Yu, Z., Schmit, T.M., Henehan, B.M. and D. Li
2009-12	Towards a Genuine Sustainability Standard for Biofuel Production		de Gorter, H. and Y. Tsur
2009-11	Conceptualizing Informality: Regulation and Enforcement		Kanbur, R.
2009-10	Monetary Policy Challenges for Emerging Market Economies		Hammond, G., Kanbur, R. and E. Prasad
2009-09	Serving Member Interests in Changing Markets: A Case Study of Pro-Fac Cooperative		Henehan, B. and T. Schmit
2009-08	Investment Decisions and Offspring Gender		Bogan, V.
2009-07	Intergenerationalities: Some Educational Questions on Quality, Quantity and Opportunity		Kanbur, R.
2009-06	A Typical Scene: Five Exposures to Poverty		Kanbur, R.

Paper copies are being replaced by electronic Portable Document Files (PDFs). To request PDFs of AEM publications, write to (be sure to include your e-mail address): Publications, Department of Applied Economics and Management, Warren Hall, Cornell University, Ithaca, NY 14853-7801. If a fee is indicated, please include a check or money order made payable to Cornell University for the amount of your purchase. Visit our Web site *(http://aem.cornell.edu/research/wp.htm)* for a more complete list of recent bulletins.