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Index futures and positive feedback trading: evidence from major stock exchanges

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Abstract

This paper tests the hypothesis that the introduction of index futures has increased positive feedback trading in the spot markets of six industrialized nations. The analysis is based on a model that assumes two different groups of investors, i.e., risk averse expected utility maximizing investors and positive feedback traders. There is evidence consistent with positive feedback trading before the introduction of index futures across all markets under investigation. In the period following the introduction of index futures, there is no evidence supporting the hypothesis that positive feedback trading drives short-term dynamics of stock returns. The possibility that this is due to possible migration of feedback traders from the spot to the futures markets is also tested. The results show no evidence of positive feedback trading in the futures markets. Overall, the findings support the view that futures markets help stabilize the underlying spot markets by reducing the impact of feedback traders and thus attracting more rational investors who make the markets more informationally efficient and thus providing investors with superior ways of managing risk.

JEL classification: G1; G15
Keywords: Stock index futures; Feedback trading; Efficiency

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1. Introduction

The debate on the causes and consequence of asset price volatility has featured prominently in both the academic and the popular literature over the last two decades. At times of market turbulence, this debate accentuates. The popular perception tends to revolve around calls for further regulatory action to curb the effects of speculative trading on the assumption that the actions of speculators destabilize prices. In addition, trading in derivative securities and particularly the existence of trading in index futures are blamed for causing destabilization in the underlying market. The alleged destabilization takes the form of higher spot market volatility. The stock market crash of 1987, the mini crash of 1989, and some more recent highly publicised financial debacles have created the impression that derivatives threaten the stability of the international financial system.[1]

While the issue whether futures trading stabilizes or destabilizes the underlying spot markets has attracted considerable empirical analysis and received the repeated attention of policy makers, the conclusion is not as clear cut as some authors suggest since it depends on the impact of speculators on asset prices. The academic literature distinguishes between two types of speculators, namely, rational speculators and "noise" traders. Rational speculators, by trading on fundamentals, are likely to stabilize markets, dampening excessive price fluctuation. This standard view dates back to Friedman (1953). As long as futures trading encourages rational speculators, the introduction of derivative markets should move asset prices towards fundamentals and thus stabilize asset prices. In support of this view, Cox (1976) argues that the introduction of futures markets increases the number of traders, given that index futures are relatively inexpensive, have low margin requirements, and low transactions costs, and hence increases the possible channels of information flow. However, an increased information flow, according to Ross (1989), leads to an increase in price volatility as prices change in response to a greater volume of information. This increased volatility, far from destabilizing markets, is simply due to greater informational efficiency in pricing.

The literature also recognizes that speculation may sometimes be destabilizing if based on noise trading.[2] More specifically, critics of index futures seem to imply that, because of the ease and low cost of transacting, futures markets attract noise traders who cause prices to deviate from fundamentals and hence increase volatility in a destabilizing fashion. A particularly destabilizing form of noise trading is positive feedback trading, a strategy that calls for buying when prices move up and selling when prices move down. Such a strategy is in accordance with extrapolative expectations, technical analysis, stop-loss orders, and portfolio insurance. In the presence of positive feedback trading, it may be optimal for

[1] The huge losses of Procter and Gamble, Orange County, Metallgesellsehaft and Barings in deals involving derivatives have created a lot of controversy (e.g., see Miller, 1995; Kuprianov, 1995).

[2] For example, Shiller (1984) argues that social norms, fashions, or fads, can influence asset price movements. Black (1986) defines noise traders as those investors who irrationally trade on noise as if it were information pertinent to the value of assets. De Long et al. (1990a) use an overlapping generations model to show that noise traders cause prices to deviate from fundamental values.

rational speculators to 'jump on the bandwagon'. The interaction of feedback traders and rational speculators may move prices away from fundamentals in the short-run. Eventually, speculators liquidate their position, and prices move closer to their fundamental values (e.g., see De Long et al., 1990b). This behaviour could translate into positive serial correlation of returns over short horizons as positive feedback traders respond to past price increases and negative correlation at long horizons as prices eventually return to fundamentals. If derivative markets were to attract noise traders in general and positive feedback traders in particular, then the potential for destabilization would be real and the claim for further regulation warranted. Hence, in light of the above, futures trading can be either stabilizing or destabilizing depending on which type of investors dominate the market and, thus, whether the existence of futures markets is destabilizing or not is ultimately an empirical question.

Empirical research has thus far reached no firm conclusion. Stoll and Whaley (1990) and Kawaller et al. (1987) find that movements in the index futures market lead movements in the spot market. However, this lead–lag relationship is rather a reflection of the ability of futures markets to process information faster, and it does not constitute evidence of destabilization. Schwert (1990) maintains that the growth in stock index futures and options trading has not caused increases in volatility. Edwards (1988a,b) finds that, for the period 1973 to 1986, stock return volatility did not rise subsequent to the introduction of index options and index futures. Similar conclusions are reached by Kamara et al. (1992), Baldauf and Santoni (1991), Becketti and Roberts (1990), Fortune (1989), Pericli and Koutmos (1997), and Darrat and Rahman (1995). On the contrary, Antoniou and Holmes (1995) and Antoniou et al. (1998), among others, found that the introduction of futures trading increased the volatility in spot prices. The authors concluded that this increase in volatility postfutures was due to an increased information flow rather than destabilizing speculation, in line with Ross (1989). Several other studies examine the impact of futures trading on various underlying assets (e.g., see Jochum and Kodres, 1998; Fortenbery and Zapata, 1997; Netz, 1995; Antoniou and Foster, 1992; Figlewski, 1981; Powers, 1970). Overall, while there is general agreement that futures trading does not impact adversely on the underlying market, there is less agreement as to why this is the case. In spite of this wealth of studies finding that volatility did not increase after the introduction of futures markets, it cannot be inferred from this evidence that futures have not had a destabilizing effect. To interpret whether changes in volatility are destabilizing or not, the causes of volatility and the changes in the underlying market dynamics before and after the introduction of futures trading need to be investigated.

The above empirical literature has examined the issue of the impact of futures markets on prices of underlying assets by focusing on either the first or the second moment of the distribution of asset prices. Studies that use the first moment to analyze serial correlation test for predictability, but they do not tell us what causes efficiency/inefficiency. Most studies that examine the second moment test whether volatility has changed and simply associate increased volatility with destabilization. However, this latter approach is only justified if changes in volatility are associated with noise trading rather than trading on information. This paper contributes to the empirical literature that investigates whether futures markets are destabilizing by examining the role of index futures in promoting or inhibiting positive feedback trading. If positive feedback traders use index futures markets to leverage their trend chasing strategies, then we should expect an increase in positive feedback trading following the introduction of index futures. Such a finding would provide support to the claim that futures trading tends to have a destabilizing effect especially if the presence of feedback trading is associated with rises in volatility. If, on the other hand, futures markets primarily attract rational speculators who use them to arbitrage away price deviations from fundamental value, then we should expect a reduction in positive feedback trading in the period following the introduction of index futures. This would provide support for the view put forward by Cox (1976) that futures trading increases the channels of information flow, and as Ross (1989) stated, the increased information flow, while it would increase price volatility, would stabilize markets. To address the above issues, the paper uses a framework that directly links return autocorrelation and volatility. In particular, unlike previous studies, this paper looks at both the first and second moments of returns and seeks to address the following questions.

- Does the existence of futures trading promote or inhibit positive feedback trading?
- Could observed return autocorrelation be accounted for by factors other than positive feedback trading?
- Is positive feedback trading linked with higher volatility?

The paper investigates these issues using data for six major stock markets, namely, the stock markets of Canada, France, Germany, Japan, the United Kingdom, and the United States. The remainder of this paper is organized as follows. Section 2 describes the positive feedback trading model used. Section 3 describes the data used and presents the main results. Section 4 concludes this paper.

2. A feedback trading model and destabilizing speculation

Different feedback trading models have different implications for the autocorrelation pattern of stock returns. For example, the feedback models used by Cutler et al. (1990) and Shiller (1984) imply positive autocorrelation of short-term returns. Given that very little positive autocorrelation is found in stock returns, it would appear that feedback trading models are not credible alternatives to the traditional martingale models for stock prices. Shiller (1989), however, points out that positive feedback trading can give rise to negligible, even negative autocorrelation. More recent research suggests that the autocorrelation pattern of stock returns is more complex than commonly believed. LeBaron (1992) uses a GARCH model with an exponential time-varying first-order autocorrelation to describe the short-run dynamics of several US index stock returns, as well as individual stock returns. He reports significant nonlinear first-moment dependencies in the sense that autocorrelation and volatility are inversely related. Stating it differently, first-order autocorrelations of stock price changes are higher during tranquil periods and lower during volatile periods. Campbell et al. (1993) find that trading volume and stock return autocorrelation are inversely related for US stock returns. During high-volume days, autocorrelations turn negative. Such a relationship is consistent with their model where risk averse market makers accommodate buying or selling pressure from liquidity or noninformed investors.

Sentana and Wadhwani (1992) assume that there are two types of investors: rational expected utility maximizers and positive feedback (trend chasing) investors. Using data from the US stock market, they find evidence that during low volatility periods, daily stock returns are positively autocorrelated, but during high volatility periods, they tend to be negatively autocorrelated. This sign reversal in stock return autocorrelation is consistent with the notion that some traders follow feedback strategies; that is, they buy (sell) when the price rises (falls). The model used in this paper follows Shiller (1984) and Sentana and Wadhwani (1992) in assuming that traders consist of two heterogeneous groups. The demand for shares by the first group (smart money or rational speculators) is consistent with expected utility maximization. This group is therefore assumed to hold a fraction of shares of the market portfolio given by

$$Y_{1,t-1} = \frac{(E_{t-1}(R_t) - \alpha)}{\vartheta\sigma_t^2} \tag{1}$$

where $Y_{1,t-1}$ is the fraction of shares demanded by this group at time $t-1$; R_t is the ex post return at t; E_{t-1} is the expectation as of time $t-1$; α is the rate of return on a risk-free asset; σ_t^2 is the conditional variance (risk) at t; and θ is the coefficient of risk aversion. Assuming θ is positive, the product $\theta\sigma_t^2$ is the required risk premium.[3] If the introduction of futures trading attracted more rational speculators to the market, then following a news shock, expected volatility will increase, and thus, the risk premium needed to induce rational speculators to hold the shares will also increase. The market price of the asset will adjust in line with the change in risk premium. In other words, in the presence of rational speculators, prices will adjust to their new equilibrium level following the arrival of news. Thus, in this context, rational speculators stabilize asset prices.

The second group of investors follows a positive feedback strategy; that is, they buy (sell) after price increases (decreases). Thus, their demand function is modelled as proportional to the past price change of the asset and is given by

$$Y_{2,t-1} = \rho R_{t-1} \tag{2}$$

where $\rho>0$.[4] R_{t-1} is defined as $(P_{t-1}-P_{t-2})$ where P_{t-1} and P_{t-2} are the natural logarithms of prices at times $t-1$ and $t-2$, respectively. Thus, if the introduction of futures attracted more positive feedback traders then following news about fundamentals, prices will be pushed above their fundamental value. How far above they move depends on the sensitivity of demand (ρ) to price changes by positive feedback traders. Under this scenario, the introduction of futures will tend to be destabilizing.

[3] Note that if all investors had the same demand function given by Eq. (1), then in equilibrium $E_{t-1}(R_t) - \alpha = \vartheta\sigma_t^2$. which is the dynamic capital asset pricing model proposed by Merton (1973).

[4] If $\rho<0$, then there is negative feedback trading (see also Sentana and Wadhwani, 1992).

In equilibrium, all shares must be held, i.e., $Y_{1,t}+Y_{2,t}=1$. It follows from Eqs. (1) and (2) that

$$E_{t-1}(R_t) = \alpha + \vartheta\sigma_t^2 - \vartheta\rho\sigma_t^2 R_{t-1}. \tag{3}$$

The term $-\theta\rho\sigma_t^2 R_{t-1}$ in Eq. (3) implies that the presence of positive feedback trading will induce negative autocorrelation in returns. The higher the volatility, the more negative the autocorrelation. The higher predictability that arises because of feedback trading will not necessarily be exploited by the first group of investors because the risk is higher. Thus, the interaction of positive feedback traders and rational speculators could lead to price movements that are not warranted by their fundamental value. In anticipation of the response of positive feedback traders, rational speculators demand more shares than they would otherwise do, and thus, instead of stabilizing prices, they move them further away from their fundamental values. Under this scenario, the introduction of futures leads to higher volatility and destabilizes the underlying market. The destabilization could come about through two possible routes. First, the introduction of futures could attract both rational speculators as well as positive feedback traders. This leads to destabilizing volatility which is transmitted to the spot market through the process of arbitrage. Second, positive feedback traders in the spot market could further exacerbate the destabilizing effect. Thus, calls for further regulation would be justified.

It is easy to convert Eq. (3) into a regression equation with a stochastic error term by setting $R_t=E_{t-1}(R_t)+\varepsilon_t$ and substituting into Eq. (3) to get

$$R_t = \alpha + \vartheta\sigma_t^2 - \vartheta\rho\sigma_t^2 R_{t-1} + \varepsilon_t. \tag{4}$$

As is, Eq. (4) does not allow autocorrelation due to nonsynchronous trading or due to market inefficiencies. To account for this possibility, the following empirical version of Eq. (4) is used in the estimation:

$$R_t = \alpha + \vartheta\sigma_t^2 + (\phi_0 + \phi_1\sigma_t^2)R_{t-1} + \varepsilon_t, \tag{5}$$

where $\phi_1=-\vartheta\rho$. Thus, the presence of positive feedback trading implies that ϕ_1 is negative and statistically significant. ϕ_0 captures the impact of nonsynchronous trading effects or perhaps market inefficiencies and frictions.

To investigate whether the introduction of futures trading has had a stabilizing or destabilizing impact on the underlying market, the following hypotheses are formulated.

(1) The introduction of futures trading will reduce the impact of positive feedback trading on the underlying market.
The rationale for this hypothesis stems from the work of Cox (1976) and Ross (1989). In particular, futures markets are expected to increase the flow of information to the underlying market, thus making this market more informationally efficient and reducing the impact of positive feedback traders. In addition, the arbitrage link between the spot and futures markets limits the extent to which spot prices can be driven away from fundamental values.

(2) Following the introduction of futures trading, positive feedback traders migrate to the futures markets.

This hypothesis is based on the view that the lower transaction costs and the greater leverage potential of futures markets are more attractive to uninformed traders. The first hypothesis is evaluated by estimating the model in Eq. (5) using stock market returns for a pre and a postfutures sample. The second hypothesis is investigated by estimating the model in Eq. (5) using futures returns.

Completion of the model requires that the conditional variance be specified. Numerous studies have shown that stock returns are conditionally heteroskedastic[5]. Consequently, the conditional variance of the returns is modelled as an asymmetric GARCH(1,1) process given by

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2 \tag{6}$$

where σ_t^2 is the conditional variance of the returns at time t, ε_t is the innovation at time t, and α_0, α_1, β, and δ are nonnegative fixed parameters. δ captures the sign effect, i.e., the asymmetric impact of positive and negative innovations. S_t takes the value of unity if the innovation at time t is negative and zero otherwise. If δ is positive and statistically significant, then negative innovations increase volatility more that the positive innovations.

Several parametric specifications have been used in the literature for stock returns, the most common being the standard normal distribution. More often than not, the standardised residuals obtained from GARCH models that assume normality appear to be leptokurtic thereby rendering standard t-tests unreliable. As such, distributions with flatter tails, such as the student's t and the generalised error distribution (GED), have been suggested. In this paper, we employ the GED. Its density function is given by

$$f(\mu_t, \sigma_t, v) = \frac{v}{2}[\Gamma(3/v)]^{1/2}[\Gamma(1/v)]^{-3/2}(1/\sigma_t)\exp(-[\Gamma(3/v)/\Gamma(1/v)]^{v/2}|\varepsilon_t|\sigma_t|)$$

where $\Gamma(.)$ is the gamma function, and v is a scale parameter or degrees of freedom to be estimated emdogenously. For v=2, the GED yields the normal distribution, while for v=1, it yields the Laplace or double exponential distribution.

Given initial values for ε_t and σ_t^2, the parameter vector $\Theta \equiv (\alpha, \theta, \phi_0, \phi_1, \alpha_0, \alpha_1, \beta, \delta, v)$ can be estimated by maximizing the log likelihood over the sample period, which can be expressed as,

$$L(\theta) = \sum_{t=1}^{T} \log f(\mu_t, \sigma_t, v) \tag{8}$$

where μ_t and σ_t are the conditional mean and the conditional standard deviation, respectively. Since the log-likelihood function is highly nonlinear in the parameters,

[5] For an excellent survey of studies modeling stock returns as conditionally heteroskedastic processes, see Bollerslev et al. (1992).

numerical maximization techniques are used to obtain estimates of the parameter vector. The method of estimation used in this paper is based on the Berndt et al. (1974) algorithm.

3. Empirical findings

3.1. Data and descriptive statistics

The data include daily observations for the stock price indexes of six major stock exchanges and their corresponding index futures. The markets under examination are those of Canada, France, Germany, Japan, the UK, and the US. These countries are chosen for investigation to allow comparisons to be made of markets with different characteristics. In examining the stock markets, the following indexes are used. Toronto 300 Composite (Canada), the CAC industrial price index (France), Frankfurt Commerzbank Index (Germany), Nikkei 225 (Japan), the FT All Share index (UK), and the S&P 500 (USA). In each case, the index represents the main index closely related to the futures contract which has been introduced for which data were available for the entire sample period. For the stock indexes (spot market), the data set extends from 2/1/69 to 24/1/96 for a total of 7040 observations. For the index futures (futures market), the starting dates are 1/2/91 (for Canada), 11/9/88 (for France), 11/23/90 (for Germany), 9/5/88 for Japan, 5/3/84 (for the UK), and 6/1/82 (for the US). The ending date for all index futures prices is 12/7/97. All data were obtained from Datastream.

Table 1
Sample statistics

	Canada	France	Germany	Japan	UK	USA
(A) Daily stock returns (1/2/69–1/24/96)						
μ	0.0210*	0.0325*	0.0153*	0.0348*	0.0329*	0.0253*
σ	0.7649	1.0904	0.9775	1.0846	1.0191	0.9237
S	−0.7049*	−0.5691*	−0.7697*	−1.0850*	−0.2669*	−2.1699*
K	19.2577*	13.5932*	9.7750*	31.0447*	8.7713*	57.8029*
D	0.1122*	0.0831*	0.0608*	0.0314	0.1048*	0.0673*
LB(5)	241.9214*	91.5181*	51.4537*	21.4137*	201.1981*	73.4206*
$LB^2(5)$	3461.0431*	236.5881*	687.247*	157.2965*	3126.8635*	429.0920*
(B) Daily futures returns (sample end date 7/11/97)						
Sample start date	(1/2/91)	(11/9/88)	(11/23/90)	(9/5/88)	(5/3/84)	(6/1/82)
μ	0.0378*	0.0304	0.0549*	−0.0138	0.0418*	0.0532*
σ	0.7308	1.1684	0.9679	1.3281	1.0465	1.1648
S	−0.1780*	−0.0814*	−0.6023*	−0.2937*	−1.5297*	−5.5747*
K	2.3193*	3.6783*	9.3819*	3.7816*	24.8461*	196.0585*
D	0.0530*	0.0273*	0.0311*	0.0249*	0.0281*	0.0535*
LB(5)	8.8974	7.0594	10.9100	3.0289	8.6528	49.9467*
$LB^2(5)$	30.8123*	105.3758*	97.1065*	318.1585*	822.7176*	322.8578*

Asterisk (*) denotes significance at the 5% level. μ—mean; σ—standard deviation; S—skewness; K—excess kurtosis; D—Kolmogorov–Smirnov statistic (5% critical value is $1.36/\sqrt{T}$, where T is sample size). LB(n) and $LB^2(n)$ are the Ljung–Box statistics for R_t and R_t^2, respectively, distributed as χ^2 with n degrees of freedom, where n is number of lags.

Daily spot and futures market returns for each country are calculated as the percent logarithmic differences in the daily stock price index and the daily futures price, i.e., R_t=100(logP_t−logP_{t-1}). Descriptive statistics for the daily returns are provided in Table 1. The statistics reported are the mean (μ) and the standard deviation (σ), measures for skewness (S) and kurtosis (K), the Kolmogorov–Smirnov (D) statistic, and the Ljung–Box (LB) statistic for five lags.[6] Both spot and futures returns are significantly negatively skewed and highly leptokurtic. These two measures provide evidence that the return series are not normally distributed. Likewise, the D-statistics suggest significant departures from normality.[7] Rejection of normality can be partially attributed to temporal dependencies in the moments of the series. It is common to test for such dependencies using the Ljung–Box portmanteau test (LB), e.g., Bollerslev et al. (1994). The LB statistic is significant for all spot return series without exception. This provides evidence of temporal dependencies in the first moment of the distribution of spot returns. The same statistic fails to uncover significant first-moment dependencies in futures returns. It is not clear to what extent nonsynchronous trading or market inefficiencies are responsible for first-moment dependencies in the returns of the spot markets. In addition, the LB statistic is incapable of detecting any sign reversals in the autocorrelations due to positive feedback trading. It simply provides an indication that first-moment dependencies are present. Evidence on higher order temporal dependencies is provided by the LB statistic when applied to squared returns. For the squared spot and futures returns, the LB statistic is significant without exception. Moreover, it is, in most cases, several times higher than the LB statistic calculated for the returns, suggesting that higher moment temporal dependencies are more pronounced. This of course is an empirical regularity encountered in almost all financial time series, especially in high frequencies. What is not clear from these statistics is the extent to which the two types of dependencies are linked, i.e., whether volatility and autocorrelation are linked because of the presence of positive feedback trading. As such, further investigation is warranted.

3.2. Empirical evidence on positive feedback trading

Table 2 reports the maximum likelihood estimates for the empirical version of the feedback model described by Eqs. (5)–(8), using data from the period before the introduction of index futures in the six stock markets. The coefficients describing the conditional variance process, α_0, α_1, and β, are highly significant in all cases with the exception of Japan where β is insignificant. This in turn implies that current volatility is a function of last period's squared innovation and last period's volatility. Interestingly, parameter δ is significant in all cases, with the exception of Canada, suggesting that the conditional variance is an asymmetric function of past squared residuals. Specifically, past negative innovations increase volatility more than past positive innovations. The

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[6] The Kolmogorov–Smirnov statistic is calculated as $D_n = \max|F_n(R) - F_0(R)|$ where F_n is the empirical cumulative distribution of R_t, and $F_0(R)$ is the postulated theoretical distribution. The Ljung–Box statistic for N lags is calculated as $\mathrm{LB}(N) = T(T+2)\sum_{j=1}^{N}(\rho_j^2/T-j)$ where ρ_j is the sample autocorrelation for j lags, and T is the sample size.

[7] For uniformity, the 5% level of significance is used throughout.

Table 2
Maximum likelihood estimates of the feedback model, daily stock returns, prefutures period

	Canada (5/27/87)	France (11/9/88)	Germany (11/23/90)	Japan (39/3/88)	UK (5/3/84)	USA (4/21/82)
α	0.0269	0.0000	0.0029	0.0289	−0.0046	−0.0001
	(0.012)*	(−0.014)	(−0.014)	(0.001)*	(−0.023)	(0.021)*
θ	0.0063	0.0000	0.0138	−0.0261	0.0222	0.0045
	(0.025)	(0.014)	(0.019)	(0.001)	(0.023)	(0.034)
φ_0	0.3187	0.1543	0.1401	0.0056	0.2282	0.2059
	(0.018)*	(0.013)*	(0.016)*	(0.001)*	(0.021)*	(0.028)*
φ_1	−0.1016	−0.0135	−0.0196	−0.0024	−0.0263	−0.0392
	(0.017)*	(0.005)*	(0.007)*	(0.000)*	(0.009)*	(0.027)
α_0	0.0213	0.0307	0.0168	1.1081	0.0202	0.0077
	(0.003)*	(0.006)*	(0.003)*	(0.001)*	(0.004)*	(0.002)*
α_1	0.1279	0.085	0.0838	0.0756	0.0692	0.0255
	(0.014)*	(0.013)*	(0.012)*	(0.018)*	(0.011)*	(0.008)*
β	0.8345	0.8781	0.8790	0.0002	0.8987	0.9318
	(0.014)*	(0.012)*	(0.010)*	(0.001)	(0.009)*	(0.008)*
δ	0.0035	0.0338	0.0465	0.0981	0.0295	0.0671
	(0.018)	(0.017)*	(0.013)*	(0.042)*	(0.013)*	(0.013)*
v	1.1592	0.9652	1.3456	0.4032	1.6257	1.5205
	(0.024)*	(0.018)*	(0.017)*	(0.006)*	(0.041)*	(0.047)*

Asterisk (*) denotes statistical significance at the 5% level. Parentheses include the standard errors of the estimates. The starting date for all indices is 1/2/69.

$$R_t = \alpha + \vartheta\sigma_t^2 + \left(\phi_0 + \phi_1\sigma_t^2\right)R_{t-1} + \varepsilon_t$$
$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$$

contribution of a positive innovation is equal to α_1, whereas the contribution of a negative innovation is α_1+δ. The ratio (α_1+δ)/α_1 can be used as an intuitive measure of asymmetry. On the basis of this measure, the US and the Japanese stock markets exhibit the highest degrees of asymmetry. On average, these two markets are approximately 2.9 times more volatile during market declines.

The parameters of most interest in this paper are those governing the autocorrelation of the returns, i.e., ϕ_0 and ϕ_1. The constant component of the autocorrelation, ϕ_0, is statistically significant in all six markets. It is possible that the source of this type of autocorrelation is related to nonsynchronous trading (e.g., see Fisher, 1966; Scholes and Williams, 1977; Lo and Mackinlay, 1990) although it could be that time variation in ex ante returns causes autocorrelation in ex post returns (e.g., see Conrad and Kaul, 1988). Atchison et al. (1987) find that for a value weighted portfolio, the theoretical autocorrelation due solely to nonsynchronous trading is much lower than that observed empirically. For a portfolio of 260 US stocks, they find the actual first-order autocorrelation to be 0.1286, with a theoretically predicted autocorrelation due to nonsynchronous trading being 0.0167. Nonsynchronous trading and/or time variation in ex ante returns can cause positive autocorrelation in ex post returns, at least in high frequency data. It is also possible that the significance of ϕ_0 is due to market frictions or inefficiencies. Positive feedback trading, on the other hand, causes negative autocorrelation which rises, in absolute terms, with the level of volatility. In this respect, it is interesting to see that, with the exception of the US market, ϕ_1 is negative and statistically significant. The implication is that positive feedback trading is an important determinant of short-term movements in these markets in agreement with the findings of Sentana and Wadhwani (1992) for the US stock market.[8] Thus, it appears that stock return dynamics are similar across national stock markets. This should not be surprising given the growing interdependence of stock markets around the world. As mentioned earlier, the greater predictability (negative autocorrelation) that is induced by feedback traders does not necessarily create arbitrage opportunities for rational risk averse investors because volatility and, thus, risk also rises. This is especially true if rational investors have short holding horizons and are concerned about liquidating mispriced assets. The extent of mispricing is likely to increase during periods of higher volatility because it is then that positive feedback traders have a greater influence on price. It can be inferred from Table 2 that for values of volatility greater than 3.14 for Canada, 11.43 for France, 7.15 for Germany, 2.33 for Japan, 8.68 for the UK, and 5.25 for the US, returns will exhibit negative serial correlation, and thus, positive feedback traders have greater impact. Thus, the autocorrelation properties of returns can change with variations in volatility. The practical significance of this finding can be illustrated by considering the October 1987 crash. For the USA, the estimated measure of volatility peaked at approximately 46, suggesting a first-order autocorrelation coefficient of −0.23. This compares with a typical volatility figure of approximately 3 and a corresponding autocorrelation coefficient of −0.005. Similar findings apply for the other countries investigated.

The presence of asymmetry in the conditional variance implies that positive feedback trading is more intense during market declines than it is during market advances. It is not obvious why feedback traders should be more active during markets declines. One possibility is that a substantial amount of feedback trading is due to portfolio insurance strategies and the extensive use of stop-loss orders. Since these strategies lead to sell decisions during market declines, it is natural to expect greater feedback activity during down markets. Margin trading could also be a contributing factor because, during large market declines, there is a greater likelihood that margin accounts will be liquidated. To investigate further, the extent to which positive feedback trading is more intense during market declines an additional term $\phi_S|R_{t-1}|$ is added in Eq. (5) so that the coefficient on R_{t-1} would be

$$\begin{array}{l} \phi_0 + \phi_s + \phi_1\sigma_t^2 \;\text{ if }\; R_{t-1}\geq 0 \\ \phi_0 - \phi_s + \phi_1\sigma_t^2 \;\text{ if }\; R_{t-1} \prec 0 \end{array} \tag{9}$$

Expression (9) implies that for $\phi_s>0$, it is more likely that there will be more positive feedback trading following market declines. The parameter estimates from estimating Eq. (9) turned out to be statistically insignificant for all countries except for the US and German markets.[9] This result is not surprising since the asymmetric–GARCH formulation already captures the asymmetric response to price changes. Thus, the results this far suggest that before the introduction of futures, positive feedback traders had a significant impact on asset prices. This, along with the finding that positive feedback

[8] Sentana and Wadhwani (1992) examine a much longer period and find significant positive feedback trading for the US market.

[9] In the interests of brevity, results are not reported but are available from the authors on request.

trading is more acute at high levels of volatility, would lend support to the view that feedback traders had a destabilizing influence on stock prices. The extent to which this destabilizing influence has been promoted or inhibited with the advent of futures trading will now be addressed.

Table 3 reports the results for the postfutures period. The nature of the time variation in the conditional variance is basically the same as in the prefutures period. There are, however, striking differences in the structure of the conditional mean. With the exception of Canada and the UK, the constant part of the autocorrelation is now insignificant. Even for Canada and the UK, the size of the parameter has been reduced substantially. This is important as it suggests that to the extent that nonsynchronous trading problems are related to market frictions, i.e., slow adjustment of prices due to transaction costs, informational asymmetries, etc., or market inefficiencies, they have become less of a problem in the postfutures period. More importantly, the feedback trading parameter, ϕ_1, is now statistically indistinguishable from zero, with the exception of Canada. Even for Canada, the size of the feedback parameter is three times smaller in the postfutures period. These significant changes in the autocorrelation structure of index returns strongly suggest that the introduction of index futures (i) has reduced possible market frictions and inefficiencies and (ii) has either driven positive feedback traders away from the market or has considerably reduced their impact in the price formation process. The existence of futures could also have enhanced the role of rational speculators and arbitrageurs. This could stabilize prices because it increases the risk-bearing capacity of the market.

Since index futures have lower transactions costs and margin requirements, it is likely that their prices respond faster to new information. Price adjustments are then transmitted to the spot market through index arbitrage activities. In addition to faster absorption of new information, index futures provide more efficient ways of managing portfolios without the need to use the spot market continuously.

To formally test the hypothesis that changes in ϕ_0 and ϕ_1 in the postfutures period are statistically significant, we modify the model as follows:

$$R_t = \alpha + \vartheta\sigma_t^2 + \{\phi_{0,1}D_t + \phi_{0,2}(1 - D_t)\}R_{t-1} + \{\phi_{1,1}D_t + \phi_{1,2}(1 - D_t)\}\sigma_t^2 R_{t-1} + \varepsilon_t \tag{5a}$$

$$\sigma_t^2 = \alpha_{0,1}D_t + \alpha_{0,2}(1 - D_t) + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2 \tag{6a}$$

where D_t is the Heaviside indicator function taking the value of unity in the prefutures period and zero thereafter. The extended model given by Eqs. (5a) and (6a) has the advantage that it utilizes the full sample thereby improving efficiency, and it allows for direct testing of the following hypotheses: $H_{0,1}$: $\phi_{0,1}=\phi_{0,2}$, $H_{0,2}$: $\phi_{1,1}=\phi_{1,2}$, and $H_{0,3}$: $\alpha_{0,1}=\alpha_{0,2}$. The estimated parameters along with t-statistics for $H_{0,1}$, $H_{0,2}$, and $H_{0,3}$ are reported in Table 4. The results confirm the findings reported earlier that in the postfutures period, overall market efficiency has improved, and positive feedback trading is no longer present. With the exception of Canada and the UK, coefficient $\phi_{0,1}$ is statistically insignificant. Moreover, the hypothesis that $\phi_{0,1}=\phi_{0,2}$ is easily rejected. Likewise, the feedback parameter $\phi_{1,2}$ is insignificant in the postfutures period save for Canada. In the latter case, although the parameter is significant, it is substantially smaller than the

Table 3
Maximum likelihood estimates of the feedback model, daily stock returns, postfutures

	Canada	France	Germany	Japan	UK	USA
α	0.0301	−0.0095	−0.0538	0.0135	0.0567	0.0223
	(−0.018)	(−0.051)	(−0.053)	(0.024)	(−0.024)*	(0.016)*
ϑ	−0.0382	0.0235	0.1051	−0.0103	−0.0259	0.0145
	(0.053)	(−0.050)	(0.074)	(−0.018)	(0.041)	(−0.023)
φ_0	0.226	0.0154	0.0385	0.0104	0.1035	0.0101
	(0.012)*	(0.040)	(0.046)	(0.030)	(0.020)*	(0.016)
φ_1	−0.0326	−0.0257	−0.0178	−0.0066	−0.0122	−0.0052
	(0.010)*	(0.023)	(0.043)	(0.009)	(0.009)	(0.008)
α_0	0.0274	0.0846	0.043	0.015	0.0246	0.0101
	(0.005)*	(0.030)*	(0.016)*	(0.005)*	(0.005)*	(0.003)*
α_1	0.0434	0.0389	0.0433	0.0216	0.0528	0.0362
	(0.020)*	(0.025)*	(0.026)*	(0.011)*	(0.014)*	(0.009)*
β	0.8365	0.8364	0.8779	0.9029	0.8799	0.9356
	(0.024)*	(0.045)*	(0.036)*	(0.013)*	(0.016)*	(0.008)*
δ	0.0671	0.0945	0.0420	0.1505	0.0566	0.0324
	(0.021)*	(0.038)*	(0.030)	(0.023)*	(0.017)*	(0.012)*
v	1.1633	1.1167	1.1894	1.2127	1.1446	1.1183
	(0.033)*	(0.054)*	(0.030)*	(0.044)*	(0.023)*	(0.025)*

Asterisk (*) denotes statistical significance at the 5% level. Parentheses include the standard errors of the estimates. The ending date for all indices is 1/24/96.

$$R_t = \alpha + \vartheta\sigma_t^2 + \left(\phi_0 + \phi_1\sigma_t^t\right)R_{t-1} + \varepsilon_t$$

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$$

prefutures value $\phi_{1,1}$. The t-statistic rejects the hypothesis that $\phi_{1,1}=\phi_{1,2}$. Thus, we can be confident that there is no evidence of positive feedback trading in the period following the introduction of index futures. The hypothesis that the unconditional variance has remained the same in the postfutures period cannot be rejected. The t-statistic testing $\alpha_{0,1}=\alpha_{0,2}$ is statistically insignificant. Thus, introduction of futures has not resulted in higher volatility.

While the insignificance of the feedback trading parameter is indicative of the reduction in the impact of feedback traders, as Cox (1976) and Ross (1989) suggest, it is also possible that it is due to an increase in market efficiency, although according to our model, improvements in market efficiency will manifest themselves as reductions in the time invariant part of the autocorrelation, namely, parameter ϕ_0.[10] To evaluate this proposition, Eqs. (5) and (6) were reestimated to include higher order lags of returns in Eq. (5). If the change in significance of the feedback parameter is due to the impact of feedback traders, then it is likely that only the one-period lagged returns will be different between the two periods. On the other hand, if it is a more general efficient markets effect, then higher order lags may also differ between the pre and postfutures periods, particularly in relation to the constant component of autocorrelation.[11] For Canada, Japan, the UK, and the USA, higher

[10] It should be pointed out that according to the model, parameter ϕ_1 arises solely due to the possibility of feedback trading and it is separate and distinct from parameter ϕ_0 which is designed to capture possible nonsynchronous trading and/or market frictions and inefficiencies. Consequently, improvements in efficiency will most likely show up as reductions in ϕ_0 rather than changes in ϕ_1.

[11] The authors are grateful to an anonymous referee for pointing this out.

Table 4
Maximum likelihood estimates of the extended feedback model; tests for parameter changes in the postfutures period

	Canada	France	Germany	Japan	UK	USA
α	0.0269	0.0009	−0.0027	0.0058	0.0324	0.0178
	(0.009)*	(0.013)	(0.014)	(0.001)*	(0.015)	(0.013)
ϑ	−0.0035	0.0005	0.0230	−0.0021	−0.0047	0.0066
	(0.022)	(0.014)	(0.017)	(0.043)	(0.019)	(0.020)
$\varphi_{0,1}$	0.3195	0.1742	0.1370	0.0036	0.2287	0.1979
	(0.018)*	(0.013)*	(0.015)*	(0.001)*	(0.021)*	(0.027)*
$\varphi_{0,2}$	0.2251	−0.0281	−0.0467	0.0105	−0.1078	−0.0184
	(0.021)*	(0.035)	(0.041)	(0.355)	(0.021)*	(0.018)
$\varphi_{1,1}$	−0.1082	−0.0161	−0.0205	−0.0029	−0.0277	−0.0357
	(0.017)*	(0.005)*	(0.006)*	(0.000)*	(0.009)*	(0.025)
$\varphi_{1,2}$	0.0275	0.0274	0.0157	−0.0067	0.0089	0.0046
	(0.008)*	(0.017)	(0.027)	(0.008)	(0.986)	(0.009)
$\alpha_{0,1}$	0.0247	0.0363	0.0182	1.2724	0.0254	0.0094
	(0.0003)*	(0.006)*	(0.003)*	(0.138)*	(0.004)*	(0.002)*
$\alpha_{0,2}$	0.0209	0.0528	0.0238	0.0155	0.0172	0.0099
	(0.028)*	(0.009)*	(0.004)*	(0.005)*	(0.002)*	(0.002)*
α_1	0.1109	0.08423	0.0750	0.0555	0.0653	0.0337
	(0.012)*	(0.013)*	(0.010)*	(0.016)*	(0.009)*	(0.006)*
β	0.8307	0.8647	0.8855	0.2322	0.8917	0.9292
	(0.012)*	(0.012)*	(0.009)*	(0.151)	(0.008)*	(0.006)*
δ	0.0183	0.0428	0.0425	0.0493	0.0387	0.0512
	(0.013)	(0.016)*	(0.011)*	(0.032)	(0.010)*	(0.009)*
v	1.1574	0.9943	1.2835	0.4031	1.5235	1.2803
	(0.019)*	(0.016)*	(0.014)*	(0.007)*	(0.017)*	(0.021)*
t-statistics $\varphi_{0,1}=\varphi_{0,2}$	19.8465*	5.3925*	4.2444*	3.1557*	11.2749*	6.6078*
t-statistics $\varphi_{1,1}=\varphi_{1,2}$	−7.2156*	−2.4342*	−2.2968*	−3.2071*	−2.8070*	−1.4830
t-statistics $\alpha_{0,1}=\alpha_{0,2}$	0.6832	−1.1921	−0.8197	1.2292	1.3084	−0.1477

Asterisk (*) denotes statistical significance at the 5% level. Parentheses include the standard errors of the estimates. Sample period, 1/2/69–1/24/96.

$$R_t = \alpha + \vartheta\sigma_t^2 + \{\varphi_{0,1}D_t + \varphi_{0,2}(1 - D_t)\}R_{t-1} + \{\varphi_{1,1}D_t + {}_{1,2}(1 - D_t)\}\sigma_t^2 R_{t-1} + \varepsilon_t$$

$$\sigma_t^2 = \alpha_{0,1}D_t + \alpha_{0,2}(1 - D_t) + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$$

order lags are not significant either before or after the introduction of futures, consistent with the previous interpretation that the change is due to a reduction in the impact of positive feedback trading. For France and Germany, the positive feedback coefficient for the second lag is significant prior to the introduction of futures but not after their introduction. This suggests that feedback traders in these markets react to a price trend over a longer period. However, for France, the constant component of autocorrelation for the second lag is significant prefutures but not postfutures. This suggests that for France, there appears to have been an improvement in efficiency in addition to a reduction in feedback trading. In contrast, for Germany, the constant component of autocorrelation for the second lag is insignificant in both periods, suggesting that it is likely that it is the feedback effect which dominates.[12]

To test the robustness of the results to different window specifications around the contract introduction event, we estimate the model using 2-, 3-, and 4-year windows. It is expected that tighter windows will provide a more rigorous test to the feedback trading story.[13] As can be seen from the estimated parameters reported in Table 5, the results generally remain qualitatively the same when the 4-year window is used. For the 3- and 2-year windows, the same results hold for Canada, France, and the UK but do not hold for the US. These additional findings lend further support to the positive feedback dynamics being less noticeable in the period following index futures introduction.

Further examination of the view that the differences may be due to changes in efficiency rather than the reduction in the impact of positive feedback trading can be considered by examining the behaviour of stock prices unrelated to futures trading for periods before and after the introduction of futures trading. If the differences are due to general improvements in efficiency, then it is expected that stock portfolios for which there is no related futures contract will behave in a similar way to those for which there is a related futures contract. Specifically, we would expect that for such portfolios, the positive feedback parameter will be significant prior to the introduction of futures but insignificant postfutures. To carry out this test, equally weighted portfolios were formed from companies that, in terms of market capitalisation, ranked between 70–120 for Canada, 275–325 for Japan, 60–80 for France, 150–200 for the UK, and 550–600 for the USA. The portfolios are rebalanced on an annual basis with companies moving in and out of portfolios depending on whether they move in or out of the above rankings. For Germany, the mid-cap index was used as reported by Datastream. All share prices were obtained from Datastream. The sample period covers 4 years before and 4 years after the introduction of futures.[14] The constructed portfolios were chosen to ensure low correlation between them and the stock indexes used in previous tests, and thus, they represent equities not influenced by the trading of futures contracts. All correlation coefficients were below 0.5.

Results for this analysis are shown in Table 6. For Japan, Germany, France, and the USA, the positive feedback coefficient is insignificant both before and after the introduction of futures. Given that the portfolios examined represent stocks within the mid- to small-cap range, it is to be expected that positive feedback traders will be less active here. The results for these four countries are in sharp contrast to those for the portfolios related to the futures contracts, suggesting that the causes of changes are due to reductions in the impact of positive feedback trading rather than general improvements in efficiency. For the UK, the coefficient is insignificant prefutures but significant postfutures. This could suggest that feedback traders have migrated to the mid-cap stocks following the introduction of futures. For the futures-related stocks, however, the implication is that it is a reduction in the impact of feedback trading which has brought

[12] In the interests of brevity, results are not reported here but are available from the authors on request.

[13] This test was suggested by an anonymous reviewer.

[14] Five- and ten-year windows were also tested, but the results are qualitatively the same. Thus, the results reported appear robust to the choice of window size.

Table 5
Maximum likelihood estimates of the extended feedback model; tests for parameter changes in the postfutures period

	Canada	France	Germany	Japan	UK	USA
Two-year window						
$\varphi_{1,1}$	−0.0305	−0.0217	−0.0118	−0.0045	−0.3592	−0.0171
	(0.009)*	(0.007)*	(0.006)*	(0.004)	(0.130)*	(0.132)
$\varphi_{1,2}$	0.0244	0.0267	0.0089	0.0077	0.2862	0.0889
	(0.012)*	(0.012)*	(0.012)	(0.009)	(0.122)	(0.105)
t-statistics $\varphi_{1,1}=\varphi_{1,2}$	−2.2156*	−2.1403*	−1.9655*	−1.2921	−8.1148*	−1.5844
Three-year window						
$\varphi_{1,1}$	−0.0422	−0.0247	−0.0190	−0.0051	−0.1287	−0.0035
	(0.008)*	(0.007)*	(0.011)	(0.005)	(0.046)*	(0.081)
$\varphi_{1,2}$	0.0259	0.0272	0.0079	0.0109	0.1527	0.0795
	(0.009)*	(0.013)*	(0.002)	(0.008)	(0.075)*	(0.075)
t-statistics $\varphi_{1,1}=\varphi_{1,2}$	−2.1866*	−2.1998*	−1.5338	−1.7590	−4.8187*	−1.6241
Four-year window						
$\varphi_{1,1}$	−0.0451	−0.0356	−0.0089	−0.0026	−0.0737	−0.0428
	(0.008)*	(0.008)*	(0.004)*	(0.004)*	(0.032)*	(0.072)
$\varphi_{1,2}$	0.0341	0.0321	0.0094	0.0146	0.0223	0.1145
	(0.010)*	(0.013)*	(0.016)	(0.007)*	(0.011)*	(0.070)
t-statistics $\varphi_{1,1}=\varphi_{1,2}$	−2.9912*	−2.6514*	−1.8566	−2.0934*	−3.0874*	−1.2791

Asterisk (*) denotes statistical significance at the 5% level. Parentheses include the standard errors of the estimates. Windows are based on the day of the introduction of the futures contract in each market.

$$R_t=\alpha+\vartheta\sigma_t^2+\{\varphi_{0,1}D_t+\varphi_{0,2}(1-D_t)\}R_{t-1}+\{\varphi_{1,1}D_t+\varphi_{1,2}(1-D_t)\}\sigma_t^2R_{t-1}+\varepsilon_t$$
$$\sigma_t^2=\alpha_{0,1}D_t+\alpha_{0,2}(1-D_t)+\alpha_1\varepsilon_{t-1}^2+\beta\sigma_{t-1}^2+\delta S_{t-1}\varepsilon_{t-1}^2$$

about these changes. Finally, for Canada, the coefficient is significant prefutures but insignificant postfutures. It is therefore possible that the changes for Canada are due to an increase in efficiency. However, the results for the higher lags suggest that this is not the case.[15] An additional albeit indirect test can be conducted for the US and the Canadian markets which are highly correlated. During the period March 21, 1982, until May 27, 1987, there was a futures contract for the US index but not for the Canadian index. The estimated feedback parameters are −0.1112 with a t-statistic of 1.61 for the US and −0.3028 with a t-statistic of 5.99 for Canada. The implication is that, although the markets are highly correlated, the absence of futures for Canada made it difficult to reduce positive feedback trading.[16] Taking the three additional sets of tests together, it appears that the changes postfutures are primarily due to a reduction in the impact of positive feedback trading rather than to improvements in efficiency.

[15] In the interests of brevity, results are not reported here. Results are available from the authors on request.

[16] We thank the editor Geert Bekaert for suggesting this test.

Table 6
Portfolio returns results, pre and postfutures

	Canada	France	Germany	Japan	UK	USA
Prefutures						
ϕ_0	0.0519	0.3947	0.0930	0.0983	0.1812	0.2096
	(0.020)*	(0.024)*	(0.023)*	(0.031)*	(0.015)*	(0.028)*
ϕ_1	−0.0794	−0.2348	−0.0242	−0.0268	−0.0212	−0.0385
	(0.021)*	(0.227)	(0.028)	(0.049)	(0.021)	(0.027)
Postfutures						
ϕ_0	0.0769	0.2602	0.1415	0.4232	0.1130	0.2295
	(0.053)*	(0.045)*	(0.040)*	(0.087)*	(0.022)*	(0.021)*
ϕ_1	−0.0194	−0.0359	−0.0276	−0.0212	−0.0357	−0.0361
	(0.017)	(0.374)	(0.045)	(0.033)	(0.007)*	(0.027)

Asterisk (*) denotes statistical significance at the 5% level. Parentheses include the standard errors of the estimates.

$$R_t = \alpha + \vartheta\sigma_t^2 + (\phi_0 + \phi_1\sigma_t^2)R_{t-1} + \varepsilon_t$$
$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$$

To summarize the results so far, the evidence presented above suggests that the introduction of futures trading has reduced the impact of positive feedback trading and, thus, the deviation of prices from their fundamental values. Given the general agreement of the results across different markets, it could be argued that irrespective of the regulatory framework, the introduction of futures has had a stabilizing effect on the underlying stocks markets. While futures contacts in Germany and France have fairly restrictive trading conditions on them relative to the US and UK contacts, the results in this paper support the view that futures markets expand the information channels through which information is transmitted to the spot market. Thus, far from destabilizing the underlying markets, they have a stabilizing effect.

It is also possible that positive feedback traders have migrated to the futures market because of the lower transaction costs and the greater leverage potential. As such, positive feedback trading has become insignificant in the spot markets. This possibility is investigated by estimating the feedback model using futures returns for all six markets. The results are reported in Table 7. It turns out that the coefficient designed to capture the presence of positive feedback trading is statistically insignificant in all six markets. This evidence rejects the notion that feedback traders are using the futures markets to implement their trend chasing strategies. On the contrary, futures markets appear to attract sophisticated investors who are probably using the futures markets to exploit arbitrage opportunities created by positive feedback traders. Once again, these results provide further support to the argument that futures trading expands the information channels and has a stabilizing effect on the underlying markets.

Finally, in all instances, the estimated degrees of freedom parameter v is well below two, the value required for normality, and very close to unity suggesting that the empirical distributions of the returns are in all cases close to the double exponential or Laplace distribution. In fact t-tests reject the hypothesis that v=2 for all six markets at the conventional level. This confirms that departures from normality observed in the raw

Table 7
Maximum likelihood estimates of the feedback model, daily futures returns

	Canada	France	Germany	Japan	UK	USA
α	−0.0190	−0.0433	−0.0239	0.0349	0.0471	0.0334
	(0.042)	(0.051)	(0.045)	(0.024)	(0.027)	(0.014)*
θ	0.0653	0.0525	0.0640	−0.0210	−0.0038	0.0139
	(0.081)	(0.040)	(0.044)	(0.018)	(0.029)	(0.014)
φ_0	0.0495	0.0183	−0.0354	−0.0106	0.0030	−0.0442
	(0.054)	(0.038)	(0.029)	(0.029)	(0.019)	(0.014)*
φ_1	−0.0284	−0.0239	−0.0077	−0.0064	−0.0038	−0.0011
	(0.081)	(0.021)	(0.014)	(0.010)	(0.005)	(0.002)
α_0	0.0155	0.0615	0.0866	0.0121	0.0269	0.0158
	(0.006)*	(0.017)*	(0.024)*	(0.004)*	(0.006)*	(0.003)*
α_1	0.0140	0.0058	0.0412	0.0277	0.0359	0.0383
	(0.013)	(0.013)	(0.025)	(0.012)*	(0.011)*	(0.011)*
β	0.9298	0.8994	0.8391	0.9101	0.9101	0.9207
	(0.020)*	(0.022)*	(0.036)*	(0.012)*	(0.013)*	(0.008)*
δ	0.0599	0.0958	0.0852	0.1251	0.0548	0.0539
	(0.020)*	(0.020)*	(0.039)*	(0.020)*	(0.016)*	(0.019)*
v	1.1667	1.3364	1.0803	1.2577	1.3709	1.0389
	(0.051)*	(0.040)*	(0.028)*	(0.046)*	(0.023)*	(0.021)*

Asterisk (*) denotes statistical significance at the 5% level. Parentheses include the standard errors of the estimates. Sample periods for futures are as in Table 1.

$$R_t = \alpha + \vartheta\sigma_t^2 + \left(\phi_0 + \phi_1\sigma_t^2\right)R_{t-1} + \varepsilon_t$$
$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$$

return series cannot be entirely attributed to temporal first- and second-moment dependencies.

4. Conclusion

This paper contributes to the debate on the stabilization/destabilization role of futures by investigating whether the existence of index futures has promoted or inhibited positive feedback trading in the spot markets of six industrialized nations. In addition, consideration has been given to the issues of whether observed return autocorrelation can be accounted for by factors other than positive feedback trading, e.g., improved efficiency and whether positive feedback trading is linked with higher volatility. Overall, there is clear evidence consistent with the view that the existence of futures markets reduces the impact of positive feedback trading and thus helps to stabilize prices. Interestingly, this finding is robust with respect to the regulatory framework governing the operation of the six markets. Thus, it is clear that the short-term dynamics of stock returns have changed following the introduction of index futures, but that futures trading impacts positively on the underlying market.

Specifically, in the prefutures period, positive feedback trading has a significant impact on return dynamics. It is well known that such behaviour can destabilize the market by moving prices away from fundamentals. It is also shown that the extent of any mispricing increases during periods of higher volatility because it is then that positive feedback traders impact most on prices. In contrast, the impact of positive feedback trading is greatly reduced in the postfutures period in all markets under examination. While prima facie, these results could be consistent with general improvements in efficiency, as suggested by Cox (1976) and Ross (1989), further tests strongly suggest that the changes postfutures are primarily due to a reduction in the impact of feedback trading.

The possibility that the reduction in the impact of positive feedback trading is due to the migration of feedback traders from the spot to the futures markets is also tested. The results show no evidence of positive feedback trading in the futures markets. Finally, there is no evidence that the volatility structure of the spot market has changed in the postfutures period. Overall, the findings are consistent with the view that futures markets help stabilize the underlying market by reducing the impact of feedback traders and thus attracting more rational investors who make the market more informationally efficient. This effect of course could be reinforced by options trading, which might also contribute to the elimination of feedback trading. However, it is recognized that, as with any empirical investigation, the results could be consistent with alternative explanations. Specifically, it is possible that the findings of positive feedback trading in the period prior to index futures may be due to market frictions and inefficiencies not necessarily related to positive feedback trading.

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