New Insights into the Impact of the Introduction of Futures Trading on Stock Price Volatility

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We examine whether, and to what extent, the introduction of trading in share futures contracts on individual stocks (i.e., individual share futures, or ISFs) has impacted on the systematic risk and volatility of the underlying shares. The use of ISFs allows a unique experimental design that complements existing work on index futures. Our major findings are as follows. First, we found a general reduction in systematic risk on individual stocks after the listing of futures. Second, we found evidence of a decline in unconditional volatility. Third, we found mixed evidence concerning the impact on conditional volatility. Fourth, the introduction of futures was found to impact on the market

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dynamics, as reflected by a change in the asymmetric volatility response, although the direction of that change is stock-specific. In general, the results point to a number of features that are case-specific and provide new insights into the mixed results that are typical of existing studies. Jrl Fut Mark 21:237–255, 2001

INTRODUCTION

The impact of derivatives trading on the volatility of the underlying asset is a controversial issue among the financial commentators and market regulators. It has also proven to be a fertile area for empirical research among financial economists. One area of the literature has considered the introduction of options trading, and in general the results provide no clear conclusion as to its effect.[1] Some studies have found a reduction in volatility associated with the introduction of options trading (e.g., Conrad, 1989; Damodaran & Lim, 1991; Ma & Rao, 1988; Skinner, 1989). Evidence to the contrary also exists, however, insomuch as volatility was not affected after the introduction of options contracts (e.g., Bollen, 1998).[2]

A second area of the literature has focused on the impact of the introduction of futures contracts.[3] Again, the evidence on whether and how the introduction of futures trading has affected the underlying asset is mixed. For example, a group of studies report a decrease (or no change) in volatility in the spot market after the introduction of futures (e.g., Choi & Subrahmanyam, 1994; Edwards, 1988a; Moriarty & Tosini, 1985; Rob-

[1]This literature is well represented by Ma and Rao (1988), Bansal, Pruitt, and Wei (1989), Conrad (1989), Skinner (1989), Damodaran and Lim (1991), Watt, Yadav and Draper (1992), and Bollen (1998).

[2]In a recent article, Sorescu (in press) argued that the mixed findings might be explained by a two-regime switching means model. Specifically, Sorescu's model produces an optimal switch date of 1981. Prior to this date, positive abnormal returns are found for stocks with new listed options, whereas after 1981, negative abnormal returns accrue for stocks with new listed options. Sorescu speculated on three possible causes of the two regimes. First, index options were introduced in 1982 that may have had the effect of completing the market. Second, there were major market regulatory changes that took place around the early 1980s. The third explanation relates to the possibility that options have made it easier for informed traders to disseminate adverse information. Of note, these explanations are largely centered on the U.S. market, yet the research findings are not specific to any one national market.

[3]The literature can be broadly classified by the type of futures contracts studied: (a) commodity futures (Cox, 1976; Powers, 1970; Working, 1960), (b) financial futures (Edwards, 1988a; Figlewski, 1981; Moriarty & Tosini, 1985), and (c) stock index futures (Antoniou & Holmes, 1995; Antoniou, Holmes, & Priestley, 1998; Bessembinder & Seguin, 1992; Choi & Subrahmanyam, 1994; Damodaran, 1990; Edwards, 1988a, 1988b; Harris, 1989; Hodgson & Nicholls, 1991; Kamara, Miller, & Siegel, 1992; Lee & Ohk, 1992; Robinson, 1994; Stoll & Whaley, 1987).

inson, 1994). In contrast, other studies report an increase in volatility after the introduction of futures (e.g., Antoniou & Holmes, 1995; Damodaran, 1990; Figlewski, 1981; Harris, 1989).

The issue remains controversial. In the middle of 1995, the Hong Kong Futures Exchange introduced a number of new futures contracts amid substantial controversy and legal battles. Similarly, new derivative products in Australia created much discussion, with the Sydney Futures Exchange (SFE) and the Australian Stock Exchange engaging in legal action over the introduction of new contracts. Settling the controversy has not generally been assisted by the inconsistency in the research findings.

Two schools of thought have emerged to explain the impact of futures contracts on the underlying asset.[4] One view is that the introduction of futures trading increases the volatility of spot prices. For example, the inflow and existence of speculators in futures markets may produce destabilizing forces, which among other things create undesirable bubbles (e.g., Edwards, 1988a, 1988b; Harris, 1989; Stein, 1987, 1989).[5] Furthermore, an increase in volatility on expiration days is expected as investors attempt to close out their positions, settle contracts, and trade on potential arbitrage opportunities. Generally, the financial press appears supportive of these arguments with claims that futures have raised volatility via the provision of low-cost speculation opportunities, especially in the case of Japan (see Miller, 1993).

The alternative argument is that the introduction of futures contracts has led to more complete markets, enhancing information flows and thereby improving investment choices facing investors (e.g., Arditti & John, 1980; Breeden & Litzenberger, 1978; Hakansson, 1978; Ross, 1977). Futures contracts allow for new positions and expanded investment sets or enable existing positions to be taken at lower costs. Futures trading may bring more (private) information to the market and allow for quicker dissemination of information. In addition, futures contracts facilitate hedging so that less reliance need be placed on spot hedging strategies. Moreover, the transfer of speculative activity from the spot market to the futures market may dampen spot market volatility. Indeed, Schwert (1990) showed that intraday index futures volatility is around 40% higher than intraday equity market volatility.

[4]We do not present a detailed review of the two competing views. The arguments are generally well known and have been reviewed in detail elsewhere (e.g., Damodaran & Subrahmanyam, 1992).

[5]Damodaran and Subrahmanyam (1992) made the point that the spot market may become more attractive to investors and, therefore, more liquid because arbitrage trading and contrarian trading strategies mitigate extreme price movements.

In this article, we reexamine the issue with a recently introduced set of futures contracts over individual shares. Individual share future (ISF) contracts, introduced in Australia in May 1994, present an attractive opportunity to conduct a study because of their unique characteristics. The introduction of ISFs was a world first for the SFE because such products had never been traded previously on anything other than a trial basis.[6,7] ISFs are futures contracts traded over specific equity shares, and currently there are 10 individual stocks on which ISFs are traded.

The study of the impact of an ISF contract on the underlying asset has several advantages. First, much of the analysis in the literature has been devoted to considering the impact of trading in market-wide instruments such as index contracts. Such studies are useful in assessing market-wide impact, but any effect in the underlying spot market can be dissipated across the many constituent assets, making it difficult to detect. Moreover, although an index futures contract is a tradable instrument, the underlying spot market index cannot be directly traded. For ISFs, we can directly observe trading in the spot market. Furthermore, studies that have examined the introduction of index futures have by definition only examined one event date, within a given market setting. For ISFs, there have been four separate introduction dates.

Second, studies of index futures have been concerned with changes in the market before and after listing. Many factors affect market prices (and volatility), and it has been impossible to separate out the effects of the introduction of index futures trading and general changes in market conditions. Because ISFs are stock-specific, however, we can control for market-wide changes and so, for example, can examine changes in the beta risk of individual stocks.[8]

Finally, Antoniou et al. (1998) argued that futures may change the role of market dynamics in terms of the way in which volatility is transmitted and, therefore, how information is incorporated into prices. The prior literature has generally restricted itself to testing changes in spot price volatility and has not considered whether reduced asymmetry, for example, has resulted from futures trading. Such a restricted testing framework is overly limiting and may lead to inappropriate policy responses. As asymmetry is typically linked to news arrival, it can be ex-

[6]For a detailed discussion of the introduction of ISF, see Brailsford and Cusack (1997).

[7]Of note, the introduction of futures contracts over individual stocks is an issue that continually surfaces in the United States (e.g., *Wall Street Journal*, May 16, 1994).

[8]Note that the potential impact of derivative introduction on the beta risk has been investigated in the context of options (e.g., Damodaran & Lim, 1991; Klemkosky & Maness, 1980; Skinner, 1989; Trennepohl & Dukes, 1979; Whiteside, Dukes, & Dunne, 1983) and indirectly through index futures (e.g., Damodaran, 1990; Kan & Tang, 1999; Martin & Senchack, 1989, 1991).

amined more directly in the context of individual stocks. In summary, the study of ISFs complements the aggregate market studies involving index contracts.

The remainder of this article is organized as follows. The Research Method section contains details of the estimation method, and the Data section describes the data. In the Results section, the results are presented and discussed. The final section concludes the article.

RESEARCH METHOD

The mean return for each stock is modeled with an augmented market model that incorporates a dummy variable designed to capture the impact of the introduction of each ISF on both the intercept and slope coefficients:[9]

$$R_{it} = \phi_0 + \phi_1 D_1 + \phi_2 R_{Mt} + \phi_3 D_1 R_{Mt} + \varepsilon_t \tag{1}$$

where R_{it} is the log price relative of the underlying stock i at time period t, D_1 is a dummy variable that takes on a value of unity after the introduction of an ISF on that stock, R_{Mt} is the log price relative of the stock market index, and ε_t is the standard error term.

Following Lee and Ohk (1992), Robinson (1994), Antoniou and Holmes (1995), and Antoniou et al. (1998), we perform our analysis within the framework of the generalized autoregressive conditional heteroskedasticity (GARCH) class of models.[10] The standard GARCH model relates the conditional variance to the lagged squared error term and past conditional variances. More recent studies in this area have extended their scope to consider the impact of listings of futures contracts on how the market responds to news. Futures trading may potentially impact on these market dynamics. According to Antoniou et al., market dynamics related to the transmission of news may be responsible for asymmetries in the volatility response mechanism.[11] Moreover, in the spirit of Lee and Ohk, dummy variables are included for individual terms. Thus, to test the impact of the introduction of ISFs, the GARCH model is modified along the lines of the threshold autoregressive conditional heteroskedas-

[9]There is little need for a thin-trading adjustment in the mean equation because the stocks on which ISFs are traded tend to be the most frequently traded and largest stocks in the Australian market.

[10]The autoregressive conditional heteroskedasticity (ARCH) model is now commonly used to capture time-varying volatility dynamics in asset returns. See Bollerslev, Chou, and Kroner (1992) for a review.

[11]It has been suggested that the traditional explanation of the leverage effect for asymmetry (see Nelson 1990a, 1990b) cannot fully account for observed asymmetry in the market (Bekaert & Wu, in press).

ticity (TARCH) model of Zakoian (1994). Hence, the augmented model may be specified as follows:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 D_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \beta_2 D_1 h_{t-1} + \gamma_1 D_1 + \gamma_2 \varepsilon_{t-1}^2 D_2 + \gamma_3 \varepsilon_{t-1}^2 D_3 \quad (2)$$

where D_1 is a dummy variable that takes on a value of unity after the introduction of an ISF on the stock and D_2 (D_3) is a dummy variable that takes on a value of unity if the error is negative in the pre- (post-) ISF introduction period and zero otherwise.

In the mean equation (Equation 1), any impact of ISF introduction on the systematic risk of the underlying stock is captured by the ϕ_3 coefficient.[12] A positive coefficient on ϕ_3 indicates increased beta risk in the post-ISF period.[13] That is, the introduction of futures trading has increased the sensitivity of the stock to market-wide movements. Alternatively, a negative coefficient on ϕ_3 indicates reduced beta risk in the post-ISF period. The specification of conditional variance equation (Equation 2) allows us to examine the unconditional stock price volatility through the γ_1 coefficient. A positive γ_1 coefficient indicates increased unconditional volatility in the post-ISF period, whereas a negative γ_1 coefficient indicates decreased unconditional volatility in the post-ISF period.[14]

The conditional variance equation (Equation 2) also allows for a number of tests of the impact of futures trading on conditional stock price volatility. We may individually test the ARCH term or the GARCH term. However, in the context of the GARCH framework, it is more appropriate to test the joint null hypotheses of no impact on the conditional variance specification ($\alpha_2 = \beta_2 = 0$) against the alternative of at least one coefficient being non-zero. Furthermore, we may test the joint hypothesis that the ISF introduction has had no impact on volatility per se ($\gamma_1 = \alpha_2 = \beta_2 = 0$) against the alternative of at least one coefficient being non-zero.

[12]For completeness, the dummy variable on the intercept is used to capture any shift in the constant term. The model was also estimated with a common intercept term for the prelisting and postlisting periods, and the results are robust to this variation in experimental design.

[13]Note that this argument assumes that any impact on the individual stock's volatility does not have a corresponding impact on the volatility of the aggregate market or relevant covariance term or, more generally, that any changes in these variables have an offsetting effect.

[14]As discussed later, Australian ISFs were listed on four separate dates, and on three of these dates, at least three ISF contracts were jointly listed. Where joint listings occur in this fashion, potential problems in inference arise because of cross-sectional dependence among contemporaneous measurements of returns and variances (e.g., Bollen, 1998). To allow for this possibility, the returns and variances of each stock that had an ISF introduced on the same date are also modeled with a multivariate GARCH model (e.g., Bera & Higgins, 1993, pp. 342–347). The results of this analysis are robust to this experimental variation but are not reported to conserve space.

In this case, the test examines both unconditional and conditional volatility effects.

Finally, we can also test whether futures trading has changed the role of market dynamics in terms of the way in which volatility is transmitted and, therefore, how information is incorporated into prices. Antoniou et al. (1998) found in their empirical analysis of six markets that there is a change in asymmetric responses to volatility prefutures and postfutures. In contrast to Antoniou et al., we simultaneously incorporate both issues of asymmetry and the potential impact of futures introduction on the level of volatility into the one model.

In Equation 2, it can be seen that when the coefficients on D_2 and D_3 are jointly equal to zero, the model collapses into the symmetric version of the GARCH model. A negative shock in the prelisting period (i.e., $D_2 = 1$) or in the postlisting period (i.e., $D_3 = 1$) can generate an asymmetric response. The nature of that response depends on the sign associated with the γ_2 and γ_3 terms. Where γ_2 or γ_3 is greater than 0 (γ_2 or $\gamma_3 < 0$), the model produces a larger (smaller) response for a negative shock compared to a positive shock of equal magnitude. Accordingly, the impact of the ISF listing on this asymmetry feature can be assessed through a comparison of γ_2 and γ_3.

DATA

Australia currently has ISF contracts traded on 10 individual stocks.[15] Each ISF contract represents 1,000 shares of the underlying stock. The contracts are available on a 3-month expiry cycle with the two near-dated contracts listed for trading at any time. Table I lists the date of introduction by the SFE for each ISF, and this information forms the basis for the creation of the pre- and post-ISF dummy variables used in the estimation procedure. Of note, options were traded on all 10 stocks that were listed prior to the introduction of ISF. Hence, there is a natural control established that allows for an examination of futures in the presence of options.

With a sample of 10 stocks for which ISF contracts have been introduced, it is possible that factors other than the introduction of futures may affect the variables considered in each of the hypothesis tests. For

[15]The stocks are Australia and New Zealand Banking Group (ANZ); Broken Hill Proprietary, Ltd. (BHP); Rio Tinto (RIO); Fosters Brewing Group (FBG); Mount Isa Mines (MIM); National Australia Bank (NAB); Newscorp (NCP); Pacific Dunlop (PDP); Westpac Banking Corporation (WBC); and Western Mining Corporation (WMC). An 11th ISF for BTR Nylex was introduced on September 26, 1994 and was subsequently suspended in September 1995 and delisted in November 1995 because of takeover activity. As this ISF is no longer traded, it was excluded from the analysis.

TABLE I

Names and Listing Dates for Australian Individual Share Futures

Company Name	*Code*	*Listing Date*
Broken Hill Proprietary, Ltd.	BHP	May 16, 1994
National Australia Bank	NAB	May 16, 1994
Newscorp	NCP	May 16, 1994
Mount Isa Mines	MIM	September 26, 1994
Westpac Banking Corporation	WBC	September 26, 1994
Western Mining Corporation	WMC	September 26, 1994
Australia and New Zealand Banking Group	ANZ	March 13, 1995
Rio Tinto	RIO	March 13, 1995
Fosters Brewing Group	FBG	March 13, 1995
Pacific Dunlop	PDP	October 18, 1995

example, market-wide changes may have occurred around the time of the ISF introduction date that altered the dynamics of the market. Our tests may erroneously attribute such a change, if it occurred, to the introduction of ISF. Thus, it is necessary to implement a control procedure. Such a control is undertaken via the construction of a control portfolio of similar stocks that did not have an ISF introduced. Where the 10 stocks behave differently to the control portfolio, the conclusions drawn with respect to the impact of the introduction of the ISF contracts are strengthened.

To this end, a control portfolio was constructed as follows. Individual control stocks were selected to match the ISF stocks on the basis of both industry grouping and market capitalization.[16] Furthermore, as all stocks on which ISFs are listed have options traded, the control stocks were also selected such that they also have options traded. Given that ISF contracts have been introduced on the largest and most heavily traded companies in the Australian market, the choice of control stock was typically the next largest participant in the industry. For example, the banks included in this study (ANZ, NAB, WBC) represent three of the big four banks in Australia, and so the choice of the fourth bank (Commonwealth Bank) as the banking sector control stock was obvious.[17] An equally weighted

[16]Of course, a general problem with a control group is that the distinguishing feature between the two groups, in this case the individual futures contract, may be endogenous such that it may depend on stock characteristics in the prelisting period.

[17]The control stocks are Comalco, Lion Nathan, North, PBL, Southcorp and the Commonwealth Bank for the Other Metals (MIM and WMC), Alcohol and Tobacco (FBG), Diversified Resources (BHP and RIO), Media (NCP), Diversified Industrials (PDP), and Banking (ANZ, NAB and WBC) sectors, respectively.

portfolio of these control stocks was constructed that would act as the control benchmark.

Daily closing stock prices are sourced from the Securities Industry Research Centre of Asia–Pacific core research database, over the period January 1, 1990 to June 30, 1998, producing a total of 2,144 observations per stock. These prices are adjusted for dilution occurring because of capitalization changes and exclude exchange holidays on the domestic market.[18] The market portfolio is proxied by the All Ordinaries Accumulation Index.

Continuously compounded percentage returns for each stock and the control portfolio are estimated as the log price relative, and Table II presents a set of basic descriptive statistics divided into two subperiods, namely, a pre-ISF listing period and a post-ISF listing period. Of greatest interest in this table are the figures obtained for the standard deviation estimates, providing an initial view of volatility for each stock in our sample. In the pre-ISF listing period, we find that BHP and NAB provide the lowest standard deviations, whereas NCP, MIM, and FBG provide the highest standard deviations. In the post-ISF listing period, BHP and NAB again produce the lowest standard deviations, although they have increased slightly, whereas NCP and FBG show considerable reductions in the standard deviation from the pre-ISF period to the post-ISF period. Similarly to the authors of earlier studies in this area, we initially conduct equality of variance tests. These tests reveal significant differences between the variance pre- and post-ISF listings for 8 of the 10 stocks.[19] This evidence suggests that some change has taken place over the relevant period and thus motivates further investigation.

RESULTS

Each individual stock return series and the returns on the control portfolio are modeled with Equation 1 with the conditional variance specified as Equation 2. The Berndt–Hall–Hall–Hausman optimization algorithm is employed to obtain maximum likelihood estimates of each of the coefficients in the mean and variance equations, and the results are presented in Table III. The standard diagnostic tests of the residuals from the model confirm the absence of any further ARCH effects, suggesting an appropriate model specification. That is, the squared standardized residuals of this modified GARCH(1,1) model reveal a general absence of

[18]Some shares are traded overseas on days the Australian market is closed.

[19]The equality of variance tests include the *F*, Siegel–Tukey, Bartlett, Levene, and Brown–Forscythe tests. The results are consistent across all the tests.

TABLE II

Descriptive Statistics of Underlying Daily Returns on Stocks on which Individual Share Futures Are Listed and Associated Control Portfolios

Panel A: Pre-ISF Listing Period

	2 Jan 1990 to 15 May 1994				2 Jan 1990 to 25 Sept 1994				2 Jan 1990 to 12 Mar 1995				2 Jan 1990 to 17 Oct 1995	
	BHP	*NAB*	*NCP*	*Control*	*MIM*	*WBC*	*WMC*	*Control*	*ANZ*	*RIO*	*FBG*	*Control*	*PDP*	*Control*
M	0.000564	0.000527	0.000879	0.000453	0.000195	−0.000202	0.000175	0.000383	−0.000127	0.000289	−0.000477	0.000314	−0.000263	0.000406
Md	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Maximum	0.045257	0.053885	0.328960	0.165947	0.102809	0.066615	0.068993	0.165947	0.084770	0.072103	0.118716	0.165947	0.058905	0.165947
Minimum	−0.056089	−0.078840	−0.223603	−0.052039	−0.070769	−0.095310	−0.068803	−0.052039	−0.090573	−0.062520	−0.098440	−0.052039	−0.072245	−0.052039
SD	0.011957	0.011818	0.028580	0.010894	0.019140	0.015810	0.016526	0.010818	0.016596	0.013675	0.020299	0.010706	0.013774	0.010508
Skewness	0.006152	−0.391395	0.952731	3.122808	0.207646	−0.286126	0.085243	2.935835	0.015857	0.160707	0.119151	2.754868	0.072074	2.607450
Kurtosis	4.224003	6.248927	26.86262	51.86335	4.261267	5.573193	3.991236	49.41435	5.352158	4.600929	6.262089	47.23528	5.061867	45.64335

Panel B: Post-ISF Listing Period

	16 May 1994 to 30 June 1998				26 Sept 1994 to 30 June 1998				13 Mar 1995 to 30 June 1998				18 Oct 1995 to 30 June 1998	
	BHP	*NAB*	*NCP*	*Control*	*MIM*	*WBC*	*WMC*	*Control*	*ANZ*	*RIO*	*FBG*	*Control*	*PDP*	*Control*
M	−0.000136	0.000573	0.000736	0.000439	−0.001272	0.000889	−0.000541	0.000526	0.001037	0.000211	0.000833	0.000654	−0.000318	0.000534
Md	−0.000557	0.000793	0.000000	0.000266	0.000000	0.001162	0.000000	0.000321	0.001692	0.000000	0.000000	0.000689	0.000000	0.000902
Maximum	0.078432	0.044348	0.085495	0.075590	0.113329	0.051225	0.097838	0.075590	0.091952	0.076633	0.074108	0.075590	0.066166	0.075590
Minimum	−0.060961	−0.055104	−0.077558	−0.066417	−0.145852	−0.063974	−0.079901	−0.066417	−0.070643	−0.120016	−0.048575	−0.066417	−0.125163	−0.066417
SD	0.013151	0.012140	0.016957	0.009604	0.021831	0.013304	0.017678	0.009575	0.015269	0.013285	0.013762	0.009586	0.016823	0.009793
Skewness	0.268466	−0.460154	0.467520	−0.036369	−0.170721	−0.198819	0.248598	−0.028818	−0.128652	−0.570001	0.044389	−0.012158	−0.870219	−0.025198
Kurtosis	5.474368	5.014947	5.393826	9.035892	7.892617	4.280864	5.471216	9.638762	5.683213	12.28749	4.238520	10.40018	9.579049	11.24201

TABLE III

Estimated Augmented Market/Generalized TARCH Model Coefficients

	Mean Equation				Variance Equation							
Stock	ϕ_a	ϕ_1	ϕ_2	ϕ_3	α_0 (xE-05)	α_1	α_2	β_1	β_2	γ_1 (xE-05)	γ_2	γ_3
Panel A: Stocks with ISF Introduction Date of May 16, 1994												
BHP	0.0002 (1.34)	−0.0005 (2.02)	1.2266 (60.9)	0.0323 (1.06)	0.3450 (3.94)	0.1252 (4.31)	−0.0643 (2.08)	0.8389 (27.7)	0.0718 (2.25)	−0.2510 (2.75)	−0.0922 (3.01)	0.0417 (2.29)
NAB	0.0003 (1.24)	0.0001 (0.12)	0.9898 (35.9)	−0.0077 (0.17)	1.0500 (3.53)	0.0224 (1.36)	0.0754 (3.79)	0.8121 (17.2)	0.1165 (2.43)	−0.7940 (2.64)	0.0439 (1.52)	−0.0973 (7.75)
NCP	0.0003 (0.76)	−0.0001 (0.28)	1.4901 (29.5)	−0.2927 (4.10)	1.4900 (6.17)	0.0776 (6.08)	0.0307 (0.96)	0.8347 (70.1)	−0.0964 (1.75)	1.7200 (2.08)	0.1336 (7.70)	−0.0140 (0.36)
Control Portfolio	0.0001 (0.79)	0.0001 (0.22)	0.8510 (41.6)	0.1426 (5.57)	2.2300 (6.29)	0.0831 (3.24)	0.0029 (0.072)	0.3264 (3.59)	0.5347 (5.13)	−1.9900 (5.38)	0.1455 (2.48)	−0.0600 (1.89)
Panel B: Stocks with ISF Introduction Date of September 26, 1994												
MIM	0.0001 (0.00)	−0.0015 (2.21)	1.4681 (32.4)	−0.1533 (1.98)	2.4400 (5.97)	0.0486 (2.84)	−0.0596 (3.39)	0.8153 (29.7)	0.1588 (5.70)	−2.0700 (4.94)	0.0526 (1.87)	0.0542 (6.08)
WBC	−0.0004 (1.31)	0.0010 (2.23)	1.2750 (29.6)	−0.2527 (4.43)	5.3400 (3.01)	0.1076 (3.02)	−0.0013 (0.02)	0.5440 (3.80)	0.2660 (1.75)	−4.2400 (2.34)	−0.0631 (1.85)	−0.0385 (1.37)
WMC	−0.0001 (0.32)	−0.0008 (1.57)	1.2523 (31.6)	0.0290 (0.48)	3.5800 (7.47)	0.0841 (2.84)	−0.0761 (2.34)	0.6846 (16.6)	0.2529 (5.77)	−3.2700 (6.58)	0.0282 (0.74)	0.0770 (3.62)
Control Portfolio	−0.001 (0.09)	0.0003 (0.12)	0.8546 (42.9)	0.0349 (0.11)	0.3500 (5.84)	0.0356 (3.10)	−0.1003 (1.86)	0.8486 (40.8)	0.0505 (0.11)	−0.4610 (0.39)	0.0762 (3.12)	0.0952 (1.07)
Panel C: Stocks with ISF Introduction Date of March 13, 1995												
ANZ	−0.0003 (0.95)	0.0006 (1.22)	1.3351 (32.9)	−0.0534 (0.93)	8.2800 (4.82)	0.1064 (4.28)	0.1048 (1.71)	0.3712 (3.05)	0.2330 (1.61)	−5.8500 (3.22)	−0.0015 (0.03)	−0.0336 (0.59)
RIO	0.0001 (0.34)	−0.0005 (1.31)	1.2452 (46.7)	−0.1057 (2.53)	0.7250 (4.24)	0.0480 (2.69)	0.0330 (1.04)	0.8469 (27.8)	−0.0106 (0.20)	−0.1050 (0.39)	0.0393 (1.73)	0.0403 (1.13)
FBG	−0.0005 (1.22)	0.0008 (1.51)	1.2641 (27.5)	−0.4223 (6.62)	1.9600 (8.75)	0.0394 (2.67)	−0.0032 (0.17)	0.8448 (58.7)	0.1258 (6.76)	−1.9000 (8.08)	0.0965 (4.19)	−0.0199 (1.28)
Control Portfolio	1.8400 (0.09)	0.0002 (0.91)	0.849 (38.8)	0.1442 (5.32)	0.2930 (2.90)	0.0504 (2.26)	0.0206 (0.49)	0.8815 (23.0)	−0.0760 (0.67)	0.0882 (0.33)	−0.0476 (1.87)	−0.0522 (1.38)
Panel D: Stock with ISF Introduction Date of October 18, 1995												
PDP	−0.0005 (1.96)	−0.0001 (0.14)	1.0771 (41.8)	−0.0820 (1.31)	1.1900 (7.09)	0.0532 (3.79)	0.0251 (0.66)	0.7928 (37.7)	0.0143 (0.30)	0.5560 (0.93)	0.0969 (3.98)	0.0609 (1.53)
Control Portfolio	0.0001 (0.48)	−0.0003 (0.24)	0.8719 (49.5)	0.1068 (0.52)	0.3960 (6.43)	0.0659 (4.35)	0.0376 (0.17)	0.824 (38.3)	0.0918 (0.24)	−0.6800 (3.77)	0.0180 (0.85)	0.0806 (0.151)

This table reports the estimated coefficients (absolute values of t statistics in parentheses) for the model:

$$R_{it} = \phi_0 + \phi_1 D_1 + \phi_2 R_{Mt} + \phi_3 D_1 R_{Mt} + \varepsilon_t \quad (1)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon^2_{t-1} + \alpha_2 D_1 \varepsilon^2_{t-1} + \beta_1 h_{t-1} + \beta_2 D_1 h_{t-1} + \gamma_1 D_1 + \gamma_2 \varepsilon^2_{t-1} D_2 + \gamma_3 \varepsilon^2_{t-1} D_3 \quad (2)$$

where R_{it} is the log price relative of the underlying equity of stock i (on which an ISF has been introduced) at time period t, D_1 is a dummy variable that takes on a value of unity after the introduction of that share's ISF, D_2 (D_3) is a dummy variable that takes on a value of unity if the mean equation error term is negative in the pre- (post-) ISF introduction period and zero otherwise, and R_{Mt} is the log price relative of the Australian stock market index. The model is also estimated at each date for an equally weighted control portfolio.

significant autocorrelation that Bollerslev and Mikkelsen (1996) argued indicates the model has captured the ARCH effects. Furthermore, the standardized residuals are largely IID $\sim N(0,1)$, which again supports the model specification.

Systematic Risk

First, consider the mean equation results reported in Table III. The beta risk estimates are represented by ϕ_2 (the pre-ISF beta risk estimate) and ϕ_3 (the post-ISF increment to beta risk relative to the ϕ_2 benchmark). All but one pre-ISF beta is estimated at greater than unity. When we consider the sign and significance of the beta risk change coefficient, ϕ_3, we find that in five cases (i.e., half), there has been a significant decline in beta risk in the post-ISF listing period and a decline, albeit insignificant, in three more cases. The largest decline occurs for FBG, with a fall in beta of around 30%.

The decline in beta risk may be due to market-wide trends. Hence, we turn to the control portfolio. In all cases, the beta for the control portfolio increases, significantly so in two cases. These results contrast with the individual stock findings mentioned previously. Hence, the evidence is consistent with a decline in systematic risk for the ISF stocks.

Unconditional Volatility

Next, consider the variance equation results reported in Table III. Recall that the unconditional volatility change coefficient is given by γ_1. Eight of the 10 stocks reveal a negative coefficient that is significant in 7 cases, thereby supporting a decline in volatility in the postlisting period. Of the remaining 2 cases, only one is significant (NCP).

In Panels A and D, we see that the control portfolio also produces a significantly negative γ_1 coefficient. However, in Panel B the control portfolio γ_1 coefficient is statistically insignificant, unlike the finding of a significant negative coefficient for all three ISF stocks over that test period. A similar result occurs for the third test period reported in Panel C, where the control portfolio coefficient is positive, whereas all three ISF stocks exhibit a negative coefficient. Hence, there is again a difference between the individual ISF results and the control portfolio, thus reinforcing the earlier conclusion favoring a decline in unconditional volatility.

TABLE IV

Variance Equation Joint Hypothesis Tests p Values

	Null Hypothesis		
Stock	$\alpha_2 = \beta_2 = 0$	$\gamma_1 = \alpha_2 = \beta_2 = 0$	$\gamma_2 = \gamma_3$
Panel A: Stocks with ISF Introduction Date of May 16, 1994			
BHP	0.0627	0.0117	0.0000
NAB	0.0000	0.0000	0.0000
NCP	0.1036	0.1080	0.0000
Control Portfolio	0.0000	0.0000	0.0019
Panel B: Stocks with ISF Introduction Date of September 26, 1994			
MIM	0.0000	0.0000	0.9650
WBC	0.0972	0.0016	0.5630
WMC	0.0000	0.0000	0.2870
Control Portfolio	0.1184	0.0019	0.8330
Panel C: Stocks with ISF Introduction Date of March 13, 1995			
ANZ	0.0090	0.0000	0.5900
RIO	0.5218	0.5111	0.9270
FBG	0.0000	0.0000	0.0000
Control Portfolio	0.7928	0.2923	0.9190
Panel D: Stock with ISF Introduction Date of October 18, 1995			
PDP	0.6675	0.0030	0.4660
Control Portfolio	0.6792	0.0007	0.9060

This table reports p values associated with Wald tests of the null hypotheses in the model:

$$R_{it} = \phi_0 + \phi_1 D_1 + \phi_2 R_{Mt} + \phi_3 D_1 R_{Mt} + \varepsilon_t \tag{1}$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 D_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \beta_2 D_1 h_{t-1} + \gamma_1 D_1 + \gamma_2 \varepsilon_{t-1}^2 D_2 + \gamma_3 \varepsilon_{t-1}^2 D_3 \tag{2}$$

where R_{it} is the log price relative of the underlying equity of stock i (on which an ISF has been introduced) at time period t, D_1 is a dummy variable that takes on a value of unity after the introduction of that share's ISF, D_2 (D_3) is a dummy variable that takes on a value of unity if the mean equation error term is negative in the pre- (post-) ISF introduction period and zero otherwise, and R_{Mt} is the log price relative of the Australian stock market index. The model is also estimated at each date for an equally weighted control portfolio.

Conditional Volatility

From Table III, there is some evidence of a decline in the ARCH and GARCH terms in the post-ISF period. However, the focus is on joint tests of the parameters. Test statistics for the null hypothesis of joint equality to zero of the change in ARCH and GARCH terms are presented in the first column of Table IV. From this table, the Wald test p values show that the null hypothesis of no change is rejected for five of the stocks at the 5% level, with a further three significant at the 10% level. The exceptions are RIO and PDP. The Wald test of null hypothesis for the control portfolio is significant only when tested against the May 1994 date. For the other three dates, the null hypothesis is accepted for the control portfolio.

This evidence suggests that the conditional variance for most of the stocks underwent some form of change around the date of the ISF introduction. As this change was not generally in evidence for the control portfolio, there is support for the change being induced by the introduction of futures trading.

The analysis can be extended to consider the impact of the futures trading on both the conditional and unconditional variance by testing that the ISF introduction has had no (joint) effect on any variance equation parameters, that is, $\gamma_1 = \alpha_2 = \beta_2 = 0$. The outcome of the Wald test for the null hypothesis is presented in the second column of Table IV, and the results indicate that the relevant coefficients in the variance equation have significantly changed in 8 of 10 stocks at the 5% level (NCP is again marginal at the 10% level). RIO is the sole exception, and ISF trading appears to have had no effect on the conditional variance for this stock. One possible explanation for this could be that the futures contracts on RIO are very thinly traded.

The joint test of this null hypothesis for the control portfolio indicates that for three of the four dates tested, a significant change in the variance equation is found. Thus, although the change to the conditional variance parameters seems largely limited to the stocks on which ISFs are traded, when we consider a joint test of a change to both the conditional and unconditional variance parameters, the control portfolio appears to mimic the individual share results more closely. Hence, support for a futures-induced change is weakened.

Asymmetry Hypothesis

The γ_2 coefficient in Equation 2 captures asymmetry in the pre-ISF listing period. Table III reveals limited evidence that responses are asymmetric in their nature, with only 4 of 10 stocks (NCP, FBG, PDP, BHP) producing statistically significant pre-ISF listing asymmetry coefficients. Of these, the first 3 cases are positive, suggesting that negative shocks elicit a larger response than positive shocks of an equal magnitude. Interestingly, Panels A and B reveal that the control portfolio also produces evidence of asymmetry in the pre-ISF period.

The impact of ISF introduction on this asymmetry may be assessed via consideration of the γ_3 coefficient that captures the nature of any bias in the post-ISF listing period. Table III reveals a mixture of evidence of asymmetric market responses, with 4 of the 10 stocks (BHP, NAB, MIM, WMC) producing statistically significant post-ISF listing asymmetry coefficients. Of these 4, only BHP produces a significant asymmetry term in the prelisting period, although the sign reverses from negative to positive. For the remaining 3 cases, MIM and WMC are positive, whereas NAB exhibits a negative coefficient, suggesting that negative shocks elicit a smaller response than positive shocks of an equal magnitude. In contrast, none of the control portfolios produces a statistically significant asymmetry coefficient in the post-ISF period. Moreover, 3 stocks (WBC, ANZ, RIO) show no evidence of an asymmetric volatility response in either period.

It is possible to test whether these pre- and post-ISF asymmetry coefficients are significantly different from one another with a Wald test of the null hypothesis, that is, $\gamma_2 = \gamma_3$. The results of this test are presented in the final column of Table IV and indicate that for BHP, NAB, NCP, and FBG, the test statistic rejects the equality hypothesis. As each of these stocks experiences a sign reversal between periods, the interpretation of these results is difficult. We can say that the nature of the asymmetry has changed for some stocks as a result of the introduction of ISF, but whether that asymmetry has increased or decreased is not clear because of the sign reversal. Thus, although the introduction of ISFs appears to have had an impact on the asymmetry of volatility, the effect is not uniform across the stocks. Moreover, there is some doubt over the cause being linked to ISF introduction for BHP, NAB, and NCP because a similar decline in asymmetry is found for the associated control portfolio.

CONCLUSION

In this article, we investigated whether and to what extent the introduction of futures trading has had an impact on the volatility of the underlying asset. The existing literature has produced evidence on this issue that is mixed. On the one hand, there is evidence consistent with the assertion that speculators in futures markets produce destabilizing forces. The policy implications of this type of behavior suggest regulation of the market, assuming that regulators can devise a sufficiently targeted means of addressing the problem that minimizes any unintended consequences. On the other hand, evidence has also been found that supports a more favorable view of futures trading in which the introduction of futures trading leads to more complete markets, enhanced information flows, and, thus, improved investment choices for investors. The implication of this hypothesis suggests that regulation is inappropriate and costly. Thus, the policy implications of the literature stand in stark contrast to each other.

One noteworthy feature of this study is that, in contrast to the extant literature for equities that has exclusively considered market-wide instruments, we focused on the impact of the introduction of ISF contracts on the specific equity on which the value of the futures contract is based. The use of an ISF contract allows us to implement a research design that not only complements existing aggregate market studies, which typically consider the mean return and variance, but also extends it into the realm of considering changes in the systematic risk of individual stocks.

The outcome of the analysis can be summarized as follows. First, we found a general reduction in systematic risk in post-ISF listing periods for the stocks that have futures contracts traded, and this trend was not evident in a control portfolio. Second, we found evidence of a decline in unconditional variance, which is not found to the same extent in the control portfolio. Third, we found evidence of some changes in the dynamics by which the conditional variance evolves. Finally, there is some evidence to support a change in the asymmetric response in individual stock returns after futures listing, although this evidence is not strong and is difficult to interpret because of conflicting sign changes. We found that there is no clear and consistent response across all stocks in this regard.

These results demonstrate that different institutional settings or different sample periods are generally not the reason for different findings in the literature. Rather, we speculate that trading conditions associated with individual stocks (or markets), such as liquidity, are the more likely cause of different findings. This is a matter of ongoing research. Moreover, the results are indicative that markets behave differently depending on the surrounding circumstances.

Overall, the results presented in this article suggest that the issue is more complex than may have been first thought. Derivatives and volatility are unlikely to have such a direct link as some commentators would suggest. Antoniou et al. (1998) argued that exclusively focusing on the two competing views is overly simplistic and potentially suboptimal from a policy perspective. Our results are supportive of their argument.

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