Impact of Futures on Spillovers in the UK Stock Market

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This paper used La Porta et al. *(1998) capital market regulatory classification to analyze the impact of information contained in various futures contracts on volatility spillovers between markets. In particular, the paper analyzed the spillover effects between foreign cross-listings in tougher, similar and more lax regulatory environments with respect to the relevant domestic indices (FTSE100) and also with the home portfolios of cross-listed equities in the UK. It was found that futures variables had a significant impact on volatility spillovers between markets.*

Introduction

Based on the approach suggested by Karolyi (1995), Longin and Solnik (1995), and Karolyi and Stulz (1996), this paper examines the impact of futures variables such as Currency, Exchange Rates, Treasury Bills, Treasury Bonds, and Stock Indices, on the integration process for cross-listed equities in the UK. A primary focus of this study was to relate the volatility spillover effects for cross-listings across markets with not only different regulatory structures but also with the content of information (other than the past returns) on volatility and correlation between markets.

La Porta *et al*. (1998) capital market regulatory classification was used to analyze the impact of information contained in various futures contracts on volatility spillovers between markets. The focus here is to examine the impact of futures contracts on the integration process between markets. The behavior of foreign cross-listed shares that were listed in different regulatory environments were examined. In particular, the paper analyzed the spillover effects between foreign cross-listings in tougher, similar and more lax regulatory environments with respect to the relevant domestic indices (FTSE100) and also with the home portfolios of cross-listed equities in the UK.

The correlation of asset returns played a special role in the finance literature. Since the seminal work of Longin and Solnik (1995) and Karolyi and Stulz (1996), changes in correlations between cross-country stock returns had been found to affect the volatility of portfolios and asset prices. Longin and Solnik (1995) used excess monthly returns for seven major countries from 1960 to 1990 and found that correlations increased overtime,

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were larger when large shocks occurred, and were related to dividend yields and interest rates. They did not investigate the impact of macroeconomic variables other than the interest rates. On the other hand, Karolyi and Stulz (1996) investigated daily return comovements between the Japanese and US stocks distinguishing between 'global' and 'competitive' shocks for asset returns. In particular, they associated global shocks with high return covariances, whereas competitive shocks were associated with low covariances. It was found that large shocks to broad based market indices (Nikkei Stock Average and Standard and Poor's 500 Stock Index) both positively impacted on the return correlations.

The objective of this paper was to extend the above-mentioned research to the UK cross-listed equities. The multivariate GARCH-BEKK introduced by Karolyi (1995) to control for the impact of fundamental factors (e.g., futures contracts) on the spillover mechanism was explicitly used. The impact of futures contracts on market spillovers were examined because the former were believed to have a significant impact on the underlying cash markets(Antoniou *et al.*, 1998). The multivariate GARCH-BEKK modeling framework approach was preferred to control the effect of regulatory investment barriers on spillover effects. In this paper, the previous analysis was extended by using a GARCH-BEKK model that accounted not only for different regulatory structures between exchanges, but also for the influence of futures contracts, on the measurement of spillover effects between markets.

The overall main findings of the paper suggested that futures variables had a significant impact on volatility spillovers between markets. It was found that the correlations between markets were not constant because information contained in futures contracts significantly impacted the volatility spillovers.

The paper provides a literature review, discusses the data and methodology, outlines the results, followed by conclusions.

Literature Review

Various studies have examined the economic consequences of changes in cross-country covariances. The seminal work of Longin and Solnik (1995), and that of Karolyi and Stulz (1996), provided evidence that information other than past returns could help forecast these covariances. In particular, Longin and Solnik (1995) found that dividend yields and interest rates contained information about futures volatility and correlation that was not contained only in the past returns. Karolyi and Stulz (1996), following Longin and Solnik (1995), investigated the impact of macroeconomic variables other than interest rates on correlation between markets. They found that large shocks to broad-based market indices (Nikkei Stock Average and the Standard and Poor's 500 Stock Index) positively impacted on the return correlations.

One possible explanation for this type of market movement was 'market contagion'. Contagion effects resulted when investor perceptions relating to stock purchase or sale brought about the same perception in other markets, regardless of the evolution of market fundamentals. In this case, market behavior as indicated by futures market behavior or/and macroeconomic factors would have little power in explaining market returns

or covariances. Typically, the notion of contagion had focused on the adverse effects of stock market collapses rather than booms. A negative shock in one market led investors to withdraw funds from other markets because of irrational fears. As a result, some investors took advantage of these panics. Panics between investors resulted in 'mistakes' in one market that were transmitted to other markets through these contagious developments. Such contagious developments, known as spillovers between markets, could have an adverse impact on investment patterns across capital markets (e.g., King and Wadhvani, 1990; and Solnik *et al.,* 1996).

Another possible explanation was that the degree of integration of international financial market changes over time and interrelatedness between markets could be affected by volatility in both cash and futures markets. For instance, Merton (1995) supported that the introduction of futures trading and derivative markets could improve market efficiency and the way in which information was transmitted between futures and cash markets. Abhyankar (1995) found that for the period 1986-90, there was a strong contemporaneous relationship between FTSE100 futures and the cash stock market index. In particular, during times of 'moderate' news, the futures market might lead the cash market.

Moreover, Antoniou and Holmes (1995) found a link between information transfer and volatility changes on the FTSE100 stock index before the introduction of futures. In particular, they found that the introduction of futures improved the quality and speed of information flowing into the spot market. Also, Antoniou *et al.* (1998) indicated that the effects of stock index futures trading on stock index cash volatility were significant. In addition to investigating the influence of asymmetric and threshold impacts of news on information transfers, Antoniou *et al.* (1998) in another study, also investigated how futures contracts influenced spillover effects and found that they had a significant impact on comovements across markets. Gannon (2005) examined the simultaneous volatility transmissions for the US and Hong Kong stock and futures markets. Competing measures of volatility from the overnight US S&P index were found to impact on the Hong Kong asset return volatility and volume of trade patterns.

A third explanation was that the cross-country covariances might also be affected by market micro-structure and regulatory differences (Pagano *et al.*, 1999). To the extent that these barriers influenced how securities were priced in their home markets, this also seemed to influence the degree to which international capital markets were segmented or integrated (Black, 1974). Stapleton and Subrahmanyam (1977), Errunza and Losq (1985), and Alexander *et al.* (1987) theoretically provided evidence that foreign listing can have a significant effect on stock price changes if markets were segmented. This suggests that the segmentation of markets provided incentives for companies to a dual-list on foreign capital markets. However, the dual-listing mechanism could also be viewed as a vehicle to enhance the integration on markets in the sense that contemporaneous equity trading for the same firm in different markets was likely to be similar. While dual-listing might enhance market integration, there were a range of barriers such as transaction costs, information costs, government tax policies, restrictions on capital transfers, language, and cultural or legal barriers that might still hinder capital market integration (Saudagaran, 1988).

Various studies have attempted to examine the influence of such barriers on volatility across markets. For instance, Theodossiou and Lee (1993) investigated the spillover of news between Japan, Korea, Thailand, and the US markets using a GARCH-M (in mean) modeling approach. They found that the US market did not influence the other markets and this might be caused by different cross-country investment restrictions. In addition, Susmel and Engle (1994) examined volatility spillovers between the New York and London stock exchanges on an hourly basis, finding that the persistence of volatility spillovers between these markets was short and small. Moreover, Ng (2000) found that the investment barriers were important to the way in which news was transferred between Pacific-Basin markets. They also found that factors such as the level of trading volume and exchange rates also influenced spillover effects between markets in the region.

Biddle and Saudagaran (1989) noted that firms were more likely to make a listing in foreign exchanges with less stringent reporting requirements as this might help to enhance liquidity. However, as noted by La Porta *et al.* (1998), it was possible for a firm to obtain a listing in a foreign market with a 'Higher', 'Lower' or 'Similar' regulatory environment. The following analysis, therefore, aimed to use the aforementioned framework to investigate the influence of futures contracts on volatility spillovers for the cross-listed equities in the UK, taking into account the regulatory differences between markets.

Table 1: Within Sample— Inter-Listing of Stock Prices

Markets	Firms	Equities	London+
Austria	6	7	2
Belgium	7	8	5
Denmark	7	9	2
Finland	4	7	4
France	32	34	15
Germany	26	56	20
Netherlands	26	30	13
Italy	12	14	7
Norway	6	11	7
Spain	20	23	7
Sweden	13	20	8
UK	40	45	0
Switzerland	7	11	4
Ireland	4	5	4
Total	210	280	98

Note: (i) Frankfurt+ comprises Berlin, Dusseldolf, Stuttgart, Munich, Xet, and Frankfurt. London+ comprises London, and XSQ. The sample includes ordinary shares, 'A' shares, 'B' shares, registered shares, but not Redeemable shares (regarded as a preference share and therefore as non-equity share).

(ii) Out of the 280 home listings, 22 have been delisted. Also, 45 of the 504 foreign listings have been delisted. In addition, 31 home and 49 foreign equity listings involve mergers. Using the Kruskal-Wallis non-para metric test we find no difference in the mean returns of delisted and merged equities in both the home and foreign markets.

(iii) Cross-lisred equities are these equities that traded in more than one stock exchange simultaneously. Authors have identified these equities by Datastream software.

Data and Methodology

Data Description

A sample of European cross-listed equities traded in the UK stock market were used as detailed in Table 1. Daily prices were drawn from the Datastream database from January 1, 1987 to December 31, 1998. This provided 3,131 closing quote observations for each firm. Daytime returns were computed as ln (natural logarithm) changes

from today's last quote divided by the previous day's quote. In particular, the formula: ln (P_t/P_{t-1}) was used. If no quote was available the daily return was declared as a missing observation.

For the UK stock exchange, two portfolios of equities: 'Home' and 'Foreign' were constructed. The 'Home' portfolio of equities was an equally-weighted portfolio for the domestic listings of cross-listed firms on all stock exchanges in the sample. The 'Foreign' portfolio of equities (i.e., the foreign quotations of cross-listed firms) were divided into three equally-weighted portfolios that included those that were cross-listed in the foreign markets with 'Higher', 'Lower' or 'Similar' regulatory environments compared to their home market. In terms of the regulatory conditions that were taken into account between markets to construct the three portfolios of foreign cross-listed equities: 'High', 'Low' and 'Same' were related to the differences in accounting standards, and shareholder and creditor protection rules between the respective markets.

Table 2 presents the descriptive statistics for the variety of futures contracts that were used in the analysis. The top panels (A and B) provided the currency and exchange rate futures data, while the middle panel (C and D) gave the descriptive values for the Treasury Bills, and Treasury Bond contracts. Finally, the bottom panel E provided the descriptive statistics for the domestic stock indices used in the current study. The overall descriptive statistics for panels A and B suggested substantial differences when compared to panels C to E. This meant currency and exchange rate futures were different (e.g., smaller means) compared to Treasury Bill, and Bond futures. Overall, this suggested that the impact of currency and exchange rate futures were likely to have a lesser influence on spillover effects for the sample of cross-listed equities compared to the other types of contracts.

Table 2: Descriptive Statistics of Future Contract Returns

	Mean	St. Dev.	T-Stat.	Skewness	Kurtosis
Panel A: Currency Futures					
British Pound	0.0000096	0.0040	0.13	–0.730	8.54
Panel B: Exchange Rate Futures					
British Pound to Euro	–0.0000300	0.0043	–0.39	0.036	4.55
Panel C: Treasury Bills Futures					
London	–0.0001900	0.0110	–0.97	–0.650	25.76
Panel D: Treasury Bonds Futures					
UK	0.0001400	0.0053	1.43	0.035	4.50
Panel E: Stock Index					
London	0.0004000	0.0096	2.32	–1.360	20.62

Methodology

Regulatory Classification

In order to undertake the analysis portfolios for the cross-listed company equities were first constructed. The main methodological approach was as follows:

The aim was to investigate relationships between the foreign portfolio and the market index (where the foreign equities were listed) and the foreign portfolio and home equity of cross-listed companies. Here the analysis was extended by investigating whether different types of regulations impacted on spillover effects. Karolyi (1995) suggested that

differences in accounting disclosure requirements between Canada and the US affect information spillovers between these two markets. The investigation aimed to know whether such differences impact on volatility correlation between the foreign equity cross-listings of European companies. Karolyi (1995) did not test to see if different disclosure requirements impacted on spillover effects and we therefore aimed to address this issue by testing to see if different regulations impacted on information transfer for cross-listed equities.

First, the regulatory classification provided in La Porta *et al.* (1998) was used to distinguish between different levels of regulation relating to accounting standards and shareholder and creditor protection rules across European stock exchanges. These were then used to identify firms that had obtained foreign cross-listings in the UK market with higher, lower or similar regulatory conditions compared to those of home listing. Portfolios were constructed for each foreign stock market as classified in Tables 3-5 according to whether the regulatory requirements were higher, lower or the same as for the home listing. This provided groups of foreign equity portfolios for cross-listed companies exposed to varying regulatory environments. After constructing these portfolios the impact of futures contracts on volatility spillovers were examined between these separate portfolios and the respective home equity listings[1] and market indices (FTSE100 in London).

Table 3: Accounting Disclosure Standards' Differences between 'Home' and 'Foreign' Markets

Home Market	Foreign Market
	London+
UK	
Belgium	High
France	High
Italy	High
Netherlands	High
Spain	High
Austria	High
Germany	High
Switzerland	High
Denmark	High
Finland	High
Norway	High
Sweden	Low

Note: The index has been created by examining and rating using a minimum of three companies in each country using 1990 annual reports studying the inclusion or omission of 90 items. These items fall into seven categories (general information, income statements, balance sheets, funds flow statement, accounting standards, stock data, and special items). The companies represent a cross section of various industry groups; industrial companies represent 70%, and financial companies represent the remaining 30% (La Porta *et al.*, 1998, p. 1125).

Source: Authors' Own Construction Defined from La Porta et al. *(1998).*

Modeling Volatility Spillovers Between Equities

A framework was used in which the conditional expected returns, variances, and covariances could be modeled dynamically and estimated in a joint simultaneous system. How shocks to the information variables affected spillovers overtime was understood in particular, to know if there were any spillover effects, in the sense that a shock at one point in time carried over into higher correlation in the next period.

[1] Any interactions between the respective market indices and the home equity of cross-listings are restricted following Karolyi (1995)'s suggestion.

Table 4: Shareholder Protection Rules' Differences Between 'Home' and 'Foreign' Markets

Home Market	Foreign Market
	London+
UK	
Ireland	Low
Belgium	Low
France	Low
Italy	Low
Netherlands	Low
Spain	Low
Austria	Low
Germany	Low
Switzerland	Low
Denmark	Low
Finland	Low
Norway	Low
Sweden	Low

Note: La Porta *et al.* (1998) use ownership concentration in 10 largest private firms as an index of investor protection: The index is constructed using the average percentage of common shares owned by the three largest shareholders in the 10 largest non-financial, privately owned domestic firms in a given country. A firm is considered privately owned if the state is not a known shareholder. It is often efficient to have some ownership concentration in companies since large shareholders might monitor managers and thus increase the value of a firm. Concentration of ownership is an adaptation to poor legal protection. Countries that for some reason have heavily concentrated ownership and small stock markets might have little use for good accounting standards, and so fail to develop them. Good accounting standards and shareholder protection measures are associated with a lower concentration of ownership, indicating that concentration is indeed a response to poor investor protection (La Porta *et al.*, 1998).

Source: Authors' Own Construction Defined from La Porta et al. *(1998).*

This assumption was based on the work of Longin and Solnik (1995) and Karolyi and Stulz (1996) and had been shown to capture reasonably well the time variation of fundamental factors on interdependencies of monthly and also daily returns. Bivariate standard ARCH models had been particularly important as a modeling framework for examining the dynamics of stock price returns and volatility, based on the original work of Engle (1982) and generalized by Bollerslev (1986). While Longin and Solnik (1995) and Karolyi and Stulz (1996) used general autoregressive conditional heteroscedasticity (GARCH) models in their estimations, the GARCH-BEKK model was used to conduct a similar investigation for European markets.

To conduct this investigation, the modified GARCH-BEKK model was used as shown in Equation (1.1) of a joint return generating process.

$$R_{ij,t} = \beta_0 + \beta_1 R_{ij,t-1} + \beta_2 Z_{ij,t-1} + e_t \quad ...(1.1a)$$

and

It was assumed that e_t followed a martingale process of ε_t.

where, $E(\varepsilon_t) = e_t = E(r_t - \mu_t)$ ...(1.1b)

μ_t was the long-term drift coefficient

or

$$E(\varepsilon_t) = e_t = E(R_{ij,t} - \mu_{ij,t} - b_1 R_{ij,t-1} - b_2 Z_{ij,t-1}) \quad ...(1.1c)$$

where the returns for each portfolio, $R_{ij,t}$, were influenced by the same set of instrumental variables $z_{ij,t-1}$, in our case futures contracts. The joint vector of residuals, ε_t, was now specified to be a martingale mean process with time-varying conditional matrix, H_t. Several parsimonious multivariate specifications were available for the covariance process (Engle and Kroner

1995, and Kroner and Ng, 1998). The constant conditional correlation (CCORR-GARCH-BEKK) model was chosen as it captured the null hypothesis that there was no incremental information that could be extracted from economic variables to influence the dynamics of conditional correlations after controlling for the conditional means and variances. The joint variance process that was used in Longin and Solnik (1995) and Karolyi and Stulz (1996) was specified as follows:

$$h_{ii,t} = c_i + a_i h_{ii,t-1} + b_i e^2_{i,t-1} + \Sigma_k d_{ik} z_{k,t-1} \quad \ldots(1.2a)$$

$$h_{ij,t} = (p_{ij,0} + \Sigma_k p_{j,ik} z_{k,t-1}) (h_{ii,t} h_{jj,t})^{1/2} \quad \ldots(1.2b)$$

where the i, j^{th} elements of H_t were given by $\{h_{ij,t}\}$, e_t was the vector of innovations assumed to be conditionally normal with a conditional covariance matrix H_t, and c_i was the vector of constant coefficient of the conditional covariance matrix H_t. In contrast to the above assumption about the normal process that follow the vector of e_t that was assumed in the study of Longin and Solnik (1995) and Karolyi and Stulz (1996), we assumed that expected innovations: $E(\varepsilon_t) = e_t$ followed a martingale process. In addition, we followed the GARCH-BEKK modelling framework as introduced in Karolyi (1995) and also in Engle and Kroner (1995). We, therefore, estimated the following model with a set of factors that influenced the conditional variance-covariance dynamics:

$$\begin{aligned} h_{ii,t+1} = {} & c^2_{ii} + c^2_{ij} + b^2_{ii,t} + 2b_{ii} b_{ji} h_{ij,t} \\ & + b^2_{ji} h_{jj,t} + a^2_{ii} \varepsilon^2_{ii,t} + 2a_{ii} a_{ji} \varepsilon_{ii,t} \varepsilon_{jj,t} + a^2_{ji} \varepsilon^2_{jj,t} \end{aligned} \quad \ldots(1.3a)$$

$$\begin{aligned} h_{ij,t+1} = {} & (1 + \Sigma_k \times z_{k,t-1}) \times [c_{ii} c_{ij} + c_{ij} c_{jj} + b_{ii} b_{ij} h_{ii,t} + (b_{ii} b_{jj} + b_{ij} b_{ji}) h_{ij,t} \\ & + b_{ji} b_{jj} h_{jj,t} + a_{ii} a_{ij} \varepsilon^2_{ii,t} + (a_{ii} a_{jj} + a_{ij} a_{ji}) \varepsilon_{ii,t} \varepsilon_{jj,t} + a_{ji} a_{jj} \varepsilon^2_{jj,t}] \end{aligned} \quad \ldots(1.3b)$$

where

$$c_{ij} = 1/(c_{ii} \times c_{jj})^{\frac{1}{2}} \quad \ldots(1.3c)$$

being constant and reversibly proportional to the squared root of c_{ii} multiplied with c_{jj}. b_{ij} was the volatility coefficient from the j portfolio of equities to the i portfolio of equities. a_{ij} was the error coefficient from the j portfolio of equities to the i portfolio of equities.

Longin and Solnik (1995) and Karolyi and Stulz (1996) imposed on the equity covariance matrix the restriction of

$$h_{ij} = c_{ij} \times (h_{ii} \times h_{jj})^{\frac{1}{2}} \quad \ldots(1.3d)$$

because they assumed that the covariance changes proportionally to the squared root of the variances. In this analysis, it is assumed that the covariance did not change

proportionally to variance. Also, the coefficients for the interactive components were jointly significant using conventional likelihood ratio tests were tested.

The main difference between Longin and Solnik (1995) and Karolyi and Stulz's (1996) GARCH approach compared to the CCORR-GARCH-BEKK approach methodology was that in the latter case, stock price variance was affected jointly by past futures market and previous period stock price markets, while in the former case stock price variance was affected only by the past futures market volatility. The advantages of the GARCH-BEKK model was that it allowed us to take into account stock price covariances that might not increase in parallel with their stock price variances and thus stock price covariances might increase more (or less) than the respective variances.

Biddle and Saudagaran (1989), for instance, noted that firms were more likely to make a listing on foreign stock exchanges with less stringent reporting requirements as this might help improve liquidity. However, as noted by La Porta *et al.* (1998), it was possible for a firm to obtain a listing in a foreign market with a 'Higher', 'Lower' or 'Similar' regulatory environment. The following analysis, therefore aimed to use the aforementioned modeling framework to investigate the influence of futures contracts on volatility spillovers for cross-listed equities in Europe, taking into account these regulatory differences between markets.

Empirical Results

Spillovers, Impact of Shocks and the Regulatory Environment

The results of volatility spillovers for our analysis of cross-listed equities considering spillovers between foreign cross-listings, home cross-listings and their respective market indices are reported here. The analysis was focused on the London+[2] stock exchange. Referring to the methodology outlined earlier, portfolios for foreign cross-listed equities on the respective exchanges were constructed according to whether they represented a listing in a higher, lower or similar regulatory environment.

The regulatory environment was classified using La Porta *et al.* (1998) taxonomy according to differences in accounting disclosure rules, and shareholder and creditor protection regulations. For example, foreign firms that obtained a listing on an exchange with lesser creditor bankruptcy protection rules were grouped into one portfolio, and those coming to a tougher creditor bankruptcy protection environment into another portfolio and those with similar rules a third portfolio. So for the following exchange (London+), a variety of portfolios were constructed for the foreign equity of cross-listed companies that took account of whether the listing represented a listing in a tougher, more lax or similar regulatory environment. The spillover effects between the different foreign portfolios were then examined with the respective home portfolios and the domestic stock index.

The aim was to see whether the spillover effects of companies that sought cross-listings in more or less onerous regulatory environments were influenced by futures market shocks. For ease of exposition, the following reported results only for where the modeling process which yielded interpretable estimates.

[2] London+ = London and XSQ.

The Impact of Futures Information on the Spillovers

Table 5 presented the results of the spillover effects for home and foreign firms on the London+ stock exchange with respect to the market stock index (FTSE100).

Table 5: The Impact of Futures Information on the Comovements Between Cross-listed Home and Foreign Equities on the London Stock Exchange and FTSE100 Taking into Account Differences in Regulatory Regimes

Disclosure of Accounting Standards			**High FTSE100 Home**
Panel A1: The Impact of British Pound/Euro Exchange Rate and Bond Price Index Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound/Euro Exchange Rate**	**Next Period's Impact from the Bond Price index**
Volatility Transmission			
Volatility Transmission from FTSE100 to High	–0.38* (0.03)	–27.57* (5.20)	–31.59* (5.06)
Volatility Transmission from High to FTSE100	–1.71* (0.15)	–303.90* (28.23)	136.28* (19.61)
Volatility Transmission from Home to High	–0.36* (0.03)	–12.66 (7.31)	–9.07 (7.44)
Volatility Transmission from High to Home	0.54* (0.25)	303.47* (30.56)	–89.97* (29.27)
Error Transmission			
Error Transmission from High to DAX100	0.59* (0.05)	NA	NA
Error Transmission from High to Home	0.66* (0.05)	NA	NA
	Volatility Persistence		
High	0.007		
FTSE100	–0.033		
Home	–0.160		
	Likelihood Ratio Tests		
Log-Likelihood	37247.16		
Chi-Squared (12)	8938.57		

(Contd...)

Table 5: The Impact of Futures Information on the Comovements Between Cross-listed Home and Foreign Equities on the London Stock Exchange and FTSE100 Taking into Account Differences in Regulatory Regimes *(...contd)*

Disclosure of Accounting Standards			**High FTSE100 Home**
Panel A2: The Impact of British Pound Currency and Treasury Bill Rate Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound Currency**	**Next Period's Impact from the Treasury Bill Rate**
Volatility Transmission			
Volatility Transmission from FTSE100 to High	–0.53* (0.03)	–7.11 (6.69)	–14.57* (2.82)
Volatility Transmission from High to FTSE100	–0.86* (0.16)	17.23 (54.58)	–4.57 (16.42)
Volatility Transmission from Home to High	–0.51* (0.03)	–20.25* (9.038)	–3.52 (2.81)
Volatility Transmission from High to Home	–0.55* (0.20)	–63.07 (43.82)	6.34 (13.51)
Error Transmission			
Error Transmission from FTSE100 to High	–0.30* (0.02)	NA	NA
Error Transmission from Home to High	–0.19* (0.02)	NA	NA
	Volatility Persistence		
High	0.25		
FTSE100	–0.17		
Home	–0.19		
	Likelihood Ratio Tests		
Log-Likelihood	38060.61		
Chi-Squared (12)	4789.57		
Panel A3: The Impact of British Pound Currency and Bond Price Index Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound Currency**	**Next Period's Impact from the Bond Price Index**
Volatility Transmission			
Volatility Transmission from FTSE100 to High	–0.28* (0.02)	–24.41* (5.68)	–2.30 (4.76)

(Contd...)

Table 5: The Impact of Futures Information on the Comovements Between Cross-listed Home and Foreign Equities on the London Stock Exchange and FTSE100 Taking into Account Differences in Regulatory Regimes *(...contd)*

Disclosure of Accounting Standards			**High FTSE100 Home**
Panel A3: The Impact of British Pound Currency and Bond Price Index Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound Currency**	**Next Period's Impact from the Bond Price Index**
Volatility Transmission from High to FTSE100	1.25* (0.12)	40.92 (47.70)	1.93 (83.54)
Volatility Transmission from High to Home	–0.67* (0.16)	–71.88* (31.27)	40.01 (73.07)
Volatility Transmission from Home to High	–0.35 (0.02)	–24.49* (8.39)	–4.84 (4.46)
Error Transmission			
Error Transmission from High to FTSE100	–6.04* (0.16)	NA	NA
Error Transmission from High to Home	6.55* (0.17)	NA	NA
Error Transmission from Home to High	–0.35* (0.02)	NA	NA
	Volatility Persistence		
High	–0.09		
FTSE100	0.16		
Home	0.09		
	Likelihood Ratio Tests		
Log-Likelihood	35315.410		
Chi-Squared (12)	4775.085		
Shareholder Protection Rules			**Low FTSE100 Home**
Panel B1: The Impact of British Pound/Euro Exchange Rate and Treasury Bill Rate Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound/Euro Exchange Rate**	**Next Period's Impact from the Treasury Bill Rate**
Volatility Transmission			

(Contd...)

Table 5: The Impact of Futures Information on the Comovements Between Cross-listed Home and Foreign Equities on the London Stock Exchange and FTSE100 Taking into Account Differences in Regulatory Regimes *(...contd)*

Shareholder Protection Rules			**Low FTSE100 Home**
Panel B1: The Impact of British Pound/Euro Exchange Rate and Treasury Bill Rate Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound/Euro Exchange Rate**	**Next Period's Impact from the Treasury Bill Rate**
Volatility Transmission			
Volatility Transmission from FTSE100 to Low	0.06* (0.00)	–42.11* (1.59)	11.09* (1.02)
Volatility Transmission from Low to FTSE100	0.90* (0.01)	–97.92* (13.41)	22.08 (11.91)
Volatility Transmission from Home to Low	0.05 (0.02)	–32.19* (2.42)	12.29* (1.76)
Volatility Transmission from Low to Home	–0.13 (0.14)	52.47* (14.83)	12.89 (13.36)
Error Transmission			
Error Transmission from Low to FTSE100	2.17* (0.04)	NA	NA
Error Transmission from Low to Home	0.84* (0.03)	NA	NA
	Volatility Persistence		
Low	0.13		
FTSE100	–0.20		
Home	–0.06		
	Likelihood Ratio Tests		
Log-Likelihood	36900.150		
Chi-Squared (12)	13378.450		
Panel B2: The Impact of British Pound/Euro Exchange Rate and Bond Price Index Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound/Euro Exchange Rate**	**Next Period's Impact from the Bond Price Index**
Volatility Transmission			
Volatility Transmission from FTSE100 to Low	0.08 (0.75)	–201.48 (31.29)	56.63* (55.01)

(Contd...)

Table 5: The Impact of Futures Information on the Comovements Between Cross-listed Home and Foreign Equities on the London Stock Exchange and FTSE100 Taking into Account Differences in Regulatory Regimes *(...contd)*

Shareholder Protection Rules			**Low FTSE100 Home**
Panel B2: The Impact of British Pound/Euro Exchange Rate and Bond Price Index Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound/Euro Exchange Rate**	**Next Period's Impact from the Bond Price Index**
Volatility Transmission			
Volatility Transmission from FTSE100 to Low	0.37* (0.02)	11.86 (7.17)	9.99 (6.12)
Volatility Transmission from Low to FTSE100	–1.58* (0.74)	249.49 (41.07)	–111.63 (39.40)
Volatility Transmission from Home to Low	0.41 (0.04)	18.43* (7.52)	6.55 (10.53)
Error Transmission			
Error Transmission from Ftse100 to Low	–0.04* (0.02)	NA	NA
Error Transmission from Low to FTSE100	1.47* (0.06)	NA	NA
Error Transmission from Low to Home	0.41* (0.04)	NA	NA
	Volatility Persistence		
Low	0.19		
FTSE100	–0.34		
Home	–0.45		
	Likelihood Ratio Tests		
Log-Likelihood	37681.99		
Chi-Squared (12)	3980.26		
Panel B3: The Impact of British Pound Currency and Treasury Bill Rate Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound/Euro Exchange Rate**	**Next Period's Impact from the Treasury Bill Rate**
Volatility Transmission			
Volatility Transmission from FTSE100 to Low	–0.36* (0.03)	9.36 (7.21)	–7.92* (1.43)

(Contd...)

Table 5: The Impact of Futures Information on the Comovements Between Cross-listed Home and Foreign Equities on the London Stock Exchange and FTSE100 Taking into Account Differences in Regulatory Regimes *(...contd)*

Shareholder Protection Rules			**Low FTSE100 Home**
Panel B3: The Impact of British Pound Currency and Treasury Bill Rate Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound/Euro Exchange Rate**	**Next Period's Impact from the Treasury Bill Rate**
Volatility Transmission			
Volatility Transmission from Low to FTSE100	–2.04* (0.16)	–177.46* (22.19)	–41.00* (7.17)
Volatility Transmission from Home to Low	–0.41* (0.03)	19.51* (7.59)	–8.40* (2.46)
Volatility Transmission from Low to Home	1.71* (0.15)	93.27* (36.05)	26.29 (18.34)
Error Transmission			
Error Transmission from FTSE100 to Low	–0.04* (0.00)	NA	NA
Error Transmission from Low to FTSE100	1.60* (0.04)	NA	NA
Error Transmission from Home to Low	–0.02* (0.00)	NA	NA
Error Transmission from Low to Home	–0.41* (0.04)	NA	NA
	Volatility Persistence		
Low	–0.08		
FTSE100	–0.55		
Home	–0.33		
	Likelihood Ratio Tests		
Log-Likelihood	38141.66		
Chi-Squared (12)	5169.37		
Panel B4: The Impact of British Pound Currency and Bond Price Index Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound/Euro Exchange Rate**	**Next Period's Impact from the Bond Price Index**
Volatility Transmission			
Volatility Transmission from FTSE100 to Low	–0.31* (0.02)	–7.95 (8.21)	15.30* (2.27)

(Contd...)

Table 5: The Impact of Futures Information on the Comovements Between Cross-listed Home and Foreign Equities on the London Stock Exchange and FTSE100 Taking into Account Differences in Regulatory Regimes *(...contd)*

Shareholder Protection Rules			**Low FTSE100 Home**
Panel B4: The Impact of British Pound Currency and Bond Price Index Futures Contracts			
Period: 5/1/87-31/12/98	**Conditional Correlation**	**Next Period's Impact from the British Pound/Euro Exchange Rate**	**Next Period's Impact from the Bond Price Index**
Volatility Transmission			
Volatility Transmission from Low to FTSE100	0.74* (0.32)	260.28* (75.73)	101.33 (51.85)
Volatility Transmission from Home to Low	0.31* (0.02)	–4.99 (7.24)	8.64 (5.10)
Volatility Transmission from Low to Home	1.20* (0.28)	–273.20* (34.85)	–13.50 (49.90)
Error Transmission			
Error Transmission from FTSE100 to Low	–0.032* (0.01)	NA	NA
Error Transmission from Low to FTSE100	1.37* (0.07)	NA	NA
Error Transmission from Low to Home	–0.40* (0.07)	NA	NA
	Volatility Persistence		
Low	–0.00046		
FTSE100	0.021		
Home	0.15		
	Likelihood Ratio Tests		
Log-Likelihood	37840.37		
Chi-Squared (12)	13233.61		

Note: (i) 'High' refers to where the foreign cross-listing is located in a market with more onerous regulatory requirements in the context of accounting rules, creditor bankruptcy and shareholder protection rules. 'Low' refers to less onerous regulatory environments and the 'Same' refers to exchanges that have similar rules.

(ii) NA means not available because we do not examine the impact of shocks on the next period's error (e.g., trading noise).

(iii) *shows significance at the 5% level.

As previously mentioned the impact of shocks on the above-mentioned spillover effects between portfolios with investment barriers were examined that arouse from differences in accounting disclosure standards, bankruptcy and shareholder protection rules[3].

Table 5 (panel A1) showed the impact of the British pound/Euro and British bond price index shocks on the spillover effects between home and foreign cross-listings given different accounting standard requirements between stock exchanges. The magnitude of conditional spillovers was dominant from the foreign cross-listed equities from laxer accounting standard requirements for different regulatory environments to both the FTSE100 stock index and home cross-listed equity portfolios. In addition, the incremental impact of the British pound/Euro and British bond price index shocks on the following period's spillover was dominant from 'High' to both the FTSE100 index and the portfolio of home cross-listed equities.

This suggested that the cross-listed foreign equities from laxer accounting standard requirements for different regulatory environments appeared to transmit conditional and next period's information to the FTSE100 index and other cross-listed home equities in London+ market.

Table 5 (panel A2) showed the conditional and next period's spillover coefficients relating to the impact of British pound and Treasury Bill shocks on the respective portfolios. This suggested that the British Treasury Bill shock influenced conditional and next period's volatility spillovers from the FTSE100 stock index to cross-listed foreign equities that had their home listing on exchanges with less onerous accounting standards. Also, there was some evidence to suggest that the British pound could influence conditional and next period's volatility spillovers from the home cross-listed equities to the aforementioned portfolio of foreign cross-listings.

Table 5 (panel A3) compared conditional and next period's estimates of spillover effects from foreign cross-listed equities on the London+ stock exchange with the market index FTSE100 and the home cross-listed equities. For ease of exposition the case of London+ stock exchange with respect to different accounting regimes to see if shocks (British pound and British bond price index) had any impact on spillovers. Comparing the three columns that reported the spillover effects it could be seen that the impact of the British pound resulted in a wider range of dynamic next period spillover effects, compared with the influence of the British bond index. In general, it seemed that when one took account futures shocks into the modeling framework, it added to the dynamics of the spillover effects (although the evidence in the case of British bond price index was rather limited).

Table 5 (panel B1) reported the statistically significant spillover coefficients for cross-listed equity portfolios (according to different shareholder protection rules) influenced by the British Pound/Euro and British Treasury Bill shocks. Generally, it was found that the conditional spillovers between portfolios were significant and also that the incremental impact of both above-mentioned shocks had a large influence on the next

[3] We do not look at the impact of shocks on the conditional correlation in London+ exchange with different bankruptcy protection rules between markets, because estimates did not converge in the CCORR-GARCH-BEKK modelling process.

period's spillovers between equity portfolios. For instance, the volatility spillover coefficient from the FTSE100 to the 'Low' (shareholder protection rules) portfolio had increased from 0.06 (in the model that examined conditional spillovers between equity portfolios) to –42.11 (after the incremental impact of the British pound/Euro was included) to 11.09 (after taking into account the incremental impact of British Treasury Bills).

Table 5 (panel B2) reported volatility and error spillover coefficients before and after the incremental impact of the British pound /Euro and British bond price index shocks on conditional correlation between equity portfolios considering differences in shareholder protection rules. Both these types of spillover coefficients (conditional and next period's spillover effects) were significant at 5% level.

Table 5 (panel B3) provided the estimates for the spillovers using the impact of the British pound and Treasury Bill shocks in the London+ stock market. Specifically, this presented the conditional and next period's impact of shocks on the conditional correlation between equity portfolios. The spillover coefficients for the measure of the incremental impact of the above-mentioned futures on the covariance of equity portfolios (taking into account the shareholder protection rules) were found to be different. In particular, the findings suggest that the British pound/Euro shock had a larger effect on the spillover from the 'Low' portfolio to the FTSE100 stock index compared with the impact of the British Treasury Bill index. It was also found that, on an average, the next period's spillovers were more dynamic for the impact of the British pound/Euro futures index compared with the British Treasury Bills shock.

Table 5 (panel B4) examined the impact of the British pound and British bond price index on the return correlations between home and foreign cross-listed equities and also between foreign cross-listed equities and the FTSE100 stock index. The results showed that the impact of British pound/Euro shock on the conditional correlation of the above-mentioned returns was larger in magnitude compared to the incremental impact of the British bond price index. Again here the impact of British pound shocks on the next period's spillover was stronger than compared with the effects of the British bond price index and British Treasury Bill rates (Table 5 – Panel B3).

The impact of futures shocks on the conditional correlation of portfolios were discussed so far and on the conditional and next period's spillover effects for cross-listed companies were commented, without discussing volatility persistence. In terms of volatility persistence, in no single case reported in Table 5, a significant influence of the previous period's volatility on the following period's volatility was found.

The overall results suggest that the British pound/Euro and British pound futures shocks had a larger impact on the following period's spillovers between return portfolios than compared with the impact of other local shocks (British Treasury Bills and the British bond price index). This meant that the impact of British currency changes and also the pound/Euro exchange rate had significant effects on next period's spillovers for cross-listed firms on the London stock exchange. There was no significant evidence of volatility persistence despite the different types of shocks that were considered.

Conclusion

This paper investigated the properties of cross-country stock return spillovers. Using Euro-denominated returns of European cross-listed shares trading in 14 European stock exchanges, how the currency, exchange rates, Treasury Bill, and Treasury Bond futures shocks could significantly affected spillovers for UK equity portfolios was presented. Controlling for conditional and next period's impact of shocks, these could have a significant impact on the magnitude of stock return spillovers. In contrast, the volatility persistence was generally found to be low and insignificant.

It was evident that correlations and covariances were high. This suggested that conditional and next period's correlations and covariances could be influenced by futures shocks variables. Regulatory differences between exchanges could influence volatility spillovers across markets.

Comparing the results of Table 5 (panel A1) with those of Table 5 (panel B2) it can be concluded that with respect to policy implications, while conditional spillovers were higher for the second case (6) in comparison to the first case (4), the incremental effects were (6) for the first case and (1) for the second case. In other words, regulators should put strength over the impact of accounting standards on stock markets in order to harmonize them rather than on the shareholder protection rules. Both these standards differed between stock markets and also caused spillovers to differ between stock markets for high, low and similar stock regulatory rules.

A similar study could be done on Southeastern markets in order to see regulators and academicians if there was a difference on the standards (accounting and shareholders protection rules) and also a different volatility and error spillover between these markets. The conclusion of this study would provide a good practice for the policymakers and would show if there was a difference on volatility spillovers between Southeastern countries and European countries with respect to differences in the accounting and shareholder protection rules. ❖

References

1. Abhyankar A H (1995), "Return and Volatility Dynamics in the FTSE100 Stock Index Futures Markets", *The Journal of Futures Markets,* Vol. 15, pp. 457-488.
2. Alexander G, Eun C and Janakiramanan S (1987), "Asset Pricing and Dual Listing on Foreign Capital Markets: A Note", *Journal of Finance,* Vol. 42, pp. 151-158.
3. Antoniou A and Holmes P (1995), "Futures Trading, Information and Spot Price Volatility: Evidence for the FTSE100 Stock Index Futures Contract Using GARCH", *Journal of Banking and Finance,* Vol. 19, pp. 117-129.

4. Antoniou A, Holmes P and Priestley R (1998), "The Effects of Stock Index Futures Trading on Stock Index Volatility: An Analysis of the Asymmetric Response of Volatility to News", *The Journal of Futures Markets,* Vol. 18, No. 2, pp. 151-166.

5. Biddle G and Saudagaran S (1989), "The Effects of Financial Disclosure Levels on Firms' Choices among Alternative Foreign Stock Exchange Listings", *Journal of International Financial Management and Accounting,* Spring, pp. 55-87.

6. Black F (1974), "International Capital Market Equilibrium with Investment Barriers", *Journal of Financial Economics,* Vol. 1, pp. 337-352.

7. Bollerslev T (1986), "Generalized Autoregressive Conditional Heteroscedasticity", *Journal of Econometrics,* Vol. 31, pp. 307-27.

8. Bollerslev T (1990), "Modelling the Coherence in Short Run Nominal Exchange Rates: A Multivariate Generalized ARCH Approach", *Review of Economics and Statistics,* Vol. 72, pp. 498-505.

9. Engle R F (1982), "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of UK Inflation", *Econometrica,* Vol. 50, pp. 987-1008.

10. Engle R F and Kroner K F (1995), "Multivariate Simultaneous Generalized ARCH", *Economic Theory,* Vol. 11, pp. 122-150.

11. Errunza V and Losq E (1985), "International Asset Pricing under Mild Segmentation: Theory and Test", *The Journal of Finance,* Vol. *XL*, No. 1, pp. 105-124.

12. Gerard Gannon G (2005), "Simultaneous Volatility Transmissions and Spillover Effects: U.S. and Hong Kong Stock and Futures Markets", *International Review of Financial Analysis*, Vol. 14, No. 3, pp. 326-336.

13. Karolyi A (1995), "A Multivariate GARCH Model of International Transmissions of Stock Returns and Volatility: The Case of the United States and Canada", *Journal of Business and Economics Statistics,* Vol. 13, pp. 11-25.

14. Karolyi A and Stulz R M (1996), "Why Do Markets Move Together? An Investigation of US-Japan Stock Return Comovements", *The Journal of Finance LI*, No. 3, pp. 951-986.

15. King M A and Wadhwani S (1990), "Transmission of Volatility between Stock Markets", *The Review of Financial Studies,* Vol. 3, pp. 5-33.

16. Kroner K F and Ng V K (1998), "Modelling the Time Varying Comovement of Asset Returns", *Review of Financial Studies*, Vol. 11, pp. 817-844.

17. La Porta R, De Silanes F L, Shleifer A and Vishny R W (1998), "Law and Finance", *Journal of Political Economy*, Vol. 106, No. 6, pp. 1113-1155.

18. Longin F and Solnik B (1995), "Is the Correlation in International Equity Returns Constant: 1960-1990?", *Journal of International Money and Finance*, Vol. 14, pp. 3-23.

19. Merton R C (1990), *Continuous-Time Finance*, Blackwell, Cambridge.

20. Ng A (2000), "Volatility Spillover Effects from Japan and the US to the Pacific-Basin", *Journal of International Money and Finance*, Vol. 19, pp. 207-233.

21. Pagano M, Roell A and Zeckner J (1999), *The Geography of Equity Listing: Why Do European Companies List Abroad?*, University of Salerno, Mimeo.

22. Saudagaran S (1988), "An Empirical Study of Selected Factors Influencing the Decision to List on Foreign Stock Exchanges", *Journal of International Business Studies*, Vol. 19, Spring, pp. 101-127.

23. Stapleton R C and Subrahmanyam M G (1977), "Market Imperfections, Capital Market Equilibrium and Corporate Finance", *The Journal of Finance,* Vol. XXXII, No. 2, pp. 307-319.

24. Susmel R and Engle R F (1994), "Hourly Volatility Spillovers between International Equity Markets", *Journal of International Money and Finance*, Vol. 13, pp. 3-25.

25. Theodossiou P and Lee U (1993), "Mean and Volatility Spillovers Across Major National Stock Markets: Further Empirical Evidence", *Journal of Financial Research*, Vol. 16, pp. 327-350.

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