

# The Impact of Foreign Cross-Listings on Symmetric Information Spillovers between Markets in Brussels and Milan Exchanges

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## Abstract

This paper develops the approach suggested by Howe, Madura and Tucker (1993) to examine the impact of cross-listing on stock price volatility in specific European markets. A primary focus of this paper is to provide a different methodology from Howe, Madura and Tucker (1993), using a modified GARCH modelling approach as suggested by Li and Engle (1998), to examine the impact of cross-listings on volatility spillovers. The analysis also takes into account the influence of different regulatory structures across the markets where firms are cross-listed. In particular, we use La Porta et al.'s (1998) broad stock market regulatory classification to analyse the magnitude and persistence of volatility spillovers from the foreign listing to the home equity of cross-listed companies in the Brussels, and Milan markets. The aim here is to examine symmetric information spillover effects from foreign equities (at the time of listing) to the home equities. Overall, we find that information spillover effects are important across specific European markets for cross-listed equities and that different regulatory environments have a significant impact on information spillovers. Volatility transmissions from foreign listing in lax regulatory environments appear to be more important in the case of spillovers to home equities in the case of Brussels cross-listed equities. With regard to foreign listing days, it appears that Monday spillovers are the most prevalent, followed by Friday. From a general perspective results also clearly indicate that volatility transmission can vary across different regulatory environments and for various listing dates.

**Key words:** Cross-listings, Symmetric spillovers, GARCH

**JEL Classification:** G15**I. Introduction**

This paper develops the approach suggested by Howe, Madura and Tucker (1993) to examine the transmission of information for cross-listed equities between markets in specific European markets. A central focus of this study is to examine the information spillover effects resulting from a foreign cross-listing.

In their seminal study Howe, Madura and Tucker (1993) examine changes in stock price volatility in association with the listing of US firms' stocks on overseas exchanges, and document significant increases in anticipated volatility following the overseas exchange listing. Also, in an earlier study, Howe and Madura (1990) examine the impact of international listing on common-stock volatility, finding no significant shifts in volatility resulting from the international listing. The above findings by Howe and Madura (1990) suggest that markets are already reasonably well integrated and also listing cannot reduce segmentation. As far as we are aware these are the only studies that examine the impact of cross-listings on volatility spillovers. Given the inconclusive findings of these two studies we extend the, albeit limited, literature by developing a GARCH modelling process to analyse whether different barriers influence the information transmission mechanism for European cross-listings.

The starting point for this paper is to develop the above-mentioned approach of Howe, Madura (1990) and Howe, Madura and Tucker (1993) for our analysis of cross-listed European securities using a modified GARCH modelling approach as suggested by Li and Engle (1998)<sup>1</sup>. In particular, the GARCH model introduced by Li and Engle (1998) is modified to take account of permanent asymmetric information effects, temporary symmetric information spillovers and the influence of different regulatory barriers across markets.

Overall, we find that information spillover effects are important across specific European markets for cross-listed equities and that different regulatory environments have a significant impact on information spillovers. The magnitude and persistence of these information spillovers varies according to the location of cross-listings.

This paper is structured as follows. Section 2 provides a literature review. Section 3 outlines the research design and the sample used in this study, and Section 4 provides the empirical results. Finally, Section 5 summarizes the main findings of the study.

**II. Literature Review**

A number of studies bring to light empirical evidence on 'volatility clustering' with regard to the impact of the news on stock price volatility. Among others, evidence about 'volatility clustering' are provided by Engle (1982), Pindyck (1986), and Bollerslev (1986). All of these studies support the view that news tends to be clustered together and this has an influence on stock price volatility. In particular, Engle (1982) introduces a new class of stochastic models referred to as autoregressive conditional heteroscedastic (ARCH) processes. In general, ARCH modelling approaches infer that past information can forecast next period's stock price volatility. (Typically the ARCH process incorporates a one-period lag structure). Bollerslev (1986) extends the ARCH modelling framework introduced by Engle (1982) to a GARCH (General ARCH) process. The GARCH model allows the past conditional variances in the current conditional variance estimation to capture volatility clustering. As such the GARCH framework is preferred to the ARCH modelling approach for investigating volatility spillovers between markets as it allows us to examine both the magnitude and persistence of spillover effects (Whereas, the ARCH approach only provides estimate of magnitude).

Volatility clustering characterises the transmission of news from one market to another. In this respect the transmission of news (say relating to a foreign cross-listing) may be: public, private or just

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<sup>1</sup> Li and Engle (1998) present a GARCH modelling framework incorporating dummy variables to take account of macroeconomic announcement on the volatility of US treasury futures.

trading noise. The public information hypothesis states that return volatility arises from the release of public information such as corporate announcements, judicial decisions, and macroeconomic news, however existing studies reject the public information hypothesis (e.g. French and Roll (1986), and Barclay, Litzenberger, and Waner (1990)). These studies tend to find that return variance will be unaffected by a cross-listing on an overseas exchange<sup>2</sup>.

Specifically, French and Roll (1986) examine the two-day return variance over US stock exchange holidays. They surmise that if public information is an important determinant of return volatility, this two-day variance should be twice the one-day variance. Their evidence suggests that, the two-day variance is only 15 percent greater than the one-day variance and they reject the public information hypothesis as an explanation for greater stock price volatility. Likewise Barclay et al. (1990) also finds that public information is not associated with volatility changes. Their study finds that US cross-listings on overseas exchanges substantially increase the trading hours for these stocks but stock price volatility remains stable.

While there is little evidence that public information influences cross-listing return volatility other literature has identified that private information may have a more impact. The view that private information influences return volatility is supported by the studies of Kyle (1985) and Admati and Pfleiderer (1988). Kyle (1985) develops a model that allows for a sequential auction market in which informed traders generate order flows based on their private information. In this setting, changes in stock price volatility occur as a result of changes in trading volume. Admati and Pfleiderer (1988) suggest that most of the trading of cross-listed shares is typically concentrated on one active market. Traders acquire private information with regard to the most active market after the listing occurs on a foreign exchange. In general, the studies that examine the influence of private information suggest that cross-listings may provide an incentive for traders to collect and exploit greater this type of news and as a result this may cause an increase in stock price volatility.

Chowdhry and Nanda (1991) also suggest that a dominant market will exist when a security has multiple locations of trading and therefore they predict that a cross listing will not change return variance. Chowdhry and Nanda (1991) suggest a multimarket trading model with informed and liquidity traders, as suggested in Kyle (1985) and Admati and Pfleiderer (1988). If more than one market exists for a security, one will emerge as the dominant market. This arises because liquidity traders look for markets with the lowest trading costs, while informed traders maximise their profitability by hiding trades in the most liquid markets. In contrast to Chowdhry and Nanda (1991), however, Freedman (1989) argues that informed traders will optimally allocate their trading amongst markets.

Lo and McKinlay (1988) and Lehman (1990) look at the impact of temporary noise on stock price volatility, and find that noise trading leads to an increase in stock price volatility over the short-term but a decline over the long-term (with negative autocorrelation). Likewise, Poterba and Summers (1988) suggest that stock price returns show positive serial correlation over short periods and negative correlation over longer intervals. In their study using NYSE returns over the 1926-1985 period they find that transitory price components account for a substantial part of the variance in equity returns. In general, the aforementioned studies suggest that noise may influence stock price volatility, and this may be temporary or permanent in nature.

The aim of this paper at the time of foreign listing, therefore, is to examine volatility spillovers for cross-listed European equities. We examine temporary noise effects and their influence on the respective volatility from the foreign to home listing. Prior to this analysis, we do not know what the impact of trading noise on stock price volatility for cross-listed equities will be, because, as far as we are aware, this has not been examined in the established literature.

Closely related to the issues of volatility transmission (whether it is through public and private information or just noise trading) is the notion of market segmentation. The greater the volatility spillover effects between markets then the higher the level of market segmentation. A growing body of

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<sup>2</sup> In contrast to these studies of stock exchanges, Harvey and Huang (1991) conclude that increased volatility in the foreign exchange market is associated with the release of US macroeconomic news. The foreign exchange market is around the clock.

literature has examined the issue of the segmentation of capital markets. For example, Stapleton and Subrahmanyam (1977) suggest three categories of corporate financial policies that can reduce the effects associated with market segmentation. They suggest that direct foreign investments, mergers with foreign firms, and the listing of the firm's securities on foreign exchanges may all reduce the influence of market segmentation.

Alexander et al. (1988) examine a sample of 34 foreign firms that listed their stocks in the United States. Thirteen of these are Canadian stocks, while the remaining 21 are American Depository Receipts (ADRs) of firms from Japan, Australia and other countries. They find positive abnormal returns in the pre-cross-listing period, no abnormal returns in the cross-listing period and negative abnormal returns in the post-cross-listing period. There is little evidence documenting significant benefits to the shareholders of firms, that cross-list their stock on a foreign exchange.

Typically the studies that examine abnormal returns associated with foreign cross-listings tend to find negative post-listing performance. Ule (1937) looks at all the stocks that cross-list on the NYSE between 1934 and 1937, finding that stock prices prior to cross listing yield a positive large return to shareholders. Likewise, Merjos (1963) investigates a sample of new cross-listings on American stock exchanges (ASE) on four different dates, and three months before cross listing to one month after the cross listing. Taking as a control factor the performance of Dow Jones Industrial Average index, she finds that stock prices outperform the stock index with a decrease in stock price observed after the cross listing. Van Horne (1970) finds that cross-listing is not 'a thing of value' nor could it be profitable activity for investors by buying stocks at the cross-listing announcement date and selling them at the actual cross-listing date.

In general, the aforementioned literature suggests that firms experience significantly negative stock returns after a dual-cross-listing on the ASE or NYSE stock exchanges. Negative post-cross-listing performance has also been reported for companies that dual-cross-list on the Tokyo stock exchange (Hwang and Jayaraman (1993)). In general, the evidence of significant benefits in terms of greater market integration associated with an overseas cross listing has been lacking. This is because most studies find relatively long negative post-listing returns and this is suggestive of substantial market segmentation. However, all this literature focuses on market abnormal returns after the cross listing whereas no study (as far as we are aware) examine volatility effects between markets after a cross listing. As such, rather than adopting the abnormal return methodology we examine post-listing volatility spillovers in order to investigate possible market segmentation issues.

A number of studies bring to light evidence that a foreign listing can also mitigate information costs due to lower accounting standards, disclosure rules and regulatory environment.. For instance, La Porta et al. (1998) have argued that common law legal system protect investors better than civil law systems<sup>3</sup>. Investors may not want to hold equity in a firm from a country with poor investor protection rules because they may fear expropriation by concentrated shareholders or managers<sup>4</sup>. Fuerst (1998), Ahearne, Griever and Warnock (2002) also argue that investors may not want to invest in foreign firms in the event that disclosure is inadequate because weak accounting disclosure rules makes it more difficult to evaluate a firm-this may further initiative companies to cross-list in markets with tougher accounting disclosure rules.

Another reason for firms seeking a foreign listing relates to investor recognition and/or liquidity reasons. When a firm cross-lists, it reduces some of the home bias providing greater investor access to the company equity. Kim and Suh (2001), for instance, find that US shareholders are more likely to accept the equity of cross-listed companies with greater turnover (liquidity) in the US market.

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<sup>3</sup> The civil law countries-the judiciary have a set of laws that they must follow with little room for flexibility. Under common law, judges are able to set precedents on matters that the established law does not cover. Under a common law system legislation is constantly evolving to address areas not previously covered by the extent legal framework.

<sup>4</sup> See LLSV (1998). Shleifer and Wolfenzon (2002) also suggest that firms from countries with weaker investor protection rules find equity financing more costly because dispersed shareholders need to be compensated for the risk of expropriation by large shareholders or managers. Stulz (1999) and Reese and Weisbach (2002) argue that a foreign firm can improve itself in protection and reduce agency costs by listing on a US exchanges-a tougher regulatory exchange.

The extant literature suggests that investment barriers relating to such things as different investor protection rules, accounting standards and other types of regulation can result in higher information and transaction costs for investors and these factors promote the incentive for firms to choose specific environments in which to cross-list. However, the available empirical evidence on the impact of cross-listings on stock price volatility across markets simply confirms the interrelationship between stock prices and volatilities without taking into account regulatory barriers. To the extent that these barriers influence how securities are priced in their home markets, this also seems to influence the degree to which international capital markets are segmented or integrated (Black (1974)).

While the established literatures implies market segmentation no studies test to see if different types of investment barriers-such as those brought about through regulatory differences between stock exchanges- have a differential impact on cross-listed volatilities. So while there seems to be evidence that segmentation is apparent we do not know whether this is influenced by regulatory differences. The final point of our analysis therefore aims to incorporate regulatory differences between markets to analyse spillover effects for cross-listed firms. This paper takes into account regulatory differences between stock markets to see if these influence the transmission of information (volatility spillovers) for cross-listed European equities.

Overall, the analysis seeks to investigate whether evidence on volatility spillovers from the foreign to the home listings is suggestive of increased or decreased market segmentation.

### III. Data and Methodology

#### 3.1. Data sample

We identify the sample by writing to stock exchanges in *Brussels, and Milan*. We request data on the ‘cross-listing’ dates and the foreign stock exchanges where ‘cross-listing’ had occurred. The exchanges provided information on 9 ‘cross-listings’ for 5 companies; these listings involve the issue of ordinary shares<sup>5</sup> and A and B ordinary shares with restricted voting rights between the years 1987 to 1998.

Cross-listings are also identified from the FT-Extel database in order to identify mergers/de-listings and capital investment changes (such as change of name) through the life of a quoted company. Daily share price information is obtained for all the home and foreign equities in the sample. Table 1 shows the name, nationality and timing of the foreign cross-listing on respective exchanges. Table 2 shows the number of foreign listing per weekday illustrating that most listings occur on Mondays and Fridays.

**Table 1a:** Sample of European Equity Cross-Listings: Name of Company, Date of Listing and Stock Exchanges:

	Foreign		Listings	
LON	ZUR	AMS	GER	
<b>Home Listings</b>				
<b>The Brussels Home Equities</b>				
Electrabel	X(3/3/92)		X(29/9/95)	
Generale Bank	X(13/3/92)		X(10/6/88)	
Petrofina	X(30/9/91)	X(8/10/87)		X(5/10/87)
Solvay	X(3/3/92)			

<sup>5</sup> These are the commonest form of shares, and comprise most of company’s share capital.

**Table 1b:** Sample of European Cross-Listings: Name of Company, Date of Listing and Stock Exchanges:

Foreign Listings	
AU	
Home Listings	
The Milan Home Equities	
Stefanel	X(23/10/89)

Note: The symbol 'X' shows the interlistings of each company on the stock exchanges.

**Table 2:** Number of Listings on overseas stock exchanges per weekday

Stock Exchanges/Weekday	Monday	Tuesday	Wednesday	Thursday	Friday	Total
Brussels	2	2	0	1	3	8
Milan	1	0	0	0	0	1
Total	3	2	0	1	3	9

The return prices for our sample of home cross-listed equities are calculated at time  $t$  as the difference of  $\ln(P_t / P_{t-1})$ , where  $\ln$  is a logarithmic difference of stock prices at their closed value at the end of the trading day. We exclude non-weekend periods for which the returns cannot be calculated due to the absence of frequent quotes. These days are identified by writing to stock exchanges and based on their answers we exclude the data sample for those holiday- days for which no quotes are observed. Also, additional information on holiday-schedules is provided by Datastream records for those years that stock exchanges are not able to provide such data. In addition, we exclude observations around the October 1987 stock market crash October 16<sup>th</sup>, 19<sup>th</sup>, 20<sup>th</sup>, and 21<sup>st</sup> as the inclusion of such information may bias the summary statistics<sup>6</sup>.

Table 3 presents the descriptive statistics for the sample of home equities in each stock exchange. Quantitative variation in returns suggests that the maximum value is 0.00040 (Brussels) and the minimum value is 0.0000055 (Milan). Some positive skewness is present in the series of the returns for home equities in Brussels and Milan stock exchanges. The data suggests stock returns with excessive kurtosis. This preliminary look at the home equities return data gives some indication of stability in the mean, skewness and kurtosis across the sample of equities on the two stock exchanges that are covered in the current paper.

**Table 3:** Descriptive Statistics for Home cross-listed equities

	Mean	St. Dev.	T-Statistic	Skewness	Kurtosis
Brussels	0.00040	0.0094	2.39	0.20	6.86
Milan	0.0000055	0.022	0.013	0.42	3.52

### 3.2. Regulatory Classification

To examine the spillover effects across markets around the time of the foreign listing we also use La Porta et al.'s (1998) regulatory classification to see if these transmission effects vary across stock markets with different regulatory features. In particular, we use the La Porta et al. (1998) classification that distinguishes between stock market regulations covering investor protection rules. Table 4 shows this classification according to our sample. For example, a listed Brussels company that obtains a foreign listing in London+, Amsterdam, Frankfurt+, and Zurich is obtaining cross-listing on four exchanges that (according to La Porta et al.) have laxer investor protection rules. For ease of exposition we use this categorization of stock market rules as a proxy for the regulatory environment. So in our analysis, this enables us to examine the influence of a foreign cross-listing in a tougher, laxer or similar regulatory environment on volatility spillovers to the home market portfolio.

<sup>6</sup> Karolyi (1995) excludes data around these dates in his study of a multivariate GARCH model of international transmission of stock returns and volatility: The case of the United States and Canada.

**Table 4:** Public information that ‘spills over’ from foreign markets to home markets with ‘high’ or ‘low’ or ‘similar’ shareholder protection rules

		Foreign	Markets		
	London+	Amsterdam	Vienna	Frankfurt+	Zurich
Home Market	LOW	LOW	SAME	LOW	LOW
Belgium Italy					

Source: Authors’ own construction defined from La Porta et al. (1998)

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).

### 3.3. Modelling Approach

As in Howe, Madura and Tucker (1993) we examine volatility spillovers from the foreign cross-listed equity (around the listing data) to the home equity. To do this we use a GARCH approach, similar to Li and Engle (1998) but we modify their model to take account of day of the week effects, and asymmetric permanent information (good and bad news). The modelling framework takes into account both permanent and transitory volatility components. The aim is to see whether symmetric temporary spillover effects from the foreign to the home market, around the time of foreign listing, (and controlling for day of the week effects) influences cross-listed companies share price volatility.

For each of the firms in the sample that had an international listing and had multiple shares available, volatility is estimated from day -10 to +10 surrounding the foreign listing day (day 0) (similar to Howe, Madura and Tucker (1993), and Dharan and Ikenberry (1995)).

The model specification used is as follows:

$$R_t = \alpha_0 + \alpha_1 R_{t-1} + \varepsilon_t, \text{ where } \varepsilon_t | \Omega_{t-1} \sim N(0, h_t) \quad (1.3a)$$

The model that we have employed for the first moments of errors in the above equation,  $\varepsilon_t$ , is a martingale process, as the equation (1.3b) shows:

$$\text{where, } E(\varepsilon_t) = E(r_t - \mu_t) \quad (1.3b)$$

$\mu_t$  is the long-term drift coefficient

and

$$h_t = \beta_0 + \beta_1 h_{t-1} + \beta_2 \varepsilon_{t-1}^2 + \beta_3 \varepsilon_{t-1}^2 + \gamma_1 T_{1t} + \gamma_2 T_{2t-1} + \gamma_3 T_{3t+1} + \gamma_4 N_{1t} + \gamma_5 N_{2t-1} + \gamma_6 N_{3t+1} + \gamma_7 P_{1t} + \gamma_8 P_{2t-1} + \gamma_9 P_{3t+1} + \gamma_{10} E_{1t} + \gamma_{11} E_{2t-1} + \gamma_{12} E_{3t+1} \quad (1.4)$$

where  $\Omega_{t-1}$  represents the information set available at the end of day t-1.  $\beta_1$  and  $\beta_2$  are the coefficients for bad and good permanent noise variables respectively.  $T_{1t}$ ,  $N_{1t}$ ,  $P_{1t}$ , and  $E_{1t}$  denote the dummy variables for day-of-the-week-cross-listing effects on Monday, Tuesday, Wednesday or Thursday, and Friday respectively.  $T_{2t-1}$ ,  $N_{2t-1}$ ,  $P_{2t-1}$ , and  $E_{2t-1}$  indicate dummy variables for the day-of-the-week-pre-cross-listing drift effects on Monday, Tuesday, Wednesday or Thursday, and Friday, while  $T_{2t+1}$ ,  $N_{2t+1}$ ,

$P_{2t+1}$ , and  $E_{2t+1}$  represent dummy variables for day-of-the-week-post-cross-listing drift effects on Monday, Tuesday, Wednesday or Thursday, and Friday respectively.

## **IV. Empirical Results**

### **4.1. Spillovers, Home Equity cross-listings and the Regulatory Environment**

This section reports the findings of our analysis that examines the influence of the foreign listing on the portfolios of home cross-listed equities in the respective markets. In particular, we focus on home cross-listed equities in the Brussels, and Milan markets. Recalling the methodology outlined above, we identify the influence of the foreign listing on portfolios of home cross-listed equities taking into account day-of-the-week-effects, asymmetric permanent information and differences in regulations (shareholder protection) across stock markets.

### **4.2. Symmetric temporary spillover effects from foreign listings to the Brussels, and Milan home equity portfolios taking into account differences in investor protection rules**

This part reports the temporary spillover effects arising from foreign listings to the two French style markets with respect to different regulatory environments. We, therefore here, analyze the impact of temporary spillovers on the volatility of home equity portfolio in pre-listing and post-listing period for Brussels, and Milan markets.

Table 5 (panel A) refers to the temporary spillover effects that arise from foreign listings to the Brussels home portfolio of equities. In particular, panel A (left column) reports the results relating to spillover effects from foreign listings on markets where there are laxer onerous investor protection rules and panel A (right column) reports the estimates in relation to similar investor protection rules.

**Table 5:** Symmetric temporary spillover effects from foreign listings to the French-style (Brussels, Milan,) home equity portfolios taking into account differences in regulatory regimes

Lax Shareholder Protection Rules		Similar Shareholder Protection Rules		
<b>Panel A: The Brussels stock market</b>				
Past Volatility of one lag	0.73* (0.01)		NA	
<b>Permanent noise</b>				
Bad News	0.08* (0.02)		NA	
Good News	0.10* (0.02)		NA	
<b>Temporary noise</b>				
Monday	0.54* (0.19)		NA	
Pre-Monday	-0.17 (0.10)		NA	
Post-Monday	-0.30* (0.15)		NA	
Tuesday	0.10 (0.22)		NA	
Pre-Tuesday	0.01 (0.22)		NA	
Post-Tuesday	-0.08 (0.11)		NA	
Thursday	-0.70 (0.52)		NA	
Pre-Thursday	-0.16 (0.13)		NA	
Post-Thursday	0.93* (0.47)		NA	
Friday	0.31* (0.11)		NA	
Pre-Friday	-0.19* (0.08)		NA	
Post-Friday	0.09 (0.10)		NA	
Log-Likelihood	13253.60		NA	
<b>Panel B: The Milan stock market</b>				
Past Volatility of one lag	0.90* (0.002)		0.90* (0.002)	
<b>Permanent noise</b>				
Bad News	NA		0.16* (0.009)	
Good News	NA		0.11* (0.006)	
<b>Temporary noise</b>				
Monday	NA		-1.66 (1.46)	
Pre-Monday	NA		-0.26* (0.02)	
Post-Monday	NA		1.85 (1.47)	
Log-Likelihood	NA		10775.68	

Note: (i) \* statistically significant at the 5 percent level.  
(ii) NA means not available.

Table 5 (panel A) reports the spillover coefficients with respect to the impact of temporary information transfer on the volatility of the Brussels home portfolio of cross-listed equities. Panel A indicates a significant impact on Monday's listing and post-listing period in Brussels stock exchange from foreign listings with 0.54 and  $-0.30$  values, respectively. A comparison of the above two values reveals a decreasing impact from a foreign listing on the spillover coefficient in the Monday's post-listing period that is equal to 0.24.

In addition, we find significant information transmission to the Brussels home market from foreign listing in the Thursday's post-listing period with a value of 0.93. This means that changes in trading noise from the foreign listing results in substantial information transmission (in terms of both magnitude and persistence) to the Brussels market. Other results indicate significant information transmission from foreign listing in the Brussels home portfolio of cross-listed equities in the Friday's listing and pre-listing period. We also find bad and good news, as well the previous period's volatility, impact on the following's period volatility in the Brussels portfolio of cross-listed equities.

Panel B of the table 5 reports the temporary spillover effects in the Milan portfolio of home cross-listed equities in relation to the foreign listings in similar regulatory environments. The temporary spillover coefficients show that there are (spillover) effects from the foreign markets to the Milan home portfolio equities in the Monday's pre-listing period ( $-0.26$ ). In addition, there is an impact from permanent bad and good news and previous period's volatility on the following period's volatility.

To sum up, the results for both Brussels and Milan indicate that spillovers arising from foreign listings may have differential impact on the home portfolios of cross-listed equities listed in markets with different regulatory environments. In addition, we find that the spillover effects in two French style markets differ in magnitude around listing. Also, news persistence is found to change sign at the time of listing and in the pre-listing and post-listing periods suggesting evidence of market segmentation.

## V. Conclusions and Summary of the results

This paper examines the impact of cross-listing on stock price volatility in specific European markets. The analysis also takes into account the influence of different regulatory structures across the markets where firms are cross-listed. In particular, we use La Porta et al.'s (1998) broad stock market regulatory classification to analyse the magnitude and persistence of volatility spillovers from the foreign listing to the home equity of cross-listed companies in the Brussels, and Milan markets. The symmetric temporary spillover effects seek to examine whether the day of listing has an impact on the magnitude and persistence of volatility spillovers. We also seek to examine whether the pre and or post-listing period has an impact on symmetric volatility spillover from the foreign to the home equity portfolios.

If one considers all the results it can be seen that spillover effects appear to be more common from foreign listings on exchanges with laxer onerous regulations. Volatility transmissions from foreign listing in lax regulatory environments appear to be more important in the case of spillovers to home equities in the case of Brussels cross-listed equities. With regard to foreign listing days it appears that Monday spillovers are the most prevalent, followed by Friday.

From a general perspective results also clearly indicate that volatility transmission can vary across different regulatory environments and for various listing dates. In addition, symmetric information effects are also likely to be important in influencing volatility spillovers between markets.

**References**

- [1] Admati, A., and P. Pfleiderer, 1988, A theory of intraday patterns: Volume and price variability, *Review of Financial Studies*, Vol. 1:3-40.
- [2] Ahearne, A., W. Grier, and F. Warnock, 2002, Information costs and home bias: an analysis of U.S. holdings of foreign equities, working paper.
- [3] Alexander, G., C. Eun, and S. Janakiraman, 1988, International listings and stock returns: Some empirical evidence, *Journal of Financial and Quantitative Analysis*, 135-151.
- [4] Barclay, M. J., R. H. Lizenberger, and J. B. Warner, 1990, Private information, trading volume, and stock-return variances, *Review of Financial Studies*, Vol. 3: 233-253.
- [5] Black, F., 1974, International capital market equilibrium with investment barriers, *Journal of Financial Economics*, 1: 337-352.
- [6] Bollerslev, T., 1986, Generalized autoregressive conditional heteroscedasticity, *Journal of Econometrics*, Vol. 31: 307-27.
- [7] Chowdhry, B., and V. Nanda, 1991, Multimarket trading and market liquidity, *Review of Financial Studies*, Vol. 4: 483-511.
- [8] Dharan, B. G., and D. L. Ikenberry, 1995, The long-run negative drift of post-listing stock returns, *The Journal of Finance* Vol. L (5): 1547-1574.
- [9] Engle, R. F., 1982, Autoregressive conditional heteroscedasticity with estimates of the variance of U.K. inflation, *Econometrica*, Vol. 50: 987-1008.
- [10] Fuerst, O., 1998, A theoretical analysis of the investor protection regulations argument for global listing of stocks, working paper, Yale University.
- [11] Freedman, R., 1989, A theory of the impact of international cross-listing, Working Paper, Stanford University, Stanford, California.
- [12] French, K. R., and R. Roll, 1986, Stock return variances, The arrival of information and the reaction of traders, *Journal of Financial Economics*, Vol. 17: 5-26.
- [13] Harvey, C. R., and R.D. Huang, 1991, Volatility in the foreign currency futures market, *Review of Financial Studies*, Vol. 4, Fall: 543-569.
- [14] Howe, J. S., and J. Madura, 1990, The impact of international listings on risk: Implications for capital market integration, *Journal of Banking and Finance*, Vol. 14: 1133-1142.
- [15] -----, J. S., J. Madura, and A. Tucker, 1993, International listings and risk, *Journal of International Money and Finance*, Vol. 12: 99-110.
- [16] Hwang, C.Y., and Jayaraman, 1993, The post-listing puzzle: Evidence from Tokyo Stock Exchange listings, *Pacific-Basin Finance Journal*, Vol. 1: 111-126.
- [17] Karolyi, G. 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: 11-25.
- [18] Kim, D., and J. Suh, 2001, Foreign shares and ownership puzzle, working paper, Chung-Ang University.
- [19] Kyle, A. S., 1985, Continuous auctions and insider trading, *Econometrica*, Vol. 53, No. 6, November: 1315-1334.
- [20] La Porta, R., F. L. De Silanes, A. Shleifer, and R. W. Vishny, 1998, Law and Finance, *Journal of Political Economy*, Vol. 106, No. 6, 1113 – 1155.
- [21] Lehman, B., 1990, Fads, martingales, and market efficiency, *Quarterly journal of Economics*, Vol. 105, February: 1-28.
- [22] Li, Li, and R. Engle, 1998, Macroeconomic announcements and volatility of treasury futures, University of California, San Diego, Discussion Paper 98-27.
- [23] Lo, A.W., and A. C. McKinlay, 1988, Stock market prices do not follow random walks: Evidence from a simple specification test, *Review of Financial Studies*, Vol. 3, Spring: 175-206.

- [24] Merjos, A., 1963, Like money in the bank: Big board listing, the record suggests, is a valuable asset, *Barron's*, Vol. 8, No. 9, July.
- [25] Pindyck, R. S., 1986, Risk aversion and determinants of stock market behavior, NBER Working Paper No. 1921.
- [26] Poterba, J.M., and L.H. Summers, 1988, Mean reversion in stock prices: Evidence and Implications, *Journal of Financial Economics*, Vol. 22: 27-60.
- [27] Reese, W., and M. Weisbach, 2002, Protection of minority shareholder interests, cross-listings in the United States, and subsequent equity offerings, forthcoming, *Journal of Financial Economics*.
- [28] Shleifer, A., and D. Wolfenzon, 2002, Investor protection and equity markets, forthcoming, *Journal of Financial Economics*.
- [29] Stapleton, R. C., and M. G. Subrahmanyam, 1977, Market imperfections, capital market equilibrium and corporate finance, *The Journal of Finance*, Vol. XXXII, No. 2, 307-319.
- [30] Stulz, R. M., 1999, Globalization of equity markets and the cost of capital, The Ohio State University, Paper prepared for the SBF/NYSE Conference on Global Equity Markets.
- [31] Ule, M. G., 1937, Price movements of newly listed common stocks, *Journal of Business*, Vol. 10: 346-369.
- [32] Van Horne, J. C., 1970, New listings and their price behavior, *Journal of Finance*, Vol. 25: 783-794.