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<u>計畫主持人:</u>蘇永成

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Direct and Indirect Barriers in International Cross-listings

Yong-chern Su

Department of Finance College of Management National Taiwan University Email: <u>ycsu@ccms.ntu.edu.tw</u> Address: 50 Lane 144 Sec. 4 Keelung Road, Taipei, Taiwan Fax: 011-8862-23637714

Abstract

In this study, we employed a time-varying GARCH model to examine direct and indirect barriers between Taiwan and the United States markets. We find that the volatility spillover effects are significant, especially in the direction of stocks to ADRs. The results indicated that the indirect barriers indeed exist between Taiwanese and the U.S. markets. We attribute indirect barriers to the different accounting standards, different level of corporate government, different level of liquidity, different level of information availability, and the business overlap. The finding is consistent with the finding of Miller (1999). However, we find that Taiwanese stocks are price leaders instead of ADR. We attribute the reason to the liquidity and availability of information of stocks in Taiwan. This is a contradiction of Domowitz, Glen, and Madhavan (1998). They argue that "From the viewpoint of domestic market-makers, there is a positive probability that the price in the foreign market reflects more recent information. This is especially so when trading activity in the ADR market greatly exceeds that of the domestic market so that price discovery essentially takes place abroad.

International capital raising has been a recent trend for global companies. On the other hand, the issue of market integration or segmentation is central to the international finance literature for decades. If international capital markets are integrated, we expected the same cost of capital without regarding to the raising sources. However, most of the previous studies support market segmentation, e.g. Foerster and Karolyi (1993) argue that although many markets with similar culture, business practices and important economics ties, there are still some degree of segmentation.

There is a common belief in financial literature that there is a variety of investment barriers among international capital market. Miller (1999) defines two types of barriers, direct barriers (e.g., legal regulation, such as ownership restrictions, different tax regimes, or government-imposed restrictions on foreign exchange and capital) and indirect barriers (e.g., accounting standards, liquidity risk, and information asymmetry or investor recognition). These barriers put international capital markets into segmentation and investors in different countries face different opportunity sets of domestic and foreign securities. Investors who trade in segmented markets spend more on transaction and information costs than those who trade in integrated markets. Therefore, the idea of dual listing comes in. Dual listings mitigate these barriers and make it possible to flow capital among markets.

Taiwanese companies have been taking advantage of international capital raising through Deposit Receipts since 1992. There have been six Taiwanese firms issuing ADR up to now. Under the "law of one price" principle, the prices of Depositary Receipts and their underlying shares should be the same, not only are they issued by the same company but also the same right and obligation they represent. They should have the same response to a random shock. Many researches find that the average prices of Depositary Receipts are usually higher than those of their underlying shares. The empirical results support the existence of direct or indirect barriers between markets. However, previous studies have not yet considered these issues about which direct or indirect barriers emerge between markets, and how serious the direct or indirect barriers influence the speed and the degree of return and volatility transmissions.

The major purpose of this study is as follow. First, we want to examine the equity markets integration between the U.S. and Taiwan in firm level. Our empirical findings suggest market segmentation between the U.S. and Taiwan exists, which is consistent with most of previous literatures. Secondly, we explore the integration between the U.S. and Taiwan, in firm level. The interesting finding is that underlying stock is the price leaders in the relation of ADR. It implies that the information availability dominances large market leading small market effect, which is a contradiction of Domowitz, Glen, and Madhavan (1998). They argue that "From the viewpoint of domestic marketmakers, there is a positive probability that the price in the foreign market reflects more recent information. This is especially so when trading activity in the ADR market greatly exceeds that of the domestic market so that price discovery essentially takes place abroad." Finally, we intend to measure the contagion effect by direct and indirect barriers through a time-varying GARCH (1, 1)-MA (1) model. We document that both direct and indirect barriers indeed exist between the United States and Taiwan, which partially support Miller (1998)'s findings that the indirect barriers in the emerging markets are significant, but the direct barriers in these markets are insignificant.

The rest of this paper is organized as follows. Sec. I is literature review. Data and methodology are presented in section II. Sec III elaborates empirical findings of indirect and direct barriers. We also discuss market integration and segmentation in this section. Section IV concludes.

I. Literature Review

ADR was developed by JP Morgan in 1927. U.S. depositary banks hold the overseas securities in custody in the country of origin and convert all dividends and other payments into U.S. dollars to receipt holders in the United States. Investors, therefore, bear all currency risk and indirectly pay fees to the depositary bank. Each depositary receipt denotes shares that represent a specific number of underlying shares in the home market, and new receipt can be created by the bank for investors when the requisite number of shares is deposited in their custodial account in the home market. Cancellation or redemption of ADRs simply reverses the process. As of 2002, about 1300 non-U.S. companies have listed their shares for trading on the New York Stock Exchange (NYSE), the American Exchange (AMEX), the National Association of Securities Dealers' Automation Quotation (NASDAQ) system, or over-the-counter (OTC), which represents a seventy five percent increase since 1991. There have been forty three Taiwanese Depositary Receipts issued, among them six are ADRs and the others are GDRs.

There have been tons of ADR papers in financial literatures. Alexander et al. (1988), Forester and Karolyi (1993), Booth and Johnston (1984), Jorion and Schwartz (1986), Mittoo (1992), and Karolyi (1992) have directly or indirectly empirically examined the extent of integration within the North American markets. Most of these studies surprisingly found the evidence of segmentation over the early 1980s.

Foerster and Karolyi (1993) studied whether the extent of economic and financial market integration (or segmentation) between a firm's home country and its

listing country would influence stock prices' reactions by examining the case of two similar countries: the U.S. and Canada. They conclude that the financial markets between U.S. and Canadian are segmented and industry-related factors may affect the degree of segmentation. But they support Booth's (1987) explanation that the different segmenting effect was because of the different tax policies which implemented on the different industries.

Domowitz, Glen, Madhavan (1998) explored the Mexican stock market, and they found the impact of cross-listing is complex-balancing the cost of order migration against the benefits of increased inter-market competition. These effects are exacerbated by equity investment barriers that induce segmentation of equity markets. Consequently, the benefits and costs of cross-listing are not evenly over all classes of shareholders.

Foerster and Karolyi (1999) studied further the stock price performance and the changes in risk exposure associated with the cross-listing of non-U.S. stocks on U.S. markets. They concluded that their evidence generally consistent with the market segmentation hypothesis and Merton's (1987) investor recognition hypothesis.

How to measure the process of market integration? How to test the equilibrium models of risk sharing? How to measure the growth affects of market integration? A prerequisite to these questions is the date that a market becomes integrated. One of the potential solutions to this problem is to specify a tightly parameterized model of the process of dynamic integration. For example, Bekaert and Harvey (1995) used a regime-switching framework to model gradual changes in market integration. However, these models are different to specify and are often statistically rejected. Another alternative approach is proposed by Bai et al. (1998) to find endogenous

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break points for the VAR parameters. He did not take a stand on an asset pricing model, but simply assumed that the variables before and after market integration follows a stationary process that was well described by a vector autoregression (VAR). Bekaert, Harvey, Lumsdaine (2001) adopted the methodology which was developed in Bai et al. (1998). Hamao, Masulis, and Victor Ng (1990) studied the short-term relations among security prices across three major stock markets: Tokyo, London, and New York. They found that unexpected changes in foreign market indices are associated with significant spillover effects on the conditional mean of the domestic market for both open-to-close and close-to-open returns.

Miller (1999) argue that barriers are due to government-imposed restrictions on foreign exchange and capital, legal barriers such as ownership restrictions, different tax regimes and indirect barriers due to differences in information access to foreign securities. He documented that the influence of indirect barriers is stronger in emerging markets given that emerging economies typically have less liquidity, less investor recognition, and fewer disclosure requirements than developed markets. However, we find that direct barriers did not impact returns significantly in Miller's setting. He explained the different outcomes of direct and indirect barriers with two possible explanations. One explanation is that indirect barriers are the dominant factor in segmented markets. An alternative explanation is that the proxy for direct barriers in his study is misspecified. Moreover, he also found that the increase in DR programs has been particularly large among firms in emerging markets, where direct and indirect barriers to capital flows can be most acute.

Forbes and Rigobon (2002) tested if contagion exists after correcting the bias arises from heteroskedasticity. However, they found that contagion only exists under the conditional correlation coefficient. But when this unconditional correlation is used in the tests for contagion, there is virtually no evidence of a significant increase in cross-contagion, there is virtually any evidence of a significant increase in cross-market correlation coefficients during the 1997 East Asian crisis, 1994 Mexican peso devaluation, and 1987 U.S. stock market crash. These results can be interpreted as evidence that there was no contagion during these three periods.

Generally speaking, most studies inferred that the international stock markets are segmented not integrated. Simultaneously, some studies arrived at the conclusion that there is a tendency of moving from segmentation to integration. Furthermore, these models predicted that cross-listing shares between two segmented markets lead to a higher equilibrium market price for a given stock and lower expected return.

Cross-listing could let a firm access to more investors. Furthermore, access to more investors could lead to higher volume, and there could be exchange-specific reasons why transaction costs might be lower in the US than in the home country. A decrease in transaction costs just is another channel through which a cross-listing might decrease a firm's cost of capital. Tinic and West (1974), Foerster and Karolyi (1998), Domowitz et al. (1998), and Smith and Sofianos (1997) all examined the effect of cross-listing in the US on the costs of transacting a particular securities. These papers generally found that spreads decrease and trading volume increases following a cross-listing, both of which will likely reflect an increase in liquidity.

In the model of Cantale (1997) and Fuerst (1998), stock prices rise when firms list on exchanges with higher disclosure standards. The idea is that cross listing commits managers to a policy of better disclosure and hence reduces managers' expected future private benefits. The empirical results of Moel (1999), Huddart et al. (1999), and Pagano et al. (2001) were also consistent with a model in which firms' cross-list as a way of bonding themselves to subsequent information releases.

Domowitz, Glen, and Madhavan (1998) brought up three levels of transparency and the effect of order flow after cross-listing, and we summarize them as follows. If two markets were integrated, information on prices and quotes in both markets would be freely available at all times because of the perfect quotation transparency. In this case, cross-listing will induce investors who would not enter the domestic market for the reason that they face higher entry cost before cross-listing to gather information and enter the foreign market after cross-listing. With more investors participating the trading, more efficient aggregation of investor beliefs occurs and more analysts who gather additional information entry. At last, cross-listing improves the quality of both markets in the condition of market integration. Moreover, order flow after cross-listing in this case has no economic impact on security prices because that the geographic distribution of trading volume is irrelevant with the prices of securities.

Fragmentation is opposite to market segmentation, that is, markets are not informationally linked. In this case, there would be fewer participants in domestic market if it's cheaper to trade in the foreign country and the diversion of order flow abroad results in less efficient prices and lower market quality in the domestic market. At the same time, the decrease in trading intensity should increase spreads and volatility in the domestic market. Therefore, order flow will lower the quality of the domestic market in this case.

This study is focus on direct and indirect barriers effects on return and volatility transmissions. We put capital inflow and outflow between markets into short term return transmission because of market efficiency. However, accounting standards or financial systems changes represent long term shocks which are persistent.

II. Data and Methodology

We examine information transmissions between ADR and underlying stock in the U.S. and Taiwan from January 1, 2002 through December 31, 2002. We have six ADRs and one TDR. They are Taiwan Semiconductor Manufacturing Company Ltd(TSMC), United Micro Corporation(UMC), Advanced Semiconductor Engineering Inc.(ASE), Macronix International Co.,(MI), Siliconware Precision Industries(SPI), AU Optronics Corp.(AUO), and ASE TEST Ltd. The data used in this study were obtained from Yahoo and the Taiwan Economic Journal (TEJ) database. We handle non-synchronous trading in consistent with Hamao, Masulis and Ng (1990). In order to study the effect of direct and indirect barrier on stock return, we employ GARCH (1,1)-MA (1) model.

Model - Volatility Spillover Model:

$$R_{t} = \alpha - MA \times \varepsilon_{t-1} + \varepsilon_{t}$$
$$h_{t} = A + Bh_{t-1} + C\varepsilon_{t-1} + SX_{t-1}$$

where, R_t : the daily returns of a market in period t,

h_t: the conditional variance in period t,
h_t-1: the conditional variance in period t-1
X_{t-1}: the square residuals jointly estimated from a GARCH (1, 1)-MA (1) of another market in period t-1

α, MA, A, B, C and S are coefficients

Model is designed to study volatility spillover. They are mostly from indirect barriers, such as accounting or financial systems.

Model - Mean Spillover Model:

$$R_{t} = \alpha - MA \times \varepsilon_{t-1} + \varepsilon_{t} + \phi Y_{t-1}$$

 $h_t = A + Bh_{t-1} + C\varepsilon_{t-1}^2$

where, R_t : the daily returns of a market in period t,

 h_t : the conditional variance in period t,

- h_{t-1} : the conditional variance in period t-1
- Y_{t-1} : residuals jointly estimated from a GARCH (1, 1)-MA (1) of another market in period t-1

 α , MA, A, B, C and φ are coefficients

Model examines the mean spillover. They are mostly from direct barriers, such as control of cash-flows in or out.

III. Empirical Results

3.1 Indirect Barriers

We find that the volatility spillovers are significant in most cases when we investigate effects from stocks to ADRs. However, the volatility spillover effects from ADRs to stocks are insignificant. When we examine returns of ADRs to stocks, we could not reject the null hypothesis of indirect barriers. On the other way, when we examine stocks on ADRs, we reject the null. Basically, we support Miller's argument that the indirect barriers exist between countries. Then, we dig out the reason why different results about the two way volatility spillover. We generalize several indirect barriers between Taiwan and U.S. equity markets as follows.

(1) Different Accounting Standards

The U.S. set a higher accounting standard than Taiwan does. This difference in accounting standards of Taiwan and U.S. makes Taiwanese companies, such as TSMC face two different accounting standards. Changes of the U.S. accounting standards have impacts on returns and volatility of underlying stocks in Taiwan. Our empirical study isolates the systematic risk of U.S. market by taking ADRs residuals. The impact of accounting standard, i.e. indirect barriers on underlying stocks in Taiwan is measured by coefficients of mean and volatility equations in our GARCH models. We find that standards changes play a role in long memory volatility spillovers.

(2) Different Level of Corporate Governance

Corporate governance has been a popular issue since Enron and WorldCom scandals. The CEO of Taiwan Semiconductor Manufacturing Company Ltd. had mentioned that the boards of directors, usually the family members or close friends, in Taiwan are merely meretricious. The protection of minority shareholders is weaker in Taiwan than that in the United States. Reeze and Weisbach(2002) have the pioneer study on corporate governance and cross-listing. However, after the enforcement of independent direct system, Taiwan Semiconductor Manufacturing Company Ltd. invited three outstanding independent directs, including Lester Carl Thurow, Michael E. Porter and Peter Leahy Bonfeild. We argue that different level of corporate governance explain long memory volatility spillovers between ADR and stock.

(2) Different Level of Liquidity

NYSE or NASDAQ is more liquid than Taiwan Stock Exchange in terms of trading volume and recognition of international investors. Financial theory predicts that a liquid market has a better price discovery ability. The more participants in market, the more liquid the market is. Therefore, we have a priori that volatility spillover from the ADR to stock is significant. However, what surprises us is that volatility spillover is more significant from the stock to ADR. We contribute the reason to the higher trading volume of stock in Taiwan than those in ADR. We document an idiosyncratic stock dominance in stock and ADR relation. Our empirical findings suggest that volatility spillover effects from stocks to their ADRs are stronger than those of the reverse direction because of the larger trading volume of individual stock.

(4) Information Availability

If the indirect barriers indeed existed between the Taiwan and the U.S. stock markets, the information availability of these samples except the TDR would be easier and cheaper in Taiwan than in the United States. As we expected, the volatility spillover effects from the returns of Taiwanese underlying stocks to ADRs are significant. It also explains why the volatility spillover effects from most stocks to their ADRs are much more significant than those of the reverse direction. It also implies that stocks are the price discover. This is a contradiction of Domowitz, Glen, and Madhavan (1998). They argue that "From the viewpoint of domestic market-makers, there is a positive probability that the price in the foreign market reflects more recent information. This is especially so when trading activity in the ADR market greatly exceeds that of the domestic market so that price discovery essentially takes place abroad."

(3) Business Overlap (Level of Liquidity)

Because of capital budgeting and diversification purposes, we expect that if two

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stocks were in the same industry, then investors would invest one of them or invest both with one less. On the other hand, we recognize that larger corporations have the advantage in selection process. Our empirical findings support that only Macronix International Co., Ltd. and AU Optronics Corp. are independent investing targets. We find that only the test of Macronix International Co., Ltd. is significant in the direction of ADRs to stocks. We conclude that business overlap is one of the possible explanations.

We summarize several interesting findings in our indirect barriers investigation. First, these t-values of β are significant in our tests of volatility spillover effects. The outcome is consistent with many previous studies which indicated that stock series are conditionally heteroskedastic. Therefore, our study approves that stock price of T period is highly correlated with the price of T-1 period. Secondly, the strong evidence of the existence of indirect barriers which is consistent with the conclusion of Darius P. Miller (1998). Third, we can derive from the different degree of the volatility spillover effects between stocks to ADRs and the reverse direction. It implies that stock is the informational leader instead of ADR.

3.2 Direct Barriers

We find that the mean spillover effects are significant in both directions. It implies that the direct barriers indeed exist between Taiwan and U.S. markets. We listed the following reasons.

(1) Law concerning about QFII or GFII and the upper limit of Foreign Investments in Taiwan

We summarized a brief table about the history which Taiwan opened capital

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market to the foreigners in Table 3-3. We conclude that capital inflows are restricted in Taiwan. Restrictions on capital flows play a role in short term return transmission because of market efficiency.

(2) Different Tax Regimes (Industry Effect)

Taiwanese companies which issued American Depositary Receipts are endowed with favorable tax rates. According to section five of Hi-tech Strategic Industry Subsidy Regulation, IC and TFT-LCD are among them. According Foerster and Karolyi (1993) and Booth's (1987), segmenting effect was because of the different tax policies on different industries.

(3) Foreign Exchange Regulations

Taiwan Central Bank had abandoned the Appointed Banks Foreign Exchange Trade Regulation since 1989. Individuals and corporation have upper limits of US\$5 million dollar and US\$50 million dollar, respectively. We believe that capital flows are restricted in some way. The limits are expected to be eliminated in the future.

3.3 Integration or Segmentation

Our empirical findings support that Taiwan and U.S. stock markets are segmented instead of integration. We attribute the segmentation to direct and indirect barriers discussed above. Furthermore, we examine spillover of U.S market to Taiwanese stocks. Among our samples, the ADRs of TSMC, UMC, ASE and AUO are listed on NYSE and the remainders are traded on NASDAQ. Therefore, we use the NYSE composite to investigate spillover of U.S market to TSMC, UMC, ASE and AUO and use NASDAQ 100 to examine the remainders. We found that most of volatility spillover effects are insignificant except TSMC and UMC, while on the mean spillover, all are significant. It indicates that the surprised shock of U.S. market indeed affect stock in Taiwan. According to the hypotheses of liquidity and investor recognition, we expect volatility spillover effect from the ADR to stock is significant. However, we found that the volatility spillover effects are only significant in TSMC and UMC. The possible explanation is that TSMC and UMC are the most wide-held Taiwanese ADRs in the United States.

IV. Conclusion

In this study, we found that the volatility spillover effects are significant, especially in the direction of stocks to ADRs. The results indicated that the indirect barriers indeed exist between Taiwanese and American markets. We attribute indirect barriers between Taiwan and the U.S. market to the different accounting standards, different level of corporate government, different level of liquidity, different level of information availability, and the business overlap. The finding is consistent with the finding of Miller (1999). However, we found that Taiwanese stocks are price leaders instead of ADR. We attribute the reason to the liquidity and availability of information of stocks in Taiwan. This is a contradiction of Domowitz, Glen, and Madhavan (1998). They argue that "From the viewpoint of domestic market-makers, there is a positive probability that the price in the foreign market reflects more recent information. This is especially so when trading activity in the ADR market greatly exceeds that of the domestic market so that price discovery essentially takes place abroad."

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Company	Taiwan Semiconductor Manufacturing Company Ltd.	UMC	Advanced Semiconductor Engineering Inc.	AU Optronics Corp.	Macronix International Co., Ltd.	Siliconware Precision Industries Ltd.	ASE TEST Ltd.
Stock Code(T)	2330	2303	2311	2409	2337	2325	9101
Stock Code(U)	TSM	USM	ASX	AUO	MXICY	SPIL	ASTSF
ADRs' Listing market	NYSE	NYSE	NYSE	NYSE	NASDAQ	NASDAQ	NASDAQ
Average trading volume (Taiwan) (Unit: thousand)	48,666	70,390	22,636	55,504	89,288	34,730	18,277
Average trading volume (U.S.)	5,647,102	3,321,645	101,058	51,364	698,679	318,667	392,772
Issuing date of ADR	1997.10	2000.9	2000.10	2002.5	1996.5	2000.7	1998.1
Outstanding Shares(Unit: thousand)	16,832,554	13,335,695	3,254,800	2,970,582	3,691,277	1,885,174	
Number of shareholders	349,869	743,493	249,573	4,772	392,461	91,399	
Transfer number	5	5	5	10	10	5	80
Number of shares owned by QFII	5,118,297	2,917,936	913,558.4	151,230.6	282,151.8	545,304.6	79579.19
Number of shares owned by foreigners	8,810,311	5,351,546	1,527,196	169879.6	297,519.5	727,239	79579.19

Table 1.1 Sample basic statistics

Table 3.1 Estimates of Volatility Spillover

 $R_t = \alpha - MA \times \varepsilon_{t-1} + \varepsilon_t$, $h_t = A + Bh_{t-1} + C\varepsilon_{t-1} + SX_{t-1}$, where, R_t : the daily returns of a market in period t, h_t : the conditional variance of returns in period t, h_t -1: the conditional variance in period t-1, X_{t-1} : the square residuals jointly estimated from a GARCH (1, 1)-MA (1) of another market in period t-1, α , MA, A, B, C and S: the coefficients

	脉	Α	В	MA	С	SPILL	Log L	Ratio	AIG
	-6.2458	4.89E-06	0.965144	0.145218	0.03486	0.22396	-944.66	**4754	1901.321
ISM页ADR	**(-9.704)	(0.002)	**(2765.9)	(1.766)	**(8.799)	**(8.549)			
	-2.4746	1.434E-05	0.457951	0.960812	0.540663	0.004407	-3285.362	**5248	6582.7234
ADR贪TSM	**(-4.044)	(0.003)	(0.477)	**(76.09)	(0.744)	(0.387)			
	-0.68816	0.0000003	0.837992	-0.0693	0.16196	0.35489	-2317.859	**5975.206	4647.7179
NYSE→TSM	**(-5.217)	(0.005)	**(35.613)	(-1.239)	**(5.221)	**(9.422)			
	-0.674172	5.98175	0.369955	0.0644	0.3549	0.01446	-732.0962	**732.096	1476.1924
UMC员ADR	*(-2.446)	*(2.234)	*(2.589)	(0.707)	**(4.851)	(0.686)			
	-0.466385	1.05199	0.8345	0.02511	0.05669	0.008675	-655.5369	**16254.3	1323.0738
ADR贪UMC	*(-2.125)	(0.924)	**(5.165)	(0.329)	(0.955)	*(1.979)			
	-0.94476	0.0000033	0.84363	0.0377751	0.155963	0.415207	-3397.691	**9395.193	6807.3826
NYSE→UMC	**(-6.671)	(0.037)	**(31.917)	(0.71)	**(4.581)	**(10.279))		
	-0.62576	2.12679	0.792095	0.075497	0.0827872	0.0358848	-729.1176	**9179.588	1470.2352
ASX贡SDR	(-1.956)	(1.188)	**(6.204)	(1.099)	(1.852)	*(2.089)			
	-0.386714	2.8E-08	0.917649	-0.18126	0.08235	0.032755	-927.267	**6604.547	1866.534
ADK页ASX	(-1.071)	(0)	**(5213.81)	**(-3.754)	**(11.661)	**(5.263)			
	-0.37241	0.87115	0.87624	-0.09216	0.04975	0.10194	-683.776	**2271.607	1379.552
NYSE→ASX	(-1.353)	(0.654)	**(5.872)	(-1.39)	(0.969)	(1.463)			
	-2.74991	0	0.816984	-0.020837	0.183016	0.0766095	-509.065	**220.834	1030.13
AUO ADR	**(-9.016)	(0)	**(152.46)	(-0.384)	(6.972)	**(7.933)			
	-1.29487	0	0.893043	-0.03828	0.106959	0.01017	-450.263	**1035.11	912.52758
ADK贞AUU	**(-5.652)	(0)	**(592.059)	(-0.539)	**(7.427)	(1.397)			

	-0.6690	0.3338	0.84859	0.02744	0.15114	-0.04682	-482.6839	**2829.405	977.36675
NYSE→AUO	(-1.561)	(0.927)	**(65.272)	(0.244)	**(11.553)	(-0.482)			
	-5.26578	0.00002	0.90714	-0.473	0.031	0.114837	-829.8611	**1174.32	1671.72
MXICY ADR	**(-10.16)	(0.001)	**(956.62)	**(-9.28)	*(2.146)	**(6.37)			
	-0.16869	0.0913	0.9925	-0.2087	0	-0.01059	-682.833	**20207.55	1377.67
ADR資MXICY	(-0.582)	(0.06)	**(7.449)	**(-3.28)	(0)	**(-2.631)	I		
NASDAQ贪MXICY	-0.59924	0.00002	0.94394	-0.1684	0.05595	-0.01196	-728.986	**4129.376	1469.972
	(-3.63)	(0.021)	**(87.657)	**(-4.347)	(0.127)	(-0.424)			
	0.36914	0	0.935006	0.05089	0.064995	-0.02805	-853.4401	**15595	1718.88
SPIL贡ADK	(1.613)	(0.001)	**(5032.39)	(1.088)	**(15.002)	**(-3.122)	I		
	-0.39226	1.4864	0.84921	-0.12601	0.04376	0.00806	-688.326	**24645.43	1388.6523
ADR資SPIL	(-1.371)	(0.433)	**(2.941)	(-1.874)	(0.653)	(1.364)			
	-0.51196	0	0.8935	-0.06965	0.10653	-0.0193	-778.9718	**9667.696	1569.944
NASDAQ→SPIL	*(-2.02)	(0)	**(682.721)	(-1.151)	**(9.277)	(-0.659)			
	-1.648	6.84E-07	0.832194	0.060975	0.167764	0.041995	-1109.61	**1058.899	2231.2196
ASTSF贫TDR	**(-8.407)	(0.004)	**(31.511)	(1.263)	**(5.14)	*(2.084)	_		
	-0.48732	1.64229	0.709295	-0.03394	0.1193	0.00471	-653.0115	**10785.52	1318.023
TDR贪ASTSF	*(-2.272)	(1.043)	**(3.104)	(-0.464)	(1.365)	**(2.692)			

* 5% level of significance

**1% level of significance

Table 3.2 Estimates of Mean Spillover

 $R_t = \alpha - MA \times \varepsilon_{t-1} + \varepsilon_t + \phi Y_{t-1}, h_t = A + Bh_{t-1} + C\varepsilon_{t-1}^2$, where, R_t : the daily returns of a market in period t, h_t : the conditional variance of returns in period t, h_{t-1} : the conditional variance in period t-1, Y_{t-1} : residuals jointly estimated from a GARCH (1, 1)-MA (1) of another market in period t-1, α , MA, A, B, C and φ : the coefficients of variables

	脉	Α	В	MA	С	SPILL	Log L	Ratio	AIG
TEMCAADD	-0.478951	1.085	0.834931	0.0361	0.104247	0.0651	-729.45	**4628.5	1470.9
1SMC页ADK	(-1.779)	(1.876)	**(12.005)	(0.535)	(2.308)	(0.606)			
	-0.2993	0.3996	0.8836	0.447	0.0376	0.4967	-572.927	**7682	1163.8531
ADR贪TSMC	**(-3.567)	(1.111)	**(10.077)	**(6.188)	(1.188)	**(15.078)			
	-0.272876	0.00198	0.937043	0.00238	0.062934	0.935764	-636.8348	**7521.805	1285.6697
NYSE→TSMC	(-1.589)	(0.084)	**(2741.597)	(0.033)	**(173.122)	**(9.459)			
	-0.2377	0.0000028	0.93969	0.03876	0.06031	0.40806	-757.418	**436	1526.835
UMC賞ADR	(-1.454)	(0.001)	**(5051.08)	(0.683)	**(15.683)	*(5.771)			
	-0.5617	0.1642	0.9613	0.40793	0.038332	0.684179	-1070.483	**15117.76	2152.9656
ADR贪UMC	(-0.892)	(0.478)	**(104801)	(1.009)	**(3780.188)) **(3.055)			
NVSE JIMC	-0.261654	0	0.830695	0.04051	0.169312	0.457785	-979.35887	**5816	1970.718
IN I SE→UNIU	*(-2.222)	(0)	**(532.399)	(0.725)	**(15.461)	**(5.594)			
	-0.2477	2.56018	0.74981	0.352592	0.0954416	0.402659	-725.0426	**8814.297	1462.0852
ASX 页AD R	(-1.474)	(1.148)	**(4.402)	**(3.871)	*(1.705)	**(3.681)			
	-0.189794	0.857458	0.87357	0.207221	0.04762	0.3263	-674.67758	**2276.01	1361.3552
ADR贪ASX	(-1.161)	(0.631)	**(5.425)	*(2.308)	(0.904)	**(4.695)			
	-0.1788	0.88603	0.86811	-0.02939	0.05112	0.6663	-675.4089	**2192.02	1362.818
NYSE→ASX	(-0.849)	(0.632)	**(5.265)	(-0.438)	(0.921)	**(4.631)			
	-0.8876	0	0.906282	0.147638	0.09372	0.566758	-513.909	**17.6204	1039.8186
AUO贪ADR	**(-3.307)	(0.001)	**(1202.11)	(1.281)	(11.304)	**(4.979)			
	-0.544945	1.87248	0.800418	0.560558	0.053004	0.55799	-420.1592	**2866.425	852.31845
ADR贪AUO	**(-4.063)	(0.333)	(1.556)	**(5.685)	(0.513)	**(8.311)			

	-0.48764	1.92182	0.82582	-0.00018	0.03505	0.77847	-431.5351	**21310.76	875.0702
NYSE→AUO	(-1.538)	(0.277)	(1.502)	(-0.002)	(0.4)	**(3.955)			
	-0.317381	1.25692	0.89421	0.59991	0.025678	0.675175	-718.94931	**32783.35	1449.8986
MIXCY贪ADR	**(-3.094)	(0.714)	**(6.888)	**(9.147)	(0.735)	**(9.595)			
	-0.783041	0.000004	0.87113	-0.12981	0.12887	0.1780	-699.3764	**115.289	1410.7528
ADR贪MIXCY	**(-4.033)	(0.001)	**(458.63)	*(-2.167)	**(9.386)	**(4.147)			
	-0.3083	1.7772	0.7543	-0.1235	00932	0.2693	-679.061	**19423.07	1370.1223
Nasdaq→MIXCY	(-1.304)	(0.915)	**(3.508)	(-1.807)	(1.22)	*(2.551)			
SPIL贪ADR	-0.24574	0.828898	0.92314	0.11659	0.02249	0.1818	-716.243	**15337.33	1444.4864
	(-1.113)	(0.474)	**(6.77)	(1.19)	(0.741)	*(2.124)			
	-0.225689	0.282474	0.97822	0.750013	0.00002935	0.808274	-690.4454	**2914.979	1392.891
ADR贪SPIL	**(-3.626)	-0.323	**(17.958)	**(10.859)	(().001)	**(14.363)			
	-0.22439	12.8415	0.005213	-0.00911	0.00062	0.59659	-691.6556	**2861.343	1395.311
Nasdaq→SPIL	(-0.994)	(0.019)	(0)	(-0.148)	(0.008)	**(5.501)			
ASTSF贪TDR	-0.7288	1.7152	0.7924	0.02724	0.15865	-0.02773	-798.04517	**1086.233	1608.0903
	*(2.316)	*(2.381)	**(14.783)	(0.395)	**(3.42)	(-0.288)			
	-0.622	0	0.903512	0.011628	0.09649	0.23398	-685.289	**421.317	1382.577
TDR贪ASTSF	**(-4.448)	(0)	**(1835.55)	(0.2)	**(12.45)	**(7.801)			

* 5% level of significance

**1% level of significance

Table 3.3 History of Taiwan capital market restrictions to the Foreigners

Date	Institution	Total	Individual	Total	Individual	Restriction on the flow of capital
		Holding	holding	amount of	amount of	Requirement of QFII
		limit	limit	investment	investment	
72/05/26	SITE	None	10%	None	None	Overseas investors withdraw
						investment after the fund have
						issued for one year at least.
80/01/02	QFII ¹	10%	5%	US\$ 2500	US\$ 5~50	1. Overseas investors remit-in
				million	million	within three months after
						approving.
						2. Overseas investors withdraw
						after at least three months'
						investment.
						3. remit-out one time a year.
85./3/3	GFII				1. No restrictions	1. Total remit-out amount can not
					on foreigners live	exceed remit-in
					in Taiwan	2. No time restriction
					2. There are	
					restrictions to	
					offshore	
					foreigners:	
					(1) USD\$5 MM	
					per person	
					(2) USD\$20MM	
					per corporation	
87/7/20				Futures tradi	ng permitted	
89/3/8	immigrant	investment				
	and	convertibl				
	foreign	e bonds				
	remittance					
89/12/30		Eliminate re	strictions on ir	dividuals or for	eigners holding	

¹ Requirement of QFII:

(1)Bank: total asset is ranked within 500 in the world and total equities holding need to be above US\$ 300 million.

(2)Insurance company: need to operate above 10 years and hold above US\$ 500 million equities.(3)Institution of fund management: establish above 5 years and manage above US\$500 million fund

90/3/7		1. Extend remitting in or out time
		from one year to two years.
		2. Cancel the cycling amount and
		control by registering and
		approving instead of cycling
		amount control.
90/12/24	TAIEX Options trading permitted.	

Source: <u>http://www.sfc.gov.tw/international.htm</u>