Foreign Ownership Restrictions, Depositary Receipt Supply, and Investor Sentiment on Taiwanese Depositary Receipt Premiums

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This paper focuses on the price difference between depositary receipts (DRs) and the underlying securities issued by Taiwanese firms under foreign ownership restrictions. We examine two issues: (1) the price relationships between DRs and their underlying securities, and (2) the determinants of the price differences between DRs and their underlying securities.

The empirical results show that large daily price differences are observed between DRs and their underlying Taiwanese securities. However, these price differences do not exist for DRs traded in different free-entry countries. We examine the determinants of the price differences between DRs and their underlying securities, and find that the time-series qualified foreign institutional investor (QFII) surplus, defined as the QFII ownership limit ratio minus the actual QFII ownership ratio, is inversely associated with the DR premium. As the foreign ownership restrictions become tighter, the QFII surplus decreases and the DR premium increases.

The results also indicate that a structural change in the relationships between DR premiums and investor sentiment variables occurred in 1997. The DR premiums are sensitive to non-QFII holdings, defined as the total foreign holdings minus the QFII holdings, before 1997. However, post 1997 the DR premiums become more sensitive to firm size, but less sensitive to non-QFII holdings post 1997. The change in demand caused by regulation and investor sentiment is reflected in DR prices, which leads to the variations in DR premiums. Furthermore, this study finds a supply-side effect on DR premiums. As firms increase DRs issues, the DR premiums become smaller. This study concludes that regulation, investor

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sentiment (both can be viewed as demand for DRs), and supply conditions explain the DR premiums.

1. Introduction

This paper investigates the impact of international barriers and investor sentiment on *depositary receipt premiums*, which are defined as the price differences between depositary receipts and their corresponding underlying securities. Depositary receipts (DRs), including global depositary receipts (GDRs) and American depositary receipts (ADRs), are negotiable certificates that represent ownership shares of the issuing companies. Because foreigners can trade DRs in the currencies of their countries, investors can enjoy the benefits of international diversification through DRs without having to go to markets abroad.

Theoretically, in a completely integrated global market, country-specific factors will be diversified away, and only a certain set of global factors will be priced (e.g., Stulz [1981]). Large price discrepancies should not be found between DRs and their underlying securities because of cross-border arbitrage. This is also documented in Kato, Linn, and Schallheim (1991).

However, barriers to international investment restrict foreigners' access to local markets, creating market segmentation. Errunza and Losq (1985) proposed that a mildly segmented market structure led to the existence of super-risk premiums for a subset of securities. In addition, related studies explain the price deviations between restricted and unrestricted shares. Eun and Janakiramanan (1986) modeled the price deviations as a function of the severity of the foreign ownership restrictions. As the restriction became tighter, the price premium of the unrestricted shares to the restricted shares increased. Hietala (1989) showed that the differential rates of returns required by local and foreign investors accounted for the cross-sectional variations of price deviations.

Based on theory, we shall anticipate that the price deviation varies among different countries where the depositary receipts originate, because of the differences in market environments and governmental regulations. Bailey, Chung, and Kang (1999) used eleven countries to study the price premiums between unrestricted and restricted shares and found that premiums vary widely across countries and throughout time by using monthly prices. In their study, the price premiums exist for Taiwan firms in general. Tsai and Li (2004) reported no significant price deviation between DRs originating from Hong Kong, but significant DR price premiums for the firms from Taiwan by using weekly prices. With respect to the securities from Taiwan, both papers have similar findings on the price premiums regardless of using different price windows and sample periods.

As an extension of these studies, this paper reexamines the premium pattern of Taiwan depositary receipts and studies the effect of governmental regulation on foreign investments, DR supply, and investor sentiment on the premiums. We compare DR prices with the parity values of the underlying securities for thirty-three

DRs issued by Taiwanese firms. Although the sample is relatively small, we have exhausted the entire population of DRs issued by Taiwanese firms for the study period. In addition, our primary analysis involves examining the firm level rather than looking at the cross-sectional price differences, making sample size less relevant, although it might still be a problem from the empirical point of view. The results indicate a significant price difference between DRs and their underlying securities. The further empirical results show that the qualified foreign institutional investor (QFII) surplus is significantly and inversely correlated to the DR premium. This suggests that DR demand decreases reduce the price premiums when QFIIs are permitted to hold more equity from underlying securities. In addition, the ratio of DR equity to total equity is inversely associated with DR premiums, implying a supply-side effect on DR premiums. Moreover, this study uses the breakpoint Chow test (1960) and detects a structure change in investor sentiment variables. The results reveal that the non-QFII foreign ownership ratio (the total foreign ownership ratios minus QFII ownership ratios) is more sensitive to DR premiums in the period prior to 1997. However, firm size becomes more important in explaining DR premiums post 1997. This suggests that the DR demand function varies with the development and internationalization of the Taiwan stock market.

Different from Bailey, Chung, and Kang (1999), who used data of eleven countries, this paper concentrates on a single country in understanding the price premiums. The single-country study enables us to develop country-specific variables to better understand the depositary receipt premiums. The generalization of our findings is subject to the countries with similar regulation or market environments. However, the results do provide public policy implications to those countries attempting to adopt a QFII mechanism, such as China.

2. Institutional Issues and Data

The DRs issued by Taiwanese firms are particularly interesting because the Taiwanese government sets various foreign ownership restrictions.[1] Similarly, other emerging markets such as Korea, Thailand, and Singapore also impose foreign ownership restrictions. In these countries, foreigners are restricted from owning too many shares of some industries[2] such as mining, marine transport, airline services, communication, agriculture, banking, financial service, and public industrial sectors. In Malaysia, the law places a 30–49 percent foreign ownership limit on each firm. The regulatory impact of these restrictions should be an important price factor for equity of firms in controlled countries or industries.

1. According to "Regulations Governing Securities Investment by Overseas Chinese and Foreign Investors" (Republic of China [1983]), only qualified overseas investors can apply to the Central Bank of China (CBC) and Securities and Futures Committee of the Republic of China (SFC) for investing directly in Taiwanese stock markets.

2. The laws or regulations set the foreign ownership limits for foreigners in some industries.

Under Taiwanese foreign ownership restrictions, only qualified investors[3] can apply to invest directly in Taiwanese securities. On the other hand, unqualified foreigners sidestep the regulatory restrictions to invest in Taiwanese firms by purchasing DRs in overseas markets instead of the underlying securities in the Taiwanese market. As a result, DRs trade as unrestricted shares in freely global markets, while the underlying securities trade as restricted shares in Taiwan under foreign ownership restrictions. According to the two-country model in Errunza and Losq (1985), the foreign ownership restrictions will raise DR prices above the amounts that the marginal domestic investor is willing to pay.

Since 1990, under Taiwanese regulations, only QFIIs can directly invest through Taiwan stock exchanges with the permission of Taiwan's Securities and Futures Commission (SFC). Moreover, Taiwanese law imposes a restriction on the total QFII ownership for any Taiwanese issuing company. The regulations have been revised several times but currently state that the foreign ownership limit ratio of each firm is 10, 15, 25, 25, 30, 50, and 50 percent at the end of 1994, 1995, 1996, 1997, 1998, 1999, and 2000, respectively. As the foreign ownership restrictions become looser, QFIIs are allowed to hold more shares and the QFII surplus increases. Therefore, QFII is a good indication of governmental control on the foreign direct investment (FDI) on its market.

This study focuses on DRs issued by publicly owned firms in Taiwan. In order to be included in our sample, the firms had to have issued DRs before the end of 1999. Three DRs are deleted due to the lack of availability of DR trading prices.[4] See Table 1 for a list of the sample firms and their issue dates. If there are stock splits or stock dividends during the research period, the prices are adjusted accordingly for the entire study period. All DR daily prices are collected from the Bloomberg databases[5] from the issuance day to the end of 2000. The data selection procedure results in 33 companies as our testing sample[6] from 1994 to 2000, but the total number of firm-years is 147 because of a different number of companies in a different year. Based on the daily prices collected, we convert them to monthly prices and annual prices. We use different price definitions for different analyses according to the model specifications. However, all price definitions are constructed based on the daily prices.

The prices for underlying securities, firm market values, total foreign ownership ratios, QFII ownership ratios, as well as QFII surplus of each firm are collected from the *Taiwan Economics Journal* (*TEJ*) databases. The daily exchange rates

3. The qualified overseas investors include QFIIs and a part of overseas Chinese. Both of them can apply to invest directly through Taiwanese stock markets. However, QFIIs are the main overseas investors.

4. Our sample is consistent with that of Chen, Chou, and Yang (2002), who also document thirty-six Taiwanese listing companies having issued DRs by the end of 1999.

5. Since the depositary receipts are issued at different times, we collect the DR daily prices from the beginning of the period that the DR is issued.

6. Our sample includes three, thirteen, sixteen, twenty-four, twenty-five, thirty-three, and thirty-three firms in the years 1994–2000, respectively.

TABLE 1

Sample Firms and DR Issue Dates

Firm Included in Sample	DR Issue Date	
Asia Cement	6/23/1992	
President Enterprises	11/24/1992	
Chia Hsin Cement	5/25/1993	
Tecom Co., Ltd.	5/4/1994	
Microelectronics Technology	5/24/1994	
Hocheng Corp.	6/29/1994	
Tong Ho Steel	9/28/1994	
Yageo Corp.	9/28/1994	
Aroura Corp.	1/27/1995	
GVC Corp.	4/3/1995	
A.S.E.	7/13/1995	
A.D.I.	9/28/1995	
Walsin Lihwa	10/3/1995	
Siliconware Precision Ind.	10/4/1995	
Aecr	11/1/1995	
Macronix International	5/14/1996	
Evergreen Transport	6/18/1996	
Lite-On Technology	9/25/1996	
Yang Ming Marine	11/14/1996	
Accton Technology Corporation	2/1/1997	
Tec Electric Co., Ltd.	3/27/1997	
Asustek Computer Inc.	5/30/1997	
Standard Foods Taiwan	6/19/1997	
Synnex Technology Corp.	6/26/1997	
Taiwan Semiconductor Manufacturing	10/8/1997	
Fubon Insurance	4/17/1998	
D-Link	9/18/1998	
Winbond Electronics Corp.	2/5/1999	
Mosell Vitelie Corp.	9/16/1999	
Hou Hai Precision Industry Co., Ltd.	10/7/1999	
RITEK	10/15/1999	
Far East Textile	10/25/1999	
Compall Electronic Inc.	11/9/1999	
Firms Being Excluded		Reason for Exclusion
China Steel	5/28/1992	Government owned
Powerchip Semiconductor Corp.	6/21/1999	OTC firm, not TSE
ACER Peripheral	6/22/1999	Not enough observations

used to adjust the underlying security prices from new Taiwan dollars (NTD) into U.S. dollars (USD) are collected from Datastream. In addition, the data regarding the approved and applied QFII cases are collected from the SFC. The percentage of equity in the form of DRs is collected from the Taiwan Stock Exchange.

3. Foreign Premium

Without foreign ownership restrictions, foreign investors can trade DRs and their underlying securities freely. Depositary receipts and their underlying securities could be converted into each other. If the DR prices are higher than the underlying security prices, the demand for DRs can induce the creation of new receipts from the underlying securities, which decreases the DR prices. On the other hand, if the DR prices are lower than the underlying security prices, the conversion of DRs back to the underlying securities increases, resulting in lower share prices for the underlying securities. Therefore, persistent and large price discrepancies should not exist between DRs and their underlying securities for firms listed in the open markets. This is supported by the findings of Kato, Linn, and Schallheim (1991).

However, regulations in Taiwan prevent overseas investors from trading freely through the Taiwan stock markets without the permission of the SFC.[7] In addition, the laws deter the issuance of DRs without SFC approvals.[8] Regulatory foreign ownership restrictions cause segmentation from the global markets. If DR prices are lower than the underlying security prices, DR holders can apply to convert DRs issued by Taiwanese firms back into their underlying securities.[9] The DR discount may thus converge to zero because of the *flowback effect*. However, if the DR prices are higher than the underlying security prices, security holders cannot directly convert the underlying securities into DRs. Thus, under this regime, regulation deters arbitrage when DRs are traded at a premium, but not at a discount. Thus, the first hypothesis is described as follows:

Hypothesis 1: Persistent price premiums exist for DRs issued by Taiwanese firms.

This paper collected all the daily prices for DRs and underlying securities to calculate the DR premiums. For most DRs, one unit is usually for several shares of the underlying security. We calculate the DR price per share ($DR_{i,t}$) by dividing the share number per unit from DR prices per unit. We then calculate the DR premium by comparing DR share price and the parity values of the underlying security using the following ratios:

$$PR_{i,t} = \frac{DR_{i,t} - P_{i,t}}{P_{i,t}} \tag{1}$$

$$PR^{*}_{i,t} = \frac{DR^{*}_{i,t} - P_{i,t}}{P_{i,t}} \tag{2}$$

7. Article 10 of the "Regulations Governing Securities Investment by Overseas Chinese and Foreign Investors" (Republic of China [1983]).

8. Article 6 of the "Criteria Governing the Offering and Issuance of Overseas Securities by Issuers" (Republic of China [1988]).

9. Article 14 of the "Criteria Governing the Offering and Issuance of Overseas Securities by Issuers" rules it.

where

$PR_{i,t}$ = the price difference ratios for firm i between the underlying securities and the DRs traded on the London Stock Exchange (LSE) on day t;
$PR^{*}_{i,t}$ = the price difference ratios for firm i between the underlying securities and the DRs traded on exchanges other than the LSE on day t;
$DR_{i,t}$ = the DR price per share for firm i on day t for DRs traded on the LSE;
$DR^{*}_{i,t}$ = the DR price per share for firm i on day t for DRs traded on exchanges other than the LSE; and
$P_{i,t}$ = the underlying security parity price per share on the Taiwan Stock Exchange for firm i on day t.

We use the t-statistic to test the null hypotheses H^{a}_{1}: $PR_{i,t} = 0$ and H^{b}_{1}: $PR^{*}_{i,t} = 0$.

This study also compares the daily prices for DRs traded across different exchanges[10] if their prices are available on Bloomberg databases. The reason for doing this is to check if the same depositary receipts listed in different overseas markets experience the price discrepancy. We calculate the price difference ratios of DRs traded in different markets as eq. (3):

$$UPR_{i,t} = \frac{DR^{*}_{i,t} - DR_{i,t}}{DR_{i,t}} \tag{3}$$

where

$UPR_{i,t}$ = the price difference ratio between DRs (unrestricted shares) traded across different markets for the ith firm on day t, and $DR_{i,t}$ and $DR^{*}_{i,t}$ are as defined above.

Again, we use the t-statistic to examine the null hypothesis H^{c}_{1}: $UPR_{i,t} = 0$.

Table 2 shows descriptive statistics for the price difference ratios between DRs and their underlying securities. For twenty-eight DRs (all the DRs except those identified as firms 11, 13, 20, 27, and 30) traded on the LSE, the $PR_{i,t}$ ranges from -0.0225 (for firm 14) to 0.4503 (for firm 16). The four negative difference ratios all indicate a discount of less than 3 percent, supporting the notion that large DR discounts would not persist because of the flowback effect. When a holder of depositary receipts requests redemption, he or she may request the depositary institution to transfer the title of the underlying securities, or to sell the underlying securities and then pay the sales proceeds to the holder after deducting the tax and related fees. Because it takes time to complete the redemption procedure, the prices may vary during the redemption period. The holders face the risk of price changes and of paying the transaction costs when they apply the redemption. Thus, the DR holder executes the redemption only if the DR discount is large enough to cover

10. Seven DRs listed in Luxemburg or the United States are also traded in the London Stock Exchange, so we can collect the trading DR prices from more than one stock exchange.

TABLE 2

Descriptive Statistics of Price Difference Ratios[a] between DRs and Underlying Securities

Firm[b]	$PR_{i,t}$			$PR^*_{i,t}$[d]			$UPR_{i,t}$		
Electronics	Mean	*t*-statistic	N[c]	Mean	*t*-statistic	N	Mean	*t*-statistic	N
1	0.0239	15.6020***	1,231						
2	−0.0070	−9.2493***	1,248						
3	0.1690	44.4857***	1,247	0.3297	9.5697***	167	−0.0189	−5.0177***	136
4	0.1520	27.2229***	860						
5	0.2008	35.2454***	928						
6	0.0011	0.1451	31	0.0078	1.2223	173	−0.0044	−0.3184	31
7	0.0439	19.0690***	275						
8	−0.0064	−15.3930***	484	−0.0736	−4.0128***	77	−0.0017	−0.2181	51
9	0.2953	30.7153***	301						
10	0.1613	23.4402***	1,023						
11				0.1161	6.0098***	70			
12	−0.0012	−0.7023	292						
13				0.0575	50.4996***	1,009			
14	−0.0225	−5.7535***	286						
15	0.0018	1.5081	295						
16	0.4503	70.5659***	1,251						
17	0.0368	14.7736***	364						
18	0.4302	38.9428***	616	0.4445	58.6449***	766	0.0019	1.4292	590
19	0.0418	25.0290***	457						
20				0.0686	3.5375***	67			
Nonelectronics									
21	0.1330	38.7288***	1,894	0.0752	10.3266***	473	−0.0056	−1.7881	412
22	0.2630	44.3548***	1,919						
23	0.0612	17.3387***	1,061						
24	0.0244	6.8320***	414						
25	0.0953	17.8580***	288						
26	0.0628	23.3111***	1,548						
27				0.0311	3.6953***	67			
28	0.1396	29.2706***	848	0.1398	10.9121***	93	0.0083	1.0260	92
29	0.1256	60.0013***	901						
30				0.0450	4.5535***	70			
31	0.1053	33.1514***	1,008	0.0449	6.4253***	141	0.0076	0.0643	54
32	0.1069	20.2232***	989						
33	0.0597	20.8689***	1,588						
Average	0.1124			0.1101			−0.0018		

***, ** significant at 0.01 and .05 levels, respectively.

[a](1) $PR_{i,t} = \dfrac{DR_{i,t} - P_{i,t}}{P_{i,t}}$ (2) $PR^*_{i,t} = \dfrac{DR^*_{i,t} - P_{i,t}}{P_{i,t}}$ (3) $UPR_{i,t} = \dfrac{DR^*_{i,t} - DR_{i,t}}{DR_{i,t}}$

[b]The names of firms are available from the author.

[c]N = number of observations.

[d]Some DRs, traded on the London Stock Exchange, are simultaneously traded in other markets. Because of data availability, $PR_{i,t}$, $PR^*_{i,t}$, and $UPR_{i,t}$ are collected in different periods, even for the same firm.

the cost and risk. This explains why a small magnitude of DR discount still exists for four firms in our sample.

On the other hand, a DR premium may persist for a period of time because regulations prevent the conversion of underlying securities into DRs. Thus, the premium would not converge to zero due to an overdemand and undersupply of the Taiwanese firm's shares. This is supported by the result that some Taiwanese firms' DRs have traded at an average premium up to 45 percent.

Table 2 displays the mean price difference ratios, $PR^{*}_{i,t}$, for twelve DRs traded in the United States or Luxemburg, ranging from −0.0736 to 0.4445. The average of the mean price difference ratio is 0.1101. Obviously, a persistent price premium exists for the DRs traded in the United States or Luxemburg. A review of the *t*-statistic presented indicates significant DR premiums for eleven of the twelve DRs traded in the United States or Luxemburg and twenty-five of the twenty-eight DRs traded on the LSE. This result is consistent with Hypothesis 1 that persistent price premiums would exist.

In our research, we have seven DRs that trade in different DR markets simultaneously. The mean $UPR_{i,t}$ (the price difference ratios between the different DR markets) of these seven DRs range from −0.0189 to 0.0083. The average of the mean price difference ratio is −0.0018. The results indicate insignificant price difference ratios for six of the seven DRs traded in the various free markets, supporting the law of one price. Because overseas investors can trade DRs in different global markets without investment restrictions, the cross-border arbitrage aligns the prices of the two securities within a bound. In contrast to the significant price differences between DRs and their underlying securities, we do not find great deviations for DR prices traded in different free markets. This implies that foreign ownership restrictions result in the persistent deviations between DRs and their underlying securities.

Some studies argue that liquidity may affect the price difference between DRs and underlying securities. According to the statistics from the Taiwan Stock Exchange,[11] the turnover rates are 11.66, 7.23, and 5.68 percent for the Taiwan Stock Exchange, New York Stock Exchange (NYSE), and LSE, respectively. The trading volumes are 32,247, 21,701, and 30,438 million shares for the Taiwan Stock Exchange, NYSE, and LSE, respectively. The liquidity of the Taiwan Stock Exchange is higher, even though the exchange size is not very large. For Taiwanese firms, the market for underlying securities is more liquid than the market for DRs, so DR discount should exist based on the liquidity hypothesis. However, our results, in contrast, show the large magnitude of DR premium. This suggests that liquidity is not the factor of DR premiums.

Can industrial difference explain the price difference between DRs and underlying securities? As Table 2 shows, DR premiums are over 10 percent for eight of the twenty electronics firms and for six of the thirteen nonelectronics firms.

11. From Taiwan Stock Exchange (2005).

These results suggest that industrial difference is also not the factor of DR premiums.

In DR pricing literature, the variation of exchange rate is one of the important variables in determining the DR price movement. Because we can only observe the apparent variation of weekly exchange rate, this paper uses the Pearson correlation test to check if the weekly price difference ratio can be explained by the weekly exchange rate (NTD/USD). The correlation coefficient between price difference ratio and the change rate[12] of exchange rate ranges from -24 percent to 16 percent, and is within ± 10 percent for fourteen of the sample firms. The correlation coefficient between the change rate of price difference ratio and that of exchange rate ranges from -20 percent to 22 percent, and is within ± 10 percent for the eighteen sample firms. Based on these results, we cannot conclude that the variation of exchange rate can explain the variation of the DR premiums.

4. Foreign Ownership Restrictions and Price Premiums

Bonser-Neal et al. (1990) used dummy variables to represent the effect of relaxed restrictions on price-to-net asset value ratio changes. However, the dummy variable only detects the trend; it cannot quantify the impact of the change in restrictions precisely. Bailey, Chung, and Kang (1999) use a foreign ownership restriction ratio as a proxy for regulatory indicators, but their results did not find a significant regulatory effect. Also, the foreign ownership restriction ratio may not be appropriate in explaining the DR premium variation across the firms because all the firms are subject to the same foreign ownership restriction ratio at a given time. Instead of using the foreign ownership restriction ratio, we construct the time-series *qualified foreign institutional investor (QFII) surplus* to quantitatively measure the regulatory impact on DR premiums. We define the *QFII surplus* as the QFII ownership restriction ratio minus the actual QFII ownership ratio. Since the restriction loosens with time, it may relax the QFII surplus and reduce the QFIIs' demand for DRs. The looser regulatory foreign ownership restrictions lead to smaller DR demand as QFIIs can invest directly in the underlying securities. This decrease in demand causes a decrease in DR price and therefore a reduction in the DR premiums. Thus, the analysis leads to the second hypothesis:

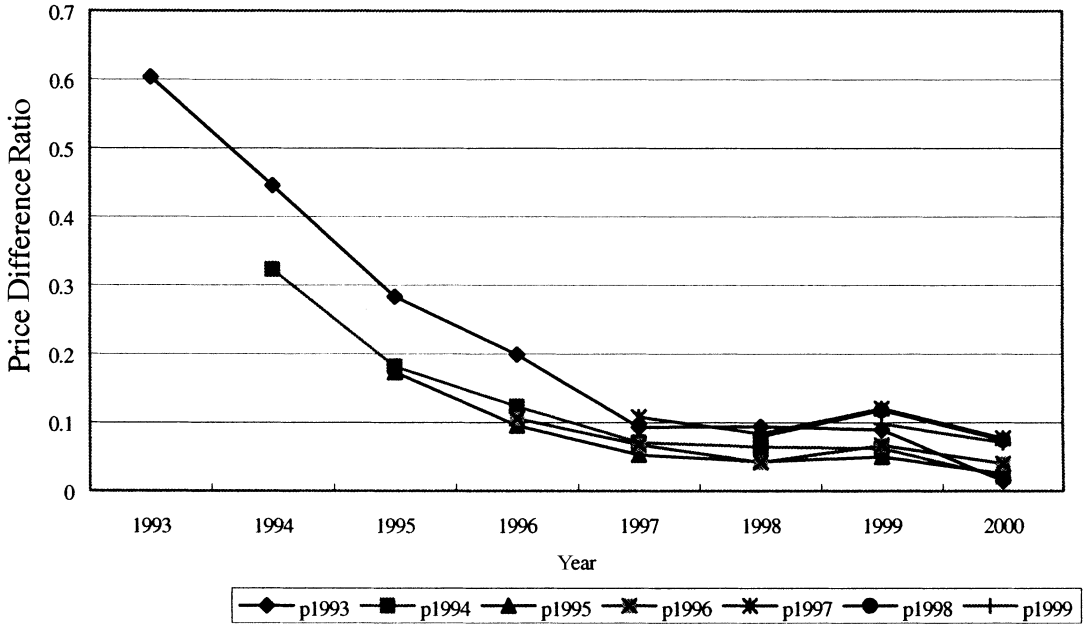
Hypothesis 2: A negative association exists between DR premiums and QFII surplus for Taiwanese firms.

To begin investigating the effect of regulatory restrictions on DR premiums, Figure 1 shows the average of the price difference ratios between DRs and their underlying securities in portfolios. These portfolios consist of all DRs issued prior to the portfolio dates. One can see that the DR premiums of each portfolio are typically positive. Because QFIIs are the only ones who can take limited holdings of Tai-

12. The change rate is calculated through the value difference between time t and time $t - 1$ deflated by the value at time $t - 1$.

FIGURE 1

Price Difference Ratios between DRs and Underlying Securities



Note: *P1993* through *P1999* are portfolios composed by the DRs issued before 1993, 1994, 1995, 1996, 1997, 1998, and 1999, respectively.

TABLE 3

The Annual Approved Number and Amount Ratios of QFII Cases

Year	1994	1995	1996	1997	1998	1999	2000	Average
Approved number ratio[a]	0.6462	1.0096	1.1066	0.9088	0.9910	0.8508	0.9298	0.9204
Approved amount ratio[b]	0.5964	1.0336	1.0557	0.8844	0.9170	0.7642	0.8235	0.8678

[a]The approved number ratio is the total approved number deflated by the total applied number of QFII cases each year.

[b]The approved amount ratio is the total approved amounts deflated by the total applied amounts of QFII cases each year.

wanese firms through the Taiwan stock markets, other foreigners can only invest in Taiwanese firms via DRs. This appears to result in persistent DR premiums. In addition, the price difference ratios between DRs and their underlying securities are decreasing with time prior to 1997, and become almost constant after 1997.

Taiwan has been a country with restrictions on inward and outward investment. As the government loosens QFII ownership limits, the DR premiums decrease, especially from 1993 to 1997. Although the government continued to loosen QFII ownership limits from 1997 to 2000, QFIIs did not increase their holdings through Taiwan stock markets after 1997. Thus, non-QFIIs or QFIIs without the permission of the SFC continue to invest in DRs in the same quantity. This results in an almost constant DR premium after 1997.

The DR premiums of these portfolios increase slightly during 1999, as indicated in Figure 1. Table 3 shows the approved number ratios and approved amount ratios of QFII cases. Notice that the approved number ratios and approved amount ratios of QFII cases in 1999 are 85.08 percent and 76.42 percent, respectively. These amounts are lower than the ratios for the previous four years (1995–1998). The government approved a smaller proportion of QFII applications in 1999 to control the foreign capital inflow to Taiwanese stock markets. This action placed the demand and supply for DRs out of equilibrium and resulted in larger price deviations between the DRs and their underlying securities.

This paper uses panel data (the pooled time-series cross-sectional data) to estimate the impact of relaxed regulatory restrictions on the DR premiums for thirty-three firms. Although some DRs were issued before 1994, the QFII surplus is only available from January 1, 1994. Hence, we run the regressions with the data from January 1994 to December 2000 for the DRs issued in 1992 or 1993; regressions from the issuance date to December 2000 are performed for DRs issued after 1994.

Because the QFII surplus does not vary frequently, it is more suitable to use the monthly data to test the time-series relationships between DR premiums and regulatory restrictions for each firm. Typically, research may assume a constant relationship between independent variables and explanatory variables across different firms. However, the QFII surplus should account for DR premiums of different magnitudes across various firms. Thus, this paper estimates the relationship

between the QFII surplus and DR premiums for each firm individually. We investigate the effect of the QFII surplus on the variation in DR premiums using time-series monthly data for each firm as a system regression in eq. (4):[13]

$$\begin{bmatrix} Y_{1,k} \\ Y_{2,k} \\ \vdots \\ Y_{33,k} \end{bmatrix} = \begin{bmatrix} \alpha_{0,1} \\ \alpha_{0,2} \\ \vdots \\ \alpha_{0,33} \end{bmatrix} + \begin{bmatrix} X_{1,k} & 0 & 0 & 0 \\ 0 & X_{2,k} & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & X_{33,k} \end{bmatrix} \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_{33} \end{bmatrix} + \begin{bmatrix} Y_{1,k-1} & 0 & 0 & 0 \\ 0 & Y_{2,k-1} & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & Y_{33,k-1} \end{bmatrix} \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \vdots \\ \lambda_{33} \end{bmatrix} + \begin{bmatrix} e_{1,k} \\ e_{2,k} \\ \vdots \\ e_{33,k} \end{bmatrix} \tag{4}$$

where $Y_{i,k}$[14] is the monthly price difference ratio between DR and underlying security for the ith firm on month k, and $X_{i,k}$ is the monthly QFII surplus for the ith firm on month k. The coefficient α_i addresses the relations between DR premiums and QFII surplus for the ith firm. System regression is used because QFII surplus may account for DR premiums in different magnitudes across firms. Thus, the relations between QFII surplus and DR premiums shall be estimated for each firm individually.

Descriptive statistics of the QFII surplus and the results of eq. (4) are shown in Table 4. For twenty-four of the thirty-three firms, there is a significant inverse relationship between the time-series QFII surplus and DR premiums. This is consistent with Hypothesis 2 that DR demand decreases when QFIIs are permitted to hold a higher percentage of equity in the underlying securities. In turn, the decrease in DR demand reduces the DR price, and subsequently the DR premiums become smaller. The QFII surplus provides a good explanation of the regulatory effect on DR premiums, which is different from Bailey, Chung, and Kang (1999).

5. Investor Sentiment, DR Supply, and Price Premiums

The investor sentiment hypothesis suggests that investors make decisions to buy or sell based on sentiment factors rather than fundamental information. This line of research indicates that investors prefer familiar securities and often ignore the principles of portfolio theory (e.g., Metron [1987]; French & Poterba [1991]; Bailey & Lim [1992]; Bodurtha, Kim, & Lee [1995]; Brennan & Cao [1997]; Kilka & Weber [1997]; Coval & Moskowitz [1999, 2001]; Huberman [2001]). The non-

13. Exchange rate is an important factor in determining the depositary receipt prices. In this paper, the exchange rate has been used to adjust the underlying security price to calculate the premium. So, it is implicitly considered in the paper.

14. Seven firms contain two series of DR premiums in our studies, *PR* and *PR**. For the seven firms, this paper chooses the series with longer and more complete price data in all the regressions.

TABLE 4

Results from System Regression (4) of DR Premiums on QFII Surplus[a]

Descriptive Statistics of QFII Surplus				QFII Surplus Coefficient		
Firm[b]	Mean	Max.	Min.		Coefficient	*t*-Values
1	24.40	45.47	0.05	α_1	−0.0890***	−5.9386
2	30.43	47.12	13.29	α_2	−0.1171***	−7.3998
3	21.13	41.00	8.00	α_3	−0.0859**	−2.5541
4	20.24	37.11	0.45	α_4	0.0190	0.2638
5	22.48	34.15	7.30	α_5	−0.0475**	−2.4958
6	29.30	44.85	12.35	α_6	−0.0627**	−2.1119
7	26.85	46.94	9.86	α_7	−0.0957***	−4.3907
8	21.89	46.99	5.16	α_8	−0.0854***	−3.1056
9	34.67	37.18	28.11	α_9	−0.0147	−0.5949
10	24.70	35.60	3.06	α_{10}	−0.0351**	−2.1576
11	15.99	19.57	0.01	α_{11}	−0.1304**	−2.2326
12	38.43	46.43	25.75	α_{12}	−0.0721***	−3.9415
13	31.28	34.11	26.22	α_{13}	−0.0477***	−2.8299
14	24.00	48.00	0.00	α_{14}	−0.0509***	−3.4142
15	21.55	24.08	18.94	α_{15}	0.2155	0.4610
16	31.14	46.33	17.13	α_{16}	−0.0782***	−5.4113
17	27.70	49.55	7.09	α_{17}	−0.0831**	−2.2441
18	47.69	48.25	46.84	α_{18}	−0.0906**	−6.1128
19	30.36	48.02	14.69	α_{19}	−0.0166	0.2106
20	26.93	47.92	8.28	α_{20}	−0.0596***	−3.7583
21	38.00	41.00	36.00	α_{21}	−0.1129***	−4.7738
22	46.64	48.51	43.97	α_{22}	−0.0601***	−5.7753
23	25.60	43.95	5.78	α_{23}	−0.0275	−1.0858
24	18.52	40.34	0.00	α_{24}	0.1408	1.1502
25	31.57	43.51	20.32	α_{25}	−0.0734	−3.6971
26	35.52	48.54	19.60	α_{26}	−0.0531***	−4.8863
27	27.80	49.53	1.12	α_{27}	−0.0609***	−3.5246
28	25.00	34.00	16.22	α_{28}	−0.5063	3.2016
29	26.90	49.41	7.45	α_{29}	−0.0675***	2.7897
30	41.19	46.50	24.30	α_{30}	−0.0211*	−1.8193
31	31.11	49.22	8.99	α_{31}	−0.0739***	−4.9831
32	25.53	49.98	0.00	α_{32}	−0.0461	−1.4523
33	30.00	44.49	15.25	α_{33}	−0.0987***	2.8402
R^2	74.63%	Adj. R^2	73.65%			

***, **, * significant at 0.01, 0.05, and 0.1 levels, respectively.

[a]T-statistics are based on the White (1980) heteroscedasticity-consistent standard errors.

[b]The firm's name is available from the author.

$Y_{i,k}$ = the monthly price difference ratio between DR and underlying security for the *i*th firm on month *k* (%), and

$X_{j,k}$ = the monthly QFII surplus for the *i*th firm on month *k* (%).

QFII foreigners[15] are allowed to invest in Taiwanese firms through joint ventures in providing know-how of production and marketing techniques. They are able to gain private information about these firms more easily. Hence, foreigners are more familiar with Taiwanese firms that have higher non-QFII holdings. Similarly, foreigners can gain more public information for firms with larger capitalization (e.g., Bailey & Jagtiani [1994]; Domowitz, Glen, & Madhavan [1997]; Kang & Stulz [1997]). If firms with higher non-QFII holdings or larger capitalization are more familiar to foreign investors, investment bias toward these firms could result in higher demand for DRs issued by these firms, and eventually account for higher market valuation or price premiums as reported in Lang et al. (2003). As a result, the hypotheses are described as follows:

Hypothesis 3^{a}: A positive association exists between DR premiums and non-QFII foreign ownership.

Hypothesis 3^{b}: A positive association exists between DR premiums and firm size.

In addition to the demand-side effect captured through regulation and investor sentiment, this paper investigates the supply-side effect on DR premiums. When Taiwanese firms issue more DR equity, more DRs are supplied to overseas investors. Given constant investor demand for DRs issued by Taiwanese firms, the increase in DR supply could reduce the DR prices and the DR premiums. This leads to the following hypothesis:[16]

Hypothesis 4: A negative association exists between DR premiums and the percentage of equity held in the form of DRs for Taiwanese firms.

For the supply-side effect, we select the percentage of DR equity as the supply indicator. For the investor sentiment effect, we select the non-QFII foreign ownership ratios and firm size, measured by market values, as the investor sentiment indicators. The non-QFII foreign ownership ratios are defined as the total foreign ownership ratios minus QFII ownership ratios. This ratio represents the proportion of capital generated directly from foreign countries rather than through Taiwan stock markets by QFII programs. Thus, we run the regression as eq. (5):

$$Y_{i,j} = \omega_0 + \omega_1 Z_{i,j} + \omega_2 F_{i,j} + \omega_3 S_{i,j} + \omega_4 X_{i,j} + \varepsilon_{1i,j} \tag{5}$$

where

$Y_{i,j}$ = the price difference ratio between the DR and underlying security for the ith firm in year j;
$Z_{i,j}$ = the percentage of equity issued as DRs, measured as the number of out-

15. The non-QFII foreigners obtain the ownership of Taiwanese firms through FDI before the firms list on the Taiwan Stock Exchange, while the QFII foreigners obtain the ownership of Taiwanese firms through foreign portfolio investment (FPI) through trading on the Taiwan Stock Exchange.

16. This hypothesis is made assuming that the increasing supply of DR has no effect on the price of underlying security. If the assumption does not hold, the negative association between DR premiums and supply is not necessarily true.

TABLE 5

Results from Regression of DR Premium on Firm Characteristics

Panel A: Descriptive statistics of the variables

	Y	Z	F	S	X
Mean	10.1545	0.0564	11.1271	75,189.93	26.3712
Median	5.2249	0.0478	9.1000	39,376.00	25.0000
Max.	60.6732	0.1581	39.820	1,406,151.00	48.9158
Min.	−15.9034	0.0071	0.0001	4,587.00	1.1183
Std. dev.	13.7421	0.0358	10.2744	148,121.80	13.0244

Panel B: $Y_{i,j} = \omega_0 + \omega_1 Z_{i,j} + \omega_2 F_{i,j} + \omega_3 S_{i,j} + \omega_4 X_{i,j} + \varepsilon_{1i,j}$[a] (5)

	Constant	Z	F	S	X	R^2 (%)	Adj. R^2 (%)
Expected Sign		−	+	+	−		
Coefficient	17.5803	−0.4602*	0.0650	0.0368***	−0.3425***	20.77	18.54
T-values	5.7795	−1.9004	0.7314	3.2855	−4.4075		

Panel C: Results of breakpoint Chow test

Chow Breakpoint Test	
F-statistic	2.9631**
Log likelihood ratio	15.0945**

***, **, * significant at 0.01, 0.05, and 0.1 levels, respectively.

[a] *T*-statistics are based on the White (1980) heteroscedasticity-consistent standard errors.

$Y_{i,j}$ = the price difference ratio between the DR and underlying security for the *i*th firm on year *j* (%),

$Z_{i,j}$ = the percentage of equity issued as DRs for the *i*th firm on year *j* (%),

$F_{i,j}$ = the non-QFII foreign ownership ratio for the *i*th firm on year *j* (%),

$S_{i,j}$ = the market value for the *i*th firm on year *j* (million NT dollars), and

$X_{i,j}$ = the QFII surplus for the *i*th firm on year *j* (%).

standing DR shares deflated by total outstanding shares for the *i*th firm in year *j*; and $F_{i,j}$, $S_{i,j}$, and $X_{i,j}$ are the non-QFII foreign ownership ratio, market value, and QFII surplus for the *i*th firm in year *j*, respectively.

In regression (5), we use annual data since the non-QFII foreign ownership ratio and market value of the firms do not vary monthly, whereas in regression (4) the monthly data are appropriate.

Table 5 presents the results of the comprehensive test of the association between firm characteristics and DR premiums for the 147 firm-year observations. The descriptive statistics are shown in Panel A; the results of eq. (5) are shown in Panel B.

In eq. (5), the coefficient ω_1 on the *DR equity* variable is −0.4602, indicating a negative association between DR premiums and the percentage of equity issued

as DRs. It implies that the price deviations between DRs and their underlying securities appear smaller for the firms with a higher percentage of equity supplied in the global markets through DRs. In addition, the coefficient ω_2 on the non-QFII foreign ownership ratio is 0.0650 but is not significant. The coefficient ω_3 on firm size is 0.0368, showing a significantly positive correlation with DR premiums. Finally, consistent with the results mentioned before, the QFII surplus, $X_{i,j}$, is negatively associated with the DR premiums.

6. Structure Change in Investor Sentiment Factors

6.1 Breakpoint Chow Test

Market environment changes through time may also affect investor sentiment. Taiwanese stocks became listed in the Morgan Stanley Capital International (MSCI) Emerging Market Free Index[17] in September 1996 because of regulatory liberalization and better economic conditions in Taiwan. Also, SIMEX MSCI Taiwan Index Futures have been listed on the Singapore Exchange (SIMEX)—Asia's leading financial futures exchange—since January 1997. Covrig, Lau, and Ng (2001) indicate that firms listed in famous worldwide indices have more visibility in the global markets. As a result of the above listings, international media and analysts pay more attention to Taiwanese firms, especially large firms. The increased availability of information increases the preference for DRs issued by large firms, which in turn increases DR premiums.[18]

We use the breakpoint Chow test (1960) to determine whether a structural change in the relationship between DR premiums and investor sentiment factors occurred in 1997. To carry out the test, we partition the data into two subsamples: one is before 1997, and the other is post 1997. The breakpoint Chow test fits eq. (5) individually for these two subsamples.

Panel C of Table 5 summarizes the breakpoint Chow test results. The *F*-statistic and log likelihood ratios are 2.9631 and 15.0945, respectively, which are significant at the 0.05 level. This supports the hypothesis that a structural change occurred in 1997.

6.2 Dummy Variable Model

To incorporate the effect of the structural change, we use dummy variables to individually estimate the change in the relationship between DR premiums and the explanatory variables. We modify eq. (5) as eq. (6):

17. Thirty of the thirty-three firms in our sample have been selected to form the MSCI Taiwan Index.

18. Coincidentally, we have the Asian financial crisis in 1997. The structure change test here is not designed to capture that effect. The market effect of the Asian financial crisis may not be relevant for this study as both depositary receipt and underlying security prices would be adjusted down at the same time.

$$Y_{i,j} = \eta_0 + \eta_1 Z_{i,j} + \eta_2 F_{i,j} + \eta_3 S_{i,j} + \eta_4 X_{i,j} + \eta_5 (S_{i,j} \times D_{i,j}) + \eta_6 (F_{i,j} \times D_{i,j}) + \varepsilon_{2i,j} \quad (6)$$

where

$D_{i,j}$ = 1 if the data are post 1997, and 0 if the data are before 1997; and $Y_{i,j}$, $Z_{i,j}$, $F_{i,j}$, $S_{i,j}$, $X_{i,j}$ are as defined in eq. (5).

To investigate the supply-side effect on DR premiums, this paper uses the *t*-statistic to examine Hypothesis 4: $\eta_1 = 0$. In eq. (6), the slope of the non-QFII foreign ownership ratio is η_2 before 1997, but becomes $(\eta_2 + \eta_6)$ post 1997. Similarly, the slope of the market value is η_3 before 1997, but becomes $(\eta_3 + \eta_5)$ post 1997. This paper uses the *t*-statistic to examine Hypothesis 3^{a1}:$\eta_2 = 0$ and Hypothesis 3^{b1}:$\eta_3 = 0$ to investigate the effect of investor sentiment factors on DR premiums before 1997. We also use a Wald test to examine Hypothesis 3^{a2}:$\eta_2 + \eta_6 = 0$ and Hypothesis 3^{b2}:$\eta_3 + \eta_5 = 0$ to investigate the effect of investor sentiment on DR premiums post 1997.

Table 6 reports the results of eq. (6), which investigates the DR premiums in relation to the structural change. The results of eq. (6) are shown in Panel A, and the results of the Wald test are exhibited in Panel B. As for the supply-side effect, DR premiums are shown to be inversely associated with the DR equity issued by

TABLE 6

Results of the Dummy Variable Model for 147 Observations[a]

Panel A: $Y_{i,j} = \eta_0 + \eta_1 Z_{i,j} + \eta_2 F_{i,j} + \eta_3 S_{i,j} + \eta_4 X_{i,j} + \eta_5 (S_{i,j} \times D_{i,j}) + \eta_6 (F_{i,j} \times D_{i,j}) + \varepsilon_{2i,j}$ (6)

	Constant	Z	F	S	X	(S × D)	(F × D)	R^2 (%)	Adj. R^2 (%)
Expected Sign		−	+	+	−	+	−		
Coefficient	19.1612***	−0.5562*	0.3393**	0.0048	−0.3460***	0.0092***	−0.4270***	26.25	23.10
T-values	4.5655	−1.6917	2.2727	1.3158	−3.5699	3.2381	−2.7887		

Panel B: Results of Wald test

Null Hypothesis	$\eta_2 + \eta_6 = 0$	$\eta_3 + \eta_5 = 0$
$\eta_2 + \eta_6$	−0.0877	
$\eta_3 + \eta_5$		0.0014
Chi-square (χ^2)	2.4773	19.4216***

***, **, * significant at 0.01, 0.05, and 0.1 levels, respectively.

[a]*T*-statistics are based on the White (1980) Heteroscedasticity-consistent standard errors.

$Y_{i,j}$ = the price difference ratio between the DR and underlying security for the *i*th firm on year *j* (%)

$Z_{i,j}$ = the percentage of equity issued as DRs for the *i*th firm on year *j* (%)

$F_{i,j}$ = the non-QFII foreign ownership ratio for the *i*th firm on year *j* (%)

$S_{i,j}$ = the logarithm of the market values (million NT dollars) for the *i*th firm on year *j*

$X_{i,j}$ = the QFII surplus for the *i*th firm on year j (%)

$D_{i,j}$ = Dummy variable, $D_{i,j} = 1$ since 1997, $D_{i,j} = 0$, otherwise.

Taiwanese firms. The coefficient associated with $Z_{i,j}$, the percentage of equity issued as DRs, is -0.5562. This is consistent with Hypothesis 4, which suggests that DR premiums are smaller for firms with a higher percentage of equity supplied in global markets via DRs.

For the investor sentiment effects, the coefficient associated with the non-QFII foreign ownership ratio before 1997, η_2, is 0.3393. This is statistically different from zero, indicating a positive relationship between DR premiums and investor sentiment. However, the results of the Wald test show that the slope ($\eta_2 + \eta_6$) is not significantly related to DR premiums post 1997. This suggests that while overseas investors prefer DRs issued by firms with higher non-QFII holdings before 1997, the preference does not remain after 1997. Another possible interpretation of the positive association between DR premium and non-QFII foreign ownership ratio is that large strategic foreign ownership might crowd out the number of shares available to portfolio investment foreign investors, leading to a large excess demand and premium. Similar discussions can be found in Dahlquist et al. (2003).

The results also show that the coefficient associated with the market value, η_3, is not significantly related to DR premiums before 1997. However, using the Wald test, the joint coefficient is significantly greater than zero. This indicates that firm size is positively associated with DR premiums post 1997, but not before, implying that overseas investors prefer DRs issued by large firms only after 1997.

The foreign demand function varies in different stages of market internationalization and development in Taiwan. The adjusted R^2 of eq. (6) is larger than that of eq. (5), which implies that eq. (6) fits better than eq. (5). Therefore, it is more appropriate to explain DR premiums in the context of a structural change model.

6.3 Sensitivity Test

By estimating eq. (6) with all 147 firm-year observations, the sample would include multiple firm observations for DRs issued prior to 1999. For example, DRs issued in 1994 would appear in the sample seven times, one for each of the years in our sample period (1994–2000). Thus, the estimate of eq. (6) may be biased because our sample includes more observations for DRs issued earlier in the sample period. To perform a robustness test, we estimate eq. (6) using only the thirteen firms for which we have observations during the entire period from 1995 to 2000. This results in seventy-eight firm-year observations. The results are consistent with the results of eq. (6) estimated using the full sample.

7. Conclusion

This paper documents the reasons for price discrepancies between DRs and their underlying securities for thirty-three Taiwanese companies under foreign ownership restrictions. In this sample, twenty-eight of the thirty-three firms have price difference ratios (difference between DRs and their underlying securities) exceeding a ± 2 percent bound. However, for those companies with DRs traded in dif-

ferent free entry markets, the price difference ratios of DRs in the two markets are within a ± 2 percent bound. Based on this observation, we conclude that the Taiwanese stock market is segmented from the international markets due to foreign restrictions.

We use panel data to investigate the effect of foreign ownership restrictions on DR premiums. The QFII surplus, our measure of foreign ownership restrictions, is inversely associated with the DR premiums. As the foreigners' demand for DRs decreases due to a relaxation in foreign ownership restrictions, the DR premiums become smaller. In addition, we explore the supply-side effect on DR premiums. We suggest that the outstanding shares of DR equity are inversely associated with the DR premiums.

Furthermore, this paper utilizes an investor sentiment hypothesis to investigate the other demand factor reflected to the DR prices. We use the breakpoint Chow test (1960) and find that a structural change in the relationship between the DR premiums and explanatory variables occurred in 1997. Thus, different investor sentiment factors are reflected in DR prices, which determine DR premiums. In other words, DR premiums are (are not) sensitive to non-QFII holdings before (after) 1997, and become more sensitive to firm size post 1997. The results indicate that the foreigners' demand functions vary in different stages of market internationalization and development.

In summary, this paper suggests that DR premiums are attributed to restrictions on foreign investment, DR supply, and investor sentiment factors.

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