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☐ **出席國際學術會議心得報告及發表之論文各一份**

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摘　　要

本研究以三種評價模式（即 Black-Scholes 模式、Constant Elasticity of Variance 模式及 Jump-Diffusion 模式）搭配三種波動性估計法（即歷史資料法、Parkinson 法、Garman and Klass 法），共七種方式來評估台灣認購權證之價格，並探討影響市價偏離理論價格之因素。

實證結果顯示，市價高於理論價格的情形相當明顯，在研究期間的 2,350 筆資料中，無論使用何種模式計算理論價格，正誤差（市價高於理論價格）比率均超過 80%，我們認為，由於認購權證之發行量有限，容易集中於少數人之手，產生獨占力，使市價偏離完全競爭之價格而偏高。本文以 Herfindahl Index 來衡量權證之持有集中度，檢定認購權證市場是否為一完全競爭市場，並驗證其對誤差程度之解釋能力。結果顯示，市場已偏離完全競爭，且市價高估之幅度與持有集中度呈正向關係，即持有集中度愈高，市價高估的情況愈嚴重。

此一市場結構對認購權證價格之影響在文獻中已有理論之證明，本文則在實證研究上首開先河。

An Empirical Analysis of the Market Structure and the Price Behavior of Warrants: The Case of Taiwan

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Abstract

The market of sponsored warrants has been increasing in popularity since its inception in June 1997. Most empirical research aiming at pricing accuracy of widely used option pricing models have found serious market overpricing. Since warrants are different from options in many ways, market overpricing may not be attributed to market inefficiency. Specifically, due to the limited supply of warrants, monopoly power may exist to a certain extent. Warrant prices may therefore be higher than their option counterparts which are priced under the assumption of perfect competition. Using Herfindahl index as a measure of the distribution of warrant holdings and hence the degree of monopoly power, we are able to draw concrete conclusions on the relationship between warrant overpricing on the market side and the magnitude of Herfindahl index. After controlling the possible influences of moneyness, liquidity and time to expiration suggested by the literature, we find strong evidence to support this hypothesis no matter whether time series, cross sectional, or pooled time series-cross sectional analyses are employed.

Keywords: warrant, Herfindahl index, moneyness, liquidity, price deviation

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I. Introduction

Local warrant market was created in June 1997, representing the very first exchange-traded derivative market for the local investors. The market started at slow and sluggish pace, but soared in late 1999 and continued into 2000 following the bullish turnaround of the stock market. As of May of 2000, 110 call warrants have been issued and traded. Trading value totaled NT$ 64 billion in 1999, which accounted for 0.2% of the trading value of the stock market. The market share increased to 0.7% for the first quarter of 2000 when the market recorded NT$ 118 billion in trading value. The warrant market not only grows fast in size but upgrades itself through innovative contract designs. We have seen warrants written on portfolios, warrants with reset clause, and warrants with cap provision, which move the market toward knowledgeable and sophistication oriented.

The development of the warrant market has also encouraged local academicians and practitioners to investigate the pricing accuracy as well as the market efficiency of the market. For example, Chen (1998) found significant overpricing in warrant premium using Black and Scholes (1973, BS thereafter) and constant elasticity of variance (CEV) types of pricing models. Lee (1999) also documented that 344 out of 396 samples showed positive deviation from BS type of pricing formulae.

It is questionable whether option pricing models serve as suitable frameworks for warrant pricing. For one thing, the supply of warrants is fixed while the open interest of options has no theoretical upper limit. It follows that market structure of warrants may well deviate from perfect competition which is assumed by option pricing models, and drift toward monopoly to a certain extent. Emanuel (1983) pointed out that sequential exercise may occur as opposed to block exercise when monopoly exists in the warrant market. Consequently, option pricing models based on block exercise tend to underprice warrants. Constantinides (1984) further documented that warrant price under block exercise and sequential exercise would be equal in a competitive equilibrium, but the equilibrium price would be lower than what would be prevail under a monopoly setting. Hunt (1985) applied the adjusted BS model developed by Galai and Schneller (1978) to empirically test warrant pricing and found better accuracy.

On the contrary, Spatt and Sterbenz (1988) proposed several barriers that may prohibit the formation of monopoly power in the warrant market. Examples are that the issuing companies are capable of reducing excess profits associated with

sequential exercise, that the other investors may provide certain counter-balance power against the monopoly, and that becoming the monopoly may be cost inefficient. But Spatt and Sterbenz (1988) concentrated on company warrants which were quite different from sponsored warrants (or third-party warrants) in the local market. Their conclusions may not be applied to explain the local phenomenon.

If the argument that monopoly power provides the intrinsic force for the overpricing of warrants relative to their option counterparts, then it is logical to search for a measure of monopoly power that serves to explain the degree of warrant overpricing. Herfindahl index has been widely used in measuring income distribution in economic researches. Dickson (1994) applied this index to explain possible cost reduction in Canadian food processing industry, which had significant implication for anti-trust issues. Cortes (1998) and Gisser (1999) are two additional examples that defined the degree of oligopoly or monopoly through Herfindahl index.

Turning to another frontier, both Santerre and Neun (1986) and Yeh and Lee (1998) applied the same index to measure the concentration of shareholding, and hence the degree of corporate control. Following the line, we shall use Herfindahl index to measure the deviation of warrant holding away from even distribution. Section II discusses how the index is calculated, and tests whether the index is significantly different from what it should be under the null hypothesis that warrant holdings are evenly distributed. Section III investigates the relationship between the warrant overpricing and the magnitude of Herfindahl index. Section IV concludes the paper with a short remark.

II. Herfindahl index and warrant holding

II.1 The calculation of Herfindahl index

Let S_i be the percentage of the number of outstanding warrants owned by *i*th investor, then Herfindahl index (H) is computed as

$$H = \sum_{i=1}^{N} S_i^2 \qquad (1)$$

where N is the number of warrant holders. On one extreme where a monopoly exists and owns all of the outstanding warrants, H = 1. On the other extreme where each investor holds just one unit of the warrant, $S_i = 1/N$, $H = N \cdot (\frac{1}{N})^2 = 1/N$, and H

asymptotically approaches zero when N approaches infinity.

Due to the difficulty associated with collecting the data of exact warrant holdings, we follow the methodology of Yeh and Lee (1998), and use the stratified data to calculate the index with equation (2)

$$H = \sum_{i=1}^{k} (S_j / n_j)^2 \cdot n_j \qquad (2)$$

where k = the number of brackets of warrant holding

n_j = the number of investors in jth bracket

S_j = the percentage of total warrant holding in jth bracket

In essence, we are assuming that n_j investors in the jth holding bracket hold exactly the same amount of warrants. Seven holding brackets are defined, namely, between one and 20 thousand units, between 21 thousand and 50 thousand units, between 51 thousand and 100 thousand units, between 101 thousand and 200 thousand units, between 201 thousand and 500 thousand units, between 501 thousand and one million units, and more than one million units.

II.2 The data

Daily data of warrant holdings for 42 issues of warrants that have at least 30 days till expiration are collected from December 4, 1999 to February 29, 2000. Data provider is the Taiwan Securities Centralized Depository Company which maintains the ownership records of all warrant issues. Our sample consists of 2350 daily data. Herfindahl index is computed by equation (2) for each warrant on each trading day. The average value of H is 0.015 while the standard deviation is 0.018. Sample maximum and minimum are 0.161 and 0.002, respectively. Table 1 provides the distribution of H of each warrant on each day and the distribution of time series average H of each warrant.

Table 1: The distribution of Herfindahl index

	The value of Herfindahl index				
	<0.005	0.005-0.01	0.01-0.05	0.05-0.1	>0.1
Number of warrant-days	592	878	762	114	4
Number of warrants	9	16	14	3	0

Notice that most individual and average values of the Herfindahl indices are between 0.005 and 0.01. The maximum of time series average H is 0.083, while the minimum is 0.003. Standard deviation of the average H is 0.017.

II.3 Testing competitiveness of warrant market

For each of the 42 warrants, we apply t-test to investigate whether its Herfindahl index is significantly different from the value under the null hypothesis of perfect competitive market. The results are tabulated in Table 2, which indicates strong rejection of perfect competitiveness.

Table 2: Test results of warrant market competitiveness

Serial no. of warrants	Time-series average of H	Standard deviation of H	Value of H of market is competitive	t-statistics
0519	0.0148	0.0000	0.000	22.1612
0520	0.0832	0.0001	0.000	74.9675
0521	0.0500	0.0003	0.000	21.3281
0522	0.0323	0.0000	0.008	30.1820
0523	0.0271	0.0001	0.000	20.4318
0524	0.0555	0.0012	0.002	12.2176
0525	0.0103	0.0000	0.000	22.4155
0526	0.0130	0.0000	0.000	79.9649
0527	0.0038	0.0000	0.000	20.0309
0528	0.0052	0.0000	0.000	17.5056
0529	0.0058	0.0000	0.000	41.5208
0530	0.0077	0.0000	0.000	22.3636
0531	0.0220	0.0001	0.000	13.1339
0532	0.0025	0.0000	0.000	33.3006
0533	0.0062	0.0000	0.000	18.4480
0534	0.0059	0.0000	0.000	25.3701
0535	0.0388	0.0000	0.000	133.8595
0536	0.0040	0.0000	0.000	90.4847
0537	0.0076	0.0000	0.000	26.5030
0538	0.0073	0.0000	0.000	56.3718
0539	0.0058	0.0000	0.000	58.6427
0540	0.0048	0.0000	0.000	24.5447
0541	0.0049	0.0000	0.000	33.4200

Table 2: Test results of warrant market competitiveness (continued)

Serial no. of warrants	Time-series average of H	Standard deviation of H	Value of H of market is competitive	t-statistics
0542	0.0060	0.0000	0.000	19.9602
0543	0.0049	0.0000	0.000	49.4232
0544	0.0179	0.0001	0.000	11.0349
0545	0.0038	0.0000	0.000	12.6789
0546	0.0105	0.0000	0.000	38.8795
0550	0.0103	0.0000	0.000	42.7963
0551	0.0075	0.0000	0.000	53.4299
0805	0.0273	0.0001	0.000	17.7258
0806	0.0037	0.0000	0.000	35.7474
0807	0.0363	0.0001	0.000	24.4269
0808	0.0063	0.0000	0.000	91.4353
0809	0.0074	0.0000	0.000	65.8268
0810	0.0116	0.0001	0.000	11.4504
0811	0.0049	0.0000	0.000	24.0064
0812	0.0078	0.0000	0.000	15.0348
0813	0.0097	0.0000	0.000	15.1775
0814	0.0188	0.0000	0.000	32.6850
0815	0.0066	0.0000	0.000	25.0227
0816	0.0085	0.0000	0.000	10.7867

III. The empirical relationship between warrant overpricing and Herfindahl index

III.1 Basic description of relevant data

All of our sample call warrants are American style and dividend protected. But this implies that all call warrants should not be exercised before expiration. Thus pricing models targeted at European options may be good benchmarks to judge the mispricing of warrants. Since Lauterbach and Schultz (1990) empirically supported the superiority of Cox'es (1975) CEV model and Kremer and Roenfeldt (1993) found that Merton's (1976) Jump-Diffusion model (JD) provided better accuracy for out-of-the-money options that are dividend protected and less-than-one-year to expiration, we therefore calculate benchmark prices with all of BS, CEV and JD models.

As to volatility measure of the underlying stocks, we use historical, Parkinson's high-low (HL) estimator and Garman and Klass'es high-low-open-close (HLOC)

estimator. On each pricing day, the volatilities are estimated using the relevant stock price data of the previous T years, where T equals the remaining life of the warrants to be priced.

Except for JD model whose volatility is calculated through a special formula (Beckers, 1981), both BS and CEV model prices are computed under all three types of volatility measures to arrive at seven different benchmark prices for each warrant on each day. Let W_{ijt} be the benchmark price of warrant j on day t produced by the ith model, W_{mjt} be the market price of the jth warrant on day t, the daily percentage deviation of market price of jth warrant from model price (PD_{ijt}) is calculated as

$$PD_{ijt} = \frac{W_{mjt} - W_{ijt}}{W_{ijt}} \qquad (3)$$

Since data synchronization is crucial to the empirical results (Cox and Rubinstein, 1985), we carefully check the time between the closing transactions of the warrants and their underlying stocks. Samples with time difference of closing transactions longer than one minute are deleted.

Both Black (1975) and Merton (1976) documented systematic pricing errors for deep-in-the-money and deep-out-of-the-money options. MacBeth and Merville (1979) discovered that BS model underpriced in-the-money options and overpriced out-of-the-money options. Therefore moneyness may be an important factor that contributes to PD's. Black (1975) and Merton (1976) also pointed out that BS values for options with less than three months to expiration tends to have systematic errors, too. MacBeth and Merville (1979) further identified the errors to be positive, i.e., BS model tends to overprice short-life options. Finally, the accuracy of option model price is subject to its market liquidity, as pointed out by Long and Officer (1997). The better the liquidity, the closer the model price and market price will be.

To accommodate for the possible explanatory power of moneyness, liquidity and time-to-expiration, we also collect necessary data to compute these three variables. Specifically,

$$\text{M = moneyness} = \frac{\text{daily price of the underlying stock} - \text{strike price}}{\text{strike price}} \qquad (4)$$

$$L = \text{liquidity} = \frac{\text{daily trading volume of warrant}}{\text{number of warrant outstanding}} \quad (5)$$

$$T = \text{time to expiration} = \frac{\text{number of days to expiration}}{365} \quad (6)$$

Table 3: Sample description of volatility, time to expiration, moneyness, liquidity and Herfindahl index

	Volatilty			time to expiration	moneyness	liquidity	Herfindahl index
	historical	HL	HLCO				
maximum	0.8435	0.5239	0.4974	1.5562	2.3390	0.526	0.1612
minimum	0.4271	0.3419	0.3274	0.0849	-0.1247	0.000	0.0017
median	0.5504	0.4330	0.4260	0.7041	0.4180	0.057	0.0075
mean	0.5448	0.4295	0.4167	0.6738	0.4805	0.079	0.0149
standard deviation	0.0760	0.0443	0.0403	0.2510	0.4109	0.070	0.0181

Table 3 tells us that on average, our sample warrants are 48.05% in the money, have about 0.6738 years (or 246 days) to expiration, and are traded quite actively with average turnover ratio 7.96%. Historical volatility on average is the highest among the three volatility measures, followed by HL and HLOC. All the other numbers are self-explaining.

Among the seven different model prices, we find that BS prices are higher than CEV prices, CEV prices in turn are higher than JD prices. Since market prices are higher than all the seven model prices, BS model, especially when historical volatility is used, enjoys the least underpricing relative to market prices. In other words, BS model with historical volatility (called BS1), though still underprices the warrants, is actually the best among all the seven models employed. Further investigation of BS1 is therefore warranted.

III.2 Price deviation of BS1 model

We further divide our samples according to the time to expiration, moneyness, liquidity and Herfindahl index of the warrants to allow us to take a closer look at how price deviations of BS1 model (BS1PD) behave among the subsamples. The results are shown in Table 4.

Table 4: The subsample characteristics of price deviation under BS1 model with historical volatility

	time to expiration			moneyness			liquidity			Herfindahl index		
range	[0, 0.5)	[0.5, 1)	[1,∞)	(-∞, 0)	[0, 0.5)	[0.5,∞)	[0, 0.05)	[0.05, 0.1)	[0.1,∞)	[0, 0.005)	[0.005, 0.01)	[0.01,1]
maximum	0.4064	0.4195	0.2689	0.4195	0.4134	0.1738	0.4195	0.4054	0.4134	0.4195	0.4134	0.3582
minimum	-0.2416	-0.1919	-0.0021	-0.0798	-0.1919	-0.2416	-0.1989	-0.2075	-0.2416	-0.1317	-0.1595	-0.2416
median	0.0127	0.0929	0.1099	0.2701	0.1182	0.0156	0.0704	0.0717	0.0632	0.1179	0.0966	0.0228
mean	0.0145	0.1075	0.1096	0.2484	0.1185	0.0101	0.0880	0.0875	0.0767	0.1261	0.1167	0.0248
standard deviation	0.1028	0.1066	0.0494	0.1159	0.0980	0.0653	0.1190	0.1062	0.1019	0.0974	0.1133	0.0895
% of samples with positive PD	61.66%	85.95%	98.23%	96.15%	89.56%	65.43%	80.93%	79.90%	80.57%	90.54%	84.97%	69.43%
number of samples	579	1658	113	156	1274	920	1059	627	664	592	878	880

Among 2350 effective samples, 1893 (or 80.56%) have positive price deviations which average to 8.47% of BS1 prices. The underpricing of BS1 model is more serious when the maturity is longer, the moneyness is smaller, and the Herfindahl index is smaller, but not much related to liquidity. The relationship between BS1PD and Herfindahl index seems to be contradictory to our intuition. But we cannot jump to this conclusion since other factors affecting price deviations are not controlled. To isolate the effect of Herfindahl index on price deviations, we then run a multiple regression which incorporates all the influential factors.

III.3 Pooled time series-cross sectional regression analysis

The literature has demonstrated that the time to expiration, moneyness and liquidity may cause market prices to deviate from model prices. Our regression (equation (7)) should therefore incorporate all these variables.

$$PD = \beta_0 + \beta_1 T + \beta_2 M + \beta_3 L + \beta_4 H + \varepsilon \qquad (7)$$

where M, L, T are defined as in equation (4), (5) and (6), and H is defined as in equation (2).

To avoid the contamination of possible multicollinearity on the coefficient estimates, we first check the correlation coefficient among the explanatory variables in equation (7). We find that H is significantly correlated with T (with correlation coefficient –0.2936), M (0.6200) and L (-0.2348). To correct the multicollinearity, we run a preliminary equation of H on M, L and T, and the substitute H in equation (7) with the estimate of residuals of the preliminary regression. The results are shown in Table 5.

As expected, β_1 is positive, indicating that the longer time to expiration, the larger the price deviation. Both β_2 and β_3 are negative, suggesting that the more in-the-money and the higher the liquidity, the less price deviation would be. As a warrant becomes more in the money, its value approaches the intrinsic value, other things being equal. Hence the positive price deviation becomes smaller. Higher liquidity reduces price discrepancy, other things being equal, which is consistent with Long and Officer's (1997) observation. Finally, we find significant positive relationship between price deviation and Herfindahl index, which supports our contention that the higher the Herfindahl index, the more monopoly power exists in the market, so that market prices of warrants get higher relative to their theoretical counterparts which

assumes perfect competition (i.e., H = 0).

III.4 Time series regression analysis

We are also interested to see whether PD of each and every warrant in our sample displays similar pattern as in Table 5. Regression (7) is thus applied to each of our 42 warrants following the identical procedure. Among these 42 regressions each with 56 observations (except for two warrants which have 55 observations only), about two thirds have positive coefficients for Herfindahl index. The coefficients of all the other explanatory variables are more or less consistent with Table 5 in sign. Table 6 provides a summary for these 42 regressions under three different pricing models.

Table 5: Empirical results of the pooled time series-cross sectional regressions

Pricing model	regression coefficient					Adjusted R^2
	β_0	β_1(T)	β_2(M)	β_3(L)	β_4(H)	
BS1	0.1037 **(0.0000)	0.0841 **(0.0000)	-0.1312 **(0.0000)	-0.1587 **(0.0000)	0.2609 *(0.0481)	0.3693
BS2	0.1205 **(0.0000)	0.2332 **(0.0000)	-0.2049 **(0.0000)	-0.2809 **(0.0000)	0.4176 **(0.0061)	0.6037
BS3	0.1298 **(0.0000)	0.2359 **(0.0000)	-0.2151 **(0.0000)	-0.2791 **(0.0000)	0.4870 **(0.0020)	0.6039
CEV1	0.3106 **(0.0000)	0.3139 **(0.0000)	-0.4372 **(0.0000)	-0.2925 **(0.0001)	1.7810 **(0.0000)	0.4599
CEV2	0.3266 **(0.0000)	0.3184 **(0.0000)	-0.4557 **(0.0000)	-0.3351 **(0.0000)	2.0036 **(0.0000)	0.5124
CEV3	0.3269 **(0.0000)	0.3193 **(0.0000)	-0.4567 **(0.0000)	-0.3354 **(0.0000)	1.9972 **(0.0000)	0.5154
JD	0.3882 **(0.0000)	0.3630 **(0.0000)	-0.5170 **(0.0000)	-1.6526 **(0.0000)	4.7780 **(0.0000)	0.5140

numbers in parentheses are p-values

* significant at 5% level

** significant at 1% level

Durbin-Waston d statistics do not reject the null hypothesis that the variables are serially uncorrelated. However, White's general heteroscedasticity test does reject homoscedasticity. Furthermore, residual variances are found to be correlated with T and M. As a remedy, we divide equation (7) by TxM to correct for heteroscedasticity and find the coefficient of H (i.e., β_4) still significantly positive. When White's heteroscedasticity-corrected variances and standard errors method is applied to equation (7), the resulting p-values are very close to those shown in the above Table.

III.5 Cross sectional regression analysis

As a final analysis, we shall attempt to examine whether on each day, our 42 sample warrants display similar patterns of price deviations compared to the results of Table 5. Since there are 56 days in our sample period, we then run 56 regressions on equation (7), each having 42 sample points (except for two days in which there are only 41 observations). The results are summarized in Table 7.

Table 6: Empirical results of the time series regressions

Pricing model	statistics	regression coefficients					Adjusted R^2
		β_0	β_1(T)	β_2(M)	β_3(L)	β_4(H)	
BS1	mean	0.4327	-0.1557	-0.2048	-0.0663	1.6715	0.5648
	median	0.1873	-0.0759	-0.0878	-0.0987	1.5905	0.5796
	standard deviation	1.3540	0.4266	0.5261	0.8309	15.5841	0.2741
	% consistent with Table 5	76.19%	40.48%	69.05%	57.14%	66.67%	
CEV1	mean	0.6343	0.0235	-0.8830	0.0170	0.8714	0.6852
	median	0.3691	0.0792	-0.6259	-0.1621	2.1911	0.9012
	standard deviation	1.8810	1.5984	1.1226	0.9923	16.3212	0.3584
	% consistent with Table 5	78.57%	64.29%	85.71%	57.14%	61.90%	
JD	mean	0.5620	0.0897	-0.9279	-0.3690	5.4449	0.8303
	median	0.3634	0.1106	-0.5188	-0.2346	3.0622	0.9331
	standard deviation	1.6490	1.3198	1.0910	1.4143	25.6065	0.2627
	% consistent with Table 5	76.19%	69.05%	83.33%	64.29%	66.67%	

Durbin-Waston d statistics do not reject the null hypothesis that the residuals are serially uncorrelated. Homoscedasticity is not rejected by White's general heteroscedasticity test, either.

Again we find that more than 80% of the regression coefficients of H under CEV1 and JD models are consistent with Table 5. The percentage is somewhat lower (only 58.93%) for BS1 model. The coefficients of all the other three explanatory variables are also highly consistent with Table 5 and need not be explained any further. Comparing Table 6 with Table 7, we see that cross sectional analyses obtain better results than time series counterparts. For example, for all 56 trading days in our sample, the coefficients of moneyness are 100% negative. But only 29 out of 42

warrants display this type of negative relationship over the sampling period. The average coefficients of H in Table 7 are smaller than in Table 6, but still positive.

Table 7: Empirical results of the cross sectional regressions

Pricing model	statistics	regression coefficients					Adjusted R^2
		β_0	β_1(T)	β_2(M)	β_3(L)	β_4(H)	
BS1	mean	0.2546	0.0874	-0.1438	-0.2079	0.0759	0.3587
	median	0.1052	0.0891	-0.1269	-0.1433	0.2391	0.3654
	standard deviation	1.1418	0.0264	0.0496	0.3358	0.6814	0.0796
	% consistent with Table 5	98.21%	100.00%	100.00%	66.07%	58.93%	
CEV1	mean	0.4462	0.3039	-0.4445	-0.3390	0.5119	0.4986
	median	0.3242	0.2533	-0.3752	-0.4004	1.0799	0.5453
	standard deviation	1.1225	0.1342	0.1467	0.7045	2.1418	0.1484
	% consistent with Table 5	94.64%	100.00%	100.00%	75.00%	80.36%	
JD	mean	0.5622	0.3420	-0.5090	-2.4795	2.0858	0.4797
	median	0.4108	0.2934	-0.4576	-2.2806	2.3841	0.5484
	standard deviation	1.1058	0.1496	0.1683	1.6377	1.9056	0.1614
	% consistent with Table 5	100.00%	100.00%	100.00%	98.21%	83.93%	

Durbin-Waston d statistics do not reject the null hypothesis that the residuals are serially uncorrelated. Homoscedasticity is not rejected by White's general heteroscedasticity test, either.

IV. Concluding remarks

The market of sponsored warrants in Taiwan has come into place since June 1997. The ever-increasing popularity of this new type of financial products raises our concerns about the accuracy of the market prices. Due to the limit supply of warrants, their prices may deviate from those of otherwise identical options whose open interests have no upper limits theoretically. The more uneven the distribution of warrant holdings is, the more monopoly power will exist, and the further away warrant prices will deviate from the option counterparts.

We empirically test this hypothesis using Herfindahl index as a measure of warrant distribution and hence the extent of market monopoly. After controlling all the other influential factors documented in the literature, such as moneyness, liquidity and the time to expiration, we find significant positive relationship between price deviations and Herfindahl index. The results are similar for time series, cross sectional and pooled time series-cross sectional analyses.

As an immediate implication, investors should be cautious about the outstanding size of the warrant issues and the distribution of the warrant holdings before trading. Option pricing models in any form may not be an accurate tool for warrant pricing. Finally, regulators should pay attention to the changes in warrant holding so that potential excess monopoly power can be avoided.

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行政院國家科學委員會補助國內專家學者出席國際學術會議報告

89 年 8 月 24 日

報告人姓名	李存修	服務機構及職稱	國立台灣大學財金系教授
會議時間地點	民國 89 年 8 月 18 日至 20 日 馬來西亞吉隆坡	本會核定補助文號	NSC 89-2416-H-002-014
會議名稱	(中文)第一屆國際金融與財務研討會：問題與對策 (英文)First International Conference on Banking and Finance: Issues and strategies.		
發表論文題目	(中文)所有權集中之情況下公司價值與家族持股之研究 (英文)Family Shareholding and Corporate Value in Concentrated-Ownership – structure Environments.		

報告內容應包括下列各項：

一、參加會議經過

見附件

二、與會心得

見附件

三、考察參觀活動(無是項活動者省略)

無

四、建議

見附件

五、攜回資料名稱及內容

見附件

六、其他

無

出席國際會議報告書

會議：First International Conference on Banking and Finance :

Issues and Strategies

主辦單位：The Northern University of Malaysia

(Universiti Utara Malaysia)

The International Journal of Finance

Kuala Lumpur Stock Exchange

地點：Hotel Nikko, Kuala Lumpur, Malaysia

時間：18-20, August, 2000

報告人：

一、 參加會議經過

由於亞洲金融風暴的衝擊與各國陸續爭取加入世界貿易組織（WTO）的影響，亞洲開發中國家的財務金融與經濟環境已經產生結構性的變動。為了順應這些衝擊與影響，亞洲各國皆針對財務金融與經濟結構進行某種程度的改革、重整與自由化政策。而相關政策的議題已受到各國產、官、學界熱烈的討論與分析，其一致的目標乃是希望增加金融市場與機構的作業效率與資訊透明度。有鑑於此，The Northern University of Malaysia（Universiti Utara Malaysia）的財務金融學院（School of Finance and Banking）乃結合澳洲 Monash University （Melbourne）的 Mohamed Ariff 教授與 International Journal of Finance 的主編 Dilip K. Ghosh 教授共同規劃本次國際性的研討會，其包括：Doctoral Symposium、Academic Sessions

與 Practice Sessions。Doctoral Symposium 包括 5 個場次，大會邀請著名期刊的編輯 Malatesta 教授（Journal of Financial and Quantitative Analysia，University of Washington）、Black 教授（Financial Review 前任編輯，University of Tennessee）、Walking 教授（Journal of Finance、JFQA、Financial Review 副編輯）與 Clark 教授（European Journal of Finance 編輯，英國 Middlesex University）擔任主持人，而所發表的 12 篇文章中有 11 篇是馬來西亞各大學所發的（另一篇為澳洲 Monash 大學），可見大會主要的用意是想透過這些著名期刊的編輯提供修改建議，以利所發表的文章未來能在國際期刊發表。而 Malatesta 教授所發表題目為「博士論文的進行過程與結構」，其對於博士生論文品質的提昇有著莫大的助益。這些立意，筆者認為相當具有開創性與功效，可協助提昇馬來西亞財務金融學術界的研究能力與知名度。

Academic Sessions 共包括 30 個場次，共發表 119 篇文章。各個場次的主題相當廣泛與完整，其涵蓋公司理財、資本結構、股權結構、股利政策、銀行管理與創新、貨幣危機與貨幣同盟、合併與收購、衍生性商品、回教國金融機構管理、市場微結構、國際證券市場、股票報酬、歐洲整合、境外銀行業務與管理，以及馬來西亞財務金融新世紀相關議題。本次大會的論文發表人共來自加拿大、USA、墨西哥、智利、UK、法國、德國、台灣、香港、泰國、馬來西亞、新加坡、印度、斯里蘭卡、阿拉伯聯合大公國、埃及與澳洲等國家的學者參與，堪稱是馬來西亞學術界的一大盛事。

Practice Sessions 共包括 8 個場次，其主題包括：吉隆坡證交所的結構與功能、國際化發展的管制與監督、金融風暴期間銀行資本重組、馬來西亞之銀行的機會與挑戰、埃及交易所的結構與功能、美國與新興國家的共同基金市場、馬來西亞固定收益證券的投資等。這些議題的內容與馬來西亞的財務金融未來發展相當契合，吸引許多馬國的實務界人士參與。

值得一提的是，M. H. Bouchet（The Head of CERAM's Global Finance

Chair）所發表的「Revisiting the Asian Financial Crisis: Were Capital Markets Caught by Surprise ?」一文，作者利用選擇權評價模式與 Clark（1991）總體經濟市場價值估計法，來分析印尼、馬來西亞與菲律賓的金融危機。作者認為當總體經濟市場價值所隱含的波動性愈大，則金融危機產生的機率愈高。筆者認為此篇文章在觀念上具有創新性，然而在研究方法與設計仍有相當大的發展空間。

另外，Clark 教授的「Political Risk in Taiwan： Valuing the Doubly Stochastic China Factor」令筆者獲益良多。Clark 教授為國際學術界第一個將政治風險量化的學者，他修正自己在 1997 與 1998 年所發表的文章，提出新的估計政治風險的模型：The Real Options Model of Heterogeneous Political Risk，並利用 The Doubly Stochastic Process 與 The Bayesian Updating Process 來估計。並且利用此模型來估計中國大陸對於台灣所產生的政治風險，提供外國公司對台灣直接投資的評價與參考。

筆者文章在股權結構與公司價值（Ownership and Value）場次發表，題目為「Family Shareholding and Corporate Value in Concentrated-Ownership-Structure Environments」，其乃探討在股權結構集中的環境下控制家族的持股對於公司價值的影響。此篇文章的貢獻在於提出一個新的股權結構衡量指標 Excess Control of Family Shareholding（ECFS），它的定義為最大家族持股比率減掉公司臨界控制股權比率；ECFS 考慮了每家公司股權結構的差異性，其為一個相對衡量指標，有別於過去任意決定的絕對指標（例如：20%）。而且 ECFS 對於公司價值的影響存在著 piece-wise 的關係，而過去文獻所使用的股權結構指標皆未發現有此種關係存在。本文的結論發現在 ECFS 介於 0%到 15%之間（亦即控制家族持股比率相對較低的公司），ECFS 與公司價值呈現負向關係。評論人 Jain 教授（Alabama A&M University）和與會人士皆肯定本文的貢獻，亦提出一些具有建設性的意見，例如：公司價值改用股票報酬、Market Value Added（MVA）、

Economics Value Added（EVA）來衡量。

二、 與會心得

參與本次會議的心得，如下所述：

1.本次會議的 Doctoral Symposium 邀請國際著名期刊的編輯來當主持人，他們所提供的建議有利於馬來西亞學者提出的文章在國際期刊上發表；其對於馬來西亞財務金融學界的研究能力與知名度的提昇有很大的助益。

2.本次會議發表的接受函直到 7 月 13 日來通知作者，而評論人直到 8 月 9 日才接到通知，整個會議議程直到 8 月 16 日才在網路上發佈。由於主辦單位的缺失，讓許多場次的評論人無法事先獲得評論文章，亦有一些場次的發表人未參與會議。而且本次大會亦未提供與會人士的 Email，較不利於往後的溝通。

3.筆者能獲得補助參與此次會議收獲良多，特別是 Bouchet 教授利用總體經濟市場價值的隱含風險來衡量金融危機發生的機率，Clark 教授發展出 Real Options Model of Heterogeneous Political Risk 來估計政治風險。筆者有幸參與此次會議，對於目前財務學界的研究主題與方向，有著相當程度的瞭解。世界各國財務學者的研究主題，日新月異；而且知識的整合與應用，亦日益密切。因此，筆者鞭策自己必須不斷吸收財務新知與經常參加國際學術研討會發表文章。

4.本次大會共計有 131 篇學術論文發表（30 場次 Academic Sessions 與 5 場次 Doctoral Symposium），8 場實務場次，共來自世界 17 個國家的學者參與，可見主辦單位舉辦國際性會議的企圖。

三、 建議

參與此次會議的建議，如下所述：

1.往後台灣各大學或學會要舉辦國際研討會，可邀請國際著名期刊的編輯來當主持人，並且由他們提供建議，以利台灣財務金融學者投稿國際著名期刊。

2.往後台灣各大學或學會舉辦國際研討會應該要事先有良好的規劃，並且儘早通知論文發表人、評論人與主持人，而且議程應該儘早在網路上發佈。論文接受函應該在二個半月前通知，評論人、主持人在一個半月前通知，完整的議程應在一個月前公佈。而且主辦單位應該提供與會人士的名單與 Email，以利於往後的溝通與討論。

3.可利用 Clark（1997、1998、2000）的模型來衡量中國大陸對於台灣的政治風險，並且分析此政治風險對於兩岸三地股市（台灣、香港、上海、深圳）的影響與衡量它們之間的互動關係。

4.有關亞太地區證券市場、外匯市場、公司理財、投資學與衍生性金融商品的研究，已受到國際學術界的重視。因此若能針對台灣、亞太與世界證券市場進行比較研究，其成果將有可能被國外著名期刊所接受。

5.往後台灣各大學或各學術研究機構在舉辦國際研討會會，可與亞太財務學會、PACAP 以及其他跨國性的學會合辦，並積極提昇與會論文與演講的品質，以提昇國內學術研究水準。

6.國科會與教育部應積極補助學者參出席國際會議，使得國內學者能有機會與國際學者交流，並獲得寶貴的建議與合作機會。

7.建議教育部電子計算機中心的 AREMOS 資料庫，能購買美國與亞太地區證券市場的個別公司資料庫，以利研究之進行。

四、　攜回資料名稱

1、 Conference Program Book

2、 Book of Abstracts

3、 筆者參與場次的部分論文

BANKING AND FINANCE:

Issues and Strategies

Petronas Twin Towers

Venue: Hotel Nikko, Kuala Lumpur
Dates: 18 – 20 August 2000

Organized by:

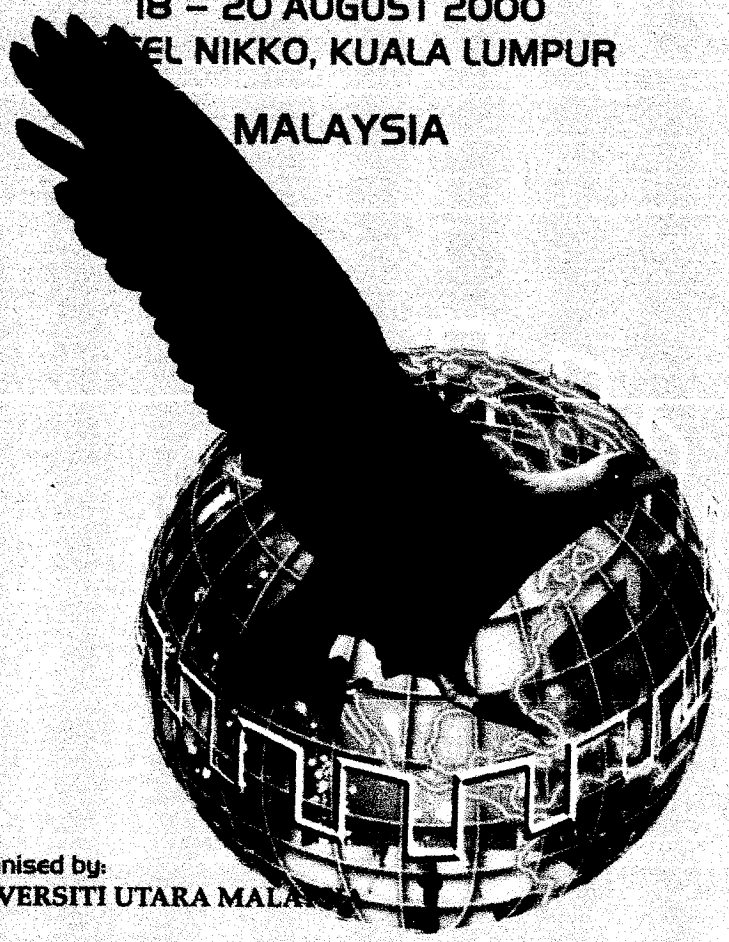
UNIVERSITI UTARA MALAYSIA
(NORTHERN UNIVERSITY OF MALAYSIA)

1st International Conference on Banking and Finance:

Issues and Strategies

BOOK OF ABSTRACTS

18 – 20 AUGUST 2000
EL NIKKO, KUALA LUMPUR
MALAYSIA



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FIRST INTERNATIONAL CONFERENCE ON BANKING AND FINANCE: ISSUES AND STRATEGIES

It is our distinct privilege and high honor to welcome you in our *First International Conference on Banking and Finance: Issues and Strategies* in the capital city of Kuala Lumpur, Malaysia in this nascent millennium. With copious assistance from the members of our secretariat and blessings of the Administration of *Universiti Utara Malaysia* we have come this far. We hope your presence and participation take us ahead and provide further push to our interest to move forward with reflective mind and deliberative intellect. We sincerely like you to interact with each other and enjoy the ambiance of academic excellence and professional serenity in this magnificent city of joy and towering elegance.

Dilip K. Ghosh, Chair
Mohamed Ariff, Chair

First International Conference on Banking and Finance: Issues and Strategies

CONFERENCE PROGRAM

		08:00 – 09:30 am 5 Parallel Sessions (academic)	08:00 – 09:30 am 5 Parallel Sessions (academic)
		09:30 – 09:45 Break	09:30 – 09:45 Break
		09:45 – 11:00 Opening Ceremony Address by Guest of Honour	09:45 – 11:00 Keynote Address
		11:00 – 11:15 Refreshment	11:00 – 11:15 Refreshment
		11:15 – 12:30 pm 3 Parallel Sessions (Practice)	11:15 – 12:30 pm 3 Parallel Sessions (Practice)
		12:30 – 02:00 Lunch	12:30 – 02:00 Lunch
		02:00 – 03:30 5 Parallel Sessions (academic)	02:00 – 03:30 5 Parallel Sessions (academic)
02:30 – 3:15 Doctoral Symposium (General Session)		03:30 – 03:45 Coffee Break	03:30 – 03:45 Coffee Break
03:15 – 03:30 Coffee Break		03:45 – 05:15 5 Parallel Sessions (academic)	03:45 - 05.15 5 Parallel Sessions (academic)
03:30 – 05:30 Doctoral Symposium 4 Parallel Sessions		08:00 – 10:00 Dinner (all participants & guests)	05:45 CONFERENCE ENDS
05:30 – 06:00 Doctoral Symposium (Summing Up Session)			
06:00 – 07:30 Reception at Petronas Twin Tower			
08:00 – 09:00* Protem Meeting of ISBF			

* Invited members.

3:45 – 5:15 pm
Session 20: **Lotus Room**

Taxes in Financial Transactions

Chair: Sudin Haron, *Universiti Utara Malaysia*

- *Taxation, Transfer Pricing and Multinational Operations: Policies and Strategies*
  Lawrence W. Nowicki, *Long Island University, USA*

- *Tax Effects in Treasury Bond Pricing*
  Ron Filante, *Pace University, USA*
  P. V. Viswanath, *Pace University, USA*
  Jayant Pandit, *Pace University, USA*

- *The Ex-Distribution Day Trading Effects of Employee Shares in the Chinese Stock Market*
  Cherry C. Chen, *Chinese University of Hong Kong, SAR China*

- *Estimating the Size and Determinants of Tax Evasion in Malaysia*
  Jeyapalan Kasipillai, *Universiti Utara Malaysia*

Discussants:

- **Sungsoo Kim,** *Rudgers University, USA*
- **Cherry C. Chen,** *Chinese University of Hong Kong, SAR China*
- **Che Ani Mad,** *Universiti Utara Malaysia*
- **Lawrence W. Nowicki,** *Long Island University, USA*

*****

3:45 – 5:15
Session 21: **Orchid Room**

Ownership and Value

Chair: Rohit Jain, Alabama A & M University, USA

- ***Wealth Creation and Managerial Pay: MVA and EVA as Determinants of Executive Compensation***
  Ali Fatemi, *DePaul University, USA*
  Anand S. Desai, *Kansas State University, USA*
  Jaffrey P. Katz, *Kansas State University, USA*

- ***The Level of Managerial Ownership, Leverage and Dividend Policies: Hong Kong Evidence***
  Rohit Jain, *Alabama A & M University, USA*
  Kam-wah Lai, *City University of Hong Kong, SAR China*

- ***Performance Difference in Privately-Owned Versus State-Owned Banks: An International Comparison***
  Marcia Million Cornett, *Southern Illinois University at Carbondale, USA*
  Shahriar Khaksari, *Suffolk University, USA*
  Hassan Tehranian, *Boston College, USA*
  Lin Guo, *Suffolk University, USA*

- *Family Shareholding and Corporate Value in Concentrated-Ownership Structure Environments*
  Yin-Hua Yeh, *Fu-Jen University, Taiwan*
  Tsun-Siou Lee, ~~*Fu-Jen University, Taiwan*~~ National Taiwan University
  Yu-Huui Su, ~~*Fu-Jen University, Taiwan*~~ Soochow University, Taiwan

Discussants:

- **Shahriar Khaksari,** *Suffolk University, USA*
- **Shekar Shetty,** *Henderson State University, USA*
- **Chee Ng,** *Fairleigh Dickinson University, USA*
- **Rohit Jain,** *Alabama A & M University, USA*

*****

THE STABILITY OF AUSTRALIAN INDUSTRY BETAS

Wong Chin Shan
Curtin University of Technology

Lakshman Alles
Curtin University of Technology

This paper examines whether Australian industry betas are stable within a five year estimation period or whether they are more consistent with a Hildreth-Houck (1968) type random coefficient model. Results show that the 5-year estimation rule for a constant beta can be applied only to certain industries. The majority of industry betas were found to be unstable, and more so over the October 87 stock market crash period. The beta unstable industries were identified within sub-sample periods, and inter-period comparisons suggested a persistent effect of the October stock market crash. With the October crash period excluded, increasing the sample length was generally associated with an increasing degree of beta instability. The normality assumption was also reviewed for the random coefficient model.

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TRADING VOLUME AND FUTURES PRICE: EVIDENCE FROM MALAYSIAN STOCK INDEX FUTURES MARKET

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This paper investigates the relationship between price and trading volume in the stock index futures period, the market in Malaysia in 1995 to December 1999. For the overall linear Granger causality tests indicate the presence of bi-directional feedbacks between volume and futures prices. Return is found to be more significant to Granger caused volume at 1 percent level than the opposite which is also significant. However, only unidirectional feedback is detected from the nonlinear GARCH model, running from futures prices to volume. Therefore,

when nonlinearity is accounted for, futures prices have valuable information content for volume prediction. The results for the sub-periods, however, are not conclusive for the linear method. Only the second sub-period is found to show a significant bidirectional relationship while the first and third sub-periods exhibit evidence of independent between the variables. On the other hand, tests of nonlinearity for the three sub-periods yield the same findings, i.e. futures prices possess a significant predictive ability of volume particularly during the currency turmoil. Although the findings for the two approaches are inconclusive, this study detects some elements of hedging practice using futures market in Malaysia.

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FAMILY SHAREHOLDING AND CORPORATE VALUE IN CONCENTRATED-OWNERSHIP-STRUCTURE ENVIRONMENT

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Because company ownership structures of many countries are highly concentrated in controlling families as opposed to diverse ownership structures, it is mportant to e-examine the relationship between ownership structure and corporate value. Highly concentrated ownership can allows controlling families to expropriate minority shareholders' interests. In this study, we focus on companies listed in Taiwan, a typical family control environment, to measure the impact of family ownership on corporate value. In order to consider the differences in ownership structure and controlling power of the largest families simultaneously, we rest the impact of excess control of family share holding and corporate performance. Our results conform a non-economic relationship between excess of family shareholding and corporate value.

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Family Shareholding and Corporate Value in Concentrated-Ownership-Structure Environments

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Abstract

Because company ownership structures of many countries are highly concentrated in controlling families, as opposed to diverse ownership structures, it is important to re-examine the relationship between ownership structure and corporate value. Highly concentrated ownership can allow controlling families to expropriate minority shareholders' interests. In this study, we focus on companies listed in Taiwan, a typical family control environment, to measure the impact of family ownership on corporate value. In order to consider the differences in ownership structures and controlling power of the largest families simultaneously, we test the impact of excess control of family shareholding (ECFS) on corporate performance. Our results confirm a non-monotonic relationship between excess control of family shareholding and corporate value.

Keywords: family shareholding, corporate value, agency theory, Taiwan

JEL classification: G32; G34

1. Introduction

Research on ownership structure and corporate valuation under the presumption of dispersed ownership was originated by Berle and Means (1932). They showed that diffuse ownership places significant power in the hands of managers whose interests do not necessarily coincide with the interests of shareholders (see also Jensen and Meckling, 1976; Shleifer and Vishny, 1986). However, there is evidence indicating that when the shareholding of managers exceeds a certain percentage of total outstanding shareholding can harm market valuation, thus supporting the management entrenchment hypothesis (Morck, Shleifer and Vishny, 1988; Stulz, 1988).

However, under the environment in which ownership is concentrated in the hands of controlling shareholders, the shareholding of the professional managers are very small. Therefore, conflicts of interest may exist between the controlling shareholders and the minority shareholders (Shleifer and Vishny, 1997; La Porta, Lopez-de-Silanes, and Shleifer, 1999). The highly concentrated ownership structure is popular among family controlled companies. Thus, examination of the shareholding of the controlling families, and not those of the managers is necessary in order to measure the impact of ownership structure on corporate valuation.

Classens, Djankov and Lang (1999 a) showed that large families reign over more than half of East Asia's corporations. Although family controlled companies are the prevailing economic organizations in Asia, Zingales (1994), Kunz and Angel (1996), Rydqvist (1996), Taylor and Whittred (1998), and Smith and Amoako-Adu (1999) also documented evidence of concentrated ownership by families in Europe, Australia and Canada. La Porta et al. (1999) further indicated that even the largest firms in approximately twenty-seven wealthy economies tend to have controlling shareholders, and that among these, shareholders tend to

be family members or state agencies, with the majority being family members[1].

Taiwan market is a typical exemplar of family control. Surveys by Semkow (1994) and Chou, Chen and Chen (1996) confirmed that typical Taiwanese listed companies are characterized by high concentrations of stock in the hands of large family groups. Management is also rarely separated from firm ownership, with shareholding controlled by board members and top executives to a significantly higher degree than that of their counterparts in Japan and the United States[2] (Chou et al., 1996; Kaplan, 1994ab). Yeh and Lee[3] (1999) indicated that, the ownership structures and board compositions typical of Taiwan firms are also observed among East Asian firms, as well as firms in many other countries.

Mok, Lam and Cheung (1992) suggested that a controlling family exerts its control by arranging for family members to play either prominent roles on boards or to hold top executive positions. The central agency problem defined by Shleifer and Vishny (1997), as well as by La Porta et al. (1999), predicts that controlling family members, in pursuing their own interests, might take advantage of minority shareholders, and that these conflicts of interest do not stem from managers without equity ownership, but rather from the tendency of controlling shareholders to expropriate minority shareholder interests.

Because ownership structures are largely controlled by family members in most Asian economies, empirical evidence of the relationship between Asian companies' ownership structures and corporate performances will provide insightful contents in this line of research. Thus this study explores the relationship between family ownership and corporate

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[1] In order to solidify their dominance in firms, the controlling family lever control through pyramidal ownership structure, cross-shareholdings (La Porta et al., 1999), and interlocking directorate (Mok et al., 1992).

[2] The surveys of Kaplan (1994 a, b), Chou et al. (1996) showed that only 12.2% and 22.6% of the Japanese and U.S. listed companies of which senior managers hold more than 0.5% of shares, respectively. In contrast, this percentage in Taiwan was 91.1%. Moreover, board members of these companies in total hold more than 28.24% of shareholding on average, markedly higher than that of their Japanese and U.S counterparts.

[3] According to Yeh and Lee (1999), family controlled companies consist of 76% of all listed companies in Taiwan, and 57.6% of those family controlled companies are with more than half of board seats hold by the controlled family members.

performance by using a sample consisting of Taiwan listed companies to provide empirical evidence of the impact of concentrated ownership conditions.

We derive a new measure of excessive family shareholding control to capture the complexity of family shareholding. In family controlled companies, the controlling family possesses significant rights in terms of control and cash flow, however, differing ownership structures in family controlled companies might incur different central agency problems. In order to examine the types of family controlled companies incurring severe central agency problems and shrinkage of corporate value, we use the excess control of family shareholding (ECFS) to test effects on corporate performance. Excess control of family shareholding is defined herein as the controlling family's shareholding in excess of the critical control level, and enables us to consider structural ownership and control power characteristics of the largest family in each company simultaneously. By definition, when the shareholding of the largest shareholder exceeds a certain critical control level proposed by Cubbin and Leech (1983) and Leech (1987 a b), the largest shareholder gains a significant control over the company. We found that the explanatory power of this new variable on performance to be stronger than other indicators commonly used in the previous studies[4]. Excessive shareholding by controlling families, not the shareholding of board members, is closer to the practices of Asian family controlled companies.

McConnell and Muscarella (1985) and Chan, Martin and Kensinger (1990) found evidence to support the hypothesis that investment affects corporate value. Cho (1998) investigates how ownership structure influences investment expenditures. The present study further examines the relationship between family ownership and investment in order to understand the influence of investment expenditures on the relationship between ownership structure and corporate performance.

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[4] Mok et al. (1992) employed the family shareholding to proxy ownership structure, while Morck et al. (1988), Cho (1998) adopted the shareholding of board of directors to measure an insider's ownership.

Our major results indicate that when the shareholding of a company's largest family are smaller than the critical controlling shareholding level (ECFS < 0%) the company is widely held, that is, owned by several families or institutional investors, and no one has a controlling interest. Monitoring among the shareholders prevents the largest shareholder from expropriating the value of the company from minorities. This explains why there is a positive correlation between the shareholding of the largest shareholder and the corporate value.

When the shareholding of the largest family exceeds the critical controlling level, the controlling family has significant control over company decisions, and has the power to undertake actions prejudicial to the interests of minority stockholders. During the stage in which the shareholding of controlling family are still small (0% < ECFS < 15%), the incentive for the controlling family to expropriate the minority stockholders is strong. This explains why there is a negative correlation between the shareholding of the largest shareholder and the corporate value. It is worth noting that as ECFS increases, R&D and advertising expenditures decrease, and that the R&D and advertising expenditures of these companies is lower than those of other companies

When the excess control of family shareholding is beyond certain level (that is, ECFS > 15%), the incentive for majority shareholders to expropriate minority shareholders decreases due to a gradual convergence of interests between the controlling family and minority shareholders. Thus, the correlation between controlling family shareholding and the corporate value is not negative.

This paper not only tests the relationship between ECFS and corporate value, and between ECFS and investment decisions, but also the relationship between ex ante ECFS (1994-1995) and ex post (1996-1997) corporate valuations and investment expenditures in order to enhance the robustness of the empirical results. The remainder of this paper is structured as follows. Section 2 summarizes the existing literature on ownership structure

and corporate value. Section 3 describes our empirical methodology, including our data sample, construction of variables, and empirical model. Section 4 presents the basic sample statistics. Section 5 discusses empirical results concerning the relationship between ownership concentration structure and corporate value, and our robustness tests. Section 6 concludes the paper.

2. Literature Review

2.1 Ownership Structure and Corporate Value Assuming Widely Dispersed Ownership Structure

The impact of ownership structure (e.g. managerial or institutional equity ownership) on corporate value has been widely debated in the literature. Jensen and Meckling (1976) indicated that agents or managers have incentives to pursue activities, while serving their own interests, which may be detrimental to the principals (shareholders). While a higher level of management shareholding implies a large sharing of any losses and ultimately a lower likelihood that management will hurt corporate value, thus giving rise to the convergence-of-interest hypothesis

In contrast, Demsetz (1983) identified the offsetting costs of managerial ownership and argued that increased managerial shareholding can result in reduced corporate value, thus giving rise to the managerial entrenchment hypothesis. The managerial entrenchment hypothesis states that a low level of managerial shareholding may be associated with low job security, thereby motivating management to strive for value maximization (Hart, 1983; Jensen and Ruback 1983). When managerial shareholding becomes high enough to ensure an entrenched position, managers may begin acting against the interests of other shareholders.

Empirical research has thus far produced only mixed results, supporting the differing

hypotheses presented in the review of theoretical literature above. Demsetz and Lehn (1985) found no evidence of a linear relationship between ownership concentration and ex-post corporate performance. This result has been criticized however, for many difficulties besides the restrictions imposed by the linearity assumption. To capture possible non-linearity, Morck et al. (1988) used a piecewise regression technique, and found evidence of a significant non-monotonic relationship between ownership structure and corporate performance. Their empirical results indicate that Tobin's Q declines as stock ownership by board directors rises over an ownership range of 5 to 25 percent. They concluded that this range of ownership tends to provoke the behavior predicted by the managerial entrenchment hypothesis.

Stulz (1988), focusing on the importance of the takeover market in disciplining corporate managers, offered an alternative explanation of the entrenchment hypothesis. McConnell and Servaes (1990) further tested the assertions mentioned above and found that an inverse U-shaped relationship exists between managerial shareholding and corporate value.

2.2 Ownership Structures around the World

Berle and Means (1932) noted the prevalence of widely held corporations in the United States, in which ownership of capital was dispersed among small shareholders; however, control rights were concentrated in the hands of managers. Thereafter, several influential propositions derived from this line of argument, such as Jensen and Meckling (1976), Grossman and Hart (1980).

Nevertheless, empirical evidence reveals that the wide dispersion of ownership proposed by the traditional assumption might not be prevalent in other countries. Even in the United States, ownership is not completely dispersed. It is not uncommon for companies' shares to be held by families and wealthy investors, and for this trend to exceed earlier

expectations (Shleifer and Vishny, 1986; Morck et al., 1988). La Porta, Lapez-de Silanes, Shleifer, and Vishny (1998) also found even more concentrated ownership structures in the ten largest non-financial corporations in forty-nine developed and developing countries.

La Porta et al. (1999) investigated the issue of ultimate control by tracing chains of ownership and, in doing so identified the individuals with the most voting rights in twenty-seven wealthy economies. Their findings indicated that, particularly for countries in which shareholders had little protection, even the largest firms tended to have controlling shareholders. Although the controlling shareholder is occasionally the state, a family, usually the founder of the firm or his descendants, frequently accounts for the majority of shareholders. Moreover, Classens et al. (1999 a) employed the methodology developed in La Porta et al. (1999) to investigate ultimate control patterns in 2,980 publicly traded companies in nine East Asian countries. According to their results, high degrees of family control prevail in more than half of all East Asian corporations. Management is rarely separated firm ownership control, and managers in two-thirds of the firms that are not widely held are related to controlling shareholders.

2.3 Ownership Structure and Corporate Value Assuming Concentrated Ownership Structures

Because company ownership in most countries is highly concentrated, it is important to re-examine the relationship between ownership structure and corporate value. Shlefier and Vishny (1997) and La Porta et al. (1999) suggested when large shareholders effectively control corporations, they might try to exploit their positions at the expense of minority shareholders and gain personal benefits. Burkart, Gromb, and Panunzi (1997) provided a theoretical model that suggests the tight control of larger shareholders constitutes an ex ante expropriation threat that reduces managerial initiative and non-contractible investments.

They also showed that ownership concentration might conflict with performance-based incentive schemes. Wolfenzon (1999) interpreted the existence of pyramiding schemes as a way of expropriating the rights of small shareholders, since they create wedges between cash flows and control rights for large block-holders.

Very few empirical studies have directly tested the relationship between ownership structure and corporate performance in a concentrated-ownership-structure environment. Yeh, Chiu and Ho (1997) contended that managers are prone to expropriate corporate wealth through transactions with affiliates or individuals concentrated ownership structure environments in Taiwan. Claessens, Djankov, Fan and Lang (1999 b) examine the degree of expropriation of minority shareholders' rights in nine East Asian countries. They concluded that the risk of expropriation is a major principal-agent problem for large corporations, as suggested by La Porta et al. (1999).

However, we do not believe that all companies with highly concentrated ownership structures having severe minority exploitation problem. We argue those in family controlled companies, the interests of the controlling family and minority stockholders will converge, especially when the shareholding of the controlling family are very large.

In the following sections, we explore in what kinds of family controlled company structures the severest central-agency problems occur, and examine the investment behaviors of those companies.

3. Empirical methodology

3.1 The sample and calculation of controlling family shareholding

The sample consisted of the Taiwan listed companies. We collected the 1994-1995 ownership structure and family-tie information about the sample companies from two major

data sources, company prospectuses, and China Credit Information Services (LTD), a data-bank company that has been collecting data on business groups in Taiwan for more than two decades. Information on major equity holders' shares, ownership distribution, board of directors' composition, directors' shareholding, and long-term company investments was collected from the prospectuses of the listed companies. It is not unusual for Taiwan listed companies to have family-dominated ownership structures and board compositions. The company shares may be owned by members of the controlling family, investment companies sponsored by the family, and by related companies through interlocking shareholding and directorships. Therefore, in calculating the shareholding of the controlling family and the ratio of board seats held by family members, knowledge of prospectus information and family ties among the agents is essential. Companies were excluded from the study when prospectuses were unavailable during the sampling period.

Financial data on sample companies were obtained from the Taiwan Economic Journal Database. We collected data on corporate value and investment decision variables during two periods, 1994-1995, and 1996-1997. We excluded companies that experienced turnover of control rights during these years, the financial industry, and companies not listed before the end of 1993[5]. Our final sample consisted of 208 companies, representing 73% of the 285 companies listed on the Taiwan Stock Exchange in 1993.

In calculating the excess control of family shareholding (ECFS), we needed to calculate controlling family shareholding first. We adopted the ultimate control concept proposed by La Porta et al. (1999). We identified the ultimate owners of capital and their voting rights in each company, and we combined the direct and indirect voting rights to assess who ultimately controlled the companies. Direct voting right was defined in terms of shares registered under the names of identifiable family members. We appended indirect control

[5] We also excluded the financial industry due to heavy regulation and its different accounting system.

rights including two strands: (1) shares held by the affiliated companies or other entities and investment companies controlled by the family; (2) shares cross-held by other listed companies in the conglomerate, which in turn were controlled by family members.

3.2 Excess Family Control Shareholding (ECFS)

In considering company ownership structure complexity, we adopted the probabilistic voting model proposed by Cubbin and Leech (1983) and Leech (1987 a, b). For each company, we constructed a Herfindhal index of ownership concentration to measure company shareholding concentration, then considered the degree of control exerted by the largest bloc and, finally, determined the critical shareholding level necessary to achieve control over the company. If a company was classified as family-controlled, then the excess control of family shareholding (ECFS) was defined as the shareholding of the largest family shareholder minus the critical control level. The ECFS is a relative indicator of ownership structure that simultaneously considers structural ownership differences and the control power of the largest family in each company.

The model, Cubbin and Leech developed uses a critical control shareholding level (P*) as a benchmark to determine how many shares one entity must own in order to gain effective control of a company. When the shareholding of the largest shareholder exceed the P*, that shareholder has a probability of α (degree of control), to win votes at shareholders' meetings depending on the particular ownership structure of the company.

Critical control shareholding (P*) is defined as follows:

$$P^{*} = Z_{\alpha}\sqrt{\frac{\pi H}{1 + Z_{\alpha}^{2}\pi}} \quad , \qquad (1)$$

where Z : the normalized value for degree of control (α),

α : the degree of control, i.e., the probability of winning votes at shareholders' meetings ,

π : the probability the shareholder can exercise voting control,

H: the Herfindahl index of concentration, defined as the sum of the squares of the shareholding of each shareholder.

In a company with high shareholding concentration (high H), the largest shareholder must have a larger controlling shareholding (P*) to control the company. And when the probability that general shareholders will exercise voting rights (π) is high, the largest shareholder also requires a larger shareholding to control the company. Furthermore, the higher the degree of control (α) over the company the largest shareholder desires, the larger the shareholding he/she must possess.

Because detailed ownership records were unavailable, we were not able calculate actual Herfindhal indices. Instead, we adopted Yeh and Chiu's approach (1996), and used data on the numbers of shareholders in each shareholding interval to simulate Herfindhal indices. The formula proposed by Yeh and Chiu (1996) is as follows:

$$H = \sum_{i=1}^{k} \left(\frac{S_i}{n_i} \right)^2 \times n_i \ , \qquad (2)$$

where n_i = the number of shareholders in the i_{th} shareholding bracket,

S_i = the total percentage shareholding of all shareholders in the i_{th} bracket,

k = the number of shareholding brackets.

where π (the probability of shareholders exercising voting rights), and the α (the degree of control) were set at 1 and .999, respectively. These two vigorous values were used to

compute the critical control shareholding level (P*) in a more conservative manner[6].

3.3 Measurements of corporate valuation and corporate characteristics

Tobin's Q is widely used to measure corporate performance (Morck, et al., 1988; McConnell and Servaes, 1990; Cho. 1998). However, Chen (1998) and Craswell, Taylor and Saywell (1997) suggested that information on replacement costs is not readily accessible in the Chinese and Australian stock markets, but this issue is not insurmountable. Chen (1998) and Craswell, et al. (1997) used an equity market-to-book ratio to approximate Tobin's Q measurement. We also adopted the equity market-to-book ratio herein by assuming that re-evaluation of Taiwanese firms' assets is closely related to replacement costs[7]. Measurement of corporate value is defined as follows:

$$\text{Proxy Q} = \text{Market Value of Equity} / \text{Book Value of Assets} \qquad (3)$$

To segregate the possible influences of corporate characteristics from corporate performance, we selected several widely recognized variables to include in the regression analysis as independent variables. Previous empirical work, such as that by Morck et al. (1988), McConnell and Servaes (1990), Craswell et al. (1997) included the following measures of corporate characteristics: (1) Debt ratio (DR), calculated as the book value of total debt divided by the book value of assets. (2) Size, measured as the natural logarithm of

[6] Shareholders' attendance at stockholder's meetings was extremely high during the sample period because many companies acquired proxy consents in exchange for cash or gave presents at the stockholder's meetings, therefore, the value of π was set to one. For example, when we set π =1 at the level of 243 of Herfindahl index, p* equals to 14.99. And when we vary π =0.6, p* equals to 14.62, *ceteris paribus*. In other word, the setting of π is not significant to affect the critical control shareholding.

[7] According to Lehn et.al. (1990), the correlation between Tobin's Q and equity market-to-book ratio is typically extremely high.

equity market value[8]. (3) The ratio of R&D and advertising expenditures (RDE), calculated as research & development and advertising expenditures standardized according to asset book values[9].

3.4 Empirical model

In considering the non-monotonic relationship between ownership and corporate performance, we implemented the following piecewise linear regression model to elucidate the relationship between the excess control of family shareholding (ECFS) and corporate value.

$$\Pr oxyQ = \beta_0 + \beta_1 ECFS + \beta_2 ECFS \times DD_1 + \delta_1 Size + \delta_2 DR + \delta_3 RDE + \sum_{i=1}^{4} \delta_{4,i} IND_i + \varepsilon \quad , \tag{4}$$

where DD_1: is a dummy variable; if ECFS > set turning point, DD_1=1; otherwise DD_1 = 0. Because ECFS falls within the range –25% and 45%, we varied the set turning point by 5% in each stage. For example, with the first set turning point at –20%, if the ECFS was greater than –20%, then DD_1 = 1; otherwise DD_1 = 0. The process was continued for thirteen consecutive tests with the set turning point moved by 5% each time to identify the most probable range.

Size: the natural logarithm of equity market value

DR: debt ratio

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[8] According to Morck, et al. (1988), Craswell et al. (1997), it could be easier to own a large proportion of equity in a smaller firm because of the smaller outlay required. Controlling for size limits the possibility that large board stakes imply small proxy firm sizes. Size may also be correlated with hidden intangible assets and hence with corporate performance.

[9] Morck, et al. (1988), McConnell and Servaes (1990) included this variable because it reflects the expense of increasing the book value of a firm's intangible assets. McConnell and Muscarella (1985), Chan et al. (1990) found evidence to support the idea that investment in research and development does affect corporate value. Crutchley and Hansen (1989); Jensen, Solberg and Zorn (1992) all used this variable to measure companies' future growth opportunities.

RDE: the R&D and advertising expenditure/ assets

IND_i: industry dummy variable; we used four major industries in this study (i=1 stands for the plastics industry; i=2 for the electrical and machinery industry; i=3 for the electronics and computer industry; and i=4 for the construction industry). For example, if the company was in the plastics industry, then IND_1=1; otherwise, 0, etc.

ε : residual item

According to the empirical results of Morck, Shleifer, and Vishny (1988), there may be two turning points in the relationship between the excess control of family shareholding and corporate value. Therefore, the empirical model is revised as follows:

$$\mathrm{Pr}oxyQ = \beta_0 + \beta_1 ECFS + \beta_2 ECFS \times DD_1 + \beta_3 ECFS \times DD_2$$

$$\delta_1 Size + \delta_2 DR + \delta_3 RDE + \sum_{i=1}^{4} \delta_{4,i} IND_i + \varepsilon \quad , \qquad (5)$$

where DD_1: the first turning point found by the algorithm defined above. For example, if the first turning point is approached when the determined turning point is x%, then DD_1 is 1 when ECFS> x%; and 0, otherwise.

DD_2 : the second determined turning point found by fixing the first determined turning point and then executing 12 more regression tests using the same algorithm. Note that the first determined turning point is skipped when finding the second one.

Maxization of R^2 is used herein to select the turning points in equations (4) and (5). In order to overcome possible heteroscedasticity problems when we ran the cross-sectional

regressions, we adjusted the standard regression model parameter estimator error using a consistent heteroscedasticity estimator technique proposed by White (1980). We also tested the non-monotonic relationship between family shareholding and corporate value, and between board of directors shareholding and corporate value to contrast improvements in ECFS with interpretation of corporate value.

4. Basic statistics of sample companies

We first, introduce the ownership structure characteristics of the Taiwan-listed companies. Table 1(A) shows that on average, the largest shareholders controlled 27.4% of the shares outstanding, which was higher than the sum of the directors' holdings (20.1%). The mean and median of critical control shareholding (P^*) are 15.3%, and 13.21%, respectively. Furthermore, the percentage of shares owned by the largest shareholders in excess of the critical control shareholding level was about 12.1%. On the other hand, the total shareholding of board members exceeds the critical control shareholding level by 20.1%, on average (15.3%), implying that the board members of these companies have control ability.

Among the 208 sample companies investigated, in 173 shares controlled by the largest shareholder exceeded the critical control shareholding level. In companies with an ultimate controller, 158 were family-controlled, 6 were stated-owned, 4 companies which ultimate owners are widely held corporations, and 5 were controlled to a significant degree by foreign companies. The 35 companies in which the shareholding controlled by the largest shareholder did not exceed the critical control shareholding level, were widely held companies. The analysis above shows that, ownership of Taiwan listed companies is rather concentrated, and family-controlled companies are the most prevalent type.

Table 1(B) summarizes the correlation analysis results of shareholding variables. It

shows a positive relationship between the shareholding the largest shareholder and the critical control shareholding level. This is intuitive since the higher the critical control shareholding level, the more shares the largest shareholder must own to guarantee total control. A similar relationship is found between the sum of directors' shareholding and the critical control shareholding level. Furthermore, this finding shows a positive relationship between the shareholding of the largest shareholder and total directors' shareholding.

The mean and median of equity market value were NT$13,027.43 million and NT$6,928.5 million, respectively. The respective mean and median debt ratios of the sample companies were 38.26% and 38.14%. The respective mean and median figures for the ratios of R&D and advertising expenditures over assets for all sample companies were 1.427% and 0.562%, respectively. The respective mean and median of corporate value (Proxy Q) were 1.461 and 1.356.

Insert Table 1 here

In order to focus on the relationship between family shareholding and corporate value, we excluded stated-owned, widely held companies owned, and companies owned by foreign entities. Companies without significant controllers were grouped as control samples.

5. Empirical results

5.1 ECFS and Corporate Value

The effects of ownership structure on corporate performance were investigated. Three ownership structure characteristic variables of were used for analysis: the excess control of family shareholding (ECFS), family shareholding (SHFAM), and board of directors'

shareholding (SHBD). Table 2 shows no significant linear relationship was found between corporate value (Proxy Q) and the three ownership structure characteristic variables. Morck et al. (1988) indicated that theoretical arguments alone cannot unambiguously predict the relationship between management ownership and market valuation of a firm's assets. To capture the possible non-linear relationship between management ownership and corporate value (as measured by Tobin's Q), Morck et al. (1988) used piecewise regression analysis and provided evidence of a significant non-monotonic relationship.

Insert Table 2 here

Equations (4) and (5) were used to test the non-monotonic relationship between the excess control of family shareholding (ECFS) and corporate value after controlling for corporate characteristics and industry variables. The 5% stepwise variation of ECFS would allows us to identify the effects of ECFS regression coefficient turning points on corporate value, where the most significant changes occur. Note that the turning points were not arbitrarily chosen in the manner of Morck et al. (1988). According to column A and column B in Table 3, $\beta_1 > 0$, $\beta_2 < 0$, and $\beta_1 + \beta_2 < 0$ at –5% and 0% of ECFS, imply that the relationship between corporate value and ECFS changes significantly in this range. This finding suggests that corporate value is positively related to ECFS when the controlling family shareholding is below the critical control level (i.e. ECFS < 0%). When ECFS exceeds the critical control level (i.e. ECFS > 0%), the relationship between ECFS and corporate value takes a downturn and becomes negative. Herein, the same algorithm was adopted and equation (5) was used to identify the second turning point by fixing the first one from the preceding run. Columns C and D in Table 5 show that the second turning point occurred at 15%, and the relationship between ECFS and corporate value rebounded from

negative to positive ($\beta_3 > 0$, $\beta_1 + \beta_2 + \beta_3 > 0$). This implies that when controlling family shareholding exceeds the critical control level its relationship to corporate value becomes negative, but turns positive again once ECFS surpasses the second turning point (15%). Taking Table 3 column D as an example, $\beta_1 = 0.014$, $\beta_1 + \beta_2 = -0.015$, and $\beta_1 + \beta_2 + \beta_3 = 0.006$, during the stage in which ECFS > 15%, and the magnitude of the positive relationship between ECFS and corporate value was quite small. According to R^2 in the regression analysis, ECFS = 0% was the first turning point, and 15% as the second one. Figure 1 depicts the relationship between ECFS and corporate value.

Insert Table 3 here

Insert Figure1 here

Based on our findings, we define companies in which the largest family shareholding is below the critical control level (ECFS < 0%) as widely held companies, companies with ECFS in the range of 0% to 15% as family controlled companies with low shareholding (FCLOW), and companies with ECFS above 15% as family controlled companies with high shareholding (FCHIGH).

Widely held companies in which no single family or institution holds sufficient voting rights to dominate company decisions, companies jointly held by more than one family or by institutional investors, and under mutual surveillance by shareholders, no one is able to exploit individual advantages at other shareholders' expense. The positive relationship between ownership and corporate value indicates that managers will have incentives to maximize company value as their stakes in the company grow.

When the controlling family shareholding reach the critical control level, the

shareholders possess sufficient control rights to influence decisions. Consequently, the controlling family may begin acting against the interests of other shareholders and may be inclined to appropriate minority rights. When the excessive shareholding over the critical controlling level is small (0% < ECFS < 15%), the controlling family has strong incentives to expropriate minority interests. In this stage, as the controlling family's shareholding increases, their control over company decisions increases, and the probability of expropriating the minority increases. Therefore, there is a negative relationship between ECFS and corporate value.

We argue that when ECFS exceeds 15%, family controlled companies with high shareholding also possess more rights over cash flow[10], and hence have weaker incentives to expropriate minority interests families in companies with low shareholding. Additional family shareholding does not cause further discounting of corporate value. Further increases in the controlling family's shareholding tend to induce the incentive effect, ultimately reaching the convergence of interest level.

This study also analyzed the non-monotonic relationship between family shareholding and corporate value, as well as the relationship between board of directors' shareholding and corporate value. First, equation (4) was used to identify changes in the relationship between family shareholding and corporate value. Table 4 (A) shows that when family shareholding is confined within the range of 10% to 45%, corporate value is not significantly affected, and the relationship between these two variables does not change significantly (i.e., no turning points exist). Table 4 (B) shows that when the algorithm in equation (4) was used to assess the relationship between board of directors' shareholding and corporate value, again, no turning points were found.

[10] According to the survey of Classens et al. (1999b), the cash flow rights of the controlling shareholders of Taiwan listed companies (15.98%) is composed of 0.832 of their ultimate control rights (18.96%).

Insert Table 4 here

The results in Table 2 and Table 4 show that the control variable, debt ratio correlates negatively with corporate value, and that R&D and advertising expenditures ratio correlates positively with corporate value. In addition, company size does not significantly affect corporate value. However, the plastic industry and electronic & mechanic industry have a higher corporate value than other industries.

5.2 ECFS, investment and robustness testing

In this section, we discuss the impact of ECFS on the investment expenditures. We use two turning points (ECFS = 0% and 15%) determined by the piecewise regression technique and show in Table 3 to test the relationship between ECFS and investment expenditures, as measured by the ratio of R&D and advertising expenditures to total assets.

The empirical results are shown in Table 5 column indicate that in widely held companies (ECFS < 0%), the ECFS positive coefficient suggests as the shareholding of the controlling family increases, investment expenditures will also increase. For FCLOW companies (0% < ECFS < 15%), the negative coefficient of the ECFS*DD_1 suggests as the shareholding of the controlling family increases, investment expenditures will decrease. For FCHIGH companies (ECFS > 15%), the negative relationship between ECFS and investment expenditures does not exist.

The empirical results above indicate a negative relationship between controlling shareholder shareholding and investment expenditures in FCLOW companies. Furthermore, the ratio mean of R&D and advertising expenditure to total assets for FCLOW companies is 0.863%, lower than that of widely held companies (1.339%), and of FCHIGH companies

(1.042%). These results suggest that controlling families in FCLOW companies do not pursue investment opportunities for developing intangible assets and ensuring future growth. Furthermore, these controlling families tend to lower expenditures for R&D and advertising to enhance the short-term profitability reflected in financial statements.

In order to test the stability of the results presented above, we re-ran the regression analysis, exchanging the average Proxy Q dependent variable for the period 1994-1995 with that for the period 1996-1997; the results are given in column B of Table 5. We also exchanged R&D and advertising expenditure ratio for 1994-1995 with that for 1996-1997 and ran the regression again; the results are given in column C of Table 5. These results are similar to the initial ones, and show that these regressions are at least suggestive of the stability of our results over time.

Insert Table 5 here

6. Conclusions

The results presented in this study confirm a non-monotonic relationship between the excess control of family shareholding (ECFS) and corporate value. In the ECFS range 0% to 15% (i.e., in FCLOW companies), the relationship between ECFS and corporate value shows a downward trend from positive to negative, consistent with the prediction of the central agency problem. The shareholdings of the controlling family for FCHIGH and FCLOW companies confer significant control rights. But the shareholding of the controlling families in FCLOW companies is lower than that of families in FCHIGH companies, so their motivation to expropriate minority shareholders is greater. Furthermore, we found a negative relationship between ECFS and the ratio of R&D and advertising expenditure to asset value in FCLOW companies, and their average expenditures for R&D and advertising were lower than those of FCHIGH and widely held companies. This suggests that the motivation of controlling families in FCLOW companies to pursue development of intangible assets and future growth opportunities is relatively small. Therefore, some restrictions might need to be placed on FCLOW companies to prevent wealth expropriation from minority shareholders. We also consider our classification variable, the excess control of family shareholding to be superior to previously published research results at explaining corporate performance.

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Table1: Sample Statistics on ownership structure and board composition

The sample consisted of 208 companies, representing 73% of the 285 companies listed on the Taiwan Stock Exchange in 1993. The sampling period was 1994 to 1995. Ownership structure and family tie data were collected from company prospectuses and China Credit Information Services, LTD, a data bank company that collects data on business groups in Taiwan

A: Ownership structure

	Mean	Standard deviation	First quartile	Median	Third quartile
Critical control shareholding	0.1530	0.0870	0.0863	0.1321	0.1901
Shareholding of the largest shareholder	0.2743	0.1854	0.1217	0.2344	0.383
Total shareholding of the board members	0.2015	0.1260	0.1088	0.1604	0.274
Percentage of board members held by the largest shareholder	0.5280	0.2780	0.3246	0.4881	0.7143

B: Corporate characteristics

Market value of equity (million NT$)	13,027.43	20,363.2	4,021	6,928.5	13,298.5
Debt ratio	38.26	13.38	28.53	38.14	47.99
Ratio of R&D and advertising expenditures	1.427	2.143	0.118	0.562	1.833
Proxy Q	1.461	0.599	1.061	1.356	1.7496

C: Ownership structure correlation analysis

	Critical control shareholding	Shareholding of the largest shareholder	Total shareholding of board members	Percentage of board members held by the largest shareholder
Critical control shareholding	1.000	0.195 (0.007)***	0.254 (0.0004)***	0.041 (0.570)
Shareholding of the largest shareholder		1.000	0.575 (0.0001)***	0.490 (0.0001)***
Total shareholding of board members			1.000	0.098 (0.174)

* : significant at 10% level ** : significant at 5% level *** : significant at 1% level
Numbers in parentheses are p-values.

Table 2: The impact of ownership structure on corporate value--OLS

This paper uses a linear regression model to investigate how the ownership structure (ECFS, SHFAM and SHBD) o affects corporate value (Proxy Q) while controlling the corporate characteristic variables (DR, RDE and Size). Three ownership structure characteristic variables of are defined: (1) the excess control of the largest family shareholding (ESFS), (2) the largest family shareholding (SHFAM), and (3) the shareholding of the board of directors (SHBD). Proxy Q calculated as market value of equity divided by book value of assets. Three corporate characteristics variables are defined: (1) Debt ratio (DR) calculated as book value of total debt divided by book value of assets. (2) Size measured as the natural logarithm of the market value of equity. (3) The ratio of R&D and advertising expenditures (RDE): calculated as the research & development and advertising expenditures, standardized by book value of assets. IND_i: defined as the dummy variable of industry (i=1 stands for the plastics industry; i=2, electric and n achine; i=3,electronics and computer; and i=4, construction).

	Proxy Q		
Intercept	2.556	2.570	2.462
	(8.292)***	(8.369)***	(8.345)***
ECFS	-0.0005		
	(-0.338)		
SHFAM		0.0007	
		(0.494)	
SHBD			0.002
			(0.661)
DR	-0.0294	-0.0294	-0.0290
	(-12.627)***	(-12.549)***	(-12.464)***
RDE	0.0287	0.0288	0.0288
	(2.014)**	(2.077)**	(2.044)**
Size	-0.0032	-0.0074	-0.0001
	(-0.0981)	(-0.2245)	(-0.004)
IND_1	0.246	0.2444	0.2464
	(2.9077)***	(2.865)***	(2.783)***
IND_2	0.3741	0.3823	0.375
	(2.779)***	(2.817)***	(2.7896)***
IND_3	0.083	0.0950	0.0940
	(0.996)	(1.1697)	(1.1694)
IND_4	-0.0369	-0.0323	-0.0322
	(-0.3564)	(-0.3080)	(-0.3087)
R^2(%)	46.39	46.42	46.40

*: significant at 10% level; **: significa nt at 5% level; ***: significant at 1% level;
Numbers in parentheses are t-values.

Table3: The relationship between the excess control of family shareholding and corporate value-- piecewise linear regression model

We used following piecewise linear regression model to test the relationship between the excess control of family shareholding (ECFS) and corporate value (Proxy Q) after controlling the corporate characteristics variables (DR, RDA and Size) and the industry variables (IND_1, IND_2, IND_3 and IND_4).

$$Proxy\,Q = \beta_0 + \beta_1 ECFS + \beta_2 ECFS \times DD_1 + \beta_3 ECFS \times DD_2 + \delta_1 Size + \delta_2 DR + \delta_3 RDE + \sum_{i=1}^{4} \delta_{4,i} IND_i + \varepsilon$$

Where DD_1: defined as the first turning point, if ECFS > setting turning point, DD_1=1; 0, otherwise. DD_2: defined as the second determined turning point, if ECFS > setting turning point, DD_2=1; 0, otherwise. IND_i: defined as the dummy variable of industry (for i=1 stands for plastic industry; i=2, electric and machine industry; i=3,electronic and computer industry; and i=4, construction industry). Please refer to Table 2 for the definitions of characteristic variables (DR, RDE and Size).

	Proxy Q			
	A	B	C	D
Intercept	2.588	2.579	2.677	2.664
	(8.409)***	(8.365)***	(8.319)***	(8.296)***
ECFS	0.008	0.010	0.012	0.014
	(1.626)	(1.798)*	(2.076)**	(2.082)**
ECFS*DD_1	-0.010	-0.021	-0.027	-0.029
	(-1.680)*	(-1.929)*	(-2.154)**	(-2.158)**
First turning point	-5%	0%	-5%	0%
ECFS*DD_2			0.020	0.021
			(1.770)*	(1.786)*
Second turning point			15%	15%
DR	-0.2897	-0.0291	-0.0290	-0.0292
	(-12.368)***	(-12.450)***	(-12.332)***	(-12.507)***
RDE	0.027	0.028	0.024	0.024
	(1.925)*	(1.928)*	(1.734)*	(1.714)*
Size	-0.003	-0.002	-0.006	-0.003
	(-0.105)	(-0.076)	(-0.182)	(-0.083)
IND_1	0.248	0.246	0.236	0.288
	(2.760)***	(2.761)***	(2.593)***	(2.530)**
IND_2	0.349	0.351	0.343	0.339
	(2.558)**	(2.584)***	(2.569)**	(2.553)**
IND_3	0.084	0.085	0.071	0.074
	(1.020)	(1.025)	(0.893)	(0.926)
IND_4	-0.049	-0.047	-0.079	-0.079
	(-0.496)	(-0.476)	(-0.784)	(-0.787)
R^2(%)	48.91	49.75	51.96	53.63

*: significant at 10% level; **: significant at 5% level; ***: significant at 1% level;
Numbers in parentheses are t-values.

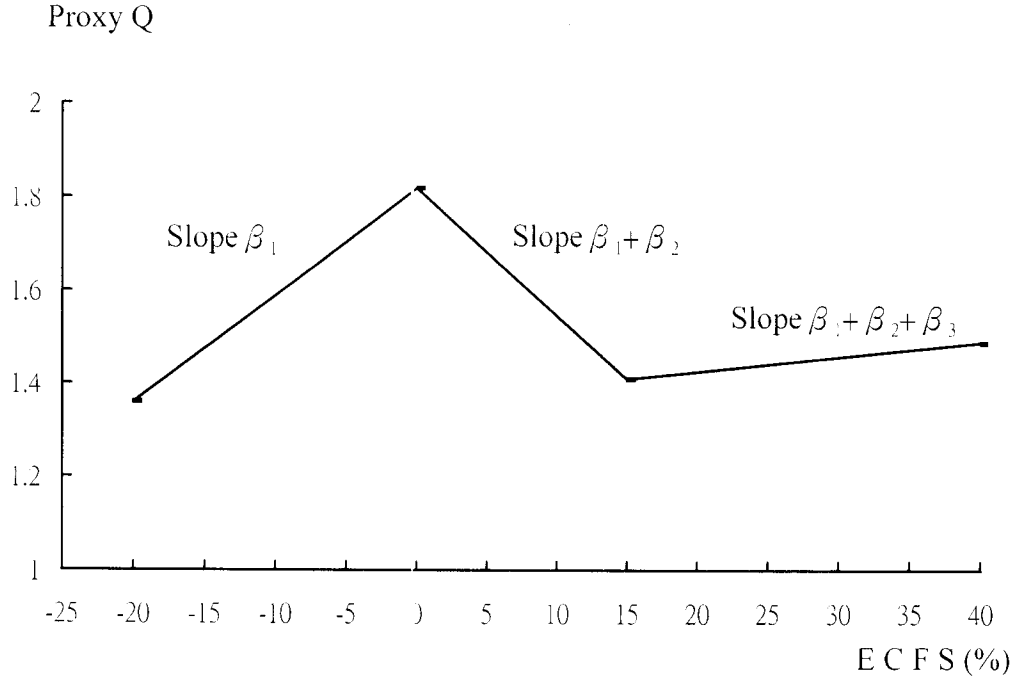

Figure 1. The piecew se relationship between the excess control of family shareholding (E CFS) and corporate value (Proxy Q)

Table 4A: The relationship between the largest family shareholding and corporate value---- piecewise linear regression model

We used the following piecewise linear regression model to determine how changes in the relationship between the largest family shareholding (SHFAM) affect corporate value (Proxy Q) by varying the SHFAM from 10% to 45%.

$$\text{Pr } oxyQ = \beta_0 + \beta_1 SHFAM + \beta_2 SHFAM > DD_1 + \delta_1 Size + \delta_2 DR + \delta_3 RDE + \sum_{i=1}^{4} \delta_{4,i} IND_i + \varepsilon$$

Where DD_1: defined as dummy variable, if SHFAM > setting turning point, DD_1=1; 0, otherwise. IND_i: defined as the dummy variable of industry (for i=1 stands for plastic industry; i=2, electric and machine industry; i=3,electronic and computer industry; and i=4, construction industry). Please refer Table 2 for the definitions of characteristic variables (DR, RDE and Size).

	Proxy Q							
Intercept	2.362	2.345	2.333	2.363	2.311	2.461	2.537	2.453
	(8.113)***	(8.112)***	(7.946)***	(7.697)***	(7.851)***	(8.450)***	(8.873)***	(8.886)**
SHFAM	0.006	0.007	0.008	0.007	0.008	0.003	0.001	0.003
	(1.287)	(1.310)	(1.244)	(1.023)	(1.454)	(0.702)	(0.395)	(1.051)
SHFAM *DD_1	-0.007	-0.008	-0.009	-0.007	-0.009	-0.003	-0.001	-0.004
	(-1.301)	(-1.323)	(-1.252)	(-0.100)	(-1.481)	(-0.638)	(-0.253)	(-1.169)
Turning point	10%	15%	20%	25%	30%	35%	40%	45%
DR	-0.029	-0.029	-0.029	-0.029	-0.029	-0.029	-0.029	-0.029
	(-12.829)***	(-12.713)***	(-12.811)***	(-12.709)***	(-12.685)***	(-12.784)***	(-12.792)***	(-12.498)***
RDE	0.028	0.028	0.028	0.028	0.028	0.029	0.029	0.028
	(1.946)*	(1.953)*	(1.956)*	(1.982)**	(2.074)**	(2.109)**	(2.093)**	(2.054)**
Size	0.008	0.008	0.009	0.006	0.008	-0.001	-0.006	-0.001
	(0.248)	(0.261)	(0.286)	(0.182)	(0.255)	(-0.021)	(-0.177)	(-0.019)
IND_1	0.231	0.230	0.231	0.249	0.264	0.235	0.236	0.217
	(2.792)***	(2.773)***	(2.797)***	(2.987)***	(3.190)***	(2.613)***	(2.459)**	(2.412)**
IND_2	0.387	0.386	0.378	0.359	0.367	0.369	0.379	0.376
	(2.808)***	(2.781)***	(2.645)***	(2.571)**	(2.663)***	(2.613)***	(2.756)***	(2.711)**
IND_3	0.073	0.084	0.087	0.093	0.094	0.093	0.095	0.093
	(0.842)	(1.002)	(1.047)	(1.127)	(1.130)	(1.137)	(1.164)	(1.143)
IND_4	-0.028	0.033	-0.032	-0.031	-0.029	-0.034	-0.033	-0.029
	(-0.269)	(-0.318)	(-0.313)	(-0.303)	(-0.282)	(-0.320)	(-0.313)	(-0.278)
R^2(%)	45.23	45.35	45.33	45.06	45.52	44.59	44.44	44.79

*: significant at 10% level; **: significant at 5% level; ***: significant at 1% level;
Numbers in parentheses are t-values.

Table 4B: The relationship between the shareholding of board of directors and corporate value---- piecewise linear regression model

The paper uses the following piecewise linear regression model to find out the change in the relationship between the shareholding of board of directors (SHBD) and corporate value (Proxy Q) by varying the SHBD from 10% to 45%.

$$\text{Proxy}Q = \beta_0 + \beta_1 SHBD + \beta_2 SHBD \times DD_1 + \delta_1 Size + \delta_2 DR + \delta_3 RDE + \sum_{i=1}^{4} \delta_{4,i} IND_i + \varepsilon$$

Where DD_1: defined as dummy variable, if SHBD > setting turning point, DD_1=1; 0, otherwise. IND_i: the dummy variable of industry (for i=1 stands for plastic industry; i=2, electric and machine industry; i=3,electronic and computer industry; and i=4, construction industry). Please refer to Table 2 for the definitions of characteristic variables (DR, RDE and Size).

	Proxy Q							
Intercept	2.422	2.403	2.365	2.386	2.279	2.360	2.378	2.447
	(8.296)***	(8.275)***	(8.354)***	(8.437)***	(8.062)***	(8.349)***	(8.465)***	(8.387)**
SHBD	0.003	0.003	0.005	0.004	0.006	0.004	0.003	0.002
	(0.651)	(0.683)	(0.849)	(0.689)	(1.148)	(0.797)	(0.781)	(0.584)
SHBD*	-0.001	-0.002	-0.004	-0.002	-0.006	-0.003	-0.003	-0.001
DD_1	(-0.460)	(-0.552)	(-0.862)	(-0.598)	(-1.464)	(-0.831)	(-0.781)	(-0.240)
Turning point	10%	15%	20%	25%	30%	35%	40%	45%
DR	-0.029	-0.029	-0.029	-0.029	-0.029	-0.029	-0.029	-0.029
	(-12.499)***	(-12.515)***	(-12.568)***	(-12.638)***	(-12.369)***	(-12.429)***	(-12.431)***	(-12.493)***
RDE	0.028	0.028	0.027	0.028	0.025	0.028	0.028	0.029
	(1.957)*	(1.906)*	(1.801)*	(1.928)*	(1.770)*	(1.923)*	(1.971)**	(2.000)**
Size	0.004	0.005	0.007	0.005	0.014	0.008	0.007	0.001
	(0.128)	(0.171)	(0.227)	(0.180)	(0.473)	(0.278)	(0.235)	(0.042)
IND_1	0.244	0.242	0.228	0.237	0.218	0.232	0.232	0.243
	(2.724)***	(2.715)***	(2.772)***	(2.543)**	(2.285)**	(2.459)**	(2.444)**	(2.619)**
IND_2	0.371	0.367	0.368	0.363	0.361	0.371	0.362	0.373
	(2.768)***	(2.719)***	(2.772)***	(2.669)***	(2.709)***	(2.779)***	(2.663)***	(2.745)**
IND_3	0.086	0.085	0.082	0.088	0.089	0.087	0.090	0.093
	(1.023)	(1.006)	(0.976)	(1.058)	(1.086)	(1.053)	(1.095)	(1.137)
IND_4	-0.033	-0.040	-0.042	-0.036	-0.028	-0.038	-0.035	-0.034
	(-0.318)	(-0.381)	(-0.395)	(-0.346)	(-0.278)	(-0.359)	(-0.331)	(-0.322)
R^2(%)	44.48	44.52	44.79	44.58	45.22	44.61	44.55	44.41

*: significant at 10% level; **: significant at 5% level; ***: significant at 1% level;
Numbers in parentheses are t-values.

Table 5: Test of empirical result stability

In order to test of stability of above results, we obtained the average Proxy Q of next period (1996-1997) for firms in our 1994-1995 sample and the regression with Proxy Q for 1996-1997 as the dependent variable, but with 1994-1995 of all the independent variables. In additions, we also test the ratio of R&D and advertising expenditures (RDE) for the year of 1996-1997. Please refer to Table 3 for the definitions of all variables.

	A	B	C
	RDE (1994-95)	Proxy Q (1996-97)	RDE (1996-97)
Intercept	1.156	1.913	1.0694
	(0.942)	(4.606)***	(1.022)
ECFS	0.029	0.0115	0.0253
	(1.980)**	(1.715)*	(1.554)
ECFS*DD_1	-0.086	-0.0369	-0.073
	(-2.110)**	(-2.449)**	(-1.771)*
ECFS*DD_2	0.048	0.0295	0.0421
	(1.585)	(2.783)***	(1.476)
DR	-0.005	-0.0282	-0.0079
	(-0.663)	(-9.105)***	(-0.986)
RDE		0.050	
		(2.198)**	
Size	0.028	0.0627	0.0313
	(0.234)	(1.517)	(0.298)
IND_1	-0.405	0.0484	-0.368
	(-1.889)*	(0.366)	(-1.368)
IND_2	0.5994	0.3208	0.596
	(1.294)	(2.134)**	(1.222)
IND_3	1.514	0.164	1.969
	(3.893)***	(1.544)	(4.170)***
IND_4	-0.480	0.0792	-0.373
	(-2.056)**	(0.614)	(-1.562)
R^2(%)	11.41	33.15	16.43

*: significant at 10% level; **: significant at 5% level; ***: significant at 1% level;
Numbers in parentheses are t-values.