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VALUE PREMIUMS AND THE JANUARY EFFECT: INTERNATIONAL EVIDENCE

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ABSTRACT

Using data from the stock markets of Japan, the U.K, and France, this paper examines the distribution and source of value premium in average stock returns for the period 1975 through 2007. Results from this study indicate a January effect in value premium, which is valid and economically meaningful for all three major non-U.S. markets. Consistent with Loughran (1997), our study suggests that January value premium is more pronounced in large stocks and high January value premium is mostly driven by superior returns of value stocks in January. In particular, value premium for January month is nearly three to nine times that of non-January months. Annualized value premiums for January (non-January months) for Japan, the U.K. and France are 28.08% (9.12%), 15.36% (2.04%), and 30.96% (3.48%). The annualized excess January value premium ranges from 13.32% for the U.K. to 27.48% for France with 18.96% for Japan. Results are robust with respect to alternative value-growth indicators as well as sample periods.

JEL: G12

KEYWORDS: Value premium, International, January effect

INTRODUCTION

Ample evidence documents that firms with high ratios of book-to-market equity (B/M), earnings to price (E/P), cash earnings to price (CE/P), or dividends to price (D/P) - commonly referred to as value firms - tend to consistently deliver higher returns than firms with low ratios of B/M, E/P, CE/P or D/P - or growth firms - both in U.S and in markets around the world. This finding known as the value premium, turns out to be quite robust to alternative definitions of value and does not disappear over time (see for example, Chan, Hamao, and Lakonishok, 1991; DeBondt and Thaler, 1985, 1987; Fama and French, 1992, 1995, 1996, 1998; Haugen and Baker, 1996; Lakonishok, Shleifer, and Vishny, 1994).

Those who are fascinated by the value premium have hazarded three competing explanations about its cause. The first explanation is that the value premium is associated with the degree of 'relative distress' in the economy, is a rational phenomenon, which is priced in equilibrium, and is a compensation for systematic risk (Black and Fraser, 2004; Fama, 1998; Fama and French, 1995, 1996, 1998; Kiku, 2006; Lakonishok et al. 1994; Lettau and Ludvigson, 2001; Petkova and Zhang, 2005; Zhang, 2005). The second argument is a behavioral one that focuses on systematic irrationalities that characterize investor decision making. Contrarian strategies produce higher returns because they exploit the tendency of some investors to overreact to good or bad news (Daniel, Hirshleifer, and Teoh, 2001; De Bondt and Thaler, 1987; Haugen, 1995; Hirshleifer, 2001; Kothari, 2000; Lakonishok et al. 1994).

The third explanation proposed for the cause of value premium is not because of rational or irrational investor behavior, but because of random occurrences (Kothari, Shanken, and Sloan, 1995). In this situation, the value premium is neither reward-for-risk nor the basis for a profitable trading strategy.

Whether value premium reflects fully rational risk premium, market irrationality, or some of the both is still a matter of considerable controversy in empirical finance. This paper aims to add to the current debate on the source of value premium by presenting additional out-of-sample evidence.

Value premium still exists in major countries outside U.S. In this study, we investigate the impact of the January effect on value premium and examine distribution of returns on value and growth portfolios of Japan, the U.K, and France for January and non-January months for the period 1975 through 2007. Our results indicate that there is a pronounced January effect in value premium phenomenon. Results are robust for different sub-sample periods of 1975 through 1990 and 1991 through 2007. Evidence of greater value premium for January is further confirmed by regression tests with explanatory variables of excess market return and a dummy variable for January month.

This is the first exploratory study of the calendar seasonality of book-to-market effect outside of the U.S. This paper furnishes a link between research that explains value premium and research that focuses on January effect. There is surprisingly little empirical research in this area. The seasonality observed among value premium is inconsistent with the risk-based explanation of book-to-market premiums. Finding a pattern of changes in the value premium has implications for investment strategies. For example, the annualized excess January value premium ranges from 13.32% for the U.K. to 27.48% for France with 18.96% for Japan. Similarly, a 'Jan' investment strategy defined as holding a 'value minus growth' portfolio in January and risk-free asset in non-January months outperforms the 'Non-Jan' strategy of holding value minus growth in non-January and risk-free in January. For instance, the 'Jan' strategy in France generates 7.78% annual return over the sample period compared to 2.45% annual return in 'Non-Jan' strategy.

The organization of the paper is as follows. Section 2 discusses some of the work related to our study. In Section 3, we describe our data and methodology to form portfolios. Section 4 is a discussion of the January effect on value premium with B/M ratio as a value-growth indicator. As a robustness check, we also present evidence on the value premium in January and non-January returns by using E/P, CE/P, and D/P. In Section 5, we attempt to find an explanation for January value premium. Section 6 concludes.

LITERATURE REVIEW

In the first study of January seasonal, Wachtel (1942) reports that odds in favor of either a rise or no change taking place in the values of twenty high yield stocks in January is 4 to 1 compared to 1 to 5 odds of decline in the value. The anomalous January return behavior caught the attention of finance researchers after Rozeff and Kinney (1976) found that the average monthly returns of New York Stock Exchange (NYSE) are higher in January than in other months. Using equal-weighted index of stocks listed on NYSE over the period 1904-1974, they report that stock market returns are higher in January compared to any other month; monthly return in January averaged 3.5 percent compared to 0.5 percent in other months. In subsequent studies, Roll (1983) and Reinganum (1983) report that January effect is predominantly strong in small size firm (measured by market capitalization). They find that January returns are more pronounced in firms with negative returns in the previous year. Furthermore, Keim (1983) finds that 50 percent of the difference between returns of small firm and large firm is concentrated in January. Blume and Stambaugh (1983) exposit that measurement of small-stocks' returns has a potential bid-ask bias; the year-end closing price is the bid price whereas the subsequent transaction price is based on ask price. They show that once Keim's results are corrected for bid-ask bounce, the size premium occurs only in January. Guletkin and Guletkin (1983) investigate the January seasonality in stock market returns of sixteen countries. They find that January effect is strong and large in fifteen countries and most of the countries have stronger January effect compared to U.S.

A multitude of explanations has been proposed for the anomalous January return. The first explanation provided in the literature is the tax-loss selling hypothesis. According to this hypothesis, investors sell 'loser' stocks in December to realize capital losses to set off capital gains and reduce their tax liability. Therefore, stocks with declining prices face a selling pressure in December and the prices rebound in January when the selling pressure disappears. Roll (1983) and Reinganum (1983) find that small firms have strong abnormal January returns. They argue that small-firms are more likely to lose value and affected by tax-loss selling hypothesis. Similar results are reported by Poterba and Weisbenner (2001) and Jones, Lee, and Apenbrink (1991) who examine the effect of changes in income tax rules on January effect. There is evidence of January effect in Australia (see Brown, Keim, Kleidon, and Marsh, 1983) where tax year starts from July and in Canada (see Berges and McConnell, and Schlarbaum, 1984) where there are no capital gains taxes.

Another explanation of January effect is based on window-dressing hypothesis proposed by Haugen and Lakonishok, (1987) and Lakonishok, Shleifer, Thaler, and Vishny, (1991). According to this hypothesis, institutional investors window-dress their portfolios before disclosing their portfolios at the year-end. Institutional managers invest in risky and small stocks to enhance their performance. However, they sell these risky and small stocks in December before making a disclosure of their holdings to SEC. Once the legal disclosure requirement is fulfilled, they reverse their positions and buy those small and risky stocks in January resulting in higher January returns of these stocks. Some other hypotheses proposed for explaining January effect are market microstructure biases related to bid-ask bounce (see Bhardwaj and Brooks, 1992; and Cox and Johnston, 1998) and differential information hypothesis (see Barry and Brown, 1984, 1985). Chen and Singal (2004) disentangle the various explanations to find the most important causes of the January effect. They attempt to separate the effect of various explanations and find that January effect in US equity market is mainly driven by tax-loss selling hypothesis.

Empirical evidence documenting the value effect and the size effect appeared almost at the same time. For example, Basu (1977) studies the return behavior of value and growth stocks and reports that value firms consistently outperform growth firms. Chan, Hamao, and Lakonishok (1991) analyze cross-sectional returns of Japanese stocks and find results supporting superior performance of value stocks compared to growth stocks. Fama and French (1992) argue that B/M is a proxy for distress risk and superior returns earned on value stocks are mainly a compensation for this distress risk. Fama and French (1993) and Davis, Fama, and French (2000) study post-1963 and pre-1963 data, respectively, and find that value stocks earned premiums in both periods. Fama and French (1998) provide international evidence of value effect in 13 countries over the period 1975-1995

While significant amount of research has been carried out to examine January effect related to size, very few studies have examined January seasonal related to book-to-market equity. This lack of research in seasonal anomalies related to book-to-market is evident in Schwert (2002), a survey paper related to market anomalies, where he highlights the seasonal impact of January on returns of small stocks, but does not mention January effect related to B/M. It is surprising that there has been a very limited research examining calendar seasonality of the book-to-market effect. In this section, we mention those studies that examine seasonal pattern observed in value premiums.

Fama and French (1993) test for January seasonal in excess stock returns after controlling for size and book-to-market. They find evidence of January seasonal related to size and book-to-market equity. They exposit that these abnormal returns are mostly explained by the corresponding seasonal in the risk factors of their multi-factor model. Daniel and Titman (1997) analyze January and non-January return patterns of different portfolios sorted on size and book-to-market. They find that value premium of large firms is exclusively a January phenomenon. Additionally, they claim that almost half of the annual value premium of medium and small size companies occurs in January.

Loughran (1997) explores the book-to-market and calendar seasonality and provides evidence supporting non-existence of value premium among large stocks outside of January. He shows that the value premium outside of January is mostly driven by low returns of small newly listed growth stocks. He further states that the largest three size quintiles, which account for 94% of the total market capitalization, exhibit negligible value premiums in non-January months.

Chou, Das, and Rao (2010) study the value premium in January and non-January months using B/M and E/P ratios as value growth indicators. Consistent with Daniel and Titman (1997) and Loughran (1997), they find that value premium of large and small stocks exhibit different seasonal patterns. They document that pronounced January value premium observed among large stocks can be explained by turn-of-the-year trading behavior. In support of their argument, they provide evidence showing that value premium is limited to the first ten trading days of the year and is driven by high value premium of loser stocks.

These studies document a seasonal pattern in the value premium in U.S. stock market. Our study examines the international reach of seasonal anomalies in three developed markets and provides out-of-sample evidence supporting calendar effect in premiums related to book-to-market.

DATA AND METHODOLOGY

Value-weighted monthly portfolio returns for Japan, the UK, and France over the period of January, 1975 through December, 2007 are obtained from the website of Kenneth French. We use four different ratios as indicators of value and growth portfolios: book-to-market; earnings-price; cash earnings to price; and dividend yield. At the end of each year t, all stocks in each country are sorted on one of the four ratios. Firms in the top 30% (High) of a sort ratio constitute value portfolio and firms in the bottom 30% (Low) form growth portfolios. The monthly value-weighted return for each portfolio is calculated for all months of year t+1. The portfolio returns are based on raw data from Morgan Stanley's Capital International Perspectives (MSCI) for 1975 to 2006 and for 2007 from Bloomberg (See Fama and French, 1998, for more detailed information about the data). A firm is included in a sort variable's portfolio if data for that variable is available. It is worth mentioning that firms included in the MSCI index are large and constitute majority of a country's market capitalization (Fama and French, 1998). We select the top three countries ranked in country weights in the MSCI EAFE index. As of May 2010, these three countries constitute more than 54% of developed countries market outside North America.

Panel A of Table 1 summarizes country characteristics. There is a great variation in the sample at the country level. For example, the average number of firms included in the French market is 110, a little more than one-fourth of 418, the average number of firms included from the Japanese market. In addition, there is a considerable country level variation in the ratios used as value-growth indicators. The average B/M and CE/P ratios for France are higher than those of the UK, but the average E/P and D/P are almost equal to or less than those of the UK. Among the three countries, the average B/M, E/P, CE/P, and D/P ratios for Japan are the lowest.

Panel B of Table 1 provides summary statistics of value-weighted monthly returns of market, value, and growth portfolios. Consistent with Fama and French (1998), Table 1 shows existences of value premium outside of the U.S. Value stocks outperform growth stocks in all three countries irrespective of the value-growth indicator. However, the choice of the value-growth indicator affects the size of the value premium. For example, the value premium is 0.75% per month in French market when dividend yield is used as a value growth indicator, compared to 0.45% when earnings-price ratio is used as a value-growth indicator. Also, the standard deviations of High B/M portfolios are greater than Low B/M portfolios. However, when other ratios are used to sort value-growth stocks, the standard deviation of High portfolio is not necessarily higher than that of Low portfolio. For example, the standard deviation of High D/P portfolio in France is 6.67% versus 6.80% for Low D/P portfolio. The use of ratios other than B/M produces results that have weaker statistical significance but are still quite large in economic terms. These results are consistent with Fama and French (1998) who suggest that value premium of countries in their study have large economic significance but statistically not significant because of high volatility of country returns.

Table 1: Country and Portfolio Characteristics of the Sample

Panel A: Country Characteristics					
Country	**Number of Firms**	**B/M**	**E/P**	**CE/P**	**D/P**
Japan	418	0.48	0.04	0.11	0.01
UK	195	0.67	0.09	0.15	0.05
France	110	0.79	0.09	0.22	0.04
Panel B: Portfolio Characteristics					
	Mean	**Std. Deviation**	**Median**	**Maximum**	**Minimum**
			Japan		
Market	1.00	6.33	0.72	25.92	-18.58
High B/M	1.53	6.94	1.03	34.78	-15.96
Low B/M	0.64	6.69	0.38	27.51	-21.58
High E/P	1.33	6.14	1.06	21.53	-17.25
Low E/P	0.65	6.91	0.43	31.09	-20.34
High CE/P	1.40	6.57	0.63	25.98	-14.47
Low CE/P	0.63	6.46	0.56	29.46	-23.46
High D/P	1.32	6.72	0.77	27.39	-18.56
Low D/P	0.70	6.67	0.35	24.95	-18.47
			UK		
Market	1.47	6.28	1.25	54.90	-22.43
High B/M	1.63	6.88	1.43	52.61	-23.29
Low B/M	1.36	6.45	1.16	53.42	-24.13
High E/P	1.74	6.57	1.58	53.92	-24.71
Low E/P	1.36	6.48	1.18	54.01	-24.59
High CE/P	1.82	6.79	1.77	57.33	-22.22
Low CE/P	1.34	6.47	1.03	53.27	-24.77
High D/P	1.57	6.35	1.49	47.74	-19.18
Low D/P	1.37	6.62	1.04	56.51	-24.79
			France		
Market	1.34	6.35	1.53	27.53	-23.80
High B/M	1.71	7.35	1.69	29.21	-24.97
Low B/M	1.23	6.40	1.25	28.72	-23.06
High E/P	1.64	7.35	1.45	30.85	-27.5
Low E/P	1.19	6.57	1.26	35.36	-19.52
High CE/P	1.74	7.62	1.61	34.39	-26.25
Low CE/P	1.17	6.60	1.11	31.09	-21.55
High D/P	1.73	6.67	1.76	29.28	-24.61
Low D/P	0.98	6.80	0.83	27.97	-27.45

Panel A shows the average values for number of firms, book-to-market (B/M), earnings-price ratio (E/P), cash earnings to price ratio (CE/P), and dividend yield (D/P) for each country included in the sample. The average number of firms is calculated for all years. The average B/M, E/P, CE/P, and D/P is first calculated for a given year for all firms as a ratio of annual value weighted sum of numerator and denominator. Panel B reports the mean, standard deviation, median, maximum, and minimum of value weighted average of monthly dollar returns for market, high book-to-market (High B/M), low book-to-market (Low B/M), high earnings-price (High E/P), low earnings-price (Low E/P), high cash earnings to price (High CE/P), low cash earnings to price (Low CE/P), high dividend yield (High D/P), and low dividend yield (Low D/P) portfolios for each country. All figures reported in the Panel B are in percent. The sample period is 1975 to 2007. The three countries included in the sample are Japan, the UK, and France.

RESULTS

The Value Premium and January Effect

Table 2 summarizes the January and non-January country returns for value and growth portfolios formed on B/M, E/P, CE/P and D/P for the period 1975 through 2007. The table also reports mean, standard deviation, median, percent positive, and sign test statistics for High, Low, and High-Low spread for January and non-January months. We also present the difference between January and non-January value premiums. The common theme running through all the panels A through D is positive January minus non-January value premium suggesting that January value premium is greater than non-January value premium. The January value premium of France is 2.58%, which is 2.29% greater than non-January value premium of 0.29%. The January minus non-January value premium is also economically large for Japan (1.58%) and UK (1.11%). The annualized excess January value premium is 27.48% for France, 18.96% for Japan, and 13.32% for the U.K (The annualized excess January value premium is calculated by multiplying the difference between January value premium and monthly average of non-January value premium by 12.). The paired test between average January value premium and non-January value premium suggests that January value premium is greater than non-January value premium most of the time. The results on the statistical significance of the excess January value premium are shown using sign test statistics. The January minus non-January value premium is positive at least two-thirds of the time and sign test is statistically significant for all three countries. It is worth mentioning that the high value premium in January is mostly driven by superior returns of value stocks in January. Our study provides out-of-sample evidence relative to tests on U.S. data of Loughran (1997). He finds that large firms have greater January value premium and value stocks exhibit higher January returns compared to growth stocks. Given that our sample includes mostly large firms; our results are consistent with Loughran.

Table 2: Value-weighted Portfolio Returns for January and Non-January Months

Panel A: Book-to-market (B/M) ratio as a value-growth indicator							
	January (N=33)			Non-January (N=363)			Jan-NonJ
	High	Low	H-L	High	Low	H-L	(H-L)
			Japan				
Mean	2.45*	0.11	2.34*	1.45	0.69	0.76	1.58
Std. Deviation	7.63	7.23	7.42	6.87	6.45	4.50	7.80
Median	1.56	-0.10	2.36	0.94	0.43	0.52	2.18
Percent positive	69.70	45.45	72.73	57.85	57.90	58.95	66.67
Sign test (z-stat)	106.50	-25.50	187.50	7316.50	3298.50	7133.50	142.50
Sign test (prob)	0.06	0.66	0.00	0.00	0.10	0.00	0.01
			UK				
Mean	3.89*	2.60	1.28*	1.42	1.25	0.17	1.11**
Std. Deviation	10.67	10.57	3.65	6.42	5.95	3.52	3.64
Median	2.27	0.02	0.81	1.38	1.25	0.46	1.38
Percent positive	69.70	51.52	63.64	61.16	59.50	55.10	66.67
Sign test (z-stat)	137.50	53.00	0.16	8934.00	8589.00	3031.00	112.50
Sign test (prob.)	0.01	0.35	0.04	0.00	0.00	0.13	0.04
			France				
Mean	3.36*	0.77	2.58**	1.58	1.27	0.29	2.29*
Std. Deviation	8.75	7.72	5.22	7.20	6.27	4.48	5.09
Median	2.37	-0.19	2.61	1.50	1.29	0.43	2.06
Percent positive	72.73	48.48	72.73	59.50	59.23	53.17	69.69
Sign test (z-stat)	119.00	23.50	150.50	3126.50	7316.50	8521.00	134.50
Sign test (prob)	0.03	0.68	0.01	0.12	0.00	0.00	0.01
Panel B: Earnings-price ratio (E/P) as a value-growth indicator							
			Japan				
Mean	1.15	0.09	1.06	1.35	0.70	0.65	0.41
Std. Deviation	5.52	6.81	5.15	6.20	6.93	4.09	5.17
Median	0.48	0.29	0.86	1.07	0.46	0.70	0.51
Percent positive	54.55	51.52	60.61	57.85	54.27	57.85	51.52
Sign test (z-stat)	46.00	-5.50	99.00	7367.50	2865.50	6865.00	45.50
Sign test (prob)	0.42	0.92	0.08	0.00	0.15	0.00	0.42
			UK				
Mean	3.75*	2.82	0.93	1.55	1.23	0.32	1.62
Std. Deviation	10.34	10.81	3.46	7.21	6.46	4.04	4.46
Median	1.35	0.07	1.31	1.44	1.27	1.23	2.92
Percent positive	63.64	57.58	57.58	63.09	57.85	54.82	72.73
Sign test (z-stat)	123.50	56.00	73.50	10148.00	7939.50	3392.00	51.50
Sign test (prob.)	0.02	0.32	0.19	0.00	0.00	0.09	0.37
			France				
Mean	2.61*	0.68	1.94*	1.55	1.23	0.32	1.62*
Std. Deviation	8.75	7.75	4.50	7.21	6.46	4.04	4.46
Median	1.55	-0.47	2.09	1.44	1.27	1.23	2.92
Percent positive	63.64	48.48	72.73	60.06	57.30	54.55	72.73
Sign test (z-stat)	100.00	18.50	131.50	8928.50	7561.00	4211.00	119.50
Sign test (prob)	0.07	0.75	0.02	0.00	0.00	0.04	0.03

Table 2 continued

Panel C: Cash earnings to price (CE/P) as a value-growth indicator							
	January (N=33)			Non-January (N=363)			Jan-NonJ
	High	Low	H-L	High	Low	H-L	(H-L)
			Japan				
Mean	1.24	-0.34	1.58*	1.41	0.71	0.70	0.88
Std. Deviation	5.88	5.13	4.09	6.64	6.57	4.02	4.06
Median	0.50	0.10	0.89	0.65	0.66	0.71	0.85
Percent positive	57.58	51.52	66.67	54.27	55.65	55.10	60.61
Sign test (z-stat)	49.50	-19.50	111.50	6520.00	3906.50	5449.00	53.50
Sign test (prob)	0.38	0.73	0.04	0.00	0.05	0.01	0.35
			UK				
Mean	4.13*	2.51	1.62*	1.62	1.24	0.38	1.24**
Std. Deviation	11.00	10.65	3.46	6.25	5.96	3.97	3.58
Median	1.65	-0.23	1.84	1.99	1.15	1.24	2.06
Percent positive	60.61	45.45	72.73	63.09	60.06	54.27	63.64
Sign test (z-stat)	129.00	27.00	133.00	10648.50	8152.50	3763.50	110.50
Sign test (prob.)	0.02	0.64	0.01	0.00	0.00	0.06	0.05
			France				
Mean	2.94*	0.58	2.36*	1.63	1.23	0.41*	1.95*
Std. Deviation	9.14	7.83	4.99	7.47	6.49	4.50	5.05
Median	1.63	-0.06	0.78	1.58	1.22	1.23	0.85
Percent positive	63.64	48.48	75.76	59.23	57.58	53.17	69.70
Sign test (z-stat)	102.00	9.50	158.00	8781.50	7872.00	3216.00	122.50
Sign test (prob)	0.07	0.87	0.00	0.00	0.00	0.11	0.03
Panel D: Dividend yield (D/P) as a value-growth indicator							
			Japan				
Mean	1.20	0.22	0.98	1.33	0.75	0.58	0.40
Std. Deviation	6.17	7.23	5.31	6.77	6.63	4.74	5.62
Median	0.17	0.37	1.44	0.78	0.34	0.75	1.27
Percent positive	51.52	51.52	57.58	55.10	53.44	54.82	57.58
Sign test (z-stat)	38.50	-20.50	76.50	6114.50	3488.50	4664.00	40.50
Sign test (prob)	0.50	0.72	0.18	0.08	0.02	0.08	0.48
			UK				
Mean	4.06*	2.46	1.61*	1.35	1.27	0.08	1.53*
Std. Deviation	9.67	11.17	4.31	5.92	6.05	3.57	4.28
Median	1.71	-0.40	1.16	1.43	1.27	1.27	1.52
Percent positive	72.73	42.42	63.64	61.43	58.68	49.86	63.64
Sign test (z-stat)	155.50	18.50	103.00	8908.50	7812.50	425.50	110.50
Sign test (prob.)	0.00	0.75	0.06	0.00	0.00	0.83	0.05
			France				
Mean	2.73*	0.21	2.52**	1.64	1.05	0.60**	1.93*
Std. Deviation	7.47	8.11	4.92	6.59	6.68	4.38	4.91
Median	2.09	-1.16	1.86	1.66	0.87	1.05	1.46
Percent positive	69.70	48.48	66.67	61.71	58.95	58.68	75.76
Sign test (z-stat)	124.50	-12.50	153.50	10459.50	6846.00	6596.50	137.50
Sign test (prob)	0.02	0.83	0.00	0.00	0.00	0.00	0.01

*All firms included in the sample are sorted on the basis of book-to-market (B/M), earnings-price (E/P), cash earnings to price (CE/P), and dividend yield (D/P). Top 30 percent of firms in a given country form value portfolios (indicated with High), and bottom 30 percent of firms constitute growth portfolios (indicated with Low). The difference between high and low portfolios is indicated with H-L. The High, Low, and H-L values are shows for January and non-January months. The last column (Jan-NonJ) shows statistics for excess January H-L over non-January H-L. This table reports the mean, standard deviation, median percent positive, sign test, and p value of sign test statistics of value-weighted monthly returns of High, Low, and H-L portfolios. Panel A, B, C, and D use B/M, E/P, CE/P, and D/P ratios, respectively, to form value and growth portfolios. All returns reported are in percent. * and ** denote significance of Jan-Non-Jan at 5% and 10% level respectively. The sample period is 1975 to 2007.*

In Table 3, we report the January, non-January, and January minus non-January value premiums for two sub-samples: 1975-1990, and 1991-2007. The results indicate that high January value premium is not a result of sample selection bias and is evident in both samples. The January minus non-January value premium is of great economic importance but statistically not significant in many cases suggesting that large standard deviations of the value premium do not offer arbitrage opportunities. The non-significance of some Jan-NonJan should not be surprising given that Fama and French (1998) (Table III, page 1980) find that, out of their sample of thirteen countries, only five countries have significant value premium when B/M ratio is used to form value-growth portfolios (The number of countries with significant value premium declines for other ratios and are three for E/P, four for CE/P, and two for D/P ratios. When D/P ratio is used, only Japan and France have significant value premium). Similarly, Capaul, Rowley, and Sharpe (1993) (Table IV, page 34) find that all six countries included in their sample (France, Germany, Switzerland, the U.K., Japan, and U.S.) have positive but non-significant value premium.

Table 3: Value-weighted Portfolio Returns for January And Non-January Months for Different Sub-samples

	1975-1990			1991-2007		
	Japan	**U.K.**	**France**	**Japan**	**U.K.**	**France**
Book-to-market						
Jan	0.03	2.75	3.52	4.52	-0.10	1.71
	6.96	3.13	6.15	7.37	3.64	4.17
NonJan	0.81	0.14	0.46	0.71	0.20	0.12
	4.25	3.43	3.98	4.72	3.61	4.9
Jan-NonJan	-0.78	2.61*	3.06**	3.81*	-0.30	1.60*
	(-0.41)	(3.47)	(1.92)	(2.10)	(-0.33)	(1.85)
Earnings-price (E/P)						
Jan	-0.17	1.20	2.12	2.23	0.68	1.76
	5.36	4.07	5.29	4.81	2.87	3.76
NonJan	0.72	-0.01	0.48	0.6	0.63	0.16
	4.14	3.26	3.92	4.06	3.53	4.15
Jan-NonJan	-0.89	1.21	1.64	1.63	0.04	1.60*
	(-0.63)	(1.26)	(1.21)	(1.51)	(0.06)	(1.90)
Cash-earnings to price (CE/P)						
Jan	0.53	2.29	3.63	2.57	0.99	1.16
	2.99	3.72	6.60	4.80	3.18	2.42
NonJan	0.73	0.07	0.48	0.67	0.67	0.34
	4.31	3.76	4.34	3.75	4.15	4.67
Jan-NonJan	-0.20	2.22*	3.15**	1.90**	0.32	0.82
	(-0.24)	(2.61)	-1.89	(1.76)	(0.37)	(1.34)
Dividend yield (D/P)						
Jan	0.02	2.24	2.53	1.88	1.01	2.52
	5.72	5.06	5.39	4.90	3.53	4.60
NonJan	0.78	-0.09	0.72	0.39	0.23	0.48
	4.64	3.49	4.65	4.83	3.66	4.12
Jan-NonJan	-0.76	2.33**	1.82	1.50	0.78	2.03
	(-0.48)	(1.89)	(1.33)	(1.27)	(0.91)	(1.87)

*All firms included in the sample are sorted on the basis of book-to-market (B/M), earnings-price (E/P), cash earnings to price (CE/P), and dividend yield (D/P). This table shows the difference between the average of value-weighted monthly returns of value portfolio consisting of top 30 percent (value) and growth portfolio of bottom 30 percent of firms in a given country for January (Jan) and Non-January (NonJan) months. The second number is standard deviation of value-weighted monthly returns. The numbers in parentheses are t statistics. The column Jan-NonJ shows statistics for excess January H-L over non-January H-L. The results shown are for sub-sample 1975-1990 and 1991-2007 respectively. * and ** denote significance of Jan-Non-Jan at 5% and 10% level respectively.*

It should be noted that January value premium is more volatile than non-January value premium. The non-January value premiums are very similar across the sub-samples. The January minus non-January value premium is mostly driven by higher January value premium. For example, the January value premium in Japan is 0.03% during 1975 to 1990 sub-period resulting in negative January minus non-January value premium. However, in the sub-period 1991-2007, the January minus non-January value premium is a remarkable 3.81% driven mostly by higher January value premium of 4.52%.

We also conduct the asset pricing tests to explain the January seasonal in the value premium. We follow Fama and French (2006) and use CAPM to test the January effect in the value premium. Our test model is

$$Premium_t = a + b(RM_t - RF_t) + JanDummy + e_t$$

where $Premium_t$ is value premium (value - growth) for month t, RM_t is market return, RF_t is one-month U.S. Treasury bill rate, and $JanDummy$, a dummy variable that takes the value 1 if month is January and zero otherwise. We use two different market returns, global market return and local market return. The monthly dollar returns of global and local market are calculated using MSCI indices.

In an efficient market, we should not expect these value premiums to be explained by the CAPM model. On the other hand, a positive a would indicate existence of value premium in non-January months, and sum of $a + JanDummy$ is the total value premium in the month of January. A positive coefficient of $JanDummy$ implies that January value premium is greater than non-January value premium and would indicate presence of January seasonal in the value premium. We use all four ratios as value-growth indicators to calculate the value premiums. Table 4 reports results using book-to-market ratios as a value-growth indicator. Table 5 shows the coefficient of $JanDummy$ using E/P, CE/P, and D/P ratios as value growth indicators.

Table 4: CAPM Regressions Using Book-To-Market Ratios as a Value Growth Indicator

	Japan		UK		France	
	$RM : Global$	$RM : Local$	$RM : Global$	$RM : Local$	$RM : Global$	$RM : Local$
a	0.85**	0.80*	0.14	0.16	0.23	0.21
t(a)	3.38	3.17	0.75	0.85	0.96	0.86
b	-0.17*	-0.08**	0.06	0.02	0.09**	0.09*
t(b)	-2.91	-1.96	1.37	0.58	1.66	2.52
Jan	1.71**	1.57**	1.07**	1.08**	2.24*	2.29*
t(Jan)	1.97	1.81	1.67	1.67	2.72	2.79
R Sq	0.03	0.02	0.01	0.01	0.03	0.04
F Value	5.90	3.59	2.44	1.64	5.38	7.14
Nobs	396	396	396	396	396	396

*The regression model used is $Premium_t = a + b(RM_t - RF_t) + JanDummy + e_t$ where $Premium_t$ is value premium (difference between value-weighted returns of high and low book-to-market portfolios) for month t, RM_t is either global market or local market returns in US dollars, RF_t is one-month U.S. Treasury bills rate, $JanDummy$ is a dummy variable which takes value of 1 if month is January and 0 otherwise. t() is the t-statistics of a regression coefficient, and R sq is the coefficient of determination. Nobs is number of months included in the sample. The sample period is 1975 to 2007. * and ** denote significance at 5% and 10% level respectively.*

Table 4 confirms the existence of seasonality in the book-to-market effect. The positive and significant coefficients of $JanDummy$ across all countries suggest that value premium seasonality is not a manifestation of a single country. Since our sample constitutes of most of the developed markets outside of North America, it is safe to say that January effect observed in our results is prevalent in countries outside of the U.S.

Table 5: CAPM Regressions using Earnings-price, Cash Earnings to Price, and Dividend Yield ratios as Value Growth Indicators

Panel A: $RM - Global$						
	Earnings-price (E/P)		Cash earnings to price (CE/P)		Dividend Yield (D/P)	
	$JanDummy$	t($JanDummy$)	$JanDummy$	t($JanDummy$)	$JanDummy$	t($JanDummy$)
Japan	0.52	0.69	0.94	1.28	0.54	0.63
UK	0.56	0.90	1.19**	1.67	1.59*	2.40
France	1.57*	2.12	1.92*	2.31	2.02*	2.43
Panel B: $RM - Local$						
Japan	0.38	0.52	0.88	1.20	0.39	0.45
UK	0.66	1.06	1.24**	1.73	1.70*	2.59
France	1.60*	2.18	1.93*	2.69	1.94*	2.43

*The regression model used is $= a + b(RM_t - RF_t) + JanDummy + e_t$ where $Premium_t$ is value premium (difference between value-weighted returns of high and low portfolios sorted on earnings-price ratio, cash earnings to price ratio, and dividend yield) for month t, RM_t is either global market or local market returns in US dollars, RF_t is one-month US Treasury bills rate, $JanDummy$ is a dummy variable which takes value of 1 if month is January and 0 otherwise. This table shows the regression coefficient and t-statistics of the dummy variable, $JanDummy$. * and ** denote significance at 5% and 10% level respectively. The sample period is 1975 to 2007.*

In Table 5, we report the coefficients of $JanDummy$ using E/P, CE/P, and D/P as value-growth separators. Panels A and B report results with excess global and local market returns, respectively, as one of the explanatory variables. The results clearly indicate presence of January seasonal, consistent with our earlier findings. For example, in case of France, the coefficients of *JanDummy* in panel A are 1.57 (t-statistic = 2.12), 1.92 (t-statistic = 2.31), and 2.02 (t-statistic = 2.43) for regressions based on E/P, CE/P, and D/P as value growth indicators respectively. Similarly, when local market (panel B) is used as a proxy for market portfolio, the coefficients of *JanDummy* for regressions using E/P, CE/P, and D/P as value growth indicators are 1.60 (t-statistic = 2.18), 1.93 (t-statistic = 2.69), and 1.94 (t-statistic = 2.43) respectively. Consistent with our results in Table 4, these positive coefficients suggest that January effect of value premium is real and not an outcome of using any specific ratio as a value-growth indicator.

Finally, in Table 6, we investigate whether our findings have implications for the success, or otherwise, of investment strategies based on the existence of a seasonal value premium. In other words, we analyze whether a portfolio formed on buying value stocks and selling growth stocks in January performs better than the one in non-January months. We compare two different investment strategies. Investment strategy ‘Jan’ is defined as holding value minus growth portfolio in January and one-month US treasury bills in non-January. ‘Non-Jan’ investment strategy is holding value minus growth portfolio during non-January months and US treasury bills in January. We compare the returns generated by above-mentioned investment strategies for the sample period 1975 to 2007 and two subsamples period of 1975-1990 and 1991-2007. The results are reported in Table 6.

The results presented in Table 6 show that for the sample period 1975-2007, ‘Jan’ strategy based on B/M as a value growth indicator outperforms 'Non-Jan' strategy by 5.33% (7.78% - 2.45%) in France and 4.88% (6.56% - 1.68%) in the UK. The Jan strategy does not perform better in Japan mainly because of poor performance in the first half of our sample period. When we only consider the 1991-2007 period, 'Jan' strategy generates superior return even in Japan. Clearly, the January seasonal affects the performance of different investment strategies.

Table 6: Comparison of Different Investment Strategies

Country	B/M		E/P		CE/P		D/P	
	Jan	Non-Jan	Jan	Non-Jan	Jan	Non-Jan	Jan	Non-Jan
Panel A: Sample Period 1975:01-2007:12								
Japan	7.41	7.70	6.27	6.76	6.84	7.27	5.81	5.61
UK	6.56	1.68	6.21	3.37	6.90	3.75	5.81	0.60
France	7.78	2.45	7.17	3.03	7.57	3.82	5.81	5.98
Panel B: Subsample Period 1975:01-1990:12								
Japan	6.99	8.50	6.91	7.56	7.72	7.62	7.85	8.06
UK	9.92	1.52	8.36	-0.10	9.44	0.56	7.85	-1.05
France	10.55	4.76	9.22	5.06	10.63	4.82	7.85	7.30
Panel C: Subsample Period 1991:01-2007:12								
Japan	8.58	7.03	6.45	6.09	6.79	7.02	4.76	3.39
UK	4.18	1.92	4.98	6.72	5.28	6.85	4.76	2.23
France	5.97	0.36	6.03	1.20	5.47	2.96	4.76	4.82

This table reports annual returns generated by two investment strategies: 'Jan' and 'Non-Jan'. Jan strategy is defined as holding value minus growth portfolio in January and one-month US treasury bills in non-January. Non-Jan investment strategy is holding value minus growth during non-January months and US treasury bills in January. The different ratios used to sort value and growth stocks are book-to-market (B/M), earnings-to-price (E/P), cash earnings to price (CE/P), and dividend yield (D/P). Panel A reports annual average return generated over sample period 1975-2007. Panel B and Panel C are for sub-sample periods 1975-1990 and 1991-2007 respectively. All returns reported are based on U.S. dollar and are in percent.

DISCUSSION

In this study we cannot tell whether positive value minus growth premiums for Japan, France and the U.K. are due to irrational investor behavior as described by behavioral theories or whether they result from compensation for risk as suggested by Fama and French (1993, 1995, and 1996). If the value premium of stocks is due to underlying risk, then the value premium should be evenly distributed among all the calendar months and should not appear only in January. Our results suggest that value stocks tend to have higher returns than growth stocks and this effect is more pronounced and impressive in January. As such, we lend support to behavioral explanation instead of risk-based one for January effect on value premium.

There is a large literature using financial market data to explore the causes of a 'January effect' which produces higher stock prices in January than in other months of the year. Proposed explanations of the January effect include tax-loss selling and window dressing. The tax-loss selling hypothesis holds that sales of 'loser' stocks in mid-December to establish tax losses tend to drive security prices below what they should be in light of earnings. Tax-loss-selling as an explanation of excess January value premium is rejected because the financial year for tax purposes in Japan and the U.K. ends in March and both countries exhibit strong January value premium. Yet another reason for rejection is that increasing number of people are using tax-sheltered retirement plans and therefore have no reason to sell at the end of the year for a tax loss. Window dressing hypothesis proposes that institutional investors 'window dress' their portfolios prior to disclosure in December by tilting their stocks with 'winner' stocks and sell 'loser' stocks. Though it seems that window dressing can be a possible explanation of the pronounced January value premium, the framework of our study does not allow us to test for this hypothesis.

CONCLUSION

Value stocks are those firms with high ratios of book-to-market equity (B/M), earnings to price (E/P), cash earnings to price (CE/P), or dividends to price (D/P) and growth stocks are those with low ratios. Value stocks have outperformed growth stocks over long periods in many countries. This difference in higher average returns for value stocks and lower average returns for growth stocks is defined as value premium. While this phenomenon may be a manifestation of a systematic risk premium, the precise nature of that risk is not fully understood. Whether value premium reflects fully rational risk premium, market irrationality or some of both still is a matter of considerable controversy in empirical finance.

This study examines monthly returns on value and growth portfolios for the period 1975-2007 to test for the existence of January effect on value premium for Japan, the U.K., and France. These three countries constitute more than 54% of developed market outside of North America. We use four different ratios to sort value and growth stocks: book-to-market; earnings-price; cash earnings to price; and dividend yield. The top (bottom) 30% of a sort ratio constitute value (growth) portfolio.

Using value-weighted monthly portfolio returns from three different stock markets over the period of January, 1975 through December, 2007, we provide evidence supporting that monthly return distributions of value premium in January have large means relative to the remaining eleven months. The difference between January and non-January value premium is mostly positive and statistically significant. In particular, value premium for January month is nearly three to nine times that of non-January months. Annualized value premiums for January (non-January months) for Japan, the U.K. and France are 28.08% (9.12%), 15.36% (2.04%), and 30.96% (3.48%) respectively. We report strong international evidence supporting that the calendar effect of value premium exists in stock markets of Japan, the U.K. and France. Results are robust with respect to different value-growth indicators as well as sample periods. Evidence of greater value premium for January is further confirmed by regression tests with explanatory variables of excess market return and a dummy variable for January month. The findings are consistent with Loughran (1997), Daniel and Titman (1997), and Chou, Das, and Rao who report pronounced January value premium in large stocks in the U.S. equity market.

One of the limitations of this study is that the value premium may be sample specific. Its appearance in past stocks return is a chance result unlikely to recur in future returns. A standard check on this argument is to test for a value premium in other samples. However, we believe that our results are not a sample specific event because chance alone cannot explain the consistent strong January value premium observed in major stock markets globally. Data availability substantially limits the stocks included in the sample.
Our sample (MSCI indices) is biased towards large cap stocks. It would be interesting to investigate whether our results hold for a portfolio biased toward small-cap stocks. Nevertheless, MSCI indices

constitute greater than 80% of the market's invested wealth and provide a good description of the market performance.

Many issues remain for future research. In particular, future research may focus on microstructure considerations, window dressing hypothesis, and portfolio rebalancing as possible explanations for January effect. Research may also consider optimal investment policy based on the magnitude of future value premium. An interesting question concerns the relationship between future return premiums to value factor and the arbitrage opportunities.

This study has broad implications for the success of investment strategies based on the existence of a value premium. Investors should also keep a close eye on January since it might have an outsize impact on the rest of the year's trading. In the absence of a well-articulated theory to explain the seasonal effect in the value premium, we are unable to predict whether this phenomenon will persist, diminish, or disappear in the coming years.

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AN EXAMINATION OF BOARD AND FIRM PERFORMANCE: EVIDENCE FROM TAIWAN

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ABSTRACT

This article discusses the impact of duality and board structure in corporate governance on corporate performance. The results showed that, regarding Tobin's Q, outside independent directors have a positive impact while other variables have no impact on corporate performance. Similar results were achieved using ROA and ROE for analysis. Duality, board size, and family-controlled directors had a negative impact on ROA and ROE. Supervisory directors, outside independent directors and inside directors had a positive impact on ROA and ROE. The analysis of large companies showed duality, board size, and family-controlled directors yielded a negative impact on ROA and ROE. Both supervisory directors and inside directors had positive impacts on ROA and ROE. Outside independent directors had positive impacts on ROE but no impact on ROA. No variable had an impact on Tobins' Q. The results from small and medium-sized companies indicate that supervisory directors, outside independent and inside directors had positive impacts on ROA and ROE. Other variables did not yield impacts on ROA and ROE. Finally, most of the variables had no impact on Tobins' Q.

JEL: G34, L25

KEYWORDS: corporate governance, board structure, duality, corporate performance

INTRODUCTION

Corporate governance concerns the effects of board structure on a firm's performance. Since shareholders elect board members, major shareholders have more influence when electing directors and supervisory directors. They account for the majority of share rights, which means they can choose and appoint persons as directors and supervisory directors. Therefore, those individuals holding the majority of share rights can control the company thus influencing the operations of the company. Further, the effectiveness of corporate governance will influence business performance. In recent years, the Taiwanese government has given more attention to corporate governance. In October 2002, the Taiwan Stock Exchange Corporation (TSEC) announced Corporate Governance Best-Practice Principles for TSEC/GTSM (GreTai Securities Market) listed companies, which stipulates that TSEC/GTSM listed companies must establish effective corporate governance structures, formulate their own corporate governance codes to enhance the function of their board of directors, perform supervisory director functions, and ensure shareholder equity.

These tasks are an effort to strengthen corporate governance effectiveness. In order to promote these goals, the Taiwanese government amended *Article 14, Securities and Exchange Act* in January 2007, to require listed companies have at least two and no less than one-fifth of directors to be independent. In Taiwan, board organizations differ from those in the U.S. because they maintain a two-tier board system composed of directors and supervisory directors. Specifically, directors are persons who determine and execute company policies while supervisory directors are those who supervise the decisions and implementation of activities made by the directors, thus serving functions similar to executive and non-executive directors in European companies. The principal role of non-executive directors is to protect shareholders' interests when the company makes decisions (Fernandes, 2008). Additionally, the role of supervisory directors in Taiwanese companies is similar to that of non-executive directors in European companies.

Many studies have investigated the relationship between corporate governance and a firm's performance. Finegold, Benson, and Hecht (2007) reviewed 105 studies conducted in major public companies between

1989 and 2005 that explored board structure, board equity, directors' remuneration, shareholder activism, degree of corporate governance, and firm performance. Additionally, Sanchez-Ballesta and Garcia-Meca (2007) analyzed 33 periodicals published between 1994 and 2006 that discuss the effects of share structure on a firm's performance. Wagner, Stimpert, and Fubara (1998) studied 30 articles that explored the relationship between board organization and firm performance. For some years, the effect of board and share structure on a firm's performance has been the subject of studies in the field of corporate governance. Major theories of corporate governance include agency theory, stewardship theory, and resource dependence theory (Nicholson & Kiel 2007). Agency theory argues that the board of directors manages a firm on behalf of shareholders; therefore, the board of directors must protect shareholders' interests and supervise the managers to prevent them from merely pursuing their own benefit when conflicts appear between the interests of themselves and those of shareholders. Further, shareholders must protect their interests because when managers pursue their own benefits, they gain advantages at the cost of shareholders (Nicholson & Kiel 2007). Therefore, shareholders elect board members and these individuals must manage the firm on behalf of its shareholders. Such a task of agency produces a dilemma (Nicholson & Kiel 2007) because it is difficult to give attention to the interests of both the board of directors and shareholders, simultaneously.

In Taiwan, many studies have explored the issue of corporate governance, focusing mainly on (1) corporate governance and performance (Chiang & Lin 2007; Her & Mahajan 2005; Huang, 2010; Li, Hu, & Chiu, 2004; Luan & Tang 2007); (2) corporate governance, leadership relations, and remuneration (Lin, 2005); (3) establishment of corporate governance indicators (Chen, Kao, Tsao, & Wu, 2007); and (4) corporate governance and financial crisis (Lee & Yeh 2004). Leadership structure includes duality with one individual serving as chair of the board and another individual serving as CEO. Additionally, board organization consists of both directors and supervisory directors, including inside directors, grey directors, and outside directors, because Taiwan has adopted the two-tier board system (Yammeesri & Herath, 2010). The implementation of corporate governance in practice also deserves exploration. As such, the following article investigates the influence of leadership structure and board organization on a firm's performance. Specifically, Taiwan's electronics industry plays an important role in the global electronics industry supply chain. Considering this, the current study reviewed three years of data from listed companies in Taiwan's electronics industry to explore corporate governance of Taiwanese electronics companies. Companies of various sizes were reviewed for the purpose of understanding the influence of board structure on a firm's performance in corporate governance and practice.

The remainder of this study is organized as follows. The next section offers a literature review, followed by an introduction to the study's methodology and description of the current sample and variable measures. The empirical results are that presented with a discussion and conclusions and implications are provided in the final section.

LITERATURE REVIEW

Three major theories explain corporate governance, (1) agency theory, (2) stewardship theory, and (3) resource dependence theory. Agency theory has two major facets, the effect of board organization on a firm's performance and the effect of board leadership structure (i.e., duality) on a firm's performance (Nicholson & Kiel 2007). The board of directors supervises primary corporate operations. Additional outside directors can also supervise corporate managers to prevent them from pursuing their own interests. Stewardship theory considers managers as reliable, high-level executives who will not exhibit behaviors that would be unfavorable to shareholders; therefore, inside directors can achieve better firm performance and create more profit for shareholders. Resource dependence theory suggests that board members have connections to important external resources and can maximize a firm's performance (Nicholson & Kiel, 2007). In corporate governance, the board of directors plays a vital role. For example, Johnson, Daily and Ellstrand (1996) pointed out three major duties of directors. First, control involves directors' supervising managers to manage the firm's interests by an agency mechanism. Independent directors (outside directors) can supervise managers in managing a firm's interests more effectively than can non-independent directors (inside directors). Second, director service involves providing the CEO with expert suggestions and opinions related to operations and management. Directors may be retired CEOs who can provide professional suggestions to newer CEOs.Third, a resource dependence role requires directors to provide resources that the firm needs to help them succeed. The directors' duty is to provide resources, supplying a certain percentage to the board of directors, a certain percentage to outside directors, and connections to different economic fields. If directors have good connections with financial institutions, the firm can locate funds easily.

The board of directors is the most important component of corporate governance; therefore, we need to understand the board structure. Finegold et al. (2007) pointed out that a component of board structure is duality, which consists of inside and outside directors, board size, board ownership share, and director remuneration. Therefore, the board's structure will influence firm performance. Many studies on corporate governance and firm performance have studied the influence of the board of directors on a firm's performance. Bonn (2004), Bonn, Yoshikawa and Phan (2004), and Jackling and Johl (2009) analyzed firm performance and board structure, while Luan and Tang (2007) analyzed independent directors and firm performance. The above studies used a board structure, or a certain property of this structure, to target different firm performance variables assessed using Tobin's Q, ROA, or ROE as measures of firm performance. Many proxy variables have been used to evaluate firm performance; however, Tobin's Q, ROA, and ROE are the most frequently used proxy variables (Bonn, 2004; Huang, 2010; Kiel & Nicholson 2003; Kota & Tomar 2010; Lam & Lee 2008; Luan & Tang 2007; Yammeesri & Herath 2010).

Two major subjects of agency theory focus on the effect of duality and the effect of board organization on firm performance (Nicholson & Kiel 2007). First, duality concerns leadership structure in terms of duality or service by separate persons; duality reduces the supervising effectiveness of a board of directors (Yammeesri & Herath 2010). Because Taiwan has a two-tiered board system, a board of directors is composed of directors and supervisory directors. Supervisory directors' major responsibilities are to audit, control, and prevent fraudulent behaviors of directors while directors' major duties are to supervise CEOs' management of the firm (Huang, 2010). The composition of directors may include inside directors, grey directors, and outside directors. Additionally, internal staff, or employees of the company (e.g., the CEO) serve inside directors who take part in the daily routines of the firm. Grey directors are persons who have relations with the firm but do not participate in daily routines. Outside directors, also called independent directors, are individuals with no relationship to the inside personnel of company (Yammeesri & Herath, 2010). Agency theory stresses that outside directors can supervise CEOs and their colleagues more effectively than inside directors (Daily, Johnson & Dalton 1999).

Finegold et al. (2007) analyzed 105 periodicals and found that, in terms of board structure, duality has a vague influence on a firm's performance. However, no consistent results have been reported concerning the proportion between inside and outside directors. Regarding board size, some studies have indicated a positive correlation, while others have indicated a negative correlation. Further, these studies indicate the need to clarify many areas of influence of board and share structure on firm performance. These different results might result from different conditions in various countries (Bonn et al. 2004).Therefore, the influence of board structure on firm performance remains a subject under investigation. As such, this article will discuss the influence of each aspect of board structure on firm performance.

Hypotheses

The effect of duality is indistinct with some studies showing positive results and others showing negative results (Finegold et al., 2007). For example, Jermias (2007) and Yammeesri and Herath (2010) found that duality has a negative effect on firm performance. According to agency theory, when the chair of the board also serves as CEO, the effectiveness of the board of directors' supervision of CEOs is reduced and the chair of the board might have more control over fulfilling private interests (Finkelstein & D'Aveni, 1994). Therefore, duality is not beneficial for a firm's operation, suggesting the concept of duality will have a negative influence on firm performance. Therefore, this study proposed the following hypothesis:

H1a. Duality relates negatively to a firm's performance.

However, Kota and Tomar (2010) pointed out that duality significantly influences firm performance. According to stewardship theory, inside directors create more profit for shareholders and achieve better performance (Nicholson & Kiel, 2007). Chiang and Lin (2007) mentioned that better performance is achieved when the chair of the board also serves as CEO due to effective and explicit leadership with unity of command. Further, Boyd (1995) believed that duality is better for corporate operations when the external environment is complicated and dynamic and lacks resources. The above findings indicate that duality is good for firm operations and positively influences firm performance; therefore, the following hypothesis was proposed:

H1b. Duality relates positively to firm performance.

The number of board members will influence the efficiency of board operations. Jensen (1993) noted that when the number of board members exceeds seven or eight, board function weakens and allows the CEO to control the board easily. Conversely, when the number of board members is small, the board's communication improves and board members are more likely to reach consensus. Bonn et al. (2004) discovered that board size of Japanese companies negatively influenced firm performance because larger boards of directors experience difficultly when communicating, coordinating, and taking part in corporate decision-making. Chiang and Lin (2007) also considered that, in Taiwan, smaller boards of directors could reduce the problem of bureaucracy and thus enable increased functioning. Based on these studies, smaller boards of directors will have better communication and will reach consensus faster. Therefore, this study proposed the following hypothesis:

H2. Board size relates negatively to firm performance.

Boards of directors in Taiwan are composed of directors and supervisory directors. In this two-tier board system, the primary duties of supervisory directors are to supervise how directors conduct their work while supervising the performance of the firm and reviewing the firm's business and financial status. Therefore, the major functions of supervisory directors in Taiwan are to audit, control, and prevent directors' disloyal behaviors (Huang, 2010). Dahya, Karbhari, Xiao and Yang (2003) suggested that the effectiveness of supervision for the majority of supervisory directors is unsatisfactory. Huang (2010) reported that the number of supervisory directors correlates negatively with firm performance, thus suggesting that firm performance decreases with increasing numbers of supervisory directors. Based on this information, the following hypothesis was proposed:

H3. The number of supervisory directors relates negatively to firm performance.

Among listed companies in Taiwan, major shareholders of families that control companies may nominate directors (Yeh, Lee & Woidtke 2001) while affiliated companies of the controlling family may nominate others. The more control a family exerts over the directors, the easier it becomes for these families to request that CEOs pursue the maximum interests of the controlling family. According this study results indicate that family businesses hold an average share ownership of 23.52%, not reaching 50%; therefore, the controlling family's interests would not be the same for all shareholders. Additionally, the more a family controls the directors, the larger the chance of a negative influence on firm performance. Filatotchev, Lien and Piesse (2005) indicated that family-controlled directors correlated negatively with firm performance. Therefore, the following hypothesis was proposed:

H4. The percentage of family-controlled directors that serve on the board of directors relates negatively to firm performance.

Agency theory suggests that outside directors can supervise high-level executives and control whether they seek their own interests, consequently reducing the agency costs (Fama, 1980). Bonn (2004) pointed out that outside independent directors in Australian companies were effective indicators of

Australian boards and correlated positively with the company's ROE. Huang (2010) found that outside directors in Taiwanese banks correlated positively with the banks' financial performance. Luan and Tang (2007) reported that outside independent directors of listed electronic companies in Taiwan correlated positively with firm performance. These studies all suggest that increasing the number of outside independent directors serving on a board is necessary to ensure the board's functioning. From the above discussion, the number of outside independent directors relates positively to firm performance. Therefore, this study proposed the following hypothesis:

H5. The number of outside independent directors relates positively to firm performance.

Inside directors: Finegold et al. (2007) found that the ratio between inside and outside directors affects firm performance. However, there are no consistent findings to conclude that increasing outside director participation would increase firm performance. For example, Wagner et al. (1998) reviewed 29 articles in a meta-analysis and discovered that increasing the number of both inside and outside directors had a positive influence on firm performance. In listed Taiwanese companies, many directors also served as vice general managers, assistant general managers, or managers; therefore, so they were inside directors. Inside directors take positions of high-level executives concurrently and participate in the companies' daily business operations (Johnson et al., 1996; Yammeesri & Herath 2010). Agency theory suggests that boards of directors need inside directors who can provide important internal supervision; without them, CEOs receive asymmetrical information. Additionally, inside directors can help the board pay careful attention to CEOs' actions and overall performance (Johnson et al., 1996). Finally, stewardship theory proposes that inside directors can achieve better firm performance and create more profit for shareholders (Nicholson & Kiel 2007). Therefore, the following hypothesis was proposed:

H6. The number of inside directors relates positively to firm performance.

DATA AND METHODOLOGY

Since Taiwan's electronic industry plays a vital role in the supply chain of global electronic industries, this study used Taiwan's electronic industry as the research sample. We obtained three year's (2007-2009) data for (TSEC/GTSM) listed companies from the Taiwan Economic Journal (TEJ) data bank and selected large firms with annual sales in the first half as research samples. Complete data were available for 662 listed electronics companies in 2007, 686 companies in 2008, and 719 companies in 2009, totaling 2,067 electronics companies for the three consecutive years. The number of companies with annual sales in the first 50% was 331 in 2007, 343 in 2008, and 359 in 2009, for the sum of 1,033 companies. Table 1 summarizes the descriptive statistical data for independent, dependent, and control variables. Table 2 shows the correlation coefficients for all variables.

In Table 1, the chair of the board also served as CEO (duality) in 307 companies, the average is 29.72%. Regarding board size, the smallest board consisted of six directors while the largest board consisted of 19 directors, with an average number of directors of 9.46. Overall, 984 companies employed supervisory directors with a maximum of five supervisory directors and an average number of 2.62. Regarding the percentage of family-controlled directors, the highest was 100% and the average was 51.61%. Among outside independent directors, 646 companies had independent directors; with a maximum having six and an average of 1.63. Regarding inside directors, 938 companies had inside directors, with a maximum of seven and an average of 1.91. Among all 1,033 companies, the lowest annual sales was NTD 1.67 billion (USD 57 million) while the highest was NTD 1,473.03 billion (USD 50 billion), with an average of NTD 27.42 billion (USD 935 million).

As seen in Table 2, independent directors correlated significantly with Tobins' Q. The variables duality, supervisory directors, family-controlled directors, and outside independent directors correlated significantly with ROA and ROE. Finally, the above analyses suggest that board structure variables do affect firm performance.

Table 1: Descriptive Statistics

	Minimum	Maximum	Median	Mean	S.D.
Duality	0	1	0	0.2972	0.4572
B-size	6	19	9	9.4569	1.9028
Sup-dire	0	5	3	2.6196	0.7872
FC-dire	0.0909	1	0.5	0.5161	0.1866
Outs-dire	0	6	2	1.6292	1.4228
Ins-dire	0	7	2	1.9148	1.3113
Sales (NTD million)	1669	1473026	5760	27418	102031
F-size	7.4197	14.2028	8.6587	8.9810	1.2053
Tobins'Q	-0.2884	12.0537	0.7168	0.9915	1.0303
ROA	-0.6239	0.5310	0.0675	0.0647	0.1033
ROE	-1.7976	0.7405	0.1083	0.0867	0.1888

Note: n=1033; Duality: is a dummy variable that is set to 1 when there is CEO duality and 0 otherwise. B-size: the number of board members. Sup-dire: the number of supervisory directors on the board of directors. FC-dire: The number of directors controlled by the controlling families and relatives/friends of controlling families. Outs-dire: the number of outside independent directors on the board of directors. Ins-dire: the number of inside directors on the board of directors. Sales(NTD million)：the annual sales of the company. F-size: the natural logarithm value of the annual sales of the company. $Tobins'Q = (MVCS + MVPS + STL - STA + LTD)/TA$ *. ROA: net income/ average total asset. ROE: net income/average net worth.*

This study applied regression analysis, taking corporate performance, Tobins' Q, ROA, and ROE as dependent variables and duality, board size, supervisor directors, family-controlled directors, independent directors, and inside directors as independent variables. Firm size was used as the control variable. The regression equation was as follows:

$$Yi = \alpha + \beta_1(Duality) + \beta_2(B-size) + \beta_3(Sup-dire) + \beta_4(FC-dire) + \beta_5(Outs-dire) + \beta_6(Ins-dire) + \beta_7(F-size) + \varepsilon \quad (1)$$

Yi=Firm performance, Y1=Tobins'Q, Y2=ROA, Y3=ROE

Ordinary Least Squares (OLS) was used to analyze regression equation (1).

Board Variables

Duality: Duality refers to the event in which one individual takes the position of both the chair of the board and CEO. Duality was coded as a dummy variable in this study. When the chair of the board also served as a CEO, the variable was coded as 1, otherwise it was coded 0.

Board size (B-size): Board size reflected the total number of directors and supervisory directors serving on the board of directors.

Supervisory directors (Sup-dire): It is the total number of supervisory directors serving on the board of directors.

Table 2: Pearson Correlation Coefficients between Variables

	Duality	B-size	Sup-director	FC-director	Outs-director	Ins-director	F-size	Tobins'Q	ROA	ROE
Duality	1.000									
B-size	-0.119***	1.000								
Sup-dire	-0.079*	0.327***	1.000							
FC-dire	-0.083**	0.083**	-0.088**	1.000						
Outs-dire	-0.128***	0.286***	0.021	-0.323***	1.000					
Ins-dire	0.225***	0.270***	0.046	0.324***	-0.169***	1.000				
F-size	-0.098**	0.212***	-0.093**	0.292***	0.064*	0.187***	1.000			
Tobins'Q	-0.050	0.038	0.011	-0.061	0.115***	-0.013	-0.038	1.000		
ROA	-0.073*	0.015	0.105***	-0.090**	0.183***	0.041	0.024	0.525***	1.000	
ROE	-0.092**	0.013	0.110***	-0.093**	0.167***	0.027	0.055	0.402***	0.928***	1.000

Note: n=1033; Duality: is a dummy variable that is set to 1 when there is CEO duality and 0 otherwise. B-size: the number of board members. Sup-dire: the number of supervisory directors on the board of directors. FC-dire: The number of directors controlled by the controlling families and relatives/friends of controlling families. Outs-dire: the number of outside independent directors on the board of directors. Ins-dire: the number of inside directors on the board of directors.. F-size: the natural logarithm value of the annual sales of the company. $Tobins'Q = (MVCS + MVPS + STL - STA + LTD)/TA$. *ROA: net income/ average total asset. ROE: net income/average net worth. *** Correlation is significant at the 0.01 level (two-tailed); ** Correlation is significant at the 0.05 level (two-tailed); * Correlation is significant at the 0.1 level (two-tailed);*

Family-controlled directors (FC-dire): Directors or supervisory directors are nominated and appointed by the major shareholder of families controlling the company (Yeh et al., 2001), by affiliated companies of the controlling families, or by relatives or friends of the controlling families. All of the above are family-controlled directors who made decisions concerning the company's operations according to controlling families' interests.

Outside Independent directors (Outs-dire): These include directors or supervisory directors not served by internal personnel, members of families controlling the company, or relatives or friends of families controlling the company, but by external persons who have no relationship to the company.

Inside directors (Ins-dire): A director who serves concurrently as deputy vice general manager, assistant general manager, or manager. Inside directors take the position of a high-level executive concurrently and participate in the companies' daily business operations (Johnson et al., 1996; Yammeesri & Herath 2010)

Performance Variables

This study adopted three performance variables that most researchers use to evaluate firm performance: Market-based Tobins' Q (Kiel & Nicholson 2003; Kota & Tomar 2010; Yammeesri & Herath 2010), accounting-based ROA (Bonn et al., 2004; Huang 2010; Kiel & Nicholson 2003; Lam & Lee 2008), and ROE (Huang, 2010; Lam & Lee 2008).

Tobins' Q: Tobins' Q as proposed by Brainard and Tobin (1968) is the ratio between market value and replacement cost of corporate assets. When Tobins' Q > 1, the company has better business performance; when Tobins' Q < 1, the company has poor business performance. This study adopted the proximate calculation formula of Tobins' Q as proposed by Chung and Pruitt (1994):

$$Approximate\_q = (MVE + PS + DEBT) / TA \quad (2)$$

In which MVE is the product of a firm's share price and the number of common stock shares outstanding. PS is the liquidating value of the firm's outstanding preferred stock, DEBT is the value of the firm's short-term liabilities net of its short-term assets, plus the book value of the firm's long-term debt, and TA is the book value of the total assets of the firm. (Chung & Pruitt 1994)

$$Tobins'Q = (MVCS + MVPS + STL - STA + LTD) / TA \quad (3)$$

MVCS= market value of common stock, MVPS= market value of preferred stock
STL= short-term liabilities, STA= short-term assets
LTD= long-term debt, TA= total assets

ROA: Return on assets (net income / average total asset).
ROE: Return on equity (net income / average net worth).

Control Variable

Firm size (F-size): Majamdar (1997) suggested that firm size positively correlates with firm performance. There are three kinds of proxy variables: Book value of total firm assets, market capitalization of firm, and total net annual sales (Lam & Lee, 2008). This article used a natural logarithm of total net annual sales as the control variable.

RESULTS

Tobins' Q for firm performance is the ratio between market value and replacement cost of firm assets. This ratio shows the achievement of business performance accumulated after years of operation and the present market value used to evaluate the firm. ROA is the return rate of firm assets; business performance is evaluated by return of total assets for the current year. ROE is the return of equity; business performance is evaluated by the return of shareholders' equity for the current year. Therefore, three business performance variables represented different applications of business performance evaluation. Tobins' Q, ROA, and ROE were used as dependent variables in the regression equation analysis to verify the six research hypotheses (see Table 3). VIF values of the independent variables in the three regression models ranged from 1.148 and 1.474; therefore, there was no collinear problem.

The first regression model used Tobins' Q as a dependent variable producing an adjusted $R^2 = 0.011$. The control variable, firm size, correlated negatively with no significant influence on the outcome variable. Outside independent directors correlated positively with, and significantly influenced firm performance in terms of Tobins' Q supporting hypothesis H5. This result is similar to Yammeesri and Herath's (2010) findings that indicated a positive correlation between independent director and firm performance in terms of Tobins' Q; however, there was no significant influence on firm performance. Duality, supervisory directors, and family-controlled directors all negatively correlated with firm performance in terms of Tobins' Q; however, no significant effects were present. Board size and inside directors correlated positively with firm performance in terms of Tobins' Q, with no significant effects. Therefore, hypotheses H1a, H1b, H2, H3, H4, and H6 were not supported.

The second regression model used ROA as the dependent variable producing an adjusted $R^2 = 0.062$. The control variable, firm size, correlated negatively with firm performance in terms of ROA, with no significant influence. Duality correlated negatively with and had significant influence on ROA for firm performance, thus supported hypothesis H1a but not H1b. Lam and Lee (2008) suggested that the influence of duality on ROA for firm performance is negative in family businesses but positive in non-family businesses, thus offering support to the notion those companies with different shareholder

Table 3: All Samples Regression Model Analysis

	Model(1)	Tobins'Q	Model(2)	ROA	Model(3)	ROE
	B-value	t-value	B-value	t-value	B-value	t-value
Intercept	1.296	4.411 ***	0.041	1.440	0.005	0.099
Duality	-0.114	-1.523	-0.020	-2.673 ***	-0.042	-3.143 ***
B-size	0.004	0.217	-0.007	-3.772 ***	-0.014	-3.766 ***
Sup-dire	-0.009	-0.193	0.017	3.968 ***	0.033	4.179 ***
FC-dire	-0.153	-0.757	-0.035	-1.762 *	-0.082	-2.279 **
Outs-dire	0.077	2.960 ***	0.015	6.000 ***	0.024	5.146 ***
Ins-dire	0.026	0.910	0.011	4.017 ***	0.018	3.490 ***
F-size	-0.043	-1.493	0.003	1.071	0.012	2.309 **
R^2	0.018		0.069		0.068	
Adjusted R^2	0.011		0.062		0.061	
F-value	2.710 **		10.792 ***		10.631 ***	
N	1033		1033		1033	

Note: Duality: is a dummy variable that is set to 1 when there is CEO duality and 0 otherwise. B-size: the number of board members. Sup-dire: the number of supervisory directors on the board of directors. FC-dire: The number of directors controlled by the controlling families and relatives/friends of controlling families. Outs-dire: the number of outside independent directors on the board of directors. Ins-dire: the number of inside directors on the board of directors. F-size: the natural logarithm value of the annual sales of the company. $Tobins'Q = (MVCS + MVPS + STL - STA + LTD)/TA$ *ROA: net income/ average total asset. ROE: net income/average net worth. This table shows the regression estimates of the equation:* $Yi = \alpha + \beta_1(Duality) + \beta_2(B-size) + \beta_3(Sup-dire) + \beta_4(FC-dire) + \beta_5(Outs-dire) + \beta_6(Ins-dire) + \beta_7(F-size) + \varepsilon$ *. i=1,2,3, Y1=Tobins'Q, Y2=ROA , Y3=ROE. The first figure in each cell is the regression coefficient. The second figure in each cell is the t-statistic. ***, ** and * indicate significance at the 1,5 and 10 percent level respectively.*

types have different effects. Board size correlated negatively with and had significant influence on ROA for firm performance, thus supporting hypothesis H2. Huang's (2010) study on Taiwan's banking industry reported that board size affected ROA for firm performance positively. This finding is different from the finding of the current study. Specifically, the current study explored the electronics industry; therefore, the reason for the different findings may be due to different competitive environments of these industries. Supervisory directors correlated positively with and had significant influence on ROA for firm performance, and thus did not support hypothesis H3. Such a result is different from Huang's (2010) finding that supervisory directors affect firm performance negatively.The variable family-controlled directors correlated negatively with ROA for firm performance and had significant influence; this finding support hypothesis H4. The variable outside independent directors correlated positively with ROA for firm performance and had significant influence, supporting hypothesis H5. This finding is similar to Huang (2010) and Bonn et al.'s (2004) findings on Australian companies. The variable inside directors correlated positively with and had significant influence on ROA for firm performance, supporting hypothesis H6. This result is different from Huang's (2010) finding that inside directors did not influence firm performance.

The third regression model used ROE as a dependent variable produced an adjusted $R^2 = 0.061$. The control variable, firm size, correlated positively with and had significant influence on firm performance. In addition, duality correlated negatively with and had significant influence on ROE for firm performance, thus supporting hypothesis H1a, but not H1b. Lam and Lee (2008) found the effect of duality on ROE for firm performance was negative in family businesses but positive in non-family businesses. Companies with different shareholder types seem to influence firm performance differently.

In addition, board size correlated negatively with and had significant influence on ROE for firm performance, supporting hypothesis H2. Supervisory directors correlated positively with and had significant influence with ROE for firm performance, rejecting hypothesis H3. This result is different from Huang's (2010) finding that indicated supervisory directors in Taiwan's banking industry have a negative influence on ROE for firm performance. Family-controlled directors correlated negatively with and had significant influence on ROE for firm performance, supporting hypothesis H4.

Filatotchev et al. (2005) found similar results. Outside independent directors correlated positively with and had significant effect on ROE for firm performance, supporting hypothesis H5. This supports the findings of Bonn (2004), Luan and Tang (2007), and Huang (2010), who found that outside independent directors have a positive influence on ROE for firm performance. Finally, inside directors correlated positively with and had significant influence on ROE for firm performance, supporting hypothesis H6.

Among the 1,033 samples collected in this study, the minimum annual revenue was NTD 1.669 billion (USD 57 million) and the maximum was NTD 1,473 billion (USD 50 billion). The company sizes also differed greatly. In order to learn about the different impacts of board structure of different sized companies on business performance, the companies were divided into three groups according to company size. Considering that a sample number of each group should be more than 300, the companies were divided as follows according to annual revenue.

Large-sized companies (*N* = 347) with an annual revenue of more than NTD 10 billion (USD 341 million); the total sample was 347. Medium-sized companies (*N* = 320) had an annual revenue from NTD 4 billion (USD 137 million) to NTD 10 billion. Small-sized companies (*N* = 366) had an annual revenue from NTD 1.669 billion (USD 57 million) to NTD 4 billion. The regression analysis of the company samples were conducted with the corporate performance variable Tobins' Q, ROA, and ROE against the board structure variable and control variable. The VIF value of every independent variable in the nine regression models was between 1.018 and 1.581. Thus there was no problem of collinearity within the nine regression models (see Tables 4, 5, and 6).
The F value of Tobins' Q regression model (model 4) was 0.617 for the large-sized companies (see Table 4); therefore, the regression analysis of Tobins' Q was not useful. The adjusted R^2 of the ROA regression analysis model (model 5) was 0.060. The variables that yielded a negative impact on ROA included duality, board size, and family-controlled directors. The variables that yielded a positive impact on ROA included supervisory directors, inside directors, and firm size.

The variable outside independent directors had no impact. The adjusted R^2 of the ROE regression analysis model (model 6) was 0.080. The variables that yielded a negative impact on ROE included duality, board size, and family-controlled directors. Finally, the variables that yielded a positive impact on ROE included supervisory directors, outside independent directors, inside directors, and firm size.

The adjusted R^2 of Tobins' Q regression analysis model (model 7) for medium-sized companies was 0.022 (see Table 5). The variables yielding a positive impact on Tobins' Q included board size and outside independent directors. Other variables had no impact. The adjusted R^2 of the ROA regression analysis model (model 8) was 0.084. The variables that yielded a positive impact on ROA included supervisory directors, outside independent directors, and inside directors. Other variables had no impact on this analysis. The adjusted R^2 of the ROE regression analysis model (model 9) was 0.071. The variables that yielded a positive impact on ROE included supervisory directors, outside independent directors, and inside directors; other variables had no impact.

Table 4: Big-size Companies' Regression Model Analysis

	Model(4)	Tobins'Q	Model(5)	ROA	Model(6)	ROE
	B-value	t-value	B-value	t-value	B-value	t-value
Intercept	0.815	1.752 *	0.037	0.633	-0.014	-0.127
Duality	-0.148	-1.467	-0.035	-2.777 ***	-0.067	-2.761 ***
B-size	-0.012	-0.530	-0.009	-3.298 ***	-0.020	-3.760 ***
Sup-dire	-0.044	-0.932	0.010	1.666 *	0.024	2.115 **
FC-dire	-0.116	-0.449	-0.083	-2.591 ***	-0.176	-2.797 ***
Outs-dire	0.019	0.580	0.006	1.538	0.013	1.675 *
Ins-dire	0.020	0.632	0.008	2.002 **	0.014	1.812 *
F-size	0.035	0.842	0.012	2.269 **	0.030	2.958 ***
R^2	0.016		0.079		0.099	
Adjusted R^2	-0.005		0.060		0.080	
F-value	0.617		0.000		0.000	
N	347		347		347	

Note: Duality: is a dummy variable that is set to 1 when there is CEO duality and 0 otherwise. B-size: the number of board members. Sup-dire: the number of supervisory directors on the board of directors. FC-dire: The number of directors controlled by the controlling families and relatives/friends of controlling families. Outs-dire: the number of outside independent directors on the board of directors. Ins-dire: the number of inside directors on the board of directors. F-size: the natural logarithm value of the annual sales of the company. $Tobins'Q = (MVCS + MVPS + STL - STA + LTD)/TA$ *ROA: net income/ average total asset. ROE: net income/average net worth. This table shows the regression estimates of the equation:* $Yi = \alpha + \beta_1(Duality) + \beta_2(B-size) + \beta_3(Sup-dire) + \beta_4(FC-dire) + \beta_5(Outs-dire) + \beta_6(Ins-dire) + \beta_7(F-size) + \varepsilon$ *. i=1,2,3, Y1=Tobins'Q, Y2=ROA , Y3=ROE. The first figure in each cell is the regression coefficient. The second figure in each cell is the t-statistic. ***, ** and * indicate significance at the 1,5 and 10 percent level respectively.*

Table 5: Medium-size Companies' Regression Model Analysis

	Model(7)	Tobins'Q	Model(8)	ROA	Model(9)	ROE
	B-value	t-value	B-value	t-value	B-value	t-value
Intercept	1.422	0.658	-0.048	-0.244	-0.151	-0.390
Duality	0.054	0.361	-0.001	-0.098	-0.030	-1.110
B-size	0.085	1.792 *	-0.007	-1.527	-0.011	-1.320
Sup-dire	-0.046	-0.474	0.032	3.688 ***	0.061	3.548 ***
FC-dire	0.162	0.393	-0.033	-0.893	-0.073	-0.995
Outs-dire	0.108	2.114 **	0.019	4.095 ***	0.030	3.300 ***
Ins-dire	0.001	0.009	0.016	2.846 ***	0.027	2.408 **
F-size	-0.158	-0.649	0.005	0.223	0.014	0.325
R^2	0.043		0.104		0.091	
Adjusted R^2	0.022		0.084		0.071	
F-value	0.054		0.000		0.000	
N	320		320		320	

Note: Duality: is a dummy variable that is set to 1 when there is CEO duality and 0 otherwise. B-size: the number of board members. Sup-dire: the number of supervisory directors on the board of directors. FC-dire: The number of directors controlled by the controlling families and relatives/friends of controlling families. Outs-dire: the number of outside independent directors on the board of directors. Ins-dire: the number of inside directors on the board of directors. F-size: the natural logarithm value of the annual sales of the company. $Tobins'Q = (MVCS + MVPS + STL - STA + LTD)/TA$ *ROA: net income/ average total asset. ROE: net income/average net worth. This table shows the regression estimates of the equation:* $Yi = \alpha + \beta_1(Duality) + \beta_2(B-size) + \beta_3(Sup-dire) + \beta_4(FC-dire) + \beta_5(Outs-dire) + \beta_6(Ins-dire) + \beta_7(F-size) + \varepsilon$ *. i=1,2,3, Y1=Tobins'Q, Y2=ROA , Y3=ROE. The first figure in each cell is the regression coefficient. The second figure in each cell is the t-statistic. ***, ** and * indicate significance at the 1,5 and 10 percent level respectively.*

The F value of Tobins' Q regression model (model 10) for small-sized companies was 0.142 (see Table 6); therefore, the regression analysis of Tobins' Q did not exist. The adjusted R^2 for the ROA regression analysis model (model 11) was 0.075. The variables that yielded a positive impact on ROA include supervisory directors, outside independent directors, and inside directors; other variables had no impact. The adjusted R^2 for the ROE regression analysis model (model 12) was 0.065. The variable that yielded a positive on ROE was outside independent directors; other variables have no impact.

Table 6: Small-size Companies' Regression Model Analysis

	Model(10)	Tobins'Q	Model(11)	ROA	Model(12)	ROE
	B-value	t-value	B-value	t-value	B-value	t-value
Intercept	3.455	1.562	-0.189	-0.959	-0.382	-1.228
Duality	-0.179	-1.241	-0.018	-1.378	-0.029	-1.414
B-size	-0.006	-0.141	-0.002	-0.523	0.001	0.145
Sup-dire	0.069	0.670	0.016	1.713 *	0.023	1.619
FC-dire	-0.507	-1.316	-0.003	-0.090	-0.015	-0.271
Outs-dire	0.076	1.457	0.020	4.261 ***	0.026	3.613 ***
Ins-dire	0.049	0.824	0.010	1.985 **	0.013	1.605
F-size	-0.305	-1.109	0.024	0.993	0.044	1.143
R^2	0.030		0.093		0.083	
Adjusted R^2	0.011		0.075		0.065	
F-value	0.142		0.000		0.000	
N	366		366		366	

Note: Duality: is a dummy variable that is set to 1 when there is CEO duality and 0 otherwise. B-size: the number of board members. Sup-dire: the number of supervisory directors on the board of directors. FC-dire: The number of directors controlled by the controlling families and relatives/friends of controlling families. Outs-dire: the number of outside independent directors on the board of directors. Ins-dire: the number of inside directors on the board of directors. F-size: the natural logarithm value of the annual sales of the company. $Tobins'Q = (MVCS + MVPS + STL - STA + LTD)/TA$ *ROA: net income/ average total asset. ROE: net income/average net worth. This table shows the regression estimates of the equation:* $Yi = \alpha + \beta_1(Duality) + \beta_2(B-size) + \beta_3(Sup-dire) + \beta_4(FC-dire) + \beta_5(Outs-dire) + \beta_6(Ins-dire) + \beta_7(F-size) + \varepsilon$ *. i=1,2,3, Y1=Tobins'Q, Y2=ROA , Y3=ROE. The first figure in each cell is the regression coefficient. The second figure in each cell is the t-statistic. ***, ** and * indicate significance at the 1,5 and 10 percent level respectively.*

DISCUSSION

This study focused on the effects of board structure in corporate governance on firm performance. A board of directors plays a critical role in corporate governance. Further, the leadership structure and organization of a board of directors also appears to affect the effectiveness of corporate governance. Therefore, this study analyzed the impact of board structure on firm performance to learn about the influence of leadership structure and board of directors on firm performance.

Regarding board leadership structure, the outcomes from this study indicate that duality has a negative influence on both the ROA and ROE. When the chair of the board also serves as CEO, firm performance worsens. This conclusion is similar to the findings of Yammeesri and Herath (2010) and indicates that a board of directors can effectively supervise the CEO to make decisions to benefit the company and promote firm performance only when the chair of the board does not serve as CEO. If the chair of the board also serves as CEO, the board of directors cannot effectively supervise the CEO to make decisions to benefit the company, thus leading to the reduction of firm performance. This conclusion is one that complies with agency theory.

Board size had a negative influence on ROA and ROE for firm performance. This conclusion mirrored that of Bonn et al. (2004) and Chiang and Lin (2007). Further, these findings suggest that it becomes difficult to coordinate, exert directors' expertise, and establish interpersonal relationships when there are too many members of a board of directors. (Forbes & Milliken, 1999). Additionally, it is difficult for a large board of directors to arrive at consensus when these obstacles to communication exist; therefore, the supervisory function of a board of directors is reduced. Jensen (1993) pointed out that a board's function would be weakened and easily controlled by a CEO when the number of board members exceeds seven or eight. When a board has few members, they can communicate and reach consensus more easily. A small board of directors can also reduce the problem of bureaucracy and enable better functioning (Chiang & Lin, 2007). Therefore, when the number of a board of directors is eight or less, the effectiveness of the board of directors and firm performance will improve.

This study found that the number of supervisory directors has a positive influence on ROA and ROE for firm performance, which indicates that a greater number of supervisory directors is linked to stronger supervisory abilities of a board of directors and improved firm performance. Dahya et al. (2003) suggested that if a supervisory director is just an honored guest, a friendly advisor, or a censored watchdog, his report will be of no use. Conversely, if a supervisory director is independent, his report will be valuable. Therefore, companies should employ more independent supervisory directors to promote firm performance.

This study also found that family-controlled directors have a negative influence on ROE for firm performance, which replicates Filatotchev et al. (2005) findings. During the three years data peripoid of the current research, listed family businesses held share ownerships of 23.52%, on average. Overall, 85 family businesses held more than 50% of share ownership, accounting for 8.23% of the 1,033 businesses examined. Family-controlled directors, appointed in 606 firms, accounted for more than 50% of the board of directors. Concerning these larger shareholder family-controlled boards of directors, their interests will often not be the same as non-family shareholders. It is evident that, when considering ROE, major shareholders will consider their own interests when participating in the company's operational decisions, in spite of the interests of other shareholders. Thus, family-controlled directors have a negative effect on ROE for firm performance.Therefore, companies should reduce family-controlled directors to promote firm performance.

Outside independent directors had a positive influence on Tobins' Q, ROA, and ROE for firm performance. This result is consistent with the findings of Luan and Tang (2007) and Bonn (2004) who found that outside directors have a positive influence on ROE. This finding is also consistent with that of Huang (2010) who found that outside directors have positive effect on ROA and ROE. Moreover, this result supports the findings of Bonn et al. (2004) who reported outside directors have a positive influence on ROA. In addition, inside directors have a positive influence on ROA and ROE for firm performance, which is consistent with the findings of Yammeesri and Herath (2010) that inside directors have positive influence on Tobins 'Q. Wagner et al. (1998) evaluated 30 articles and discovered that both outside independent directors and inside directors have a positive effect on firm performance, a finding supported by the current study.

Although there are grey directors on a board of directors, this study did not analyze this variable. Since Yammeesri and Herath (2010) found that grey directors have no effect on firm performance, companies should increase the number of outside and inside directors to reduce grey directors and promote firm performance. Finally, appropriate proportions between outside directors and inside directors needs further examination.

By analyzing different sized companies, it was found from the Tobins' Q of corporate performance that large and small-sized companies are not be affected by board structure. However, medium-sized companies are positively affected by board size and the numbers of outside independent directors. This means, among medium-sized companies, the larger the board size, the more outside resources might be available to promote performance of corporate Tobins' Q. When there are many independent outside directors, performance of corporate Tobins' Q improves. In terms of ROA and ROE, duality, board size, and family-controlled directors yielded a negative impact on large-sized companies, indicating when the chairperson of the board in large-sized companies also serves as the CEO, he might negatively effects business operations by pushing a private benefit agenda. Larger boards result in a malfunction of board operations, thus causing a decline in performance of the company’s ROA and ROE. Likewise, family-controlled directors may also cause the performance of the company’s ROA and ROE to decline by pushing an agenda in favor of the family’s private benefits.

The positive impact of both supervisory directors and inside directors means, in large-sized companies, effective supervision by a board of supervisory directors can enhance the performance of the company's ROA and ROE. Inside directors will be devoted to their duties and better communication between the board of directors and managers can improve the performance of the company's ROA and ROE. Outside independent directors have a positive impact on ROE but have no impact on ROA. This indicates when there are many outside independent directors in a large-sized company, the company’s ROE performance will be promoted under the outside independent directors' supervision.

In medium-sized companies, supervisory directors, outside independent directors, and inside directors have a positive impact on ROA and ROE, indicating that the effective supervision of managers by supervisory directors in medium-sized companies can promote the performance of the company's ROA and ROE. This is because, in these companies, inside directors will be more devoted to their duties and increased communication between the board of directors and managers will improve the performance of the company's ROA and ROE.

In small-sized companies, outside independent directors have a positive impact on ROA and ROE, indicating supervision by outside independent directors in small-sized companies can promote the performance of the company’s ROA and ROE. In terms of ROA, supervisory directors and inside directors have a positive impact, indicating the effective supervision by supervisory directors overseeing managers in small-sized companies can promote the performance of the company’s ROA. As with large and medium-sized companies, these inside directors will be more devoted to their duties and allow better communication between the board of directors and managers, which will improve the company’s ROA. Finally, duality, board size, and family-controlled directors have no impact on ROA and ROE in small and medium-sized companies as well as for companies with annual revenue of less than NTD 10 billion.

The two major subjects of agency theory include the effect of the board of directors and the effect of duality on firm performance (Nicholson & Kiel, 2007). The results of this study indicate that duality has a negative impact on firm performance in terms of accounting-based ROA and ROE, which complies with agency theory. This indicates that, when the chair of a board also serves as CEO, the supervisory functions of the board of directors will be reduced, consequently weakening firm performance. Among the five variables of board organization, board size has a negative influence on firm performance, which supports Jensen (1993) who claimed that firm performance would improve when the board of directors maintained a smaller size. This result does not support resource theory.

Both the number of supervisory directors and outside independent directors has a positive impact on firm performance; family-controlled directors have a negative influence on firm performance. Both of the above results complies with agency theory; however, the positive effect of inside directors on firm performance does not comply with agency theory. Rather it complies with stewardship theory (i.e., inside directors will work hard to create maximal profit for shareholders) (Nicholson & Kiel, 2007). As evident from accounting-based firm performance in the conclusion of this study, the board functions in corporate governance of Taiwan’s electronic companies largely complies with agency theory. Most functions of a board of directors in large-sized companies conform to agency theory. Finally, only some of the functions of a board of directors in small and medium-sized companies conform to agency theory.

CONCLUSION

This study explored the impact of board structure in corporate governance on corporate performance. Our analysis was conducted by dividing the companies into three size groups based on annual revenue (more than NTD 10 billion (USD 341 million), NTD 4-10 billion (USD 137-341 million), and NTD

1.669-4 billion (USD 57-137 million). Analytical samples included 1,033 TSEC/GTSM listed companies during 2007-2009. OLS regression model was applied to the analysis. According to the results, only outside independent directors have a positive impact on firm performance for Tobins' Q, while the other variables have no impact. In terms of ROA and ROE, duality, board size and family-controlled directors have a negative impact while supervisors, outside independent directors and inside directors have a positive impact.

Based on the results, this study determined that in companies with annual revenue of more than NTD 10 billion (USD 341 million), duality, board size, and family-controlled directors have a negative impact on ROA and ROE for firm performance. Both supervisory directors and inside directors have a positive impact on ROA and ROE for firm performance and outside independent directors have a positive impact on ROE for firm performance. None of the variables of board structure had any impact on corporate performance considering Tobins' Q. In companies with annual revenues of less than NTD 10 billion, supervisory directors, outside independent directors, and inside directors have a positive impact on ROA and ROE. Thus, in practice, large-sized companies exercise caution when forming the board of directors to ensure an effective operation and to promote the performance of ROA and ROE. Likewise, small and medium-sized companies should increase the number of supervisory directors, outside independent directors, and inside directors when forming the board of directors to promote performance of ROA and ROE.

This study analyzed only companies from Taiwan's electronic industry. Additionally, only large companies whose performance rankings were among the first 50% and annual revenues were more than NTD 1.669 billion were analyzed. The corporate governance of companies whose annual revenues were below NTD 1.669 billion (USD 57 million) and whose achievements were small were not considered. The above conditions are restrictions of this study. Additionally, major family shareholders, who might then control the firm, might hold the majority of firm shares and such a family business would unavoidably have certain impacts on the implementation of corporate governance. This was also a condition that this study failed to consider and will cause certain limitations to the application of the current findings.

Bonn et al. (2004) revealed different results concerning corporate governance conditions of Australian and Japanese companies. In Japanese companies, board size correlated negatively with firm performance, while in Australian companies, board size did not influence firm performance. Further, in Australian companies, outside directors influenced firm performance positively, while in Japanese companies, outside directors did not influence firm performance. Huang (2010) found that among Taiwanese banks, board size correlated positively with firm performance. This finding is different from the result of the current study, which indicated that board size of Taiwanese electronics companies correlates negatively with firm performance. Among previous studies on the influence of duality on firm performance, Kota and Tomar (2010) reported a positive effect of duality in Indian companies on firm performance. Coles, McWilliams and Sen (2001) found that duality in American companies also positively influenced firm performance, which is different from the result of this study that found duality in Taiwanese electronics companies correlates negatively with firm performance. The differences between previous research findings and the findings of this study may be due to different environments or different characteristics of industry competitiveness. Therefore, corporate governance in different countries and different industries deserves further study. This study did not conduct analyses for family businesses or for companies whose annual revenues were less than NTD 1.669 billion, both of which should be considered for further study.

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THE IMPLIED VOLATILITY OF ETF AND INDEX OPTIONS

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ABSTRACT

We examine the option-implied volatility of the three most liquid ETFs (Diamonds, Spiders, and Cubes) and their respective tracking indices (Dow 30, S&P 500, and NASDAQ 100). We find that volatility smiles for ETF options are more pronounced than for index options, primarily because deep-in-the-money ETF options have considerably higher implied volatility than deep-in-the-money index options. The observed difference in implied volatility is not due to a difference between the realized return distributions of the underlying ETFs and indices. Differences in implied volatility for ETF and index options also do not appear to be explained by discrepancies in net buying pressure, as theorized by Bollen and Whaley (2004).

JEL: G11; G12

KEYWORDS: exchange-traded funds, index options, implied volatility, open interest

INTRODUCTION

In this paper, we study the option-implied volatility of exchange-traded funds (ETFs) and their tracking indices. ETFs are relatively cheap instruments for diversification in terms of direct costs. They have greatly increased in popularity and have become important investment vehicles for both professional and individual investors. The Investment Company Institute (ICI) reports that there were 80 ETFs in 2000 and 359 ETFs in 2006, a 350 percent increase. ETF assets also increased significantly from $65.59 billion in 2000 to $422.55 billion in 2006, an increase of 544 percent for the period. Most of the literature on ETFs focuses on their tracking errors relative to their respective indices. However, very little research has been conducted on ETF volatility.

The paper contributes to the literature in several ways. First, the paper fills the void in the existing literature on the volatility of ETFs, which play an important role in risk diversification. We examine both the realized return volatility and the option-implied volatility – a commonly used estimate of future volatility. We find that the implied volatility of ETF options is different from that of index options, especially for deep-in-the-money options. However, we find no significant difference in the realized return volatilities of ETFs versus their indices. Second, the paper adopts a unique sample to reexamine the net buying pressure theory of Bollen and Whaley (2004). The advantage of using pair samples of ETF options and index options is that return distributions of ETFs are insignificantly different from those of their tracking indices. Our results are inconsistent with the argument of Bollen and Whaley (2004) that an option's implied volatility function should be positively related to its net buying pressure. Therefore, the difference in implied volatility functions between ETFs and indices can be attributed to other factors.

The remainder of this paper is organized as follows: The next section examines the related literature and develops the scope of this research study. We then describe our data and methodology and discuss the results of our empirical tests. The final section concludes.

LITERATURE REVIEW AND RESEARCH DEVELOPMENT

In recent years, ETFs have exploded in popularity as investment tools. However, most of the extant literature on ETFs focuses on their tracking error (e.g., Poterba and Shoven, 2002; Engle and Sarkar, 2006). To our knowledge there are no studies on the volatility of ETFs. In a study of the excess volatility characteristics of closed-end funds, Pontiff (1997) finds that closed-end funds are more volatile than their underlying securities. Closed-end funds are similar to ETFs in that both are traded on a stock exchange throughout the trading day, but ETFs are structured differently from closed-end funds. For example, ETFs legally resemble open end funds in the sense that new ETF securities can be issued.

ETFs are passive investment vehicles. The ETF manager closely tracks the yield and price of the underlying index by acquiring the stocks in the index. Nevertheless, ETFs do not necessarily mimic their underlying indices perfectly for several reasons. First, the proportions and exact composition of the ETF portfolio might differ slightly from that of the underlying index as the portfolio manager seeks to minimize costs. Second, ETFs accumulate dividends in a non-interest bearing account and distribute accumulated dividends in a lump sum periodically. (Spiders and Cubes distribute dividends quarterly, while Diamonds pay dividends monthly.) Third, ETFs continue trading after hours until 4:15 p.m., while indices are reported at 4:00 p.m. These differences may cause the return of an ETF to deviate from that of its underlying index.

Christensen and Prabhala (1998) show that a stock's future volatility is predicted more reliably by the option-implied volatility than by the stock's past realized volatility. Therefore, we also investigate the implied volatility of the three best-known and most liquid ETFs: Diamonds, Spiders, and Cubes. These ETFs track the yield and price of the Dow Jones Industrial Average (i.e., Dow 30), S&P 500, and NASDAQ 100, respectively. ETFs are traded like stocks, so ETF options can be considered stock options. The existing literature shows that the implied volatility function of stock options is different from that of index options. Bakshi, Kapadia, and Madan (2003) study S&P 100 index options and the 30 largest stocks in the index and find that the index volatility smile (the variation of the implied volatility across strike prices) is more negatively sloped than individual stock volatility smiles. They show that this difference comes from the more skewed return distribution of individual stocks. Hence, we first test whether the implied volatility functions of ETF and index options differ. We find that ETF options commonly have higher implied volatilities than their indices, especially for deep-in-the-money options.

In view of this result, we examine not only the mean return of ETFs versus their tracking indices, but also the entire return distribution. We focus on the higher moments of return – volatility, skewness, and kurtosis. Using realized daily returns over a period spanning more than six years, we find no significant difference between the return distributions of ETFs and indices. Since ETFs track their underlying indices closely and are not significantly different from their underlying index in the return distributions, this produces a unique sample to explore the implied volatility of stock options versus index options.

Bollen and Whaley (2004) argue that option prices and implied volatilities are affected by the demand for options. When arbitrage is limited, the option supply curve is upward sloping so that implied volatility is related to the net buying pressure from orders submitted by investors. Bollen and Whaley study both index options and stock options and find that changes in the implied volatility of S&P 500 index options (individual stock options) are most affected by demand for index puts (individual stock calls). They suggest that net buying pressure is related to investor speculative or hedging demand for options. Put options are widely used for downside protection – especially out-of-the-money puts, which are low-cost hedging instruments. Call options provide upside potential; thus, out-of-the-money calls are more likely used for speculation. Therefore, we attempt to determine whether ETF options are used more often for speculative or hedging purposes – a question that, to the best of our knowledge, has not been explored in prior studies. Index options are widely used for hedging purposes (Evnine and Rudd, 1985). While Moran

(2003) suggests that ETFs are also widely used for hedging, the speculative motive for trading cannot be ruled out. We investigate this question by examining the behavior of both calls and puts of varying levels of moneyness. The level of open interest provides some indication of the demand for an option. Therefore, we perform multivariate regressions to determine whether the implied volatility of ETF and index options is related to open interest in the manner suggested by the net buying pressure hypothesis. Our paper is related to studies by Chan, Cheng, and Lung (2004) and Kang and Park (2008). Chan, Cheng, and Lung use the Bollen and Whaley (2004) net buying pressure metric to examine the implied volatilities, premiums, and profits of Hong Kong Hang Seng index options. Kang and Park use the net buying pressure metric to examine the implied volatilities of KOSPI 200 options. In another work, Chan, Cheng, and Lung (2006) study Hang Seng index options during the Asian Financial Crisis and find evidence in support of the net buying pressure hypothesis. We also account for transaction costs. Peña, Rubio, and Serna (1999) use the bid-ask spread as a proxy for transaction costs and find that the spread influences the curvature of the volatility smile.

DATA AND METHODOLOGY

We study three ETFs: Spiders (SPY), Diamonds (DIA), and Cubes (QQQQ after the switch from AMEX to NASDAQ on 12/1/2004, and QQQ before the switch). Data for these ETFs and for the S&P 500 index are obtained from the Center for Research in Security Prices (CRSP). Data for the Dow Jones Industrial Average are obtained from Dow Jones Indices website (http://djindexes.com), and data for the NASDAQ 100 index are obtained from the NASDAQ Indices website (http://dynamic.nasdaq.com). One potential problem with our data is that closing index levels are reported as of 4:00 p.m., while ETFs continue trading until 4:15 p.m. Thus, to align the trading periods, we use the NYSE Trade and Quote (TAQ) database to obtain the last price for each of our ETFs within one second of 4:00 p.m. each day. Our sample period is from 3/10/1999 to 12/29/2006.

We use options data from the Chicago Board Options Exchange (CBOE) from 2003 to 2006 provided by DeltaNeutral.com. Index options for the Dow 30, S&P 500, and NASDAQ 100 are all European and expire on the Saturday following the third Friday of the expiration month. However, the ETF options are American. The data from DeltaNeutral.com includes implied volatilities based on the Black-Scholes option pricing model. While this is correct for index options, which are European, it is incorrect for ETF options, which are American. Thus, we compute a new set of implied volatilities for ETF options based on a 100-step binomial tree model.

The options dataset is filtered based on the criteria suggested by Day and Lewis (1988) and Xu and Taylor (1994). The options used to form the sample are required to meet the following criteria:

a) The time to expiration must be greater than 7 days and less than 30 days.
b) The option must satisfy the European option boundary conditions, $c < Se^{-\delta T} - Xe^{-rT}$ and $p < Xe^{-rT} - Se^{-\delta T}$.
c) The option must also satisfy the American option boundary conditions, $C < S - X$ and $P < X - S$.
d) The option must not be so deep out of or in the money that exercise is either impossible or absolutely certain; i.e., the absolute value of the option's hedging delta is between 0.02 and 0.98.

After applying these filters, we sort the remaining options in the sample by implied volatility and remove those observations in the top and bottom 1 percent, resulting in a final sample of 87,588 ETF options and 105,679 index options. These criteria ensure that the option prices used in this study are reasonable and help to avoid the problems of thin trading and excessive volatility, which might endanger the soundness of our conclusions. We determine each option's moneyness using the Bollen and Whaley (2004) method based on the options' delta, as shown in Table 1.

Table 1: Bollen and Whaley Classifications of Moneyness Based on Option's Delta

Category	Labels	Range
1	Deep-in-the-money (DITM) call Deep-out-of-the-money (DOTM) put	$0.875 < \Delta C \leq 0.98$ $-0.125 < \Delta P \leq -0.02$
2	In-the-money (ITM) call Out-of-the-money (OTM) put	$0.625 < \Delta C \leq 0.875$ $-0.375 < \Delta P \leq -0.125$
3	At-the-money (ATM) call At-the-money (ATM) put	$0.375 < \Delta C \leq 0.625$ $-0.625 < \Delta P \leq -0.375$
4	Out-of-the-money (OTM) call In-the-money (ITM) put	$0.125 < \Delta C \leq 0.375$ $-0.875 < \Delta P \leq -0.625$
5	Deep-out-of-the-money (DOTM) call Deep-in-the-money (DITM) put	$0.02 < \Delta C \leq 0.125$ $-0.98 < \Delta P \leq -0.875$

This table shows Bollen and Whaley's five moneyness categories.

To investigate the potential difference in the implied volatility functions of index options versus stock options, we consider several possible explanations:

1. ETFs and indices have different return distributions as argued by Bakshi et al. (2003).
2. Demand, as measured by open interest, is different for ETF options and index options.
3. Transaction costs, as measured by the bid-ask spread, are larger for index options than for ETF options.

To determine which of these explanations are best supported by the data, we perform univariate and multivariate tests on the implied volatility function.

EMPIRICAL RESULTS

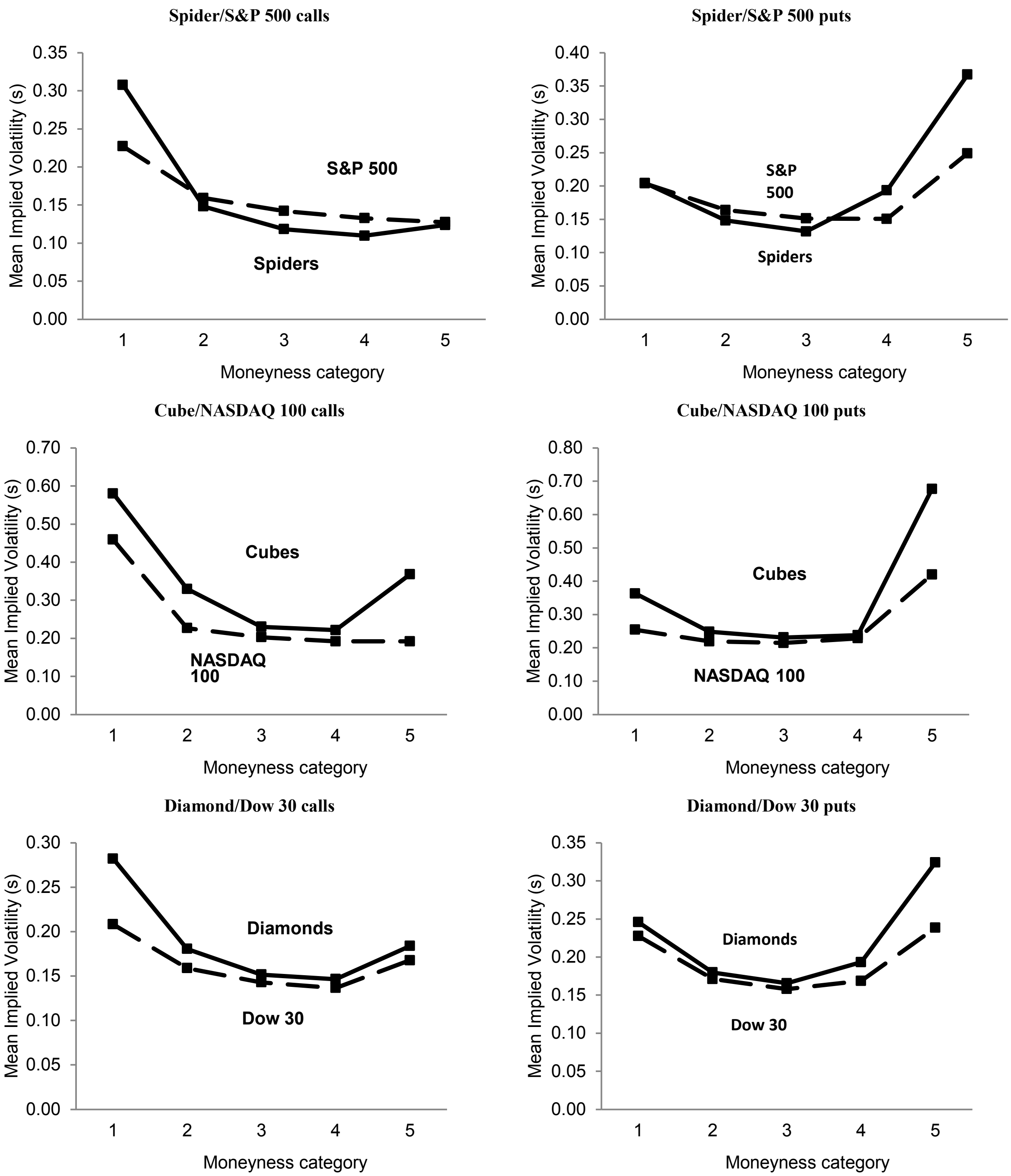
First we examine the implied volatility levels of ETF and index options. Because ETF options are American, we compute their implied volatilities by using a 100-step binomial tree model in lieu of the Black-Scholes formula. Figure 1 presents the mean implied volatility for the ETF and index options in each of the five moneyness categories described previously. Results are presented separately for calls and puts. In each case, ETF options have slightly more pronounced volatility smiles than their corresponding index options. We also note that implied volatilities for Diamond and Cube options are higher in each moneyness category than for Dow 30 and NASDAQ 100 options. For Spider/S&P 500 option pairs, the relative levels of implied volatility depend on the level of moneyness. In every case, DITM ETF options (i.e., Category 1 calls and Category 5 puts) exhibit considerably higher implied volatility than DITM index options, even after using a binomial model to account for potential early exercise of ETF options. For other categories, implied volatility is usually fairly close for ETF vs. index options, but DOTM Cube options do have considerably higher implied volatility than DOTM NASDAQ 100 options.

The documented difference in the implied volatilities of ETF and index options might be due to ETFs and indices having different return distributions, as suggested by Bakshi et al. (2003). Alternatively, the difference may be explained by transaction costs (e.g., bid-ask spreads may be larger for index options compared to ETF options) or by the demand for different types of options, as measured by their open interest.

To address the first of these possible explanations, we begin by examining historical realized daily returns of ETFs and indices. Because Spiders (Cubes) [Diamonds] are designed to be priced at 1/10 (1/40) [1/100] the level of their tracking index, we scale down each index by its appropriate factor to facilitate comparison. Table 2 shows summary statistics using closing prices. The average price level and return of ETFs and indices are very close. The volatility, skewness, and kurtosis are similar as well, which suggests no significant difference in the distributions of ETFs and indices.

In Table 3, we present the same summary statistics using synchronized prices and index levels. Synchronization is performed by obtaining intraday stock price data from the NYSE TAQ database.

Figure 1: Mean Implied Volatilities for ETF and Index Options



This figure shows the Implied Volatility Smiles of the three ETFs versus their tracking indices.

Table 2: Summary Statistics for ETFs and Indices Using Closing Prices

	Spider (SPY) price	**1/10 × S&P 500 index level**	**Spider (SPY) return**	**S&P 500 index return**
Mean	119.6085	119.3234	0.0002	0.0001
Median	120.1350	119.9080	0.0006	0.0004
Standard deviation	16.6891	16.7584	0.0115	0.0113
Skewness	−0.2926	−0.2965	0.1843	0.1686
Kurtosis	−0.5382	−0.5501	2.3392	2.4259
N	1966	1966	1966	1966
	Cube (QQQQ) price	**1/40 × NASDAQ 100 index level**	**Cube (QQQQ) return**	**NASDAQ 100 index return**
Mean	55.2167	54.9418	−0.0000	−0.0001
Median	39.2206	38.7200	0.0007	0.0009
Standard deviation	38.7042	38.7544	0.0259	0.0255
Skewness	2.0920	2.0902	−3.7728	−3.9158
Kurtosis	4.2214	4.2004	84.9578	87.1130
N	1966	1966	1965	1965
	Diamond (DIA) price	**1/100 × Dow 30 index level**	**Diamond (DIA) return**	**Dow 30 index return**
Mean	102.6733	102.5845	0.0003	0.0002
Median	104.6875	104.6693	0.0005	0.0003
Standard deviation	9.2366	9.2876	0.0110	0.0109
Skewness	−0.7532	−0.7467	0.0158	0.0320
Kurtosis	0.5675	0.5568	3.6962	3.5818
N	1963	1963	1962	1962

This table shows the closing prices, volatility, and returns of ETFs and indices. Data are for the period 3/10/1999 until 12/29/2006.

Table 3: Summary Statistics for ETFs and Indices Using Synchronized Prices

	Spider (SPY) price	**1/10 × S&P 500 index level**	**Spider (SPY) return**	**S&P 500 index return**
Mean	119.6081	119.3269	0.0002	0.0001
Median	120.1850	119.9615	0.0004	0.0004
Standard deviation	16.6857	16.7492	0.0114	0.0113
Skewness	−0.2982	−0.3004	0.1541	0.1588
Kurtosis	−0.5287	−0.5434	2.4674	2.3855
N	1948	1948	1947	1947
	Cube (QQQQ) price	**1/40 × NASDAQ 100 index level**	**Cube (QQQQ) return**	**NASDAQ 100 index return**
Mean	54.9223	55.1998	−0.0001	−0.0001
Median	38.6900	39.2070	0.0007	0.0007
Standard deviation	38.6966	38.6456	0.0255	0.0259
Skewness	2.0914	2.0930	−3.9800	−3.8039
Kurtosis	4.2195	4.2414	89.6180	85.3869
N	1949	1949	1948	1948
	Diamond (DIA) price	**1/100 × Dow 30 index level**	**Diamond (DIA) return**	**Dow 30 index return**
Mean	102.6511	102.5772	0.0003	0.0002
Median	104.6700	104.6662	0.0004	0.0003
Standard deviation	9.2419	9.2870	0.0109	0.0109
Skewness	−0.7621	−0.7528	0.0495	0.0142
Kurtosis	0.5818	0.5640	3.5602	3.5510
N	1944	1944	1943	1943

This table shows the synchronized prices, volatility, and returns of ETFs and indices. Data are for the period 3/10/1999 until 12/29/2006.

For each of the three ETFs, the last trading price within one second of 4:00 p.m. is extracted and matched with its closing index level. In rare cases where no ETF price is quoted within one second of 4:00 p.m., that day's observation is deleted from the synchronized dataset. The results in Table 3 are similar to those in Table 2 in that there is no significant difference in volatility, skewness, and kurtosis between ETFs and indices, which again shows similarity in the return distributions of ETFs and indices.

We now test formally for equality between the return distributions of ETFs and their corresponding indices. Table 4 presents Kolmogorov-Smirnov values and significance levels for each of the ETF-index pairs examined in this study. The Kolmogorov-Smirnov test is a non-parametric test based on the maximum distance between the cumulative distribution functions of two random variables. Our results show no significant difference in the distributions of ETF returns and that of their underlying indices, regardless of whether we use closing or synchronized ETF prices. We perform additional tests on the similarity between distributions of ETFs and underlying indices returns with quantile-quantile (Q-Q) plots. In doing so, we observe that ETF and index returns quantiles plot on a straight line against each other, indicating that the two distributions are the same. These plots are not shown but are available upon request. These findings further confirm that our observed differences in implied volatilities are not due to differences between the underlying ETF and index return distributions.

Table 4: Kolmogorov-Smirnov Test for Equality of Distribution Functions

	Using Closing ETF Prices			Using Synchronized ETF Prices		
	KS value	**p-value**	**Decision**	**KS value**	**p-value**	**Decision**
Spiders vs. S&P 500	0.0117	0.6536	Fail to reject	0.0049	0.9999	Fail to reject
Cubes vs. NASDAQ 100	0.0079	0.9671	Fail to reject	0.0064	0.9971	Fail to reject
Diamonds vs. Dow 30	0.0079	0.9671	Fail to reject	0.0087	0.9273	Fail to reject

This table shows the Kolmogorov-Smirnov (KS) test results of closing and synchronized ETF and index returns. The test has a null hypothesis of equality between the distribution functions of the two series being compared. Data are for the period 3/10/1999 until 12/29/2006.

We now explore alternative explanations for differences in the implied volatility function. When there are limits to arbitrage, it is possible that implied volatility may be related to the demand for an option, as suggested by Bollen and Whaley's (2004) net buying pressure argument. It is also possible that differences in bid-ask spreads may be partly responsible for different implied volatility levels. To test these two predictions, we estimate the multivariate regression model:

$$\hat{\sigma}_i = \beta_0 + \beta_1 OpInt_i + \beta_2 BidAsk_i + \beta_3 ExpirationTime_i + \beta_4 DummyIndex_i + \beta_5 OpInt * DummyIndex_i + \varepsilon_i, \quad (1)$$

where $\hat{\sigma}$ is the option's implied volatility, *OpInt* is open interest divided by 1,000,000, *BidAsk* is the percentage bid-ask spread (calculated as the dollar spread divided by the ask price), *ExpirationTime* is the amount of time until option expiration, and *DummyIndex* is equal to 1 for index options and 0 for ETF options. Table 5 presents regression results for option categories 1 and 5 (DITM and DOTM options). Results for other categories are not reported but are available from the authors upon request.

Given that open interest is a proxy for demand, we would expect this variable to be positively related to an option's price (and therefore, its implied volatility). However, this is not the case; we document a consistently negative and significant relation between open interest and implied volatility. Therefore, our regression results do not appear to provide evidence for the net buying pressure theory of Bollen and Whaley (2004). The significant relation between the bid-ask spread and implied volatility supports the argument that the volatility smile is related to transaction costs. However, the direction of this relationship is not the same in each case. In general, implied volatility is negatively related to percentage spreads for DITM options, but positively related for DOTM options. The signs and significance levels of the *DummyIndex* coefficients confirm that on average, index options have lower implied volatilities than ETF options. This is especially true for DITM options.

Although we did not obtain the expected sign for the open interest regression variable in Table 5, it is worth noting that open interest is an imperfect proxy for net buying pressure since the level of open interest is affected by both buyer- and seller-initiated trades. Therefore, it is still possible that the demand for different option types may have a nontrivial impact on implied volatilities. It is not surprising that the greatest implied volatility differences are noted for DITM and DOTM options. DOTM options are especially useful for speculators due to the high elasticity of their premium with respect to the underlying asset price or index level. However, DOTM puts and calls can also be useful for hedging by establishing floors on long positions and caps on short positions, respectively. In addition, DITM options can be very useful for establishing delta-neutral hedges; because their gammas are near zero, it is not necessary to adjust the hedge ratio as often when the value of the underlying asset changes. The difference in the implied volatility functions noted in Figure 1 shows that ETF and index options are not perfect substitutes for each other. Although more research is needed in this area, their overall higher implied volatilities suggests that ETF options may be more attractive instruments to hedgers and speculators.

Table 5: Regression Results on the Implied Volatility

Panel A: Category 1 (DITM call, DOTM put)						
	Spider/S&P 500 calls		**Cube/NASDAQ 100 calls**		**Diamond/Dow 30 calls**	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Intercept	0.5840***	<.0001	1.1453***	<.0001	0.4943***	<.0001
OpInt	−5.4610***	<.0001	−3.0671***	<.0001	−8.9034***	<.0001
BidAsk	−6.5819***	<.0001	−7.8635***	<.0001	−2.1254***	<.0001
ExpirationTime	−0.0073***	<.0001	−0.0141***	<.0001	−0.0057***	<.0001
DummyIndex	−0.0384***	<.0001	−0.2199***	<.0001	−0.0605***	<.0001
*OpInt*DummyIndex*	5.1483***	<.0001	−35.3780***	<.0001	5.4452***	<.0001
Adjusted R^2	0.5379		0.2757		0.3725	
Observations	11439		9624		8088	
	Spider/S&P 500 puts		**Cube/NASDAQ 100 puts**		**Diamond/Dow 30 puts**	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Intercept	0.2154***	<.0001	0.3242***	<.0001	0.2066***	<.0001
OpInt	−0.9303***	<.0001	−0.1805***	<.0001	−1.9325***	<.0001
BidAsk	0.0241***	<.0001	0.1267***	<.0001	0.0834***	<.0001
ExpirationTime	−0.0002***	0.0015	−0.0029***	<.0001	−0.0004***	0.0007
DummyIndex	−0.0117***	<.0001	−0.0284***	<.0001	−0.0299***	<.0001
*OpInt*DummyIndex*	0.8439***	<.0001	−0.9001***	<.0001	1.5635***	<.0001
Adjusted R^2	0.0432		0.3580		0.1222	
Observations	11572		8197		10619	
Panel B: Category 5 (DOTM call, DITM put)						
	Spider/S&P 500 calls		**Cube/NASDAQ 100 calls**		**Diamond/Dow 30 calls**	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Intercept	0.1628***	<.0001	0.4688***	<.0001	0.2097***	<.0001
OpInt	−0.4040***	<.0001	−0.9929***	<.0001	−4.3334***	<.0001
BidAsk	−0.0047**	0.0496	0.0692***	<.0001	0.0286***	<.0001
ExpirationTime	−0.0018***	<.0001	−0.0079***	<.0001	−0.0019***	<.0001
DummyIndex	0.0058***	0.0026	−0.1342***	<.0001	−0.0303***	<.0001
*OpInt*DummyIndex*	0.0768	0.3802	−0.8588***	<.0001	3.7567***	<.0001
Adjusted R^2	0.1039		0.4449		0.0772	
Observations	6262		8579		7581	
	Spider/S&P 500 puts		**Cube/NASDAQ 100 puts**		**Diamond/Dow 30 puts**	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Intercept	0.6429***	<.0001	1.0959***	<.0001	0.5777***	<.0001
OpInt	−2.8990***	<.0001	−4.1980***	<.0001	−9.6072***	<.0001
BidAsk	−8.5135***	<.0001	−8.4264***	<.0001	−3.5049***	<.0001
ExpirationTime	−0.0079***	<.0001	−0.0119***	<.0001	−0.0062***	<.0001
DummyIndex	−0.0216***	<.0001	−0.2254***	<.0001	−0.0621***	<.0001
*OpInt*DummyIndex*	4.0745***	<.0001	−34.9441***	<.0001	8.0899***	<.0001
Adjusted R^2	0.6132		0.4037		0.4236	
Observations	12979		14124		7298	

*This table shows regression results based on equation (1). The time period is from January 2003 to December 2006. OpInt is open interest divided by 1,000,000; BidAsk is the dollar bid-ask spread divided by the ask price; ExpirationTime is the amount of time to option expiration; DummyIndex is 1 for index options and 0 for ETF options. *, **, *** indicate significance at the 10, 5, and 1 percent levels respectively.*

CONCLUSION

In this paper we study a popular investment vehicle that has recently grown in prominence, the exchange-traded fund. Options on ETFs are a recent development and as such have not been extensively studied. We document that there is a difference between the implied volatilities of ETF and index options. However, we find no evidence of a difference in the return distributions of ETFs versus their tracking indices, contrary to the predictions of Bakshi et al. (2003).

Because the underlying return distributions are the same, we investigate other possible explanations for differences in the implied volatility functions. We find that implied volatility is related to the percentage bid-ask spread, although the direction of this relationship varies depending on the option's moneyness. We also investigate Bollen and Whaley's (2004) net buying pressure argument. We find that implied volatility is related to open interest (our proxy for option demand), but not in the expected direction. However, given that open interest is an imperfect measure of net buying pressure, we cannot rule out Bollen and Whaley's explanation altogether. Our findings do indicate that ETF options have more pronounced volatility smiles than their equivalent index options. This is driven primarily by the fact that DITM (and, to a lesser extent, DOTM) ETF options have higher implied volatilities. Although the precise reasons for this are still unknown, it is plausible that in some cases ETF options may be more attractive instruments for hedging and speculation. In any event, it is clear that they are not perfect substitutes for index options.

The paper has a natural limitation in the selection of open interest as a proxy for option demand. Option demand could be better measured with the exact net buying pressure variable computed using the Bollen and Whaley procedure, which utilizes intraday option data. However, given that our dataset provides only end-of-day option prices, the computation of the exact net buying pressure metric is not possible at this stage. In a future study, we plan to address this issue after acquiring the intraday option data. Another interesting extension of this paper would be a more detailed examination of Cube options. Cubes switched trading from AMEX to NASDAQ on 12/1/2004, and in a future paper we plan to examine how this change affected the implied volatility of the corresponding ETF and index options.

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THE DYNAMIC INTERACTION BETWEEN FOREIGN EQUITY FLOWS AND RETURNS: EVIDENCE FROM THE JOHANNESBURG STOCK EXCHANGE

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ABSTRACT

This research examines the dynamic relationship between foreign portfolio equity flows and equity returns on the Johannesburg Stock Exchange (JSE). The primary objective of this research is to uncover how equity market returns influence foreign cross border portfolio equity flows and in turn how those portfolio flows affect equity returns. To understand the linkages between equity flows and market returns, the current research employs vector autoregressive models and presents the results of variance decompositions, impulse response functions and causality tests. The results show that foreign equity flows are 'pulled' into South Africa by high returns on the JSE. This finding is consistent with a broad literature on other emerging markets. This research also finds causal link between net equity flows and returns, indicating that the evolution of the JSE is independent of foreign portfolio activity.

JEL: F21; G15; G11; 014; 016

KEYWORDS: Portfolio flows, International investment, Africa

INTRODUCTION

The broad purpose of this research is to understand the dynamic linkages between foreign portfolio equity flows and equity returns in South Africa. The key questions this research addresses are: 1) Do foreign equity flows affect equity returns on the Johannesburg Stock Exchange (JSE)? 2) Do returns on the JSE forecast changes in foreign equity flows? These questions have been of recurrent interest to investors, economists and policy makers, and are posed with greater urgency during times of financial upheaval or changes in the distribution of capital flows. Frequently, the answers to the above questions have cast international investors in a negative light. It is often argued that foreign equity flows lead to price overreaction, and when withdrawn contagion. An alternative efficient markets view is that equity flows are merely one of the processes by which information is incorporated into asset prices.

While there are numerous strongly held views, there is surprisingly little information on the behavior of international portfolio flows and their relation to equity returns, particularly in South Africa. South Africa's economy has been growing at a very healthy rate since 1999. The average annual GDP growth rate between 2000 and 2006 was in excess of 3.5%, well above the previous decade. Consequently, South Africa has become one of the economic powerhouses of Africa, with a gross domestic product (GDP) four times that of its southern African neighbors and comprising around 25% of the entire continent's GDP (African Competitiveness Report, 2007). The country leads the continent in industrial output, mineral production and generates most of Africa's electricity (African Competitiveness Report, 2007). As a result of South Africa being an economic powerhouse, it also has the most developed equity market in the region, and provides one of the best opportunities on the continent for foreign investors seeking diversification or capital appreciation. South Africa also has a relatively solid financial infrastructure. Its banking sector has ranked consistently among the top ten globally according to the World Economic Forum. Additionally, the Johannesburg Stock Exchange (JSE) is the 18th largest stock exchange in the world in terms of market capitalization. A decade of comprehensive institutional reform and sound economic management has been rewarded with solid credit ratings, implying less risk for investors and cutting the cost of capital for the country's public and private sector borrowers (Global Competitiveness report, 2007).

South Africa's rapid growth and improving financial infrastructure has lead to an increase in foreign portfolio equity flows to the nation. This increase in foreign portfolio capital has emerged as an important policy issue for the country. The danger of a 'Thailand-style' abrupt and sudden withdrawal of equity and the destabilizing effects on equity markets are of concern. While these concerns are justified, comparatively less attention has been paid to analyzing the actual flow data and understanding the key relationships between these flows and equity markets. A proper understanding of the influence of foreign equity flows on equity market returns and equity returns on portfolio flows is essential for a meaningful debate about their effect.

The objective of this research is to first to uncover how equity market returns influence foreign equity flows from and in turn, how these portfolio flows affect equity returns. To this end, we first look at the key features of equity flows and then study the relationship between equity flows and stock markets with the key objective of determining causality or more generally forecast ability. To address these questions, this research uses Vector Autoregressive (VAR) models. The attractive feature of VAR analysis is that since the relationship between flows and returns is not well established and neither variable is known to be exogenous, VAR allows for each variable in the system to be treated symmetrically.

This research finds a strong link between returns on the JSE and foreign equity flows. In particular, this work finds favorable returns on the JSE forecast greater net flows of foreign capital in subsequent periods. This finding is consistent with the work of Bohn and Tesar (1996), Froot, O'Connell and Seasholes (2001) and indicates that foreign investors are relaying on past observations of the return sequence of the JSE when making portfolio allocation decisions. These finds are robust to a variety of empirical specifications. On the other hand, no causal link is found running from net flows to returns; this is a positive sign for the development of the JSE, as it demonstrates that the actions of foreign portfolio investors are not unduly influencing the evolution of the Johannesburg Stock Exchange.

The remainder of this research is organized as follows. Section 2 discusses the relevant academic literature, section 3 discusses the empirical methodology, section 4 describes the data, section 5 presents the results and section 6 concludes.

LITERATURE REVIEW

The motivation for capital flows has long been a subject of research in financial economics. This research began with studies of the degree of capital mobility among countries. Early models of capital flows found it convenient to assume perfect mobility of capital. However in 1980, the Feldstein-Horioka puzzle was identified--the finding of low capital mobility in OECD countries (Obsterfeld and Rogoff, 2001). Today the continued existence of the Feldstein-Horioka puzzle is particularly puzzling, since there are several indications that industrial countries' international capital markets are well integrated (Stulz, 1999). In practice, this puzzle, along with other complications, implies that it has proven difficult to model capital flows in a world in which capital is not perfectly mobile or information is not distributed uniformly (Bekaert, Harvey and Lumsdaine, 2002). This has led researchers to rely on single equation and vector autoregressive models to determine the nature of the relationship between equity flows and returns.

Existing evidence indicates a strong relationship between net flows of foreign capital and market returns. Griffin, Nardari, and Stulz (2004) recently confirmed this result in their study of emerging Asian equity markets. They find that for many emerging Asian markets foreign investors follow past realizations of the flows sequence. French and Ahmad (2011) study foreign equity flows into the United States and confirm the strong dynamics between returns and equity flows in the context of a developed country.

What is unsettled is the interpretation of this relationship and implications for the role of foreign investors in emerging markets. There are several competing hypotheses to explain this relationship. One hypothesis is that the participation of foreign investors in the market brings about a demand shift and hence a permanent price change. This broadening of investor base increases risk sharing opportunities and hence lowers the required rate of return. Merton (1987) provides theoretical arguments for this mechanism, and Bekaert and Harvey (2000) and Henry (2000) report empirical work on the effect of liberalization on emerging markets. Another hypothesis conjectures that foreign equity inflows affect equity returns via a temporary price pressure effect due to market illiquidity in absorbing the extra demand. Support for the price pressure hypothesis has been difficult to uncover.

Empirical work in mutual fund literature by Warther (1995) and in equity flows by Clark and Berko (1997) fail to find support for this notion. As the above discussion illustrates, the role of foreign investors in emerging market is also much debated, as they are alternately described as trend chasers (Cho, Kho, and Stulz, 1999, Bohn and Tesar, 1996), informed traders (Seasholes, 2004, Grinblatt and Keloharju, 2000), or investors with information disadvantage (Brennan and Cao 1997, Brennan, Cao, Stong, and Xu, 2005).

Several theoretical arguments made for the dynamic relationship between equity flows and returns in other countries may be relevant in South Africa. The first compelling theory is commonly called, 'portfolio rebalancing', which implies, investors sell equities from countries that are the best performers in their portfolio since they become overweighed in these securities. The portfolio-rebalancing channel predicts that high U.S. returns would generate flows toward foreign (non-U.S.) markets. Hau and Rey (2006) model this relationship with an intuitive (though rigorous) model called the 'uncovered equity parity' condition, assuming incomplete risk trading. One of the implications of Hau and Rey's model is a negative relationship between net equity flows and returns of the South African market.

A second compelling theory that may explain the relationship between returns and net flows is often termed 'return chasing', or 'positive feedback trading'. Bohn and Tesar (1996) document that when the returns are expected to be high in a market, U.S. investors' move into that market and retreat from that market when predicted returns are low. Dahlquist and Robertsson (2004) document this feedback trading behavior in the Swedish market. However, the return chasing hypothesis is not without challenge, for example, Portes and Rey (2005) in a large panel study fail to find evidence of return chasing.

Information asymmetry has also been used to describe the dynamics of equity flows from the U.S to emerging and developed markets (see Brennan and Cao, 1997 and Brennan et al., 2005). Asymmetric information theory proposes that when foreign investors are less well informed about returns on foreign investment, they tend to be more sensitive to new public information than the domestic investors are. Following news in a given national market, foreign investors revise their assessments of expected returns and change their allocations in a more rapid or non-symmetric manner compared to that of domestic investors. Consistent with the asymmetric information theory, Brennan and Cao (1997) and Tesar and Werner (1995) find evidence of positive, contemporaneous correlation between expected returns and international portfolio flows. Brennan et al. (2005) analyze how international investors adjust their expectations of asset returns in a given country in response to information. They find that relative to the domestic investors, foreign investors become more bullish about the stock market of a country as the returns of that country's market portfolio increase. The findings Griffin et al. (2004), Bohn and Tesar (1996) and Brennan and Cao (1997) also evidence this 'trend-chasing' behavior of foreign investors' results in a positive correlation between lagged domestic market returns and contemporaneous and lagged expected returns.

One final branch of literature in this are worth noting is the study of equity flows surrounding financial crises. Choe et al. (1999) who study the nature of capital flows and their relationship with stock returns in

Korea before and during the Asian financial crisis (November 30, 1996 to the end of 1997). The authors find that before the Korean crisis foreign investors purchased more Korean stocks on days following an increase in the market and bought Korean shares that outperformed the market over the previous day. This finding evidences positive feedback trading by the foreign investors. However, the evidence of positive feedback trading was found to be much weaker during the crisis period. Froot et al. (2001) find that during the Asian financial crisis, emerging markets and Asian markets experienced inflows of foreign capital. They report that daily inflows during the crisis period (July 1997-July 1998) averaged 40% into all emerging markets and 30% into Asian markets of their pre-crisis levels.

METHODOLOGY

In order to understand the dynamic relationship between flows and returns we estimate several vector autoregressive models. A vector autoregression (VAR) model is useful for forecasting systems of interrelated time-series variables and testing causality among these endogenous variables. Let a VAR be expressed as:

$$Z_t = \mu + \Gamma_1 Z_{t-1} + ... + \Gamma_p Z_{t-p} + \varepsilon_t , \qquad (1)$$

where $Z_t = [R_{it}, f_{it}]'$ and R_{it} and f_{it} are returns of market i and net flows (inflows-outflows) to South Africa, μ is a parameter vector and Γ's are the matrices of the parameters estimated, and ε_t is the residual vector. The lag length is determined by the Akaike information criterion (AIC).

It has become standard in VAR to restrict parameters assuming that one variable has no contemporaneous effect on the other; this is known as Choleski decomposition. For example, if one assumes that returns respond to flow innovations with a one-period lag or that net flows respond to innovations in returns with a one period lag, identification is achieved. This sort of identification mechanism can sometimes lead to sensitivity of the results to the ordering of variables. However, the major results of a VAR of flows and returns in South Africa are not influenced by the ordering of the variables, which is consistent with Bekarert et al (2002), and Dahlquist and Robertsson (2004).

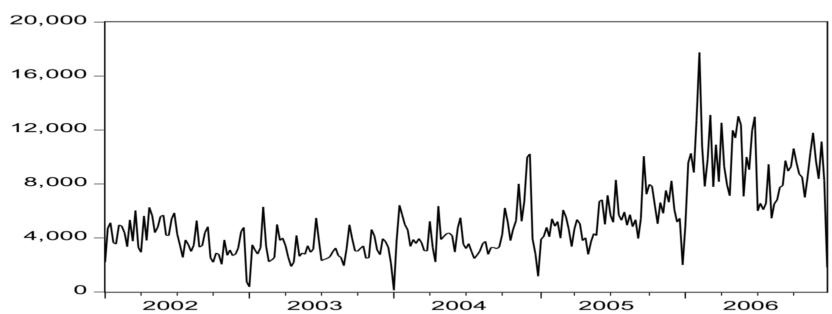
To further understand the dynamic relationships between net flows and returns, we use the fact that equity flows are highly autocorrelated, and decompose flows into and expected and unexpected sequence. Tests for autocorrelation of the residuals are performed using the generalized LaGrange multiplier test to check for autocorrelation. We then estimate an autoregressive (AR2) model using the full sample and use the coefficients to predict one-step-ahead values of net flows (i.e. anticipated or expected net flows) and term the residual from this AR(2) regression unanticipated or unexpected net flows. This decomposition gives both an expected and an unexpected net flow series, this methodology was adopted from Warther (1995). We then estimate VAR models using these decomposed net equity flow series and returns on the JSE.

Data and Summary Statistics

Portfolio flows are distinguished from other international capital flows by the degree that they are reversible. Some clarification and definitions may be useful at this point. Capital flows are generally broken into three components: Direct Foreign Investment (FDI), bond flows and equity flows. FDI flows are distinguished from other international capital flows by the degree to which the investor owns or controls the firms. FDI is typically defined as the direct or indirect ownership or control by a single domestic entity of at least ten percent of the voting securities of an incorporated foreign business firm or the equivalent in an unincorporated enterprise. Bond flows represent flows from abroad to South African bond markets for portfolio reasons. Similarly, the equity flows used in this study represent flows from foreign investors (non-South African) to the Johannesburg equity markets for portfolio reasons (representing less that 10% ownership stakes). The source for the equity flows used in this study is directly from the Johannesburg Stock Exchange. The equity flow data is weekly for the period of January 4, 2002 to December 29, 2006. This equity flow data is paired with weekly index levels and returns on the Johannesburg Stock Exchange, which are obtained from Bloomberg data services.

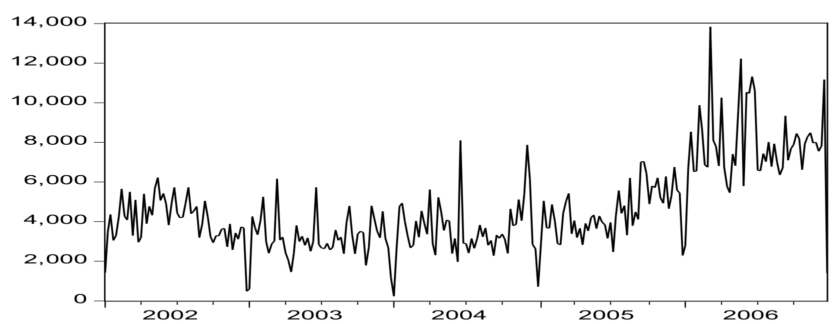
Figure 1 presents the breakdown of weekly portfolio equity flows to/from South Africa. As Figure 1, Panel A clearly illustrates, inflows to South Africa from abroad have increased substantially over our sample period and all indications are that equity flows to the region should continue to grow. Figure 1, panel C plots the evolution of net flows foreign equity flows into South Africa. Net flows represent inflows of foreign capital minus foreign outflows of capital. Panel C shows that for most weeks during the sample period net flows have been positive, indicating that on average more foreign equity capital is entering the South African equity market than is leaving.

Figure 1 Panel A: Weekly Equity Flows from the Abroad to South Africa: 01/04/02-12/29/06



This figure shows the trend in weekly foreign equity flows from foreign investors into South Africa for the period of January 2002 to December 2006. These flows are commonly called equity inflows; the vertical axis is in millions of South African Rand.

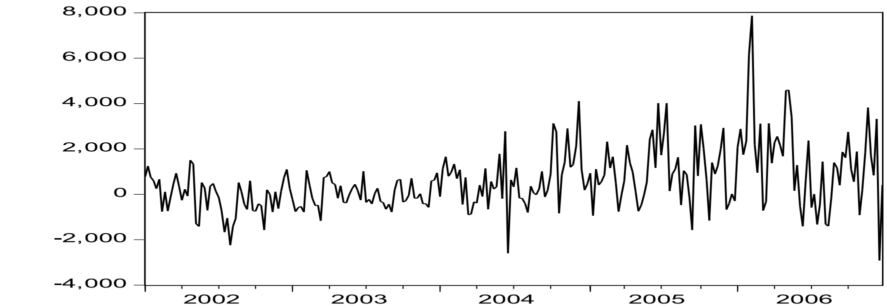
Figure 1, Panel B: Weekly Equity Flows from the South Africa to Abroad: 01/04/02-12/29/06



This figure shows the trend in weekly foreign equity flows from foreign investors out of South Africa for the period of January 2002 to December 2006. These flows are commonly called equity outflows; the vertical axis is in millions of South African Rand.

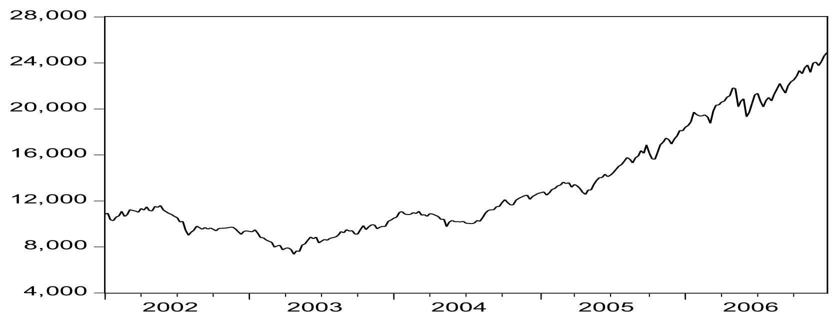
Figure 2, plots the evolution of the Johannesburg Stock Exchange (JSE) over our sample period. It is evident that the JSE has been consistently trending upward. This could provide one potential explanation for the increase in portfolio equity flows to South Africa; foreign investors are funneling their monies to South Africa to take advantage of the rapid growth opportunities. However, this could also indicate an alternative hypothesis that foreign investors are pressuring returns up via excess demand and illiquidity in the South African equity market. If foreign investors' are pressuring returns upward, then any sign of weakness in the JSE could send lead to a rapid withdraw of capital by foreign investors, and have negative consequences for the JSE. In the next section of this paper, we will address these issues in a dynamic VAR model.

Figure 1: Panel C: Weekly Net Equity Flows: 01/04/02-12/29/06



This figure shows the trend in weekly net equity flows foreign equity flows (inflows minus outflows) into South Africa for the period of January 2002 to December 2006; the vertical axis is in millions of South African Rand.

Figure 2: Johannesburg Stock Exchange Index: 01/04/02-12/29/06



This figure shows the weekly trend in the Johannesburg Stock Exchange Index for the period of January 2002 to December 2006.

Summary statistics for the variables used in this study are reported in Table 1. The mean net flow per week to the JSE from all overseas investors was 576.48 million Rand, with much larger inflows and outflows, demonstrating that investors are constantly rebalancing or adjusting their portfolios, within South Africa to changing economic conditions. Returns on the JSE also had a positive mean over the sample period returning about 0.35% per week. The JSE is a volatile market with an average return standard deviation of 2.4% per week with a maximum return over our sample period of 7.4% and a minimum return of -7.42%.

Table 1: Summary Statistics: 01/04/02-12/29/06

	Obs	Mean	S.D	Min	Max
INFLOW	260	5219.66	2745.65	134.83	17746.49
OUTLFLOW	260	4643.18	2167.54	237.49	13832.16
NETFLOW	260	576.48	1378.38	-2913.30	7869.26
INDEX	260	13264.51	4632.81	7361.15	24915.20
RETURN	260	0.0035	0.024	-0.0742	0.0744

Means, standard deviations and extreme values for data on foreign equity flows and returns are reported in the table above. INFLOW represents inflows from the foreign portfolio investors to South Africa, OUTFLOW represents outflows from South Africa to the foreign investors, NETFLOW represents INFLOW minus OUTFLOW, the raw flow data are in millions of South African RAND. INDEX is the Johannesburg Stock Exchange index level, RETURN is the return on the Johannesburg Stock Exchange. All flow data is on a weekly basis and was provided by the Johannesburg Stock Exchange. Equity market information was obtained from Bloomberg.

EMPIRICAL RESULTS

Before estimating VAR models several diagnostic tests are performed. First, index and net flows are tested for a unit root using standard Augmented Dickey Fuller (ADF) procedures. VAR models are misspecified in the presence of nonstationary variables. The results ADF test are not reported, but as expected index in the level is integrated of order one, but returns and net flows are stationary. The next step in our empirical methodology is to decompose the net flow series into an expected (or anticipated) and an unexpected (or unanticipated) series. Net flows are decomposed using a simple autoregressive model of order two. Two lags were selected to eliminate serial correlation in the residuals. This is the appropriate method to decompose the net flow sequence since net flows are found to be autocorrelated. It is common in literature to find that net flows are autocorrelated. For example, French and Naka (2008) report that net flows in both China and India are similarly auto correlated. The next step in our empirical analysis is to address the dynamic interactions between equity flows and returns on the JSE. In order to garner a full understanding of the nature of the linkages between net flows and returns we estimate three separate VAR models based on equation one in our methodology section.

Our baseline model is a bivariate VAR between returns and net flows; lag length of two is selected based on the AIC criteria for all VAR models estimated. Table 2 summarizes the granger causality results for all three VAR equations estimated. The granger causality results for our base VAR model of net flows and returns are reported in the first column of the table below. We note unidirectional causality running from returns to flows, but fail to find a statistically significant causal relationship running from net flows to returns. Column one of table two reports the Chi-Squared statistic along with the level of significance. We find a very highly significant (at the 1% level) causal relationship between returns on JSE and net equity flows.

Table 2: Summary of Granger Causality Tests

Model	VAR [RETURN, NETFLOW)	VAR [RETURN, EXPECTED]	VAR [RETURN, UNEXPECTED]
Flows Causing Returns	0.68	0.13	0.61
Returns Causing Flows	21.16***	19.09***	21.26***

*The table below presents a summary of two Granger causality tests: Granger 1: Flows do not Granger cause returns. Granger 2: returns do not Granger cause flows. Causality results are based on the model outlined in equation one of the text. Chi-square statistics are reported. Results are summarized for three VAR models under three different specifications. RETURN is equal to the weekly return of the Johannesburg stock exchange, NETFLOW is inflows minus outflow, EXPECTED are expected net flows as predicted from an AR(2) model. UNEXPECTED are the residuals of an AR(2) model of net flows. *** Significance at 1%, ** significance at 5% and *significance at 10%*

This finding is consistent with the 'Return Chasing' hypothesis developed by Bohn and Tesar in 1996 and supported in subsequent research (see French and Naka, 2008 for a recent example). Our baseline model indicates that foreign investors increase their allocation to South Africa following a positive return realization. We also note the important finding that net foreign equity flows do not appear to granger cause returns; this finding is consistent with Clark and Berko's (1997) finding in Mexico.

The failure to find a causal relationship between net flows and returns indicated that foreign equity investment does not appear to be artificially pressuring prices in South Africa upward. We now turn to the results of our variance decompositions stemming from our baseline VAR of returns and net flows. These results are reported in Table 3 and support the general findings of the granger causality results, showing that the return sequence is exogenous (in a statistical sense). The first three columns report the variance decomposition of returns from an unexpected shock to the return sequence and from an unexpected shock to the net flow sequence. We note that almost all of the variance in the return sequence is attributable to a shock in returns, indicating that the sequence is statistically exogenous. Turning the variance decomposition in the final three columns of table 3 we note that almost 10% of the variance in the net flow sequence is attributable to a shock in the return sequence. This finding indicates that a significant portion of the variance in the net flow sequence is attributable to shocks in returns on the JSE.

Next, we analyze the impulse response functions (IRF) as reported in Figure 3. The graph in the top left corner shows the response of the return sequence to a shock in returns. We find that a one standard deviation shock to returns leads to a contemporaneous increase in returns in the next period, but this effect is quickly eroded. The top right graph shows the response of returns to a one standard deviation shock to net flows. We note that consistent with the previous findings there is not statistically significant response on returns from a one standard deviation shock in net flows.

Table 3: Variance Decomposition

	Std. error	RETURN Shock	NETFLOW Shock	Std error	RETURN Shock	NETFLOW Shock
Period	*Variance Decomposition RETURN*			*Variance Decomposition NETFLOW*		
1	0.02	100.00	0.00	1190.13	0.02	99.98
2	0.02	99.76	0.24	1306.03	6.51	93.49
3	0.02	99.72	0.27	1363.94	8.57	91.43
4	0.02	99.72	0.27	1381.76	9.13	90.87
5	0.02	99.72	0.28	1389.07	9.34	90.66
6	0.02	99.72	0.28	1391.80	9.42	90.58
7	0.02	99.72	0.28	1392.85	9.45	90.55
8	0.02	99.72	0.28	1393.26	9.46	90.54
9	0.02	99.72	0.28	1393.42	9.47	90.53
10	0.02	99.72	0.28	1393.48	9.47	90.53

Table 3 presents the variance decomposition from the VAR of RETURN and NETLFOW described in equation one in the text. Shocks are identified using the Cholesky decomposition. Standard errors and the percent of variation in each variable explained by shocks to itself and other variables in the system are reported.

Turning to the main findings of our IRF analysis in the bottom left graph in figure 3, which shows the response of net flows to a one standard deviation shock to returns. We find a statistically significant increase in net flows over the next 1-4 weeks following an unexpected return shock. Additionally a shock to net flow tends to lead to higher levels of net flows for about the next 6 weeks, demonstrating that net flows tend to follow net flows (this supports the autocorrelation finding).

To summarize our main findings in our base model of returns and net flows. We find a highly significant relationship between net flows and returns. In particular unexpected shocks to returns forecast greater net foreign equity flows into South Africa beyond what could be predicted from lagged net flows. This results is consistent with broad literature that has found that foreign equity investors are 'return chasers'. We also fail to find a significant relationship running from net flows to returns, this finding indicates that foreign equity investment does not appear to pressure prices upward in South Africa.

To better understand the joint dynamics between returns and net flows in South Africa we take advantage of the fact that net flows are autocorrelated. We follow the seminal work of Warther (1995) and decompose the flow sequence into an anticipated and an unanticipated series, where the unanticipated series is the residual of an AR(2) model and the anticipated is the fitted values. The current paper then estimates VAR using these decomposed sequences. The VAR between anticipated net flows and returns is estimated and column two of table 2 summaries the granger causality results. Similar to the baseline model it is found that anticipated flows do not forecast returns, this would be expected, since net flows are positively autocorrelated higher levels of net flows lead to higher levels of net flows in the future, markets appear to anticipate this reaction and are not influenced by anticipated or expected net flows. On the other hand, returns do strongly forecast future expected net flows this can be seen by the high Chi-squared statistic and the significance level of 1%.

To get a better idea of the joint dynamics between anticipated net flows and returns we estimate IRF in a similar fashion to our base models. The IRF for our second model are reported in figure 4. Focusing on the graph in the lower left corner of figure 4 we find that a one standard deviation shock to returns produces an increase in the permanent (or expected) component of net flows over the next 6 weeks.

Figure 3: Impulse Response Functions: Var [Returns, Netflows]

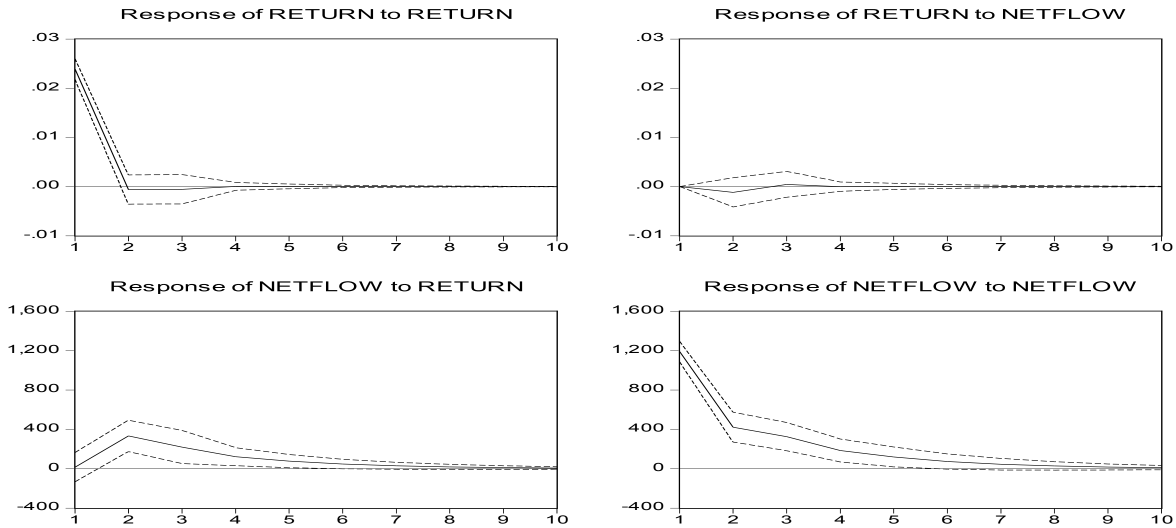


Figure 3 presents the standard impulse response functions for a VAR of RETURNS and net flows, where net flows are foreign equity inflows into South Africa minus foreign equity outflows from South Africa. Dotted lines are 90%-confidence bounds, which were generated by a Monte-Carlo simulation with 1000 draws from the posterior distribution.

Figure 4: Impulse Response Functions: Var [Returns, Expected]

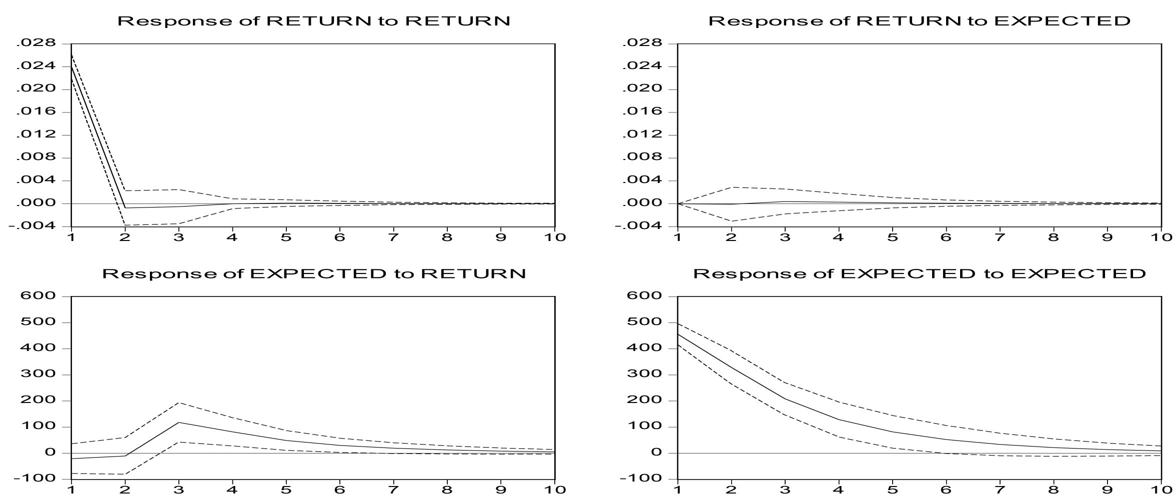


Figure 4 presents the standard impulse response functions for a VAR of RETURNS and EXPECTED, where EXPECTED, are the forecasted net flows using an AR(2) model. Dotted lines are 90%-confidence bounds, which were generated by a Monte-Carlo simulation with 1000 draws from the posterior distribution.

This again provides evidence that foreign investors are relaying on past realizations of the return sequence to make their portfolio allocation decisions. With higher returns in South Africa leading to higher expected allocation of foreign capital to the JSE.

As a final step to understand the dynamic linkages between returns and net equity flows to South Africa we estimate a third VAR model between returns and unexpected equities flows (or those flows that could not be predicted using the autocorrelated structure of the net flow sequence).

Consistent with the previous two models we find a unidirectional relationship between unexpected net flows and returns. Column three of table 2 reports the granger causality results. As far as forecast ability, unexpected net flows do not have forecasting power on returns. This finding provides evidence against the notion the foreign investors or pressuring prices higher on the JSE. Warther (1995) found a similar result for mutual fund flows and Clark and Berko (1997) did not find evidence of foreign equity flows pressuring the Mexico equity market upward. However, returns do appear to forecast future unanticipated equity flows strongly and quickly within a week or two unanticipated foreign equity flows jump by about 360 million Rand. This finding demonstrates that in South Africa foreign investors are very responsive to changes in the price of the JSE and adjust their portfolio to reflect these changes, but do not appear to significantly influence the evolution of the return sequence. The results of the granger causality test are supported by the IRF's reported in Figure 5 below. It is notes that an unexpected shock to return illicit a statistically significant response from unexpected net equity flows, whereas returns evolve independently of shocks to unexpected net equity flows.

Figure 5: Impulse Response Functions: Var [Returns, Unexpected]

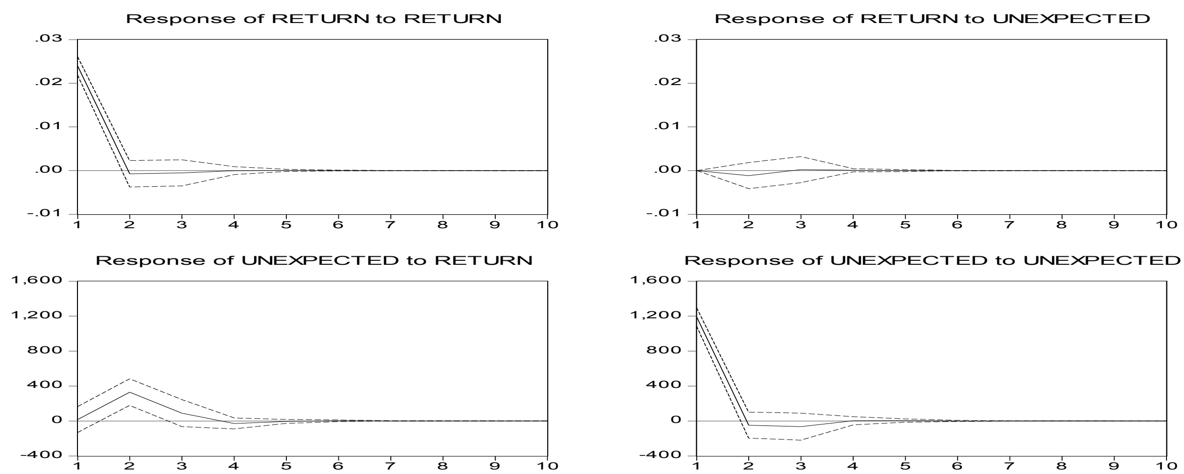


Figure 5 presents the standard impulse response functions for a VAR of RETURNS and UNEXPECTED, where UNEXPECTED, are residuals from an AR(2) model of net flows. Dotted lines are 90%-confidence bounds, which were generated by a Monte-Carlo simulation with 1000 draws from the posterior distribution.

CONCLUSION

This paper has addressed the important issue of the relationship between net foreign equity flows and returns on the JSE. Vector autoregressive techniques are used as a filter to isolate the specific effects that returns have on flows and flows on returns. Additionally the net flows sequence is decomposed into an expected and an unexpected series and VAR models are estimated. This research uncovered the following relationship between foreign portfolio equity flows and returns on the JSE.

In South Africa, returns tend to forecast foreign equity flows; this finding is consistent with the idea that foreign portfolio investors are 'Chasing' high returns into the JSE. This finding is robust to all specifications of net flows (i.e. expected and unexpected). The relationship found in South Africa are consistent with the findings of Bohn and Tesar (1996), Froot and Seasholes (2001) and are in contrast to the work of Portes and Rey (2005). The findings of the current paper have several important implications for South Africa. The finding of a strong link running from returns to net foreign equity flows, demonstrates that foreign portfolio investors are relying on past realizations of the return sequence of the JSE to make portfolio investments. Second, the absence of the link running from net foreign equity flows to returns indicates that foreign investors are not exerting undue influence on the returns of the JSE; this is positive sign in the overall development of the JSE.

While the current paper is a first step to understanding the influence of foreign equity flows on the development and evolution of the Johannesburg stock exchange, it does have several limitations and implications for further research. Let us begin with the limitations, the first and most significant limitation of this work is that equity flows are aggregated, so that we cannot determine if investors from different nations have asymmetric influences on equity markets or display different patterns of investment in South Africa with respect to different return sequences. A second limitation of this work is that we only considered the dynamics of returns and net equity flows as a first step to understanding foreign investment behavior in South Africa. The limitations of this study provide several interesting paths for future research. First, obtaining country specific equity flows to South Africa would allow a research to determine if different countries display non-similar investment patterns. A second path forward is to expand the variables included in the analysis to include global push and pull factors into the analysis to see the impact of variables such as exchange rates, interest rates and growth on the dynamics of foreign investment in South Africa. With these limitations and suggestions noted, the current research presents a first effort at understanding the influences that foreign equity flows have on the Johannesburg stock exchange and the influence that returns have at drawing equity investment into Africa's premier financial market.

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INTERNAL CORPORATE GOVERNANCE MECHANISMS: EVIDENCE FROM TAIWAN ELECTRONIC COMPANIES

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ABSTRACT

This study's focuses on the effects of directors and employee stock bonus plans on electronic companies listed on the Taiwan Stock Exchange Corporation. In addition, the paper examines the appropriate internal corporate governance mechanisms for firms. The evidence shows firms with different scale measured by paid-in capital, need different corporate governance mechanisms. That is, raising directors' ownership may enhance corporate governance mechanisms for small firms. Appointing independent directors voluntarily may enhance corporate governance mechanisms for middle size firms. Furthermore, large firms may enhance corporate governance mechanisms by raising all directors' ownership, appointing independent directors voluntarily, or decreasing the proportion of managers serving concurrently as directors. Independent directors appear to have more effects on middle size and large firms.

JEL: G 34, G35,M48

KEYWORDS: corporate governance, independent directors, independent supervisors

INTRODUCTION

Issues of corporate governance have received heightened emphasis in recent years, following the event of Enron in the U.S.A. and the scandals of Rocomp Informatics Ltd. and Infodisc Technology Co. Ltd. in Taiwan. To strengthen corporate governance in Taiwan, the government has implemented a series of reforms. One reform is the introduction a system of independent directors and supervisors. Investors hope that independent directors and supervisors are more focused on shareholder rights and interests. On the contrary, many companies doubt the benefits of independent directors and supervisors. Such a situation triggered our motivation to explore the appropriate corporate governance mechanisms for different firms in the perspective of employee bonus plans.

In the USA and UK, the primary duty of a firm's directors is to monitor the managers on behalf of shareholders, thereby reducing agency problems (Fama, 1980; Fama and Jensen, 1983; Williamson, 1983). Agency problems will be more severe when the function of directors and supervisors is ineffective and firm performance and stock price will be affected accordingly (Core et al., 1999). The independent director mechanism is one of the most important determinants of corporate governance, and has been discussed by scholars and enterprisers extensively (Weisbach, 1988; Rosenstein and Wyatt, 1990; Brickley et al., 1994; Core et al., 1999). The results regarding whether inside or independent directors and supervisors bring more benefits to a company are mixed. Many researchers argued that independent directors perform their duty of monitoring, thereby bringing benefits to a company (Weisbach, 1988; Rosenstein and Wyatt, 1990). However, some studies do not find a significant correlation between the proportion of independent directors and firm performance (Baysinger and Butler, 1985; Hermalin and Weisbach, 1991; Yermack, 1996; Bhagat and Black, 1997). Nevertheless, this does not imply there is no need to maintain inside directors. Some suggest that inside directors' expert knowledge is necessary for a company (Rosenstein and Wyatt, 1997), and the inclusion of inside directors on the board can lead to a more effective decision-making process (Fama and Jensen, 1983). Furthermore, inside directors are often concurrently shareholders. Higher the director stock ownership of the firm, implies greater alignment of firm performance and directors' benefits, hence the greater incentive for such inside directors to monitor firm operations.

Many executives credit employee stock bonus plans with recruiting innovative employees thereby helping Taiwan's high-tech companies become globally competitive. In Taiwan, firms have applied employee stock bonus plans extensively with the goal of improving firm performance and increasing firm value. Because firms were not allowed to purchases their own stock in the open market until 2000, for the past two decades employee stock bonus plans have been the primary tool used to provide equity-based compensation and incentives by Taiwan firms, especially among high-tech firms. A high level of employee bonus grants benefit employees at the expense of stockholders' wealth, since distribution of employee stock bonuses result in the dilution of firm EPS. Prior to the amendment of May 24, 2006, Taiwan's Business Accounting Law stipulated that distribution of earnings of a business, such as dividend and bonus, shall not be recorded as an expenses or loss. In 1989, Taiwan's Financial Accounting Standards Board explained that employee stock bonuses are similar to earnings distribution. In practice, the firm treated employee stock bonus grants as earnings distribution and credited "Common Stock/ Preferred Stock" by multiplying par value（$10, NT dollars, hereafter）by the number of shares, accordingly. Hence, net income is overestimated when computing EPS. On the other hand, the denominator becomes larger after employee stock bonuses grants when calculating EPS.

Furthermore, qualification requirements of employees who are entitled to receive dividend bonuses, including the employees of subsidiaries of the company meeting certain specific requirements, may be specified in the articles of incorporation. The arguments regarding distribution and the amounts of paid dividend bonuses include the transparency of the decision making process, the independence of related decision makers, and the rationality of the amount distributed. Because the plans of surplus earning distributions are proposed by boards of directors, this study explores the appropriate corporate governance mechanisms for firms in view of the effects of the Securities and Exchange Act regarding ownership and systems of (independent) directors and (independent) supervisors on employees stock bonus plans (ESBP) of Taiwan Stock Exchange listed electronic companies (TSEC).

This study differs from previous studies except for that of Kuo et al. (2006), in that not only directors' ownership and supervisors' ownership but also the number of directors and number of supervisors are taken as separate independent variables. Previous studies combine these variables as one. The main contribution of this study is that the evidence shows firms with different scale, measured by paid-in capital, need different corporate governance mechanisms. That is, to raise all directors' ownership may enhance corporate governance mechanisms for small firms. To appoint independent directors voluntarily may enhance corporate governance mechanisms for middle size firms. Furthermore, large firms may enhance corporate governance mechanisms by raising all directors' ownership, appointing independent directors voluntarily, or decreasing the proportion of managers serving concurrently as directors to total directors. The system of independent directors seems to have more effects on both middle size and large firms.

The remainder of this paper is organized into 6 sections. Section 2 briefly describes the independent directors system and independent supervisors system in Taiwan. Section 3 discusses relevant literature and develops the hypotheses. Section 4 describes the sample selection and empirical design. Section 5 shows the empirical results mainly surrounding the association between the percentage of employee stock bonuses granted and the board and ownership structure variables. Section 6 explores the appropriate corporate governance mechanisms for firms in view of the effects of the Securities and Exchange Act regarding ownership and systems of (independent) directors and (independent) supervisors on ESBP of TSEC-Listed electronic companies. A summary and conclusion is provided in Section 7.

INDEPENDENT DIRECTORS/SUPERVISORS SYSTEMS IN TAIWAN

Mechanisms for corporate governance can be divided into two parts, internal and external mechanisms.

Structural conflicts inherent inside large-scale corporations may result in many different problems with respect to corporate governance. TSEC began requiring that IPO firms listed from February 2002 on should have two independent directors and one independent supervisor.

Article 14-2 of the Securities and Exchange Act states：A company that has issued stock in accordance with this Act may appoint independent directors in accordance with its articles of incorporation. The Competent Authority, however, shall as necessary in view of the company's scale, shareholder structure, type of operations, and other essential factors, require it to appoint independent directors, not less than two in number and not less than one-fifth of the total number of directors. Independent directors shall possess professional knowledge and there shall be restrictions on their shareholdings and the positions they may concurrently hold. They shall maintain independence within the scope of their directorial duties, and may not have any direct or indirect interest in the company. Regulations governing the professional qualifications, restrictions on shareholdings and concurrent positions held, assessment of independence, method of nomination, and other matters for compliance with respect to independent directors shall be prescribed by the Competent Authority. There has been no system of independent supervisors since the amendment of the Securities and Exchange Act on January 11, 2006.

Article 14-4 of Securities and Exchange Act states: A company that has issued stock in accordance with this Act shall establish either an audit committee or a supervisor. The Competent Authority may, however, in view of the company's scale, type of operations, or other essential considerations, order it to establish an audit committee in lieu of a supervisor; the relevant regulations shall be prescribed by the Competent Authority. The audit committee shall be composed of the entire number of independent directors. It shall not be fewer than three persons in number, one of whom shall be convener, and at least one of whom shall have accounting or financial expertise.

LITERATURE REVIEW AND RESEARCH HYPOTHESES

Agency theory argues that under conditions of incomplete information and uncertainty, two agency problems arise: adverse selection and moral hazard. The problems of adverse selection and moral hazard imply that fixed wage contracts are not always the optimal way to organize relationships between principals and agents (Jensen and Meckling, 1976). The provision of ownership rights reduces the incentive for agents' adverse selection and moral hazard because it makes their compensation dependent on their performance (Jensen and Ruback, 1983). Equity-based compensation is one of the mechanisms to align the interests of employees and shareholders. However, managers have an economic incentive to manipulate earnings in order to increase their compensation resulting in another agency problem (Healy, 1985; Watts and Zimmerman, 1986).

Corporate governance structure specifies the distribution of rights and responsibilities among different participants in the corporation, such as, the Board, managers, shareholders and other stakeholders, and spells out rules and procedures for making decisions on corporate affairs. Corporate governance may lower agency costs or prevent agency problems. The core of the internal mechanism is the board of directors and supervisors in Taiwan. Fama (1980), Fama and Jensen (1983) argued that the function of the board may solve agency problems. Therefore, board characteristics are an issue worth exploring. Furthermore, many executives credit employee stock bonus plans with recruiting innovative employees and thus helpings Taiwan’s high-tech companies become globally competitive.

While a number of studies have examined the relationships between board characteristics and variables such as firm performance and corporate value, relatively few studies have investigated the correlation between board characteristics and ESBP. Hypotheses tested here are focused on the effects of Taiwan’s Securities and Exchange Act regarding ownership and systems of (independent) directors and (independent) supervisors on ESBP.

Ownership of the Entire Body of Either Directors or Supervisors

Jensen and Meckling (1976) put forward the convergence-of-interest hypothesis. They argued that from an agency theoretic perspective, the need to monitor management stems from divergence of interests between managers and stockholders. The higher the managers' ownership stakes in the company, the greater the alignment of managers' and stockholders' incentives. Due to a reduction of agency costs, this hypothesis predicts that firm value and performance increases as management ownership rises.

While a number of studies have examined the relationships between board characteristics and variables such as firm performance and corporate value, relatively few studies have investigated the correlation between board characteristics and employee stock bonus plans. Empirical results in Taiwan regarding ownership structure and firm performance/value are generally consistent with the convergence-of-interest hypothesis or self-interest hypothesis.

Some prior studies (Chen et al., 2004；Hsu and Cheng, 2004) showed that the ownership of directors and supervisors are negatively correlated to employee (stock) bonuses granted. The results are consistent with the convergence-of-interest hypothesis or self-interest hypothesis. On one hand, directors' ownership is commonly much higher than that of supervisors in Taiwan. Prior results can therefore be contributed mainly to directors' ownership. On the other hand, most directors also serve as employees. That is, when the directors hold a substantial amount of a firm's stock, they will not propose an earnings distribution with high percentage of employee stock bonus grants since the dilution effects of employee stock bonus grants may be larger than the motivation effects. However, owing to the different characteristics, it may be inappropriate to combine directors' ownership with supervisors' ownership as an explanatory variable. The study of Kuo et al. (2006) was the first to use ownership of directors and ownership of supervisors separately as independent variables. Their results indicate that the ownership of general directors is negatively correlated to employee stock bonuses grants. The evidence is consistent with the convergence-of-interest hypothesis or self-interest hypothesis. Based on the self-interest hypothesis, the author infer that the higher the directors' ownership, the less likely they will do harm to stockholders' equity. Therefore, the following hypothesis is developed：

H1：Ceteris paribus, the greater all the board of directors' ownership of the firm, the lower the percentage of employee stock bonuses granted.

No prior research except that of Kuo et al. (2006) has examined correlation between employee stock bonuses granted and the supervisors' ownership of the firm. Their study indicated a positive relationship between general supervisors' ownership of the firm and percentage of employee stock bonuses granted. This finding is consist with the evidence of Mork et al. (1988) who find the entrenchment effect is dominant within the 5%-25% ownership range. The average ownership of general directors for 146 firms in the study of Kuo et al. (2006) is 6.70%. The evidence is also consistent with the self-interest hypothesis. Because supervisor ownership is low, the dilution effects may be less than the motivation effects resulting from employee stock bonuses grants. Based on the above inference, the following hypothesis is developed：

H2：Ceteris paribus, the greater all the supervisors' ownership of the firm, the higher the percentage of employee stock bonuses granted.

The Number of the Entire Body of Either Directors or Supervisors

As aforementioned, Chen et al. (2004) argued that participation of board members in employees' profit sharing reinforces the approval of employee stock bonuses. This is consistent with the arguments of Lipton and Lorsch (1992), Jensen (1993), and Yermack (1996) that the board's decision-making quality decreases with board size because more people in the group lower the group's coordination and processing skills. The results of Kuo et al. (2006) support the argument that board decision-making quality decreases with board size, just as proposed by Lipton and Lorsch (1992), Jensen (1993), and

Yermack (1996). Based on the above inference, the following hypothesis is developed:

H3：Ceteris paribus, the larger the number of all the directors of the firm, the higher the percentage of employee stock bonuses granted.

In Taiwan, for a company whose shares are issued to the public two or more supervisors must be elected. The role of supervisors in Taiwan is similar to that of independent directors in the U.S. One may argue that if the minimum number of supervisors regulated by Taiwan's Company Law is adequate to perform the duties.

Large U.S. listed companies generally maintain various functional committees such as a nomination committee, finance committee, public issues committee, audit committee, compensation committee, and executive committee. Audit committee, nomination committee and compensation committee exercise different kinds of monitoring functions. In December 1999, the NYSE and NASDAQ modified their requirements by mandating that listed companies maintain audit committees with at least three directors all of whom have no relationship to the company that may interfere with the exercise of their independence from management and the company. Compared to the U.S., this study argues that one supervisor regulated by Taiwan's Company Law (two for public issued companies) is inadequate to carry on the monitoring functions.

A positive correlation between the number of supervisors and the monitoring functions can therefore be hypothesized:

H4：Ceteris paribus, the larger the number of all the supervisors of the firm, the lower the percentage of employee stock bonuses granted.

Corporate governance is considered a comprehensive system to promote integrity of securities markets. The ultimate goal of this system is to protect shareholders' rights and interests. Enhancing the board of director's function is one of the most important ways to achieve this goal. Two principles a TSEC /GTSM (Gretai Securities Market) listed company shall follow when setting up the corporate governance system, in addition to complying with relevant laws and regulations are (1) to strengthen the powers of the board of directors, and (2) to fulfill the function of supervisors (Article 2 of Corporate Governance Best-Practice Principles for TSEC/GTSM Listed Companies). Furthermore, independent directors system and independent supervisors system are mechanisms to strengthen board of director powers and to empower the function of supervisors as stated in the aforementioned Corporate Governance Best-Practice Principles. The author infers that both independent directors and independent supervisors protect shareholders' rights and interests.

Owing to the lack of research with regard to correlation between independent directors/supervisors and employee stock bonus plans, the author apply related studies in developing hypotheses regarding independent directors/supervisors. Pincus et al. (1989) found that the portion of board seats held by outside (nonmanager) directors was associated with audit committee formation. They explained this relationship as stemming from the liability exposure of outside directors. An alternative explanation comes from the management literature, where the portion of insiders on the board has been used to measure of management's influence in several studies (Kesner et al., 1986; Kosnik, 1987; Siggh and Harianto, 1989). A high proportion of insiders on the board is a strong signal that the company is dominated by its officers. As manager incentives can conflict with those of shareholders, the board's effectiveness in the execution of its duties depends in large part on its independent directors (Jemison and Oakley, 1983). Several papers present evidence suggesting that effective governance and firm performance increase with board independence (Brickley et al., 1994; Byrd and Hickman, 1992; Weisbach, 1988). With regard to the empirical results of board composition and firm performance in Taiwan, most studies find a positive correlation between firm performance and number of independent directors, proportion of independent directors, or independent directors' ownership of the firm (Lin, 2002; Chen, 2003; Chen, 2006; Lin, 2006). That is, independent directors may enhance the function of corporate governance.

Effective governance includes preventing excessive dilution effects that result from large amounts of employee stock bonuses grants. That is, the better the corporate governance the lower level the employee stock bonuses grants, holding all else equal. From the above discussions, it is therefore reasonable to assume that both the independent directors act rationally in proposing the level of stock bonuses grants and the independent supervisors act rationally in auditing the level of stock bonuses grants. Based on the above inference, the following hypotheses are developed：

H5：Ceteris paribus, the greater the number of independent directors appointed by the firms voluntarily, the lower the percentage of employee stock bonuses granted.

H6：Ceteris paribus, the greater the number of independent supervisors appointed by the firms voluntarily, the lower the percentage of employee stock bonuses granted.

<u>Other Determinants of ESBP</u>

(1) *CEO Duality*: The empirical results of Core et al. (1999) suggested that CEO compensation was higher when the CEO also serves as chairman of the board. According to Taiwan's Company Act, in the case of a company limited by shares, remuneration of managerial personnel shall be decided by a resolution to be adopted by a majority vote of the directors at a meeting attended by at least a majority of the entire directors of the company. Thus, when a CEO is also the chairman of the board, he or she will have significant influence in determining his or her own compensation package. As pointed out by Finkelstein and Hambrick (1989), a CEO may set his or her own compensation. Most employee stock bonuses are distributed to high-level management teams in Taiwan. The directive function of the board of directors to managers will be more ineffective when a CEO also serves as chairman of the board, and the problem of agency will be more serious. Boyd (1994) suggested that if the role of the CEO and chairman of the board are separated, he would expect less influence over executive pay setting institutions. Empirical results of Hsu and Cheng (2004) showed that the employee (stock) bonuses were higher when the chairperson of board of directors is also the CEO which supports the management self-interest hypothesis. However, Chen et al. (2004) and Kuo et al. (2006) did not find a significant correlation between employee stock bonus grants and CEO duality.

(2) *Firm Size:* Since employee stock bonuses grants are a part of the employees' compensation, firm size may effect employee stock bonuses grants. Owing to the fact that the larger the firm's size the more complicated the management and hence the more efforts managers shall make, as large firms offer better compensation to attract outstanding managers. Prior research indicates that firm size is positively correlated to managers' compensation (Backer et al., 1988). Empirical evidence of Lin (2002), Yiin (2004) and Chi (2005) showed that the ratio of employee stock bonuses grants is negatively correlated to firm size. On the contrary, Chang (2003) found that larger firms tend to grant more employee stocks than smaller firms. The results of Tsui (2003), Hsu (2004), and Huang (2005) were similar to Chang's (2003) findings. However, Hsu and Cheng (2004) did not find a significant correlation between employee stock bonuses grants and firm size in their research.

(3) *Firm Performance*: Chi (2005) collected pooled time-series data which included 44 companies (176 observations) of listed & OTC information software firms during 1998~2003 in Taiwan. He used firm size, prior ROE, growth opportunity, the importance of human resources and cash salary ratio as the effecting factors and identified the influence of percentage of employee dividends sharing, the weights of stock bonuses, and the weights of cash bonuses. He found prior ROE had a positive influence on the percentage of employee dividends sharing, the weights of stock bonuses, and the weights of cash bonuses. Meanwhile, Huang (2005) also found the same results－prior ROE had a positive influence on

the percentage of employee dividends sharing, the weights of stock bonuses, and the weights of cash bonuses. Contrary to the prediction, Lin's (2002) research showed that lower prior ROE implies higher dividends sharing in middle and high levels.

(4) *Growth Opportunities:* Chang (2003) found that firms with higher growth opportunities tend to apply the policy of employee stock bonuses. Lin (2002), Tsui (2003) and Yiin (2004) argued that employee stock bonus grants were positively related to firms' growth opportunities. Huang (2005) stated that growth opportunities were positively related to both employee bonus grants and the size of employee stock bonus grants. On the other hand, Hsu and Cheng (2004) found no significant correlation between employee stock bonus grants and growth opportunities. In addition, Chi (2005) indicated that there was no significant correlation between employee stock bonus grants and the percentage of employee dividend sharing, the weights of stocks bonuses, or the weights of cash bonuses.

(5) *Financial Conditions:* Lin (2002) argued that cash flow constraints are correlated with employee stock ownership plans. The results of Hsu and Cheng (2004) indicated that the relationship between the ratio of employee stock bonuses grants and free cash flows was consistent with economic expectations. They followed the model of Dechow et al. (1996) that the ratio of free cash flows equals cash flows from operations plus cash flows from investments divided by total assets. However, Tsui (2003) did not find a significant correlation between employee stock bonus grants and cash flow shortfalls in her study. Yiin (2004) found that higher financial leverage ratios imply more employee stock bonus grants on a book value basis. Chen et al. (2004) and Hsu and Cheng (2004) showed that the relationship between the ratio of employee stock bonus grants and liability ratio was consistent with economic expectations, as well.

(6) *R&D Expenses:* Antti Kauhanen (2002) suggested that firms with higher R&D expenses are more likely to use employee ownership plans. Tsui（2003）found R&D expenses had positive effects on employee stock bonuses grants. Furthermore, Chen et al. (2004）and Hsu and Cheng (2004) showed the ratio of employee stock bonuses grants was higher when R&D expenses were larger.

DATA AND METHODOLOGY

The authors apply OLS regression to test the hypotheses in this study. The regression models are as follows:

$$\begin{aligned} MBP_{it} = {} & \alpha_0 + \alpha_1 DIRH_{it} + \alpha_2 SUVH_{it} + \alpha_3 ALLDIRN_{it} + \alpha_4 ALLSUPN_{it} \\ & + \alpha_5 INDDIRN_{it} + \alpha_6 INDSUVN_{it} + \alpha_7 INDDIRN_{it} * COMPL_{it} \\ & + \alpha_8 INDSUVN_{it} * COMPL_{it} + \alpha_9 DUAL_{it} + \alpha_{10} MADIR_{it} \\ & + \alpha_{11} LOGSALE_{it-1} + \alpha_{12} ROE_{it-1} + \alpha_{13} PBR_{it-1} + \alpha_{14} FCF_{it-1} \\ & + \alpha_{15} DEBT_{it-1} + \alpha_{16} R\&D_{it-1} + \varepsilon_{it} \end{aligned} \quad (1)$$

$$\begin{aligned} TMBP_{it} = {} & \alpha_0 + \alpha_1 DIRH_{it} + \alpha_2 SUVH_{it} + \alpha_3 ALLDIRN_{it} + \alpha_4 ALLSUPN_{it} \\ & + \alpha_5 INDDIRN_{it} + \alpha_6 INDSUVN_{it} + \alpha_7 INDDIRN_{it} * COMPL_{it} \\ & + \alpha_8 INDSUVN_{it} * COMPL_{it} + \alpha_9 DUAL_{it} + \alpha_{10} MADIR_{it} \\ & + \alpha_{11} LOGSALE_{it-1} + \alpha_{12} ROE_{it-1} + \alpha_{13} PBR_{it-1} + \alpha_{14} FCF_{it-1} \\ & + \alpha_{15} DEBT_{it-1} + \alpha_{16} R\&D_{it-1} + \varepsilon_{it} \end{aligned} \quad (2)$$

(1) Dependent Variables

MBP: market value of the level of employee stock bonuses granted (%), i.e., market value of employee stock bonuses granted measured at the end of year t-1 ÷ paid-in capital.
TMBP: market value of the level of total employee bonuses granted (%), i.e., market value of total employee bonuses granted measured ÷ paid-in capital.

(2) Independent Variables

DIRH: all directors' ownership of the firm at the end of the month prior to the date the shareholders' meeting convened (%). Board of directors makes the proposal for earnings distributions and then shareholders ratify the proposal in the shareholders' meeting in Taiwan. According to Article 172 of Taiwan's Company Act, for a publicly issued company, a notice to convene a regular meeting of shareholders shall be given to each shareholder no later than 30 days prior to the scheduled meeting date. Hence, we use related data at the end of the month prior to the date the shareholders' meeting convened as the proxy for the circumstance while the board proposes the proposal of earnings distribution.
SUVH: all supervisors' ownership of the firm at the end of the month prior to the date the shareholders' meeting convened (%).
ALLDIRN: the number of all directors of the firm at the end of the month prior to the date the shareholders' meeting convened (%).
ALLSUPN: the number of all supervisors of the firm at the end of the month prior to the date the shareholders' meeting convened (%).
INDDIRN: number of independent directors at the end of the month prior to the date the shareholders' meeting convened.
INDSUVN: number of independent supervisors at the end of the month prior to the date the shareholders' meeting convened.
COMPL: a dummy variable； COMPL＝1 denotes firms listing from February 2002 on after the announcement of related regulations, COMPL＝0, otherwise. The TSEC began requiring that IPO firms listing from February 2002 on should have two independent directors and one independent supervisor, the appointment of the independent director and independent supervisor for firms listing from February 2002 on after are forced by regulations, whereas those appointments for firms listing before February 2002 are voluntary.

(3) Control Variables

DUAL: CEO duality at the end of the month prior to the date the shareholders' meeting convened； used as an indicator variable, 1＝ CEO is concurrently the chairman of the board.
MADIR: proportion of managers concurrently as directors to total directors.
LOGSALE: natural log of net sales(expressed in thousands of New Taiwan dollars), used as a proxy for firm size.
ROE: return on equity (%), used as a proxy for firm performance.
PBR: ratio of market price to book value per share, used as a proxy for growth.
FCF: ratio of free cash flows, i.e., (cash flows from operations ＋ cash flows from investments) ÷ total assets (expressed in thousands of New Taiwan dollars); a proxy for financial position.
DEBT: debt ratio (%), i.e., total debt ÷ total assets; used as a proxy for financial position.
R&D: R&D ratio (%), i.e., R&D expenses ÷ net sales; used as a proxy for innovation.

Directors in Taiwan do not have the same role as directors in the U.S. To examine the correlation between ownership and the system of (independent) directors/ supervisors, and percentage of employee stock bonuses granted in corporate governance and regulatory perspectives, this study used data from 2002 through 2004. This data period was selected because the TSEC began requiring IPO firms to list starting from February 2002. Starting at that time, Taiwanese firms were required to have two independent directors and one independent supervisor.

Data related to research on board characteristics in Taiwan has been generally drawn from the data base of the Taiwan Economic Journal (TEJ) and has been a summary of data composed of both directors and supervisors as of December 31. Since board holdings may change significantly from December 31 of the previous year to the date that the surplus earning distribution proposal is proposed by a board of directors, it may be misleading or incorrect to use year-end data. In this research, we used related data at the end of the month prior to the date the shareholders' meeting convened. Data observations are annually.

In summary, the research subjects are those TSEC-listed electronic companies, whose regular meetings of shareholders were convened from 2003 to 2005 and with employee's stock bonuses granted in those years. Firms distributed their retained earnings of 2002 in 2003 according to the Company Act. This empirical research differs from previous studies in the following way: (1) the different roles played by directors and supervisors are more clearly identified. That is, not only directors' ownership and supervisors' ownership but also number of independent directors and number of independent supervisors are taken as separate independent variables, instead of combined as one, respectively, and (2) more precise data with regard to board characteristics are applied.

Financial data (employee's stock bonuses, net sales, percentage of returns on equity, book value per share, cash flows from operations, cash flows from investments, the paid-in capital, debt ratio, R&D ratio, and total assets) and Market data (market price) were collected from the TEJ. Dates of shareholders' meeting were collected from the Market Observation Post System of the TSEC. Data regarding independent directors and independent supervisors were collected from the Market Observation Post System of the TSEC. Data regarding directors and supervisors {the number of (independent) directors, the number of (independent) supervisors directors' ownership of the firm, and supervisors' ownership of the firm} were collected from the Taiwan Securities & Futures Information Center of Securities & Futures Institute. Directors' and supervisors' ownership of the firm were footed by this study； CEO duality and managers concurrently as directors were judged by the authors after examining files of each sample company.

This study focused on TSEC-listed electronic companies. To be selected for inclusion in the sample, a firm must have disclosed the aforementioned financial and market data, convened a shareholders' meeting with employee stock bonuses granted in the following year, and filed in data regarding inside directors' ownership one month prior to the date of shareholders' meeting. Any firm with omission of data was eliminated from the sample. As a result, the final sample of this study includes 478 TSEC-listed electronic companies.

EMPIRICAL RESULTS

Descriptive statistics of the sample companies are presented in Table 1. As shown, on average, the ratios of stock bonuses and total bonuses granted measured by market value, MBP and TMBP, are 5.482% and 6.242%, respectively. As for all directors' ownership (DIRH) and all supervisors' ownership (SUVH), the maxima are 63.10% and 53.34%, respectively. The number of all directors (ALLDIRN) and the number of all supervisors (ALLSUPN) ranged from 4 to 13 and 1 to 6, respectively. The number of independent directors (INDDIRN) and the number of independent supervisors (INDSUVN) ranged from 0 to 4 and 0 to 2, respectively.

Table 1: Descriptive Statistics（n＝478）

Variables	*Mean*	*Min.*	*Max.*	*Std. Dev.*
MBP	5.482	0.112	58.630	7.071
TMBP	6.242	0.174	58.630	7.987
BBP	1.633	0.079	9.589	1.162
TBBP	2.393	0.132	14.213	2.135
DIRH	20.643	1.480	63.100	10.800
SUVH	6.561	0.000	53.340	9.214
ALLDIRN	6.540	4.000	13.000	1.606
ALLSUPN	2.841	1.000	6.000	0.542
INDDIRN	0.862	0.000	4.000	0.981
INDSUVN	0.544	0.000	2.000	0.645
COMPL	0.418	0.000	1.000	0.494
DUAL	0.356	0.000	1.000	0.479
MADIR	0.279	0.000	1.000	0.195
LOGSALE	6.760	5.669	8.625	0.604
ROE	16.881	-4.070	66.100	10.074
PBR	1.544	0.522	5.131	0.671
FCF	-0.004	-0.410	0.395	0.119
DEBT	37.750	5.760	67.630	13.795
R&D	3.708	0.000	23.301	3.662

This table shows descriptive statistics of related variables. MBP: market value of the level of employee stock bonuses granted measured at year end, t-1(%). TMBP: market value of the level of total employee bonuses granted measured at year end, t-1 (%) BBP: book value of the level of employee stock bonuses granted (%). TBBP: book value of the level of total employee bonuses granted (%). DIRH: all directors' ownership of the firm at the end of the month prior to the date the shareholders' meeting convened (%). SUVH: all supervisors' ownership of the firm at the end of the month prior to the date the shareholders' meeting convened (%). ALLDIRN: number of all directors at the end of the month prior to the date the shareholders' meeting convened. ALLSUPN: number of all supervisors at the end of the month prior to the date the shareholders' meeting convened. INDDIRN: number of independent directors at the end of the month prior to the date the shareholders' meeting convened. INDSUVN: number of independent supervisors at the end of the month prior to the date the shareholders' meeting convened. COMPL: a dummy variable ; COMPL＝1 denotes firms listing from February 2002 on after the announcement of related regulations, COMPL＝0, otherwise. DUAL: CEO duality at the end of the month prior to the date the shareholders' meeting convened, 1＝ CEO is concurrently the chairman of the board. MADIR: proportion of managers concurrently serving as directors to total directors. LOGSALE: natural log of net sales(expressed in thousands of New Taiwan dollars). ROE: return on equity (%). PBR: ratio of market price to book value per share. FCF: ratio of free cash flows, i.e., (cash flows from operations ＋ cash flows from investments) ÷ total assets (expressed in thousands of New Taiwan dollars); used as a proxy for financial position. DEBT: debt ratio (%), i.e., total debt ÷ total assets; used as a proxy for financial position. R&D: R&D ratio (%), i.e., R&D expenses ÷ net sales; used as a proxy for innovation.

A preliminary examination of the Pearson correlation matrix of the model indicates that correlations among explanatory variables are generally low. The variance inflationary factor (VIF) for the explanatory variables are calculated to identify any multicollinearity issues. The VIF of the explanatory variables of the model are under 10 indicating no significant multicollinearity problem.

The regression models test H1 to H6, and the results are presented in Table 2. Some observations are worth pointing out when the dependent variable is the market value of the level of employee stock bonuses granted (MBP). First, the coefficients on ownership of board of directors (DIRH) and the number of independent directors (INDDIRN) are both negative as predicted and are statistically significant at the 0.01 and 0.05 levels, respectively. The coefficient on the number of all supervisors

(ALLSUPN) is negative as predicted but is statistically insignificant.

Furthermore, as expected, the coefficients on supervisors' ownership of (SUVH) and the number of all supervisors (ALLDIRN) are positive and statistically significant at the 0.05 and 0.10 levels, respectively. Contrary to the prediction, the coefficient on number of independent supervisors (INDSUVN) is positive and statistically significant at the 0.05 level. These results indicate that the market value of employee stock bonuses granted (MBP) increase as SUVH, ALLDIRN or INDSUVN increases, and decrease as DIRH or INDDIRN increases. In other words, the evidence provides support for H1, H2, H3 and H5 but does not provide support for H4 and H6.

Secondly the results indicate that the market value of the level of employee stock bonuses granted (MBP) increase as proportion of the managers concurrently serving as directors to total directors (MADIR) or return on equity (ROE) or ratio of market price to book value per share (PBR) increases. It is worth noting that the proportion of managers concurrently serving as directors to total directors (MADIR) has the second highest positive influence on market value of the level of employee stock bonuses granted (MBP). Higher levels of MADIR imply higher BBP. From the perspective of corporate governance, the results support the maintenance of independent directors because According Article 17 of "Supplementary Provisions to the Taiwan Stock Exchange Corporation Criteria for Review of Securities Listings" issued by the TSEC, the board of directors, being an employee of the company applying, cannot independently perform their functions. Finally, the coefficient on INDDIRN*COMPL is statistically significant at the 0.05 level when the dependent variable is market value of the level of employee stock bonuses granted (MBP). The results indicate that firms appointing independent directors compulsorily by regulations result in worse effects than those of firms appointing independent directors voluntarily

The results of equation (2) with regard to independent variables are similar to those of equation (1). The results of equation (2) with regard to other control variables are similar to those of equation (1) except that the coefficients on natural log of net sales (LOGSALE) and the coefficients on R&D ratio (R&D) become statistically significant at the 0.05 and 0.10 levels, respectively whereas the coefficient on the proportion of managers serving concurrently as directors to total directors (MADIR) turns out to be statistically insignificant at the 0.10 level

In summary, the results show support for H1, H2, H3 and H5 but do not support H4 and H6. The level of employee stock bonuses granted is negatively correlated to DIRH or INDDIRN, whereas it is positively correlated to SUVH, ALLDIRN or INDSUVN. The evidence provides support for our argument that it may be inappropriate to combine directors' ownership with supervisors' ownership as one explanatory variable, as has been done in previous studies. In addition, the results provide support for Article 2 of the Rules and Review Procedures for Director and Supervisor Share Ownership Ratios at Public Companies, which regulates indicates the minimum total registered shares that shall be owned by the directors. From the perspective of corporate governance consideration of employee stock bonuses grants, the empirical results indicate that the greater the board of directors' ownership of the firm, implying lower percentage of employee stock bonuses granted. It is therefore necessary to set a minimum threshold for directors' share holdings. On the contrary, as the results indicate, the greater the supervisors' ownership of the firm, the higher percentage of employee stock bonuses granted. This evidence is not in contradiction to the Article, because the minimal total registered shares that shall be owned by the supervisors, as regulated by the Article, range from 0.5% to 1.5%, which are quite low.

Table 2: Results of the Regressions

Independent variables	Hypotheses	Panel A Equ. (1)		Panel B Equ. (2)	
		Coefficient	t-value	Coefficient	t-value
Constant		-10.130	-3.27***	-12.041	-3.55***
DIRH	H1	-0.078	-3.54***	-0.100	-4.12***
SUVH	H2	0.075	2.96***	0.082	2.98***
ALLDIRN	H3	0.249	1.92*	0.279	1.96*
ALLSUPN	H4	-0.564	-1.45	-0.577	-1.35
INDDIRN	H5	-1.076	-2.46**	-1.317	-2.75***
INDSUVN	H6	1.400	2.32**	1.639	2.47**
INDDIRN*COMPL		1.211	2.08**	1.615	2.53**
INDSUVN*COMPL		-1.046	-1.21	-1.491	-1.57
DUAL		-0.131	-0.29	0.067	0.14
MADIR		2.209	1.97**	1.742	1.42
LOGSALE		0.629	1.58	0.866	1.99**
ROE		0.285	9.17***	0.370	10.84***
PBR		4.129	8.68***	4.019	7.71***
FCF		-0.877	-0.47	-0.197	-0.10
DEBT		0.003	0.18	0.003	0.13
R&D		0.105	1.58	0.141*	1.94
N		478		478	
Adjusted R^2		61.6%		63.8%	
F value		48.819***		53.640***	

This table shows the regression estimates of the equations (1) and (2). Panel A Shows the results for equation (1), $MBP_{it} = \alpha_0 + \alpha_1 DIRH_{it} + \alpha_2 SUVH_{it} + \alpha_3 ALLDIRN_{it} + \alpha_4 ALLSUPN_{it} + \alpha_5 INDDIRN_{it} + \alpha_6 INDSUVN_{it} + \alpha_7 INDDIRN_{it} *COMPL_{it} + \alpha_8 INDSUVN_{it} *COMPL_{it} + \alpha_9 DUAL_{it} + \alpha_{10} MADIR_{it} + \alpha_{11} LOGSALE_{it-1} + \alpha_{12} ROE_{it-1} + \alpha_{13} PBR_{it-1} + \alpha_{14} FCF_{it-1} + \alpha_{15} DEBT_{it-1} + \alpha_{16} R\&D_{it-1} + \varepsilon_{it}$. Panel B Shows the results for equation (2), $TMBP_{it} = \alpha_0 + \alpha_1 DIRH_{it} + \alpha_2 SUVH_{it} + \alpha_3 ALLDIRN_{it} + \alpha_4 ALLSUPN_{it} + \alpha_5 INDDIRN_{it} + \alpha_6 INDSUVN_{it} + \alpha_7 INDDIRN_{it} *COMPL_{it} + \alpha_8 INDSUVN_{it} *COMPL_{it} + \alpha_9 DUAL_{it} + \alpha_{10} MADIR_{it} + \alpha_{11} LOGSALE_{it-1} + \alpha_{12} ROE_{it-1} + \alpha_{13} PBR_{it-1} + \alpha_{14} FCF_{it-1} + \alpha_{15} DEBT_{it-1} + \alpha_{16} R\&D_{it-1} + \varepsilon_{it}$.

MBP＝market value of the level of employee stock bonuses granted （%）, i.e., market value of employee stock bonuses granted measured at the end of year t-1 ÷ paid-in capital. *MBP: market value of the level of employee stock bonuses granted measured at year end, t-1 (%). TMBP: market value of the level of total employee bonuses granted measured at year end, t-1 (%). DIRH: all directors' ownership of the firm at the end of the month prior to the date the shareholders' meeting convened (%). SUVH: all supervisors' ownership of the firm at the end of the month prior to the date the shareholders' meeting convened (%). ALLDIRN: number of all directors at the end of the month prior to the date the shareholders' meeting convened. ALLSUPN: number of all supervisors at the end of the month prior to the date the shareholders' meeting convened. INDDIRN: number of independent directors at the end of the month prior to the date the shareholders' meeting convened. INDSUVN: number of independent supervisors at the end of the month prior to the date the shareholders' meeting convened. COMPL: a dummy variable ; COMPL＝1 denotes firms listing from February 2002 on after the announcement of related regulations, COMPL＝0, otherwise. DUAL: CEO duality at the end of the month prior to the date the shareholders' meeting convened, 1＝ CEO is concurrently the chairman of the board. MADIR: proportion of managers concurrently serving as directors to total directors. LOGSALE: natural log of net sales (expressed in thousands of New Taiwan dollars). ROE: return on equity (%). PBR: ratio of market price to book value per share. FCF＝: ratio of free cash flows, i.e., (cash flows from operations ＋ cash flows from investments) ÷ total assets (expressed in thousands of New Taiwan dollars); used as a proxy for financial position. DEBT: debt ratio (%), i.e., total debt ÷ total assets; used as a proxy for financial position. R&D: R&D ratio (%), i.e., R&D expenses ÷ net sales; used as a proxy for innovation. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.*

Although the evidence does not provide support H4, the empirical results show that the coefficients on SUVH and INDSUVN are positive. In general, larger numbers of independent supervisors (INDSUVN), imply higher ownership percentages by supervisors (SUVH). The results give support for the Securities and Exchange Act that states there shall be no system of independent supervisors since enactment of the amendment on January 11, 2006. Besides, Article 14-4 of the Securities and Exchange Act states that a company that has issued stock in accordance with this Act shall establish either an audit committee or a supervisor. The competent authority may, however, in view of the company's scale, type of operations, or other essential considerations, order it to establish an audit committee in lieu of a supervisor. The relevant regulations are prescribed by the competent authority. The audit committee shall be composed of all independent directors. Because the audit committee shall be composed of all independent directors, the results suggest the TSEC/GTSM listed companies establish an audit committee in lieu of a supervisor.

As with previous studies, the authors combine: (1) all directors' and all supervisors' stock ownership, and (2) the number of independent directors and the number of independent supervisors, respectively, and rerun equations (1) and (2). The regression models are specified as follows where, D&SH is the total ownership of all directors and all supervisors ALLD&SN is the total number of directors and supervisors and INDD&INDSN is the total number of independent directors and independent supervisors.

$$\begin{aligned} \text{MBP}_{it} = {} & \alpha_0 + \alpha_1 \text{D\&SH}_{it} + \alpha_2 \text{ALLD\&SN}_{it} + \alpha_3 \text{INDD\&INDSN}_{it} \\ & + \alpha_4 \text{INDD\&INDSN*COMPL}_{it} + \alpha_5 \text{DUAL}_{it} + \alpha_6 \text{MADIR}_{it} \\ & + \alpha_7 \text{LOGSALE}_{it-1} + \alpha_8 \text{ROE}_{it-1} + \alpha_9 \text{PBR}_{it-1} + \alpha_{10} \text{FCF}_{it-1} \\ & + \alpha_{11} \text{DEBT}_{it-1} + \alpha_{12} \text{R\&D}_{it-1} + \varepsilon_{it} \qquad (3) \end{aligned}$$

$$\begin{aligned} \text{TMBP}_{it} = {} & \alpha_0 + \alpha_1 \text{D\&SH}_{it} + \alpha_2 \text{ALLD\&SN}_{it} + \alpha_3 \text{INDD\&INDSN}_{it} \\ & + \alpha_4 \text{INDD\&INDSN*COMPL}_{it} + \alpha_5 \text{DUAL}_{it} + \alpha_6 \text{MADIR}_{it} \\ & + \alpha_7 \text{LOGSALE}_{it-1} + \alpha_8 \text{ROE}_{it-1} + \alpha_9 \text{PBR}_{it-1} + \alpha_{10} \text{FCF}_{it-1} \\ & + \alpha_{11} \text{DEBT}_{it-1} + \alpha_{12} \text{R\&D}_{it-1} + \varepsilon_{it} \qquad (4) \end{aligned}$$

The results are shown in Table 3. All coefficients on independent variables become statistically insignificant. Furthermore, the adjusted R-squares of equations (3) and (4) are smaller than those of equations (1) and (2) in Table 3, respectively. The evidence provides support for the contention that it is inappropriate to combine directors' data with supervisors' data as has been done in many previous studies. We do not run equations (3) and (4) in the following analysis. As we can see, the coefficients on both LOGSALE and R&D turn to be positive and significant when the independent variable is MBP.

THE APPROPRIATE CORPORATE GOVERNANCE MECHANISMS FOR FIRMS

First, by dividing the sample into three groups according to paid-in capital of the companies, the authors rerun equations (1) and (2). The classification criterion is based on the related regulation of Article 2 of Rules and Review Procedures for Director and Supervisor Share Ownership Ratios at Public Companies announced by Securities and Futures Bureau, Financial Supervisory Commission, Executive Yuan, R.O.C. Because there is no company whose paid-in capital is NT$300 million or less in our sample, the author divides the sample into three groups: 1) Those companies whose paid-in capital is more than NT$300 million but NT$1 billion or less (expressed as Group 1 hereafter), which counts for 126 companies in the sample 2) Those companies whose paid-in capital is more than NT$1 billion but NT$2 billion or less (expressed as Group 2 hereafter), which counts for 150 companies in the sample, and 3). Those companies whose paid-in capital is more than NT$2 billion (expressed as Group 3 hereafter), which counts for 202 companies in the sample.

Table 3: Results of the Regressions

Independent variables	Panel A Equ. (3)		Panel B Equ. (4)	
	Coefficient	t-value	Coefficient	t-value
Constant	-14.990	-5.22***	-17.570	-5.56***
D&SH	-0.013	-1.02	-0.022	-1.58
ALLD&SN	0.130	1.11	0.153	1.19
INDD&INDSN	-0.038	-0.17	-0.090	-0.37
INDD&INDSN*COMPL	0.147	0.62	0.203	0.78
DUAL	-0.226	-0.49	-0.053	-0.10
MADIR	2.203	1.92*	1.756	1.39
LOGSALE	1.020	2.63***	1.313	3.07***
ROE	0.292	9.18***	0.377	10.78***
PBR	3.906	8.09***	3.775	7.11***
FCF	-0.599	-0.31	0.144	0.07
DEBT	0.014	0.74	0.016	0.76
R&D	0.160	2.43**	0.207	2.84***
N	478		478	
Adjusted R^2	59.8%		61.9%	
F value	60.126***		65.477***	

This table shows the regression estimates of the equations (3) and (4). Panel A Shows the results for equation (3), $MBP_{it} = \alpha_0 + \alpha_1 D\&SH_{it} + \alpha_2 ALLD\&SN_{it} + \alpha_3 INDD\&INDSN_{it} + \alpha_4 INDD\&INDSN*COMPL_{it} + \alpha_5 DUAL_{it} + \alpha_6 MADIR_{it} + \alpha_7 LOGSALE_{it-1} + \alpha_8 ROE_{it-1} + \alpha_9 PBR_{it-1} + \alpha_{10} FCF_{it-1} + \alpha_{11} DEBT_{it-1} + \alpha_{12} R\&D_{it-1} + \varepsilon_{it}$ Panel B Shows the results for equation (4), $TMBP_{it} = \alpha_0 + \alpha_1 D\&SH_{it} + \alpha_2 ALLD\&SN_{it} + \alpha_3 INDD\&INDSN_{it} + \alpha_4 INDD\&INDSN*COMPL_{it} + \alpha_5 DUAL_{it} + \alpha_6 MADIR_{it} + \alpha_7 LOGSALE_{it-1} + \alpha_8 ROE_{it-1} + \alpha_9 PBR_{it-1} + \alpha_{10} FCF_{it-1} + \alpha_{11} DEBT_{it-1} + \alpha_{12} R\&D_{it-1} + \varepsilon_{it}$
MBP: market value of the level of employee stock bonuses granted measured at year end, t-1 (%). TMBP: market value of the level of total employee bonuses granted measured at year end, t-1 (%). D&SH: total ownership of all directors and all supervisors. ALLD&SN: total number of directors and supervisors. INDD&INDSN: total number of independent directors and independent supervisors. *DUAL: CEO duality at the end of the month prior to the date the shareholders' meeting convened, 1= CEO is concurrently the chairman of the board. MADIR: proportion of managers concurrently serving as directors to total directors. LOGSALE: natural log of net sales (expressed in thousands of New Taiwan dollars). ROE: return on equity (%). PBR: ratio of market price to book value per share. FCF: ratio of free cash flows, i.e., (cash flows from operations + cash flows from investments) ÷ total assets (expressed in thousands of New Taiwan dollars) ; used as a proxy for financial position. DEBT: debt ratio (%), i.e., total debt ÷ total assets; used as a proxy for financial position. R&D: R&D ratio (%), i.e., R&D expenses ÷ net sales; used as a proxy for innovation. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.*

Second, equations (1) and (2) are rerun by substituting book values for market values, respectively. The results of Group 1 show that the dependent variables are negatively correlated to DIRH, whereas they are positively correlated to SUVH. The evidence strongly provides support for the argument that owing to different characteristics, it may be inappropriate to combine related data of directors with related data of supervisors as one explanatory variable, as has been done in previous studies. Employee (stock) bonuses are positively correlated to LOGSALE, ROE, PBR or R&D, and are generally negatively correlated to FCF.

The evidence from Group 2 indicates the dependent variables are negatively correlated to INDDIRN, and are positively correlated to INDSUVN. In addition, the results indicate that employee (stock) bonuses are positively correlated to INDDIRN*COMPL, whereas they are generally negatively correlated to INDSUVN*COMPL. Furthermore, the dependent variables increase as LOGSALE or ROE increases. Two of the four coefficients on PBR and R&D are statistically positive.

The results of Group 3 indicate that the dependent variables are generally negatively correlated to DIRH or INDDIRN, whereas they are generally positively correlated to INDSUVN. The dependent variables are positively correlated to ROE or R&D. In additions, employee stock bonuses generally increase as MADIR, LOGSALE, or PBR increases.

SUMMARY AND CONCLUSIONS

This study focuses on the effects of the Securities and Exchange Act regarding ownership and structure of (independent) directors/supervisors on employee stock bonus plans of TSEC-Listed electronic companies. Furthermore, appropriate corporate governance systems as related to directors and supervisors are explored. This research differs from previous research except for that of Kuo et al. (2006) in two ways: (1) the roles of directors and supervisors are more clearly identified. Not only directors' ownership and supervisors' ownership but also the number of directors and the number of supervisors are taken as separate independent variables, respectively, instead of combined as one; and (2) more precise data with regard to board characteristics are employed.

Empirical results generally support the expectations of this study. The level of employee stock bonuses granted increase in accordance with the increase of all supervisors' ownership or the number of all directors, whereas they decrease in accordance with the increase of all directors' ownership or number of independent directors. The evidence provides support for our argument that, owing to different characteristics, it may be inappropriate to combine director and supervisor data as one explanatory variable.

Contrary to prediction, the level of employee stock bonuses granted increases when number of independent supervisor increases. The evidence gives support to Article 14-2 of the amended Securities and Exchange Act that mandates that a company that has issued stock in accordance with this Act may appoint independent directors in accordance with its articles of incorporation. There has been no system of independent supervisors since the amendment in January 11, 2006.

Finally, firms with different scale need different corporate governance mechanisms. Raising all directors' ownership may enhance corporate governance mechanisms for small firms (Group 1). Appointing independent directors voluntarily may enhance corporate governance mechanisms for middle-size firms (Group 2). Furthermore, large firms (Group 3) may enhance corporate governance mechanisms by raising all directors' ownership, appointing independent directors voluntarily, or decreasing the proportion of managers serving concurrently as directors to total directors. The system of independent directors seems to have more effect on large firms.

Research limitations are stated as follows. First, the sample in the study is restricted to TSEC-listed electronics companies; the results cannot be generalized. Further studies to examine the effects of directors and supervisors on employee stock bonus grants on other industries are suggested. Second, though in the view point of regulatory that supervisors carry the duty of supervision whereas boards of directors are responsible for business execution in Taiwan. This is different from the system in the USA or in the UK where boards of directors not only carry the duty of supervision but also execute business. The study may not capture the effects of supervisors on employee stock bonuses granted since both directors and supervisors are not only hired by the same group but also attend the meeting of the board of directors at the same time. Third, the study may have omitted variables. Scholars could try to detect the external governance mechanisms effect or the cross-culture research in further research.

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THE IMPACT OF SARBANES-OXLEY ON MARKET EFFICIENCY: EVIDENCE FROM MERGERS AND ACQUISITIONS ACTIVITY

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ABSTRACT

One of the main goals of the Sarbanes Oxley Act of 2002 (SOX) is to ensure a greater flow of timely and accurate accounting information to investors. While there has been a lot of criticism of SOX, mostly with regard to compliance costs, very little light has been shed on the impact of SOX on market efficiency. The type of funding (stock vs. cash) used in mergers has been shown to be highly correlated with the level of firm mispricing. We thus use merger data gathered in the pre and post-SOX years to reveal a significant shift from stock type mergers (popular during periods of high misvaluation) to cash type mergers. We use logistic regression analysis to show that the implementation of SOX, resulted in greater reliability of market information, lower levels of mispricing and hence a more efficient market. In addition, our results also provide evidence that the SOX imposed compliance costs are not as burdensome as critics claim.

JEL: G34, G38

KEYWORDS*:* Sarbanes Oxley, Mergers and Acquisitions, Market Efficiency

INTRODUCTION

The Efficient Market Hypothesis (EMH) is one of the foundations of finance. It makes strong assumptions that all agents are rational and that new information entering the market is correctly and immediately impounded into securities' prices. An efficient market is essential, because in an efficient market, investors are protected as asset prices are at, or close to their intrinsic values. The availability of relevant information to all investors directly impacts the efficiency of a market. If market participants are presented with a greater amount of relevant information, they will be able to price assets and securities more accurately.

The Sarbanes-Oxley Act of 2002 (SOX) was initiated in response to the blatant acts of manipulation and greed that resulted in significant loss of shareholder wealth. The actions of the management of Tyco, Enron and WorldCom are cases in point. SOX compelled managers to alter their actions and divulge information to investors, in greater quantity and more importantly, with greater reliability, than they had previously done. Managers were now directly accountable for the information firms released. Specifically, under the provisions of SOX, effective July 30, 2002: The CEO and financial officers are required to certify periodic financial reports and are subject to criminal penalties based on such certifications. They are required to forfeit certain bonuses and profits if their companies issue an accounting restatement as a result of misconduct.

In the corporate world, SOX was very unpopular and the main criticism stemmed from the allegation that it was too expensive to implement. Academic research on SOX has also tended to focus mostly on the cost aspect and not so much the benefits. One of the largely ignored benefits of SOX is improved market efficiency. In view of the current financial crisis, and the government's attempt at imposing new regulations, it becomes critically important and beneficial to understand how previous attempts to regulate financial markets fared. We thus advance the literature by investigating the impact of SOX on market efficiency. We also address the cost aspect of SOX.

Mergers (mergers and acquisitions) are a crucial strategic activity of firms. When considering a merger, misvaluation of both the acquire and target plays an important role in the choice of payment. A firm that is overvalued by the market would be more likely to use its overvalued stock as currency to acquire a target firm (especially if the target is undervalued by the market). When the stock prices are more accurate, financing a merger with stock would offer no material advantage and the firm would be indifferent to paying with cash or stock.

Since SOX compels managers to disclose more relevant (and accurate) information to investors, we expect that the market prices will be closer to the intrinsic value of the firm. We would thus expect to see a reduction in stock type mergers after the implementation of SOX. One of key variables that measure the level of mispricing is the Market-to-Book ratio (MB). We thus study the focus a significant portion of this study on the variations in the market-to-book (MB) ratio pre and post-SOX using both univariate tests as well as logistic regressions.

The next section is the literature review, followed by the hypothesis development and the data and methodology section. We then present and discuss the empirical results followed by our conclusion.

LITERATURE

Financial markets are crucial to corporations and the economy in general. Capital is a scarce resource and a market that is efficient will allow the most efficient and successful firms to have access to capital. When investors have better access to credible information, they are able to make better investment decisions, thus aiding the capital allocation process. However, this allocation process is complicated by the fact that managers possess more information about their firms' investment opportunities than investors. Investors thus look to managers to provide the information necessary to enable better assessment of the value of the firm's assets and to be able to make better investment choices for their respective investment horizons (Healy and Palepu 2001).

Optimal allocation of resources is not possible with severe informational asymmetry. If markets are inefficient, then investors would suffer repeated losses and would refuse to invest. Supply of capital would be severely curtailed leading to recession and ultimately market failure. Thus, the flow of credible information is of crucial importance to market efficiency. The greater the flow of this information and the more reliable it is, the more accurate will be the pricing of financial securities. The financial scandals at Tyco, Enron and Worldcom had eroded the faith of investors, lawmakers needed to act to restore confidence in financial markets. The SOX legislation was passed to make managers more accountable for the information that they provided the public (this ensured a greater credibility of the information). Firms were also now responsible for providing more information to the public (the greater volume of information would lead to better pricing).

Due to the additional pressure that SOX placed on firms and their management, it was of course not popular. One of the main criticisms was that it was too expensive to implement. There is however literature that challenges this assertion (Leuz 2007). However, as the author points out, the net effect of SOX on the economy remains unclear. Our work advances the literature on SOX and its impact on financial markets.

We chose mergers and acquisitions as the backdrop for our study for several reasons. Merger decisions being of extreme strategic importance have been a fertile area for research and the literature is well developed. According to theory, mergers and acquisitions are a response to system shocks such as regulatory changes (e.g. deregulation or imposition of regulation as in the case of SOX). Gort (1969) proposes a model which predicts an increase in M&A activity in times of economic change while Mitchell & Mulherin (1996) document an intensifying of merger activity and explain it as the result of shocks like deregulation and financial innovation. Some research focuses on the return levels of firms surrounding intensified merger activity, while others have studied the methods of payment. Servaes (1991), Mitchell & Mulherin (1996), Franks & Mayer (1996), all report high abnormal returns of acquiring firms around mergers. Positive abnormal returns to acquirer firms in the 60's and 70's are documented by Eckbo (1983) and Asquith (1983). Contrary to this, Morck et al. (1990), Byrd Kent and John (1992) document negative abnormal returns during the '80s. For target firms, the picture is more encouraging. Eckbo & Langohr (1989), Schwert (1994), and Martynova et al. (2006) document positive cumulative abnormal returns to target firms. But, Dodd (1980), Smith & Kim (1994), and Andrade et al. (2001) show that these gains (or losses) are statistically insignificant.

An important finding in merger research is that the method of payment is a key determinant of the abnormal returns. Researchers create sub-samples by method of payment (hostile, friendly or tender offers, related vs. unrelated mergers etc.) and find that all equity bids show significant negative returns, whereas cash deals have positive returns (Loughran & Vijh, 1997; Mitchell & Stafford, 2000; Sudarsanam & Mahate, 2003). While hostile takeovers seem to fare better than friendly bids (Franks et al., 1991), corporate raiders incur losses (Croci, 2007). Goergen & Renneboog (2004) find that returns of bidding firms are significantly higher in the case of stock payments than those where cash was used. This indicates that the gains are due to overvaluation of bidding firms' stock.

There is sufficient variation in findings to warrant further investigation. Besides this, merger activity is highly sensitive to mispricing levels. Dong et al. (2006) find broad evidence which indicates that investor mispricing is a driver. Melicher et al. (1983) show that stock price and bond yield changes can predict merger activity. Andrade and Stafford (2004) find similar results. Myers and Majluf (1984) imply that managers exploit their insider information and the knowledge that their firm's stock is overvalued, to make capital structure decisions.

The preceding discussion show that the motivations driving cash vs. stock type mergers during different periods have been well documented. On a different front, emerging behavioral theories of finance claim that market timing by managers is a possible reason for merger waves (Schleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan 2004). Both these studies claim that managers tend to strategically use their overvalued stock as currency in mergers.

In the years subsequent to the passing of SOX, a great deal of criticism was directed towards SOX, mostly questioning its efficacy and complaining of the onerous costs of compliance. Not surprisingly several studies have focused on these issues. Jain and Rezaee (2005) find that SOX has restored investor confidence and had a positive impact on shareholder wealth. Jain, Kim and Rezaee (2008) find that market liquidity measures had improved, however Li, Pincus and Rego (2003) report adverse market reaction immediately after SOX but favorable reaction subsequently. Engel, Hayes and Wang (2007) indicate that prohibitive costs may have compelled small firms to go private. Another thread of literature examines the impact of SOX on financial reporting (i.e. on levels of earnings management and conservatism). Cohen et al. (2005a,b) find that accrual-based earnings management which had increased from 1987 onwards had declined subsequent to SOX. Zhou & Lobo (2006) report similar results and document an increase in conservatism. What is relevant though is how the costs compare to the benefits of SOX and one of the greatest benefits would be an increase in market efficiency.

HYPOTHESES

The most important aspect of SOX is the fact that managers were now accountable for their actions and that firms are required to provide more accurate information and in greater quantity, to investors. This increased flow of credible information should lead to more informed analysis by investors, which would in turn result in smaller pricing error, more accurate prices and consequently a more efficient market. If the stocks are not significantly overpriced there is no incentive to pay for mergers with stock and there should be a significant fall in the proportion of stock type mergers. Furthermore, if SOX was as costly to implement as claimed by firms, there should be a decrease in the overall cash holdings of firms and the proportion of cash type mergers. But on the other hand if SOX is not as costly as claimed, then the proportion of cash type mergers would either increase or remain at pre-SOX levels. The impact of higher costs would also lower the average relative cash balances of firms. We test these contentions with the following hypotheses which compare the pre and post-SOX periods.

H1: The proportion of stock type mergers will significantly decrease in the post-SOX period.
H2: The proportion of cash type mergers will increase or remain unchanged in the post-SOX period.
H3: The average cash balances of firms would decrease if costs are significant

Prior research as mentioned in the literature review, has established that the Market-to Book ratio is closely related to pricing error and the variance of the MB ratio would be greater. The greater the overpricing, the greater will be the likelihood of stock type mergers. Therefore the MB ratio will have a significant and positive impact on the likelihood of stock type mergers. This yields the next two hypotheses

H4: The variance of the MB ratio would decrease in the post-SOX period
H5: The MB ratio has a positive impact on the likelihood of stock type mergers

One of the central arguments of this paper is that SOX has impacted market efficiency through increasing the information flow between firms and investors. If prices move closer to their intrinsic value due to reduction in informational asymmetry then, this should result in a reduction of the impact of MB ratio on the likelihood of stock type mergers. Our fifth hypothesis tests the impact of SOX on market efficiency by analyzing the market-to-book ratio of publicly traded firms by a logistic regression.

H6: Post SOX, the impact of the MB ratio on the likelihood to pay with stock will decrease.

Besides this, in comparison to pre-sox levels, the variance of the market-to-book ratio, across firms should diminish post-SOX, reflecting lower levels of over and under-pricing in publicly traded firms.

DATA AND METHODOLOGY

The sample consists of all mergers in the SDC database, between January 1989 and April 2008 excluding 2002 which was the year SOX was implemented. The earliest year of the sample was chosen as 1989 so to avoid contamination from the effects of the tax reforms of 1987. All financial and holding companies, leveraged buy-outs (LBOs) and management buy-outs (MBOs) are excluded from the acquirers group. This leaves a sample of 4185 mergers. We use this sample to test the trends in merger activity and to test changes in proportions (method of payment in pre and post-sox). The sample for the logistic regressions consists of firms with prices and accounting data available on CRSP and COMPUSTAT. The target firms are comprised of 1965 public firms, 2099 private firms and 121 subsidiaries.

We partition the sample into pre and post-SOX subsamples and using the methodology of Rhodes-Kropf & Viswanathan (2004), we construct the MB ratio as Market Value/Book Equity where Market Value is computed as CRSP Market Equity plus COMPUSTAT book assets (item 6) minus deferred taxes (item 74) minus book equity (item 60). We control for size with total assets (item 6), total plant, property and equipment (item 8), total cash (item 1) and CAPEX (item 128). The profitability leverage measures that we use are net income (item 172), ROE, ROA, Current Ratio, Quick Ratio, Book leverage and Market leverage. Book Leverage is computed as (1-book equity/total assets) and market leverage is calculated as (1 - market equity/market value). We also construct a relative value measure for the size of the merger transaction as transaction value/market value. A dummy (=1) to indicate the pre-SOX period is also included. We use a test of proportions to test H1, H2 and H3 while we use the following logistic model to test H4 and H5

$$P\{MP = 1|x\} = \frac{e^{g(x)}}{1 + e^{g(x)}}$$

with the following logistic transformation of x for the pre and post-subsamples

$$g(x) = \beta_0 + \beta_1 LMB + \beta_2 LMval + \beta_3 LTransval + \beta_4 Relval + \beta_5 ROE + \beta_6 Lev + \beta_7 Mktlev + \beta_8 Bklev + \beta_9 LSP + \beta_{10} LNI + \beta_{11} EPS$$

For the pooled sample, a dummy DUM (=1 for pre-SOX and an interaction term Pre_LMB are added to obtain

$$g(x) = \beta_0 + \beta_1 LMB + \beta_2 LMval + \beta_3 LTransval + \beta_4 Relval + \beta_5 ROE + \beta_6 Lev + \beta_7 Mktlev + \beta_8 Bklev + \beta_9 LSP + \beta_{10} LNI + \beta_{11} EPS + \beta_{12} DUM + \beta_{13} Pre\_LMB$$

MP the method of payment the dependent variable is binary and takes a value of 1 if the payment is by stock and zero if the payment is by cash. The ratio of the base of the natural logarithm raised to the logistic transform estimates the probability of MP being equal to one i.e. the probability of a stock type payment. The independent variables are defined as follows: LMB is the natural log of the MB ratio. If H4 is correct, the coefficient of this variable should be positive and significant. DUM is a dummy variable that is set to zero if transaction is pre-Sox and one otherwise.

We also have an interaction variable Pre_LMB which is constructed as DUM*LMB which estimates the difference in slopes or the difference between the impact of MB on the method of payment pre and post sox. The coefficient of this term should be significant and positive if the influence of mispricing was greater pre-SOX than post-SOX. The rest of the variables are to control for differences in firm size, transaction value returns etc. LMval is the log of market value. LTransval is the log of the transaction value of the merger deal. Relval is computed as (transaction value/market value). ROE is the return on equity. Lev represents the debt-to-total assets ratio and is computed as long-term debt/total assets. Mktlev is the variable for market leverage while Bklev is book leverage. LSP is the variable for the log of the S&P 500 index level. LNI is the Log of Net Income.

EMPIRICAL RESULTS

We begin by reviewing the breakdown of completed mergers (mergers and acquisitions) over the time period 1989 – 2008. In Table 1 below, Cash (Stock) signifies a merger where 80% or more of the consideration for the merger constituted cash (stock). Hybrid mergers are those that have a mix of cash and stock, where neither of these forms of consideration exceed 80%. For the S&P500, we have two columns; Level is the actual level if the S&P500 at the end of the year while S&P/15 is scaled by a factor of 15 which is to make the graph more readable. The merger activity is plotted in the graph (Figure 1) that follows immediately after. Figure 2 depicts merger activity by stock exchange.

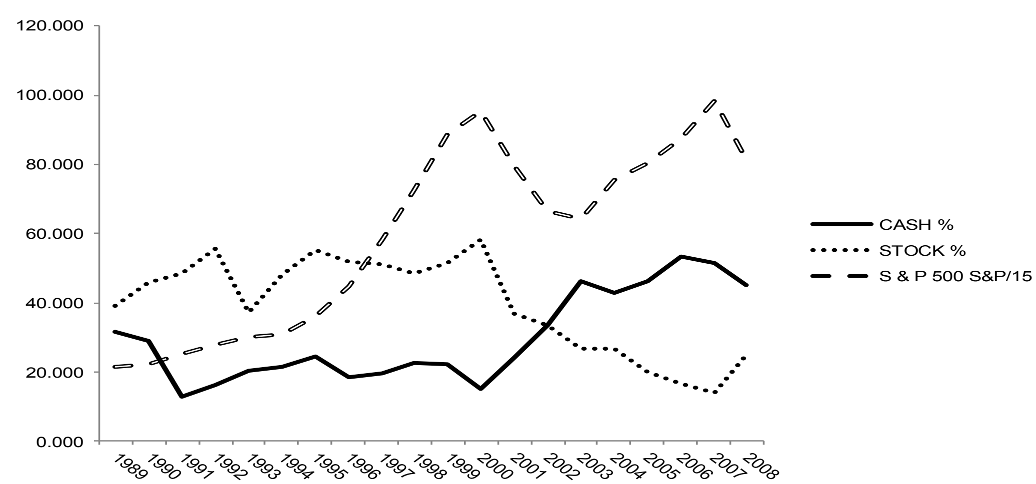
We see that the mergers of both types were positively correlated with market activity pre–SOX, which is expected since merger activity intensifies during periods when the market is hot. But during the post-SOX period the cash type mergers maintain the positive correlation, but the stock type mergers fall away dramatically. In fact they have a negative correlation. This is the first evidence in support of H1 which predicts a reduction in the level of stock mergers.

Table 1: Merger Activity by Method of Payment

YEAR	CASH		STOCK		HYBRID		OTHER		S & P 500	
	Number	%	Number	%	Number	%	Number	%	Level	S&P/15
1989	25	31.650	31	39.240	9	11.390	13	16.460	323.05	21.537
1990	17	28.810	27	45.760	9	15.250	6	10.170	334.53	22.302
1991	11	12.640	42	48.280	20	22.990	12	13.790	376.19	25.079
1992	16	16.160	55	55.560	12	12.120	14	14.140	415.75	27.716
1993	27	20.150	50	37.310	26	19.400	31	23.130	451.61	30.108
1994	45	21.430	101	48.100	43	20.480	21	10.000	460.42	30.694
1995	67	24.630	150	55.150	31	11.400	22	8.090	541.72	36.115
1996	62	18.510	174	51.940	57	17.010	33	9.850	670.49	44.700
1997	76	19.690	197	51.040	73	18.910	29	7.510	873.43	58.229
1998	94	22.490	202	48.330	94	22.490	23	5.500	1085.50	72.367
1999	103	22.100	239	51.290	98	21.030	25	5.360	1327.33	88.489
2000	70	15.020	270	58.060	96	20.650	15	4.590	1427.22	95.148
2001	54	24.000	83	36.890	71	31.560	7	3.230	1194.18	79.612
2002	53	33.330	54	33.390	43	27.040	9	3.950	993.93	66.262
2003	71	46.290	44	26.830	36	21.950	11	4.820	965.23	64.349
2004	79	42.930	49	26.630	48	26.090	8	3.430	1130.65	75.377
2005	102	46.150	44	19.910	60	27.150	11	5.820	1207.23	80.482
2006	104	53.330	32	16.410	50	25.640	9	4.620	1310.46	87.364
2007	97	51.600	26	13.830	55	29.260	10	5.320	1477.18	98.479
2008	9	45.000	5	25.000	4	20.000	2	10.000	1220.04	81.336

The above table reports merger activity by method of payment. The main columns denote payment by cash, stock, hybrid i.e. both cash and stock and the last column reports the level of the S&P500. The first of the sub-columns reports the number of mergers and the second shows the percentage of each type of payment. The last sub-column shows the S&P500 scaled by a factor of 15.

Figure 1: Mergers by Method of Payment



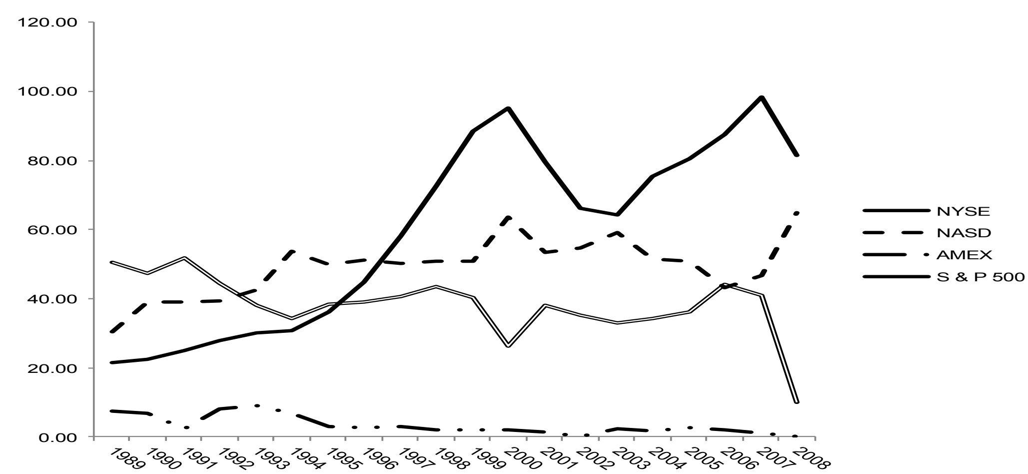
The figure plots the percentage of cash and stock type mergers from 1989 to 2008 along with the level of the S&P500 scaled by a factor of 15 for better contrast. The long dash line represents the scaled S&P500, the dotted line signifies percentage of stock type payments and the solid line represents the percentage of cash payment mergers.

Table 2: Merger Activity by Exchange

YEAR	NYSE		NASD		AMEX		S & P 500	
	Number	%	Number	%	Number	%	Level	S&P/15
1989	40	50.630	24	30.380	6	7.590	323.05	21.537
1990	28	47.460	23	38.980	4	6.780	334.53	22.302
1991	45	51.720	34	39.080	2	2.300	376.19	25.079
1992	44	44.440	39	39.390	8	8.080	415.75	27.716
1993	51	38.060	57	42.540	12	8.960	451.62	30.108
1994	72	34.290	113	53.810	14	6.670	460.42	30.694
1995	104	38.380	135	49.820	8	2.940	541.72	36.115
1996	131	39.100	171	51.040	9	2.690	670.50	44.700
1997	156	40.520	193	50.130	11	2.860	873.43	58.229
1998	181	43.410	212	50.840	9	2.160	1085.5	72.367
1999	188	40.340	237	50.860	9	1.930	1327.3	88.489
2000	122	26.240	296	63.660	10	2.150	1427.2	95.148
2001	86	38.220	120	53.330	3	1.330	1194.2	79.612
2002	56	35.220	87	54.720	0	0.000	993.94	66.262
2003	54	32.930	87	59.150	4	2.440	965.23	64.349
2004	63	34.240	95	51.630	3	1.630	1130.6	75.377
2005	80	36.200	112	50.680	6	2.710	1207.2	80.482
2006	84	44.100	84	43.080	4	2.050	1310.5	87.364
2007	77	40.960	88	46.810	2	1.060	1477.2	98.479
2008	2	10.000	13	65.000	0	0.000	1220.0	81.336

The table above shows merger activity by exchange, i.e. number and percentage of mergers on each major exchange. Each of the main columns contains data for NYSE, NASD and AMEX while the last column shows the market level scaled by a factor of 15. The first of the sub-column reports the raw number of mergers while the second reports the percentage. The rows do not add up to 100% since activity on minor exchanges is not reported.

Figure 2: Merger Activity by Exchange



The figure shows merger activity from 1989 to 2008 on each exchange along with the level of the S&P500. The solid line represents the S&P500 scaled by 15 for contrast, while the dashed line represents the NASD. The double line represents the NYSE and dash-dot linesignifies the AMEX

Table 3 that follows, provides descriptive statistics of firm characteristics from the Pre and Post Sox sub-samples. Standard errors are relatively small but the distributions are skewed to the right which is an expected result as it is mostly large and successful successful firms that would indulge in merger activity.

Table 3: Pre and Post Sox Descriptive Statistics

	PANEL A					PANEL B				
Name	Mean	Std Err	Median	Std Dev	Skewness	Mean	Std Err	Median	Std Dev	Skewness
Cash & Equivalents	304.12	20.132	51.657	954.73	8.504	1299.6	121.47	142.52	3056.0	3.343
Inventories	293.70	17.419	18.267	826.08	4.547	450.63	48.272	36.936	1214.5	4.719
Current Assets	1246.3	75.444	192.13	3577.8	6.615	3135.3	294.27	450.19	7403.7	3.946
PPE	994.15	74.055	61.441	3511.9	8.383	1704.6	226.65	136.20	5702.4	7.225
Total Assets	3183.2	201.26	376.05	9544.5	7.156	8065.9	782.58	1042.1	19689	4.167
Current Liabilities	858.52	60.744	74.786	2880.7	7.335	2070.4	219.84	184.56	5531.1	4.391
Debt	501.42	35.521	16.227	1684.5	7.379	1140.7	129.90	96.300	3268.2	5.327
Total Liabilities	1767.7	124.83	142.40	5920.1	7.422	4214.3	463.50	391.00	11662	4.929
Retained Earnings	793.32	56.743	36.531	2691.0	6.941	1785.6	308.06	100.36	7750.7	0.4970
Book Equity	1368.9	83.982	202.61	3982.7	7.644	3783.1	342.50	544.77	8617.1	3.721
Stockholders' Equity	1385.5	84.519	202.91	4008.2	7.562	3789.9	342.74	544.77	8623.2	3.723
Profitability Measures										
Net Income	210.59	17.109	15.910	811.37	5.976	567.81	62.806	38.062	1580.2	3.632
EBITDA	552.40	36.486	47.946	1730.3	6.115	1225.0	122.32	121.50	3077.6	4.041
Revenue	2897.1	171.09	324.77	8113.9	5.984	6335.6	623.62	826.52	15690	3.884
EPS	0.7030	0.0430	0.7700	2.049	-4.189	1.025	0.0780	0.8300	1.954	0.1770
ROE	0.3150	0.1760	0.1170	8.356	22.367	-0.1750	0.1750	0.1060	4.398	-22.173
ROA	0.0180	0.0060	0.0540	0.2890	3.662	-0.0020	0.0150	0.0560	0.3660	-11.804
Leverage Measures										
Current Ratio	3.344	0.0950	2.273	4.501	9.642	3.069	0.1270	2.149	3.198	5.589
Quick Ratio	2.879	0.0950	1.700	4.510	9.734	2.656	0.1260	1.696	3.183	5.834
Leverage	0.1360	0.0030	0.0840	0.1570	1.316	0.1340	0.0060	0.0990	0.1450	1.106
Market Leverage	0.2110	0.0040	0.1530	0.1890	0.9980	0.2250	0.0070	0.1880	0.1710	1.148
Book Leverage	0.4350	0.0050	0.4340	0.2160	0.1180	0.4200	0.0080	0.4180	0.2010	0.2680
Financial Leverage	0.1030	0.0030	0.0500	0.1250	1.475	0.1090	0.0050	0.0730	0.1200	1.131
Market Measures										
Market Equity	11457	870.72	981.37	41293	6.607	14909	1349.1	1590.7	33944	3.410
Market Value	13272	931.86	1281.1	44192	6.015	19191	1714.4	1958.7	43134	3.283
Market to Book	14.725	2.474	4.165	117.34	22.257	5.044	0.7930	3.155	19.953	22.910
Other Measures										
Net Cash Flow	32.841	6.268	3.555	297.26	1.354	151.08	38.139	4.647	959.56	1.774
CAPEX	243.21	18.014	20.575	854.27	7.779	327.14	38.461	32.696	967.66	6.386
Transaction Value	845.01	110.18	85.037	5224.9	19.566	901.73	159.11	136.49	4003.2	13.499
Relative Value	0.1820	0.0040	0.1020	0.1960	1.470	0.1620	0.0070	0.0850	0.1860	1.574

Table 3 above shows descriptive statistics of the firm characteristics and control variables used in the logistic regressions. The variables of interest are divided into categories viz. size variables, profitability, leverage and market measures. Panel A and Panel B show the statistics for the Pre-and Post Sox subsamples respectively. The column report from left to right, the mean, standard error of the mean, median, standard deviation and the skewness in that order.

In Table 4, we evaluate the difference in proportions of mergers by payment type and the difference in means of cash balances. Post signifies the post SOX period (after the year 2002) while Pre signifies the pre-SOX period (before the year 2002). We also include the distribution of private and public targets as well as activity on the major exchanges during these periods. H1 states that the proportion of stock type mergers would decrease in the post-SOX period, the Post-Sox proportion is 0.2543 whereas the pre-SOX proportion is 0.7022 and the difference is negative and is highly significant showing that the proportion of stock type mergers has decreased as hypothesized. Similarly the proportion of cash type mergers has increased from 0.2489 (pre) to 0.6346 and the increase is also very significant proving H2. Finally H3 is also supported by the data since the mean cash balance increased from 337.44 to 1674.33, thus providing evidence that SOX implementation did not impact the liquidity position of firms negatively.

Table 4: Test of Proportions/Means of Method of Payment (Post – Pre)

Name of Proportions (Means)	Post	Pre	Z
Cash Payment (All)	0.6346	0.2489	19.950***
Cash Payment (No Hybrids)	0.6308	0.2234	18.990***
Stock Payment	0.2543	0.7022	-21.810***
Cash Balance Means (Equal Variance)	1674.1	337.44	6.642***
Cash Balance Means (Unequal Variance)	1674.1	337.44	3.603***
Private Targets	0.5336	0.4664	3.670***
Public Targets	0.4602	0.4995	-2.150***
Merger Activity on NYSE	0.4250	0.4302	-0.2700
Merger Activity on NASD	0.5750	0.5698	0.2700

*The above table shows the proportions and means of mergers and other quantities before and after SOX and the result of a test of differences. The first column reports the Post Sox proportion or mean, the next shows the same values for the Pre SOX period and the last reports the Z-statistic of the difference test. The difference in proportions of Cash and Stock type mergers are shown in the first three rows. The difference in means of cash balances are in the next two. Finally difference proportions of private and publicly owned targets and difference in proportion of mergers on the NYSE and NASD are in the subsequent rows. ***, **, * indicate significance at the 0.01, 0.05 and 0.10 level, respectively.*

Before proceeding with the logistic regression analysis, we test the relevant for any abnormalities. That is whether there is an extreme value or an outlier which may bias the estimates of the logistic regression. Table 5 below shows the means of the variables before and after SOX and reports the t-statistic of the test of difference in means. The average MB of the Pre SOX period seems to be significantly higher which is as expected and the post SOX cash balances are higher lending credence to the contention that implementation costs are not as burdensome as firms seem to claim. The average acquiring firm seems to have more net income but less profitable. There does not seem to be a difference in leverage. Table 6 shows that the variances of the variables Pre and Post Sox and the F-statistic of the results of the test of difference in variance. It can be seen that the variance of MB has decreased from 13769.6 (pre) to 398.13 (post) with a highly significant F-statistic. This directly proves Hypothesis 4.

Table 5: Difference in Means (Pre – Post SOX)

Name	Pre-SOX	Post-SOX	t-Stat
MB	14.724	5.044	3.726***
Cash	304.12	1299.6	-8.085***
Total Assets	3183.2	8065.9	-6.043***
Net Income	210.59	567.81	-5.488***
ROE	0.3140	-0.1750	1.972**
Leverage	0.1360	0.1340	0.346
Market Equity	11457	14909	-2.149***
Market Value	13272	19191	-3.034***
Transaction Value	845.01	901.73	-0.293
Net Cash Flow	32.841	151.08	-3.059

*The table above shows the means of the variables used in the logistic regressions. Column one shows the means of the pre SOX and column two the post SOX values. The last column reports the t-statistic of the test of difference along with the significance level. MB i.e. Market-to-Book is the main variable of interest since it proxies for mispricing and information. The others are control variables. ***, **, * indicate significance at the 0.01, 0.05 and 0.10 levels respectively.*

Table 6: Difference in Variance Pre & Post Sox

Name	Pre-SOX	Post-SOX	F-Stat
MB	13770	398.13	34.586 ***
Cash	911518	9339218	10.246 ***
Total Assets	91096845	387664886	4.256 ***
Net Income	658320	2496897	3.793 ***
ROE	69.810	19.340	3.609 ***
Leverage	0.0200	0.0200	1.173 ***
Market Equity	1705071900	1152173434	1.480 ***
Market Value	1952941181	1860582470	1.050
Transaction Value	27299452	16025534	1.703 ***
Net Cash Flow	88362	920756	10.420 ***

*The table above shows the variances of the market-to-Book ratio and other control variables used in the logistic regression model. It also reports the difference in variance of each of the variables between the pre and post SOX subsamples and the F-static of the test. The first column reports the re SOX and column two the post SOX values respectively. The last column shows the F-statistic of the test of difference in variance. As noted, MB is of particular interest since it is in agreement with H4. ***, **, * indicate significance at the 0.01, 0.05 and 0.10 level, respectively.*

Previous research has established that MB is a driver of merger and acquisition activity and in particular is higher MB increases the probability of stock type mergers. The results of the logistic regression of the pre and post sub-samples is documented in Panels A and B of Table 7. In support of H5 the coefficient of LMB is significantly positive in both periods (pre-Sox: 1.839 and post-Sox: 1.106) showing that MB, the proxy for misevaluation is indeed a positive factor in increasing the likelihood of a stock type payment.

Table 7: Logistic Regressions

	PANEL A: Pre-SOX			PANEL B: Post-SOX			PANEL C: Pooled		
Parameter	Estimate	Std Err	Wald	Estimate	Std Err	Wald	Estimate	Std Err	Wald
Log MB	1.839	0.2350	61.498***	1.106	0.3930	7.908***	1.177	0.2210	28.467***
Log Market Value	0.1390	0.1190	1.375	0.6770	0.2680	6.388**	0.2300	0.1070	4.618**
Relative Value	0.5920	0.6810	0.7560	6.298	1.369	21.164***	1.815	0.6150	8.719**
ROE	-0.0380	0.0070	27.125***	-0.2470	0.4150	0.3540	-0.0420	0.0070	33.886***
Leverage	0.6530	0.6160	1.121	-0.4710	1.340	0.1240	0.5760	0.5600	1.056
Market Leverage	6.590	1.307	25.434***	2.100	1.877	1.252	6.420	1.139	31.751***
Book Leverage	-6.532	1.030	40.222***	-3.411	1.735	3.863**	-6.196	0.8820	49.376***
Log Transaction Value	0.2430	0.0790	9.502**	-0.0260	0.1460	0.0320	0.1700	0.0690	6.001**
Log SP500	-0.5200	0.1310	15.836***	-2.554	0.8990	8.071***	-0.5740	0.1290	19.745***
Log Net Income	-0.2470	0.0980	6.366**	-0.5320	0.2250	5.583**	-0.2760	0.0890	9.756***
EPS	-0.2260	0.0640	12.69***	-0.1810	0.1400	1.661	-0.2190	0.0570	14.779***
DUM							1.206	0.2670	20.465***
Pre_LMB							0.7000	0.1800	15.166***
Intercept	2.274	0.912	6.217**	12.388	6.396	3.752*	0.8590	0.9830	0.7650

The above table is the most important of all. It reports the results of the logistic regressions of the pre and, post SOX and pooled samples in Panel A, B and C respectively. The logistic regression has a transform function for the pre and post SOX subsamples as follows $g(x) = \beta_0 + \beta_1$ LMB+ β_2 LMval+ β_3 LTransval+ β_4 Relval+ β_5 ROE+ β_6 Lev+ β_7 MktLev+ β_8 BkLev+ β_9 LSP+ β_{10} LNI+ β_{11} EPS and $g(x) = \beta_0 + \beta_1$ LMB+ β_2 LMval+ β_3 LTransval+ β_4 Relval+ β_5 ROE+ β_6 Lev+ β_7 MktLev+ β_8 BkLev+ β_9 LSP+ β_{10} LNI+ β_{11} EPS + β_{10} DUM + β_{11} Pre_LMB for the pooled sample. The logistic function is set to evaluate the likelihood of a stock type payment. Log MB is natural logarithm of Market-to-Book. It is the main variable of interest as it proxies for mispricing and information. The rest are control variables of various effects such as the market controlled by log of market value and log S&P500, profitability controlled by ROE, EPS and log Net Income. Leverage effects are accounted by three measures i.e. log overall leverage and market and book leverages. The pre and post regressions do not contain the Dummy DUM and the interaction term Pre_LMB. DUM is set to 1 for the pre SOX sample and zero for post SOX. The key variable is Pre_LMB which is the interaction between DUM and log MB. It measures the difference in effect of MB i.e. Pre – Post. Column 1 of each panel records the estimate of the coefficient, column 2 shows the standard error of the estimate and the last column shows the Wald statistic along with the significance level.
***, **, * indicate significance at the 0.01, 0.05 and 0.10 levels respectively.

The central hypothesis of this paper is that SOX has reduced the level of mispricing and thereby improved market efficiency as hypothesized by H6. The previous two tables have shown that the coefficient of the LMB variable was smaller for the post-SOX period but a formal proof of that is produced in the pooled regression (Panel C of Table 8) where once again the coefficient of LMB is positive and significant. But, most importantly, the interaction term Pre_LMB which measures the difference in size of the coefficients i.e. Pre – Post has a positive and significant coefficient. This is the crucial result in support of H6 which confirms that that SOX has indeed increased market efficiency

CONCLUSION

SOX was implemented to provide protection to investors by increasing the level of information available to them as well as by holding managers responsible for the information that their firms provided. Surprisingly, the impact of SOX on financial markets has been largely unexplored; our research provides insights that are particularly relevant, given the current financial crisis that has impacted global financial markets.

In this study, our main goal is to review the effectiveness of SOX in terms of its impact on financial market efficiency. We also evaluate the criticism that SOX imposed an unnecessary burden on firms. Our results indicate that mispricing in the market decreased significantly after the imposition of SOX, causing the market to become more efficient.

The significant reduction in the variance of the MB ratio across firms in the post-SOX environment is a clear indication that firm prices across the spectrum of firms are more accurate. The reduction in the variance is caused by fewer firms being significantly overvalued or undervalued. The evidence of the reduction in mispricing comes from the results of the logistic regression. The difference in the size of the coefficient of the MB term is clear from the pre and post logistic regression is apparent. However the convincing proof comes from the coefficient of the interaction term in the pooled regression. This effectively measures the difference in coefficients

The reversal in the proportion of cash mergers vs. stock mergers after the implementation of SOX is expected after the above finding on the MB ratio. The extent of the reversal though is absolutely stunning. This reversal that we find from the test of proportions is further confirmed using the logistic regression methodology. In examining the average cash balances of acquiring firms before and after SOX we find that cash balances have increased significantly from 304.12 pre-SOX to 1299.6 post-SOX (see Tables 3 & 5). This fact indicates that firms are not overly burdened by the implementation costs of SOX. We use the cash balances as an indicator since all SOX related implementation costs are necessarily cash. Also this evidence should be examined in the light of the fact that the average acquirer is less profitable (ROE pre SOX ROE: 0.3140 and post SOX ROE: -0.1750 see Table 5). If on one hand firms are less profitable but have increased cash balances, and yet indulge in costly and critical mergers knowing well that their profitability in the near future is likely to be low, we are propelled towards the conclusion that firms are not apprehensive of the recurring costs of SOX. Claims have been made that quite a number of firms are going private to avoid the costs of SOX. We do not see compelling evidence of this, in fact, the extra cash coupled with the lesser profitability seems to contradict this claim. However we must admit that the evidence we provide is not conclusive but only inferential.

Overall we conclude that SOX has achieved its main goal of injecting greater accuracy and transparency into the market place, and contributed to the restoration of investor confidence and increased stock market efficiency. A further research in this area can include target attributes and a comparative sample surrounding another regulatory event. However it may be difficult control for differences between the two events and to find common measures of performance. The evidence supports the conclusion that regulatory reforms can be successful and though they may be unpopular and attract criticism, they must nevertheless, be implemented.

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THE IMPACT OF SHORT SALE RESTRICTIONS ON STOCK VOLATILITY: EVIDENCE FROM TAIWAN

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ABSTRACT

Governments implement policies to stabilize stock markets in times of financial crisis. The most common intervention is to forbid short sales. For instance, around the financial crisis of 2008, eleven governments announced restrictions on naked short sales in their stock markets. In light of the Greek credit crisis in 2010, Germany also disallowed naked short sales. Opinions were widely divided regarding the appropriateness of government to interfere in markets. This paper studies the influence of volatility asymmetries caused by the Taiwanese government's naked short sale restrictions. Intraday data is used to analyze the issue by way of EGARCH models. We find the high liquidity associated with large stocks increases asymmetric volatility. However, asymmetric volatility of middle and small sized stocks decreases around the naked short sale ban.

JEL: C22; C58; G18;

KEYWORDS: Asymmetric volatility, Information exposure, Naked short sale, Firm size, EGARCH

INTRODUCTION

The Greek debt crisis in 2010 caused a variety of financial concerns. In an attempt to stabilize the financial situation, the German Federal Financial Supervisory Authority forbid the naked short sale for Euro zone bonds, and shorting some financial stocks. The rule came into effect on May 19, 2010 until March 31, 2011. In 2008 global financial crisis resulted in global stock market collapse together, It also made every government adopt all kinds of policies to stabilize the stock market, such as limiting or banning the naked short sale in Taiwan, Korea, Belgium, Holland, Canada, German, Ireland, England, America, Australia, and Russia; pausing to trade in Russia, Korea, and Brazil; stopping to trade in Russia, Ukraine, Kuwait and Indonesia.

Limiting or banning naked short sales was the policy nearly every government carried out to stabilize its stock market. The effectiveness of this approach is debated. This paper researches the effects of banning naked short sales in the Taiwan stock market after the financial crisis of 2008. In the past, most research has been based on the closing prices, thereby ignoring changes in intraday volatility. In this paper, we advance the analysis to include intraday volatility. We conclude that the banning naked short sales increases return volatility for large firms, but it can decrease the return volatility for the middle and small sized firms.

This paper is organized into five parts. The following section contains a literature review about short sale restrictions and asymmetric volatility. The third part presents the data and methodology which is based on EGARCH Analysis to assess the influence of short sale bans on intraday data asymmetric volatility in the stock market. The fourth part presents the empirical results, which reveals that interfering policies and the banning naked short sales have certain influences on intraday asymmetric volatility. The paper closes with a summary and some concluding comments.

LITERATURE REVIEW

Limiting or banning naked short sales was a common policy to provide stability to the stock markets around the recessions of 2008. However, the success of this approach remains debatable. Woolridge and Dickinson (1994) studied the relationship between stock prices and securities lending. They found that securities lending couldn't collapse stock prices, those who traded in securities lending were not able to earn super-normal return, and it provided liquidity. Frost and Savarino (1988) found investment limit restrictions could not only help to reduce the estimated error, but also improve portfolio returns. Ho (1996) studied the Singapore stock market, from 1985 to 1986. He found that by forbidding naked short sales affected volatility. He used unconditional fluctuation and conditional fluctuation in his tests and found strictly limiting naked short sales would increase the volatility of the stock market. Hong and Stein (2003) derived a model for the heterogeneous expectations and used limited naked short sales to explain why stock prices showed negative skewness. In other words, stock price declines were an excess volatility phenomena.

Diether, Lee, and Werner（2009）examined 2,485 stocks, 1,352 from the NYSE and 1,133 from the NASDAQ. They explored how naked short sales affect liquidity, volatility and the effects of market quality. While short-selling activity increased both for NYSE and NASDAQ-listed Pilot stocks, returns and volatility at the daily level were unaffected. NYSE-listed Pilot stocks experience more symmetric trading patterns and a slight increase in spreads and intraday volatility after the suspension while there was a smaller effect on market quality for NASDAQ-listed Pilot stocks.

Chelley-Steeley and Steeley (1996), Laopodis (1997), Hu et al. (1997), and Yang (2000) discovered the existence of asymmetric volatility. The phenomenon of asymmetric volatility refers to a situation when new information causes price change. When new information is positive, future price volatility is smaller. When new information is negative, future price volatility is greater. Black (1976) first found that current returns had a negative correlation with future volatility. Christie (1982) and Schwert (1990) later found the same results. Liau & Yang (2008) argued that asymmetric mean reversion and volatility reflect the fact that investors react more strongly to bad news than to good news, confirming the volatility of asymmetry.

This paper researches naked short sale bans in the Taiwan stock market after the global financial crisis in 2008 which affected the degree of volatility. Based on the above studies, we can assume that when new information results in falling stock prices, the financial leverage of companies will rise. In other words, the risk of holding a stock increases, and future returns will be more volatile. On the other hand, when new information causes stock price to rise, the financial leverage of companies will decrease, and fluctuation of future returns will be less volatile. This phenomenon is called the leverage effect. Whether asymmetric volatility of stock returns is caused by leverage effects is still not conclusive. Sentana & Wadhwani (1992) on the other hand assume the asymmetric volatility phenomenon was due to herding behaviors by trader. Lo and MacKinlay (1987) argued that asymmetric volatility resulted from non-synchronous trading.

In the empirical model, when dealing with high-frequency financial data, Engle (1982) established the Autoregressive Conditional Hetroskedasticity Model (ARCH) to solve self-relative and hetroskedasticity problems. Bollerslev (1986) extended this work to the GARCH model (generalized ARCH) to describe the phenomenon of volatility clustering of returns. However, the GARCH model cannot distinguish differences in volatility between positive and negative information (the phenomenon of the violability asymmetries). Nelson (1991) developed the exponential GARCH model (EGARCH) to distinguish this difference. Campbell and Hentschel (1992) distributed the asymmetric volatility by the quadratic GARCH model (QGARCH). Later, Engle & Ng (1993) compared these two models, finding the EGARCH model had a better distribution, and Hafner (1998) proved with empirical data that the EGARCH model was better at distributing the volatility of high-frequency data. The EGARCH model is widely applied to high-frequency data so this research uses the EGARCH model to discuss the asymmetric volatility of stock returns.

Duffee (1995) utilized the daily return square root of the sum to construct the estimated volatility, to study the relations between return and volatility of individual stocks, and return and volatility of the aggregate market. He found positive relations between return and volatility of individual stocks was the primary reason why the stock price fell, return volatility rose. The relationship was stronger for small firms. Kunt and Levine (1996) analyzed the development of stock markets. They found positive relations between development of stock markets and financial agencies , banks and non-banks. He discovered that large scale markets have the low volatility properties.

DATA AND METHODOLOGY

Data and Descriptive Statistics

After the global financial crisis in 2008, the Taiwan stock market introduced the uptick rule on September 22, 2008. Later, naked short sales were banned on October 1, 2008. The uptick rule ban was lifted on January 5, 2009. The policy express in Table 1.

Table 1: The date of Banned the naked short sale in the Taiwan Stock Market

Order	Start	End	Event
1	2005/5/16	2008/9/21	Besides the composition stock of Tai 50 and Tai mid-cap 100 uptick rule
2	2008/9/22	2008/9/30	All stock Uptick rule
3	2008/10/1	2008/12/31	banned the naked short sale
4	2009/1/5		Besides the composition stock of Tai 50 and Tai mid-cap 100 uptick rule

This table presents the period of Banned the naked short sale in the Taiwan Stock Market

This paper studies the influence of banning naked short sales has for the asymmetric volatility of the stock market pre-period, in the period, and post-period in Taiwan markets. Skinner (1989) found that a minimum of five hundred observations is necessary in ensuring reliable estimates with the EGARCH model. Thus we adopt intraday data for each 30 minutes of the TAI 50 and TAI mid-cap 100 indices before, in and after banning naked shorts sale as our data. Data were obtained from the Taiwan Stock Market Exchange. Because the Taiwan stock market doesn't have a small-cap index, we assume the pattern of the TAIEX weighted average index. First, we calculate the market value. The base period is December 28, 2004. The index of the base period is 6000. The index on December 28, 2004 is show in Table 2. The small cap index mode, is computed using Eq. 1.

$$I_s \equiv \frac{\text{market value} - \text{the value of the constituent stock of the TAI 50 and TAI mid cap 100}}{\text{the value of the base period}} * 6000 \qquad (1)$$

Where the base period is December, 28, 2004, and the market value to reduce the value of the composition stock of the TAI 50 and TAI mid-cap 100 is 5283103 thousands.

Table 2: The Index and Market Value

	index	Market Value
TAIEX weighted average index	4521.5	13541728
Tai 50 index	6000.6	6271838
TAI mid-cap 100 index	6053.2	1986787
TAI small-cap	6000.0	5283103

This table presents the index and market value in 2004/12/28

Figure 1 plots the 30 min. stock price movements for the four indexes. The return for each market are calculated as the percent logarithmic difference in the 30 min stock index, i.e., $R_t = ln\left(\frac{P_t}{P_{t-1}}\right) \times 100$,where R_t,P_t,P_{t-1} stand for the market return and price for each 30 min, respectively; ln is the continuous compounding factor. Return' descriptive statistics of three subperiods are exhibited on Table 3. The skewness statistics indicate that all return series are either negatively or positively skewed. The excess kurtosis statistics suggest departure form normality, that is, all series are highly leptokurtic. Hence, the Jarque-Brea statistics rejects the normality for each return series. The Augmented Dickey-Fuller (ADF) and Phillips and Perron (PP) unit root tests revel all the series are stationary.

Figure 1: Taiwan Stock Index of the 30 min

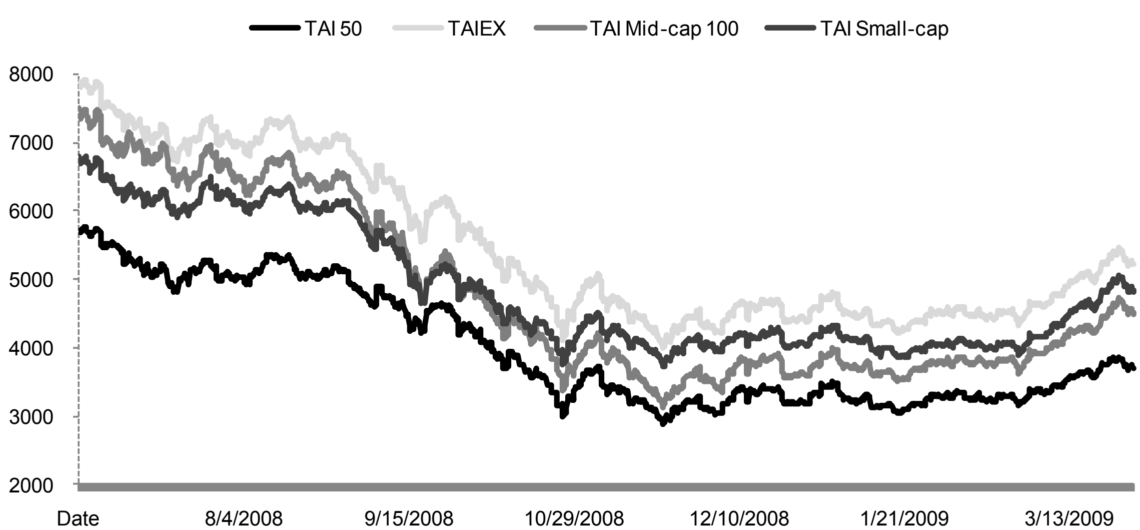

Table 3: Number of Observations

	index	Start	End	Obs.
1	Pre-	2008/6/23	2008/9/21	576
2	In	2008/10/1	2008/12/31	585
3	Post	2009/1/1	2009/3/31	513

This table presents the observation for three sub-periods

This research used return series to analyze asymmetric volatility. The Ljung-Box (LB) statistics for 12 lags applied to residuals and squared residuals indicate significant linear/nonlinear dependence exist.
If the Q statistic of Ljung-Box return series is significant, it shows the autocorrelation phenomenon exists in this series. That is to say, if the Ljung-Box of the square of return series Q statistic is significant, it indcates the series variance exists for the autocorrelation phenomenon. This implies this series contains the heteroskedasticity phenomenon.

The tests of LB(12)、$LB^2(12)$ shown in Table 4 show that most return series and the square of return series all contain the autocorrelation phenomenon. As such, the analysis models should conssider autoregression (AR), and conditional hetrocedesticity (CH). The mean equation of the GARCH Family Model can resolve autocorrelation series, and its variance equation allows the variance to be decided by the pre-variance and disturbance term. So the existence of conditional hetrocedesticity is acceptable. In order to explain the phenomenon, it is optimal to adopt the GARCH Family Models.

Table 4: Descriptive Statistics of Three Index Each 30min Stock Return in Four Sample Periods

EVENT	PERIOD	μ	σ	S	K	JB	LB(12)	$LB^2(12)$	ADF	PP
TAI 50	Per-	-0.04	0.70	0.43	14.15	3002.02	38.14 ***	104.28 ***	-21.86 ***	-21.84 ***
	In-	-0.04	1.02	-0.83	12.89	2450.64	20.59 **	86.33 ***	-24.14 ***	-24.14 ***
	Post-	0.02	0.64	0.30	16.92	4148.83	13.62	23.09 **	-23.97 ***	-23.94 ***
TAI Mid-cap 100	Per-	-0.07	0.81	-0.63	14.93	3453.07	37.74 ***	115.81 ***	-21.75 ***	-21.68 ***
	In-	-0.04	1.04	-0.73	10.90	1574.11	9.67	88.58 ***	-23.54 ***	-23.54 ***
	Post-	0.04	0.65	0.32	12.44	1913.89	14.84	39.60 ***	-24.47 ***	-24.40 ***
TAI Small-cap	Per-	-0.05	0.73	-0.42	19.10	6238.80	35.96 ***	145.70 ***	-25.07 ***	-25.05 ***
	In-	-0.02	0.87	-0.61	11.19	1671.30	5.92	137.94 ***	-24.61 ***	-24.61 ***
	Post-	0.03	0.57	0.49	10.29	1155.59	19.70 **	22.61 **	-25.19 ***	-25.09 ***

Notes：, ** and*** denote significance at the .1, .05 and .01 level, respectively. μ and σ are sample mean and standard deviation; S and K are measures for skewness and excess kurtosis. JB represents Jarque-Bera statistics, testing for normality. LB(12) is are the Ljung-Box test statistics testing for autocorrelation in the residuals and squared residuals up to the twelfth lags, which is distributed as χ^2 with degree of freedom equal to the number of lags. ADF and PP stand for the augmented Dickey-Fuller and Phillips-Perron unit root tests. The critical values of ADF and PP at the .05 and .01 level are -2.86 and -3.43, respectively.*

The autoregressive process is required in describing linear dependent series. We adopt the Akaike information criterion (AIC) to determine the order of the AR(p) and the smallest value of AIC is chosen. As shown in Table 5, the result is show that AR(1) is adopted for all indexes and periods.

The Asymmetric Volatility Model

The diagnostics of higher order autoregressive conditional heteroskedasticity and volatility clustering suggest that a GARCH-class model would be appropriate. Nevertheless, ordinary GARCH models do not distinguish differential impacts of good and bad news on volatility. To examine the asymmetric responses of volatility to positive and negative innovations, the EGARCH model developed by Nelson (1991) is employed. As suggested by Bollerslev, Chou, and Kroner(1992) to use a model that is as parsimonious as possible, we adopt the EGARCH(1,1) model. The model is described as follows：

$$R_t \big| I_{t-1} \sim f\left(\mu_t, \sigma_t^2\right) \tag{2}$$

$$R_t = \beta_0 + \sum_{i=1}^{p} \beta_i R_{t-1} + \varepsilon_t \tag{3}$$

$$\ln\left(\sigma_t^2\right) = \alpha_0 + \alpha_1\left(\left|z_{t-1}\right| - E\left[\left|z_{t-1}\right|\right] + \delta z_{t-1}\right) + \phi \ln\left(\sigma_{t-1}^2\right) \tag{4}$$

Equation 2 expresses the conditional return R at time t, given the information set I at time t-1. With the conditional density function f(•), R_t has the conditional mean $\mu_t=E(R_t|I_{t-1})$ and conditional variance $\sigma_t^2=E(\varepsilon_t^2|I_{t-1})$, where ε_t represents the innovation at time t, i.e., $\varepsilon_t = R_t - \mu_t$. Eq. 3 describes the autoregressive process of order p for the stock returns, with $\sum_{i=1}^{p} \beta_i R_{t-1}$ capturing the autocorrelation. As described in the previous section, the order of AR(p) is decided based on the Akaike information criterion. The selected order for each market in each period is presented in Table 4. The process of conditional variance is expressed by Eq. 4, where the logarithm of the conditional variance is modeled as an asymmetric function of last period's standardized innovation, z_{t-1}, and the logarithm of last period's conditional variance.

Table 5: Values of AIC

EVENT	PERIOD	Values of AIC					
		1	2	3	4	5	6
TAI 50	Per-	**2.1179**	2.1224	2.1262	2.1292	2.1303	2.1349
	In-	**2.8792**	2.8807	2.8839	2.8873	2.8901	2.8933
	Post-	**1.9372**	1.9397	1.9415	1.9395	1.9434	1.9471
TAI Mid-cap 100	Per-	**2.4066**	2.4118	2.4121	2.4128	2.4098	2.4147
	In-	**2.9193**	2.9194	2.9228	2.9262	2.9292	2.9324
	Post-	**1.9920**	1.9954	1.9981	1.9943	1.9979	2.0011
TAI Small-cap	Per-	**2.2130**	2.2181	2.2211	2.2237	2.2259	2.2285
	In-	**2.5566**	2.5574	2.5603	2.5635	2.5663	2.5689
	Post-	**1.7111**	1.7133	1.7170	1.7163	1.7195	1.7218

Note: bold number represents the minimum value.

The standardized innovation, z_t is defined as ε_t/σ_t^2 such that a positive z_t implies an unexpected increase in stock returns whereas a negative z_t implies an unexpected decrease. Thus the second term in Eq. 3 allows conditional variance process to respond asymmetrically to rises and falls in stock price. Specifically, the term $|z_t|$-E$|z_{t-1}|$ represents the size effect of the innovation, that is, providing α_1 is positive, a past innovation then a positive (negative) impact on $\ln(\sigma_t^2)$ when the magnitude of z_{t-1} is larger (smaller) than its expected value. The term δz_{t-1} on the other hand captures the sign effect; that is, when the coefficient δ is significantly negative (positive), then negative (positive) innovation increases volatility more than does a positive (negative) innovation of the same magnitude. In essence, to examine the presence of asymmetric volatility is present, the impact of positive innovation on $\ln(\sigma_t^2)$ is equal to$\alpha_1(1-|\delta|)|\ z_{t-1}|$ and the impact of a negative innovation is $\alpha_1(1+|\delta|)|\ z_{t-1}|$.

Given the data for the return series R_t, estimates of the parameters in Eq. 3 and Eq. 4 (namely β_0, β_1, α_0, α_1, δ, ψ) can be derived by maximizing the log-likelihood of the returns over the sample period. Diagnostic test for appropriateness of the models are performed on the standardized residuals and squared residuals via Ljung-Box test and Lagrange multiplier test. Specifically, the Ljung-Box test applied to the standardized residuals tests for remaining serial correlation in the mean equation, whereas the Ljung_Box test as well as the Lagrange multiplier test applied to the squared standardized residuals checks the specification of the variance equation.

EMPIRICAL RESULTS

This paper mainly examines banning naked short selling in the Taiwan Stock Market. The paper uses intraday data for each 30 minutes, and applies them to the above EGARCH(1,1) Model. Table 6 shows the resulting analysis. First, we divide the data into three sub-periods—the pre-period, in the period, and the post-period, to assess whether the samples in Taiwan Stock Market have the Asymmetric Volatility phenomenon in each stage. This paper compares the difference of the asymmetric volatility for the three periods and discusses if δ value differs dramatically among the three sub-periods.

Asymmetric volatility exists when volatilities caused by positive information and negative information are in different ranges. When δ is negative, negative information will increase future volatility more than that of positive information. Likewise, if δ is positive, positive information will increase future volatility more than that of negative information. For example TAI Mid-cap 100 banning short sale period, the EGARCH(1,1) Model estimate of the result would be as follows:

$$R_t = -0.0066 + 0.0333 R_{t-1} + \varepsilon_t$$
$$\ln\left(\sigma_t^{\,2}\right) = 0.0677 + 0.1478\left(\left|z_{t-1}\right| - E\left[\left|z_{t-1}\right|\right] - 0.0559 z_{t-1}\right) - 0.9404 \ln\left(\sigma_{t-1}^{\,2}\right)$$

If the t-1 period contains negative information to make εt-1 become negative, $z_{t-1}=\varepsilon_{t-1}/\sigma_{t-1}^{2}$ should be negative, then z_{t-1} in each unit will make $\ln(\sigma_t^2)$ increase 0.1478(1-0.0559) in the next period (t period), it is equal to 0.1473. On the contrary, if there is positive information, each t-1 period will contain positive information, then each z_{t-1} will make $\ln(\sigma_t^2)$ increase 0.1478(1+0.0559) in the next period, which is equal to 0.1561. So, compared to the positive and negative information, the volatility caused by the former will be 1.0597 times by the latter. That is to say the higher the absolute value of δ become, the more volatile the asymmetric volatility will be. In other word, the degree of asymmetry can be measured by (1+|δ|)/(1-|δ|) (Koutmos and Saidi (1995)). Because the degree of asymmetry is measured by (1+|δ|)/(1-|δ|) and a higher absolute value of δ implies a higher degree of asymmetry, we can simply compare the absolute values of δ between the three sub-periods to examine whether is a change in the extent of asymmetry.

Table 6: Maximum Likehood Estimates of the EARCH

Event		TAI 50			TAI Mid-cap 100			TAI Small-cap	
Period	Pre	In	Post	Pre	In	Post	Pre	In	Post
AR(p)	AR(1)	AR(1)	AR(1)	AR(1)	AR(1)	AR(1)	AR(1)	AR(1)	AR(1)
β_0	-0.0036	0.0431	0.0282	-0.0626	-0.0066	0.0306	-0.0258	0.0081	0.0314
	(0.7969)	(0.0000) ***	(0.0317) **	(0.0028) ***	(0.6335)	(0.0671) *	(0.0930) *	(0.5704)	(0.0185) **
β_1	0.0334	0.0342	-0.0086	0.0969	0.0333	-0.0514	0.0201	0.0136	-0.0424
	(0.1233)	(0.0000) ***	(0.6560)	(0.0002) ***	(0.0023) ***	(0.0617) *	(0.5322)	(0.3338)	(0.1832)
α_0	0.0077	-0.0139	-0.3031	-0.0225	-0.0677	-0.3219	-1.1968	-0.0260	-1.5035
	(0.4360)	(0.8447)	(0.1325)	(0.2402)	(0.7386)	(0.1078)	(0.0004) ***	(0.1594)	(0.0002) ***
α_1	-0.0379	-0.0098	-0.0799	0.0077	0.1478	-0.0295	0.4985	0.0301	0.4468
	(0.0271) **	(0.9249) **	(0.3695) **	(0.7787) **	(0.0016) **	(0.7451) **	(0.0000) **	(0.2431) **	(0.0030) **
Δ	-0.0935	0.1599	-0.0838	-0.0876	-0.0559	-0.1177	0.0572	-0.0484	-0.1843
	(0.0000) ***	(0.0943) *	(0.2137)	(0.0005) ***	(0.0425) **	(0.0813) *	(0.4184)	(0.0133) **	(0.0674) *
Ψ	0.9866	0.6452	0.6936	0.9742	-0.9404	0.6691	0.0599	0.9926	0.0710
	(0.0000) ***	(0.0270) ***	(0.0001) ***	(0.0000) ***	(0.0000) ***	(0.0002) ***	(0.8541)	(0.0000) ***	(0.7920)
Log L	-469.3761	-643.7005	-368.3761	-574.0872	-710.3047	-422.2639	-489.3824	-609.6951	-346.1007
LB(12)	11.6940	23.5770	13.3000	21.7180	8.5151	13.9660	30.2410	5.6073	18.0450
$LB^2(12)$	18.5520	79.0390	22.7030	39.1540	38.2890	36.4190	74.2730	76.4490	23.0960
LM(6)	4.0819	4.3606	3.8951	3.4458	4.0335	4.0316	2.0894	9.1180	6.2808
$\frac{1+\lvert\delta\rvert}{1-\lvert\delta\rvert}$	1.2063	1.3806	1.1829	1.1920	1.1185	1.2669	1.1213	1.1017	1.4518

*Notes: ** and*** denote significance at the .05 and .01 level, respectively. Numbers in parentheses are standard errors. As the order of AR(p) is different for each event, to save space the estimates of the conditional mean equations are shown. LB(12) and $LB^2(12)$ are the Ljung-Box test statistics testing for autocorrelation in the standardized residuals and standardized squared residuals for the EGARCH model up to the twelfth lags, which is distributed as χ^2 with degree of freedom equal to the number of lags. LM(6) represents the Lagrange multiplier test statistics examining whether the standardized residuals exhibit additional ARCH up to the sixth lags, which is distributed as χ^2 with degree of freedom equal to the order. (1+|δ|)/(1-|δ|) measures the degree of asymmetry.*

This paper found it wasn't significant for the Tai 50 pre-period and Tai Small cap post-period. However, the others were significant, and the maximum and minimum of |δ| were 0.1843, and 0.0484, respectively, showing that the asymmetric volatility existed in the intraday data. We compared the pre-period to the post-period. Except the volatility change ((1+|δ|)/(1-|δ|)) of the TAI 50 was the biggest in the period of the banning naked short selling (1.2063,1.3806,11829, respectively), the others (TAI Mid-cap 100, TAI Small-cap) significantly decreased in the period of the naked short selling ban (1.1920→1.1185), (1.1213→1.1017)). Upon lifting the naked short selling ban, the asymmetric volatility was rose significantly (1.1213→1.1017), (1.1017→1.4518)), as is shown in Table 7.

Table 7: T-Test of δ for the Period

Event	Period	Obs.	δ	significance	σ	t-value	
TAI 50	pre	576	-0.0935	***	0.0160	16.5655	***
	in	585	0.1599	*	0.0956		
	pre	576	-0.0935	***	0.0160	-3.1883	***
	post	513	-0.0838		0.0674		
	in	585	0.1599	*	0.0160	-24.9726	***
	post	513	-0.0838	***	0.0674		
TAI Mid-cap 100	pre	576	-0.0876	***	0.0252	-55.4353	***
	in	585	0.0016	**	0.0276		
	pre	576	-0.0876	***	0.0252	9.5356	***
	post	513	-0.1177	*	0.0676		
	in	585	0.0016	**	0.0276	36.3741	***
	post	513	-0.1177	*	0.0676		
TAI Small-cap	pre	576	0.0572		0.0706	-2.8673	***
	in	585	-0.0484	**	0.0196		
	pre	576	0.0572		0.0706	23.8302	***
	post	513	-0.1843	*	0.1008		
	in	585	-0.0484	**	0.0196	30.0479	***
	post	513	-0.1843	*	0.1008		

*Note : * , **and *** denote significance at the .1 ,.05 and .01 level*

SUMMARY AND CONCLUSIONS

Asymmetric volatility has received more research attention recently, but research on intraday volatility is limited. This paper uses the EGARCH model to research asymmetric volatility. The Taiwan stock market restricted short sales for three months, so this paper uses 30 minutes intraday data to research intraday volatility. Most researchers adopted the last trade price of each day to study asymmetric volatility. However, ignoring intraday volatility resulted in different conclusions. This paper is based on intraday data to analyze asymmetric volatility and long-run and short-run effects. Based on our research, we concluded that intraday asymmetric volatility also exists.

The policy of banning short selling was mainly to prevent investors' excessively panic moods from making unreasonable decisions. This paper found banning naked short selling was effective at decreasing asymmetric volatility for mid-cap and small-cap stocks. It was not effective for decreasing asymmetric volatility for large firms. On the contrary, the asymmetric volatility was increased. We argue it is easy to acquire information of large firms so that the investor analyze rationally. The policy resulted in increasing the asymmetric volatility of the stock market. This study supports the findings of Hogan, Melvin (1994) and Tse and Tsui (1997). The lemma of heterogeneous expectations is that the heterogeneous expectation would be more serious if government interference was expanded or increased. However, it was not easy to acquire the information of mid-cap and small scale of firms. The results were similar to those of Greenwald and Stein (1991) that researched the America stock market. They find the interposed policy provides the opportunity to calm investors, reduced trading noise, and volatility. We close the paper with a fall for more research to more fully understand the affects of intraday asymmetric volatility.

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DOES FIRM DIVERSIFICATION REPRESENT A VALUE ADDED FOR STOCKHOLDERS?

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ABSTRACT

This study empirically tests the effect of diversification on firm performance, controlling for factors influencing returns other than diversification. This study also investigates if the diversification effect has the same impact on firm performance at different points in time. The sample used consists of all firms with available data from Compustat Industry Segment Database and Research Files for the period between 1979 and 2006. Carhart (1997) four-factor model results suggest that diversification is related to firm performance. Diversified firms show a general trend of underperforming non-diversified firms. Results also suggest that the diversification effect may change through time. The evidence presented may help managers and stockholders in considering the effects of diversification on firm value when making decisions.

JEL: G11; G34

KEYWORDS: Diversification strategy, firm performance

INTRODUCTION

Why firms diversify is a question that has been studied broadly in corporate finance. Moreover, academics, management and stockholders have demonstrated interest in the effects that diversification may have on firm performance. Previous research on this topic has shed some light on the issue (Campa & Kedia, 2002; Hyland & Diltz, 2002; Pandya & Rao, 1998; Servaes, 1996). Despite the use of different samples, time frames or methodologies there is no agreement as to how diversification affects firm performance.

There is insufficient corroborating empirical evidence to produce a consensus on the consequences of firm diversification. Some studies favor the notion that diversification is related to a performance discount, while others find that diversification leads to an enhancement in performance. A third group of academics state that diversification does not affect performance. This study contributes to the existent literature by implementing a more accurate and reliable methodology, Carhart's (1997) four factor model. A longitudinal study is also performed to evaluate if the diversification effect has the same impact on firm performance at different moments across time. Both, the stockholders and the firm's upper management, could use this information as guidelines to their investment decisions and strategic planning

The remainder of the paper is organized as follows. Section 2 briefly discusses the relevant literature. Data selection, research methodology, and empirical models are described in Section 3. Section 4 provides analysis and interpretations of the empirical results and Section 5 concludes the paper.

LITERATURE REVIEW

The main objective of most financial decisions is to increase shareholder wealth. Most of these decisions are made expecting positive and constant growth. Corporate growth normally occurs when there is an internal expansion. This type of expansion takes places when the existing divisions of the firm grow through normal capital budgeting activities. However, past studies agree and answer the initial question of why do firms diversify. The most remarkable examples of growth occur as a consequence of mergers and acquisitions (Brigham & Daves, 2004).

Corporate mergers and diversification can be explained from two viewpoints: synergistic strategies and financial strategies. Economies of scale, economies of scope and market power are synergistic. Alternatively, profit stability, improvement of financial performance and agency problems are considered financial strategies.

Whether firm diversification is synergistic or financial in nature, this decision will influence firm performance. Three different theoretical positions have been proposed regarding the diversification effect in firm performance: (1) diversification reduces firm performance, (2) diversification enhances firm performance and (3) diversification does not have direct influence on firm performance.

There is evidence that suggests diversification deteriorates firm performance and diminishing shareholder wealth (Berger and Ofek, 1995; Lang and Stultz, 1994; Servaes, 1996). Lang and Stulz (1994) show that diversified firms have lower q's than comparable portfolios of pure-play firms. They also explain that firms which choose diversification are poor performers relative to firms that do not. Berger and Ofek (1995) also find a value loss from diversification (about 14 percent loss) in the 1980s, while Servaes (1996) finds a diversification loss in the 1960s but to a lesser extent in the 1970s.

Numerous studies point out that a reduction in firm performance may occur because the costs of diversification outweigh the benefits. Some explain that these costs may arise from inefficient allocation of capital among divisions of a diversified firm (Lamont & Polk, 2001; Rajan, Servaes & Zingales, 2000). Agency problems in a diversified firm can also generate additional costs of diversification. Diversified firms may suffer from agency problems because of division manager’s opportunistic or sub-optimal behavior, information asymmetries between central and divisional managers and difficulties in designing optimal incentive compensation schemes (Aggarwal & Samwick, 2003; Jensen, 1988).

A second group of researchers provide evidence to suggest that firm diversification may enhance performance. Billet and Mauer (2000) develop a model of equity restructuring that illustrates the linkages among firm's internal capital market, the potential for a spin-off, and the issuance of tracking stock. Hadlock, Ryngaert, and Thomas (2001) find that issues by diversified firms are viewed less negatively by the market than issues by non-diversified firms. Fauver, Houston, and Naranjo (2003) find the value of corporate diversification is negatively related to the level of capital market development, international integration, and legal systems. Their results suggest that there is not diversification discount and, in some cases, there is a diversification premium especially where capital markets are less developed.

Finally, other studies attempt to highlight the difficulties involved in precisely measuring the effect of diversification on firm performance. Campa and Kedia (2002) argue that the documented discount on diversified firms is not per se evidence that diversification deteriorates value. They proposed that diversification policy is endogenously determined by the firm’s management along with other policies and firm characteristics that taken together, determine how investors value the firm.

Graham, Lemmon, and Wolf (2002) find that firms acquired in a diversifying merger have been discounted by capital markets prior to the merger announcement. Mansi and Reeb (2002) also find that diversification is insignificantly related to excess firm value. Thus, diversification discount observed in many studies may be artifacts of measurement errors in using Tobin's q as a proxy for firm value. In short, results from previous studies on the diversification effect are neither consistent nor conclusive, which may be due to econometric problems.

Diversification strategies may or may not have a direct effect over performance. Some scholars show results to suggest that diversification effects change across time. Most of the findings on the diversification performance of the firm are based on static sample periods (cross-sectional studies) where no further tracking of the diversification's effect is considered throughout the entire period. To determine how performance changes as a function of diversification level at different moments it is important to trace the same firm portfolios at different intervals within the period of consideration. By doing so, it is possible to compare the diversifying firm's performance in the course of the full sample period. Hence, it is possible to determine if the diversification effect on firm performance is driven by time-varying factors. Some studies reveal that the diversification effect on firm performance is different for different time periods. This occurs even using the same sample and methodology to evaluate the effect.

Hyland and Diltz (2002) find evidence that may explain the diversification discount. Their results suggest that in the period of diversification and up to five years after diversifying, firms have negative long-run abnormal performance. Examination of the two-day announcement period returns provides evidence of increased performance, at least upon the announcement of a diversifying event. The authors conjecture that if the immediate impact and the long-run consequences of corporate diversification differ in direction, then it is possible that diversification enhances firm performance in some economic climates and reduce it in others.

McGahant (1999) examines firm diversification controlling for year, industry, corporate focus and firm effects on corporate performance. The author finds that year effects had a small but significant impact on corporate performance. These results reflect shifts in macroeconomic conditions that affected industries and firms differently, may have generated transient industry and firm performance effects.
Servaes (1996) examines q-ratios for various sub-samples and over various time periods. The results suggest that diversified firms are valued at a discount relative to single-segment firms during the 1960's and the discount vanished during the 1970's. The author concludes that the market's assessment of the cost of diversification has varied over time.

Whether or not diversification promotes efficiency, it is definitively guided by different managerial motives and it is likely to differ across firms, across industries, and through time. Although most of the studies on this area have been performed over a relatively small period of time (five to ten years on average), once the sample is chosen, no further tracking on the diversification status of the firm during the period under study is considered. Consequently, there is no definite or consistent evidence to suggest that the diversification effect on firm performance is dependent on the period that diversification takes place.

DATA AND METHODOLOGY

To test the effects of diversification on firm performance, a sample containing non-diversified (single-segment) and diversified (multi-segment) firms is used. The sample used consists of all firms with available data from Compustat Industry Segment Database and Research Files for the period between 1979 and 2006. In 1976 the Financial Accounting Standard Board (FASB) issued Statement of Financial Accounting Standard No. 14 (Financial Reporting for Segments of a Business Enterprise). It requires that for fiscal years starting after 1978, firms had to report information about the industry segments in which they operate. Therefore, in order to have a complete data set for all the firms selected, 1979 is chosen as starting point for this sample.

Consolidated firm data is obtained from Compustat Industrial Annual database for this period. Stock returns are obtained from the Center for Research and Security Prices (CRSP), Monthly Stock database. The Fama-French three-factor and the momentum factor data were directly downloaded from Kenneth R. French Homepage Data Library (French, 2007). The sample includes a set of firms that meet the following criteria: (1) they are listed in COMPUSTAT at any moment from 1979-2006 (active and inactive firms); (2) firms are classified by the North American Industry Code System (NAICS), as well as their correspondent segments and (3) firms and their segments have annual total sales available during the study period.

Consistent with previous studies, (Berger and Ofek, 1995; Lang and Stultz, 1994), firms with primary NAICS codes in the finance and insurance industry (NAICS industry sector 52) are eliminated, as they typically have financial ratios that are difficult to compare to firms in other industries. Additionally, utilities firms are eliminated (NAICS industry sector 22) from the sample because of their highly regulated nature.

These filters yield 185,001 total firm-year observations. In total 17,929 consolidated firms are included in the sample. The segments included by using the same filters, and matched up with their correspondent consolidated firms, yield 523,256 segment-year observations.

A given firm is defined as "diversified" once the number of reported segments for the firm increases to more than one. This is essentially the same selection sample criteria used by Lang and Stultz (1994), Berger and Ofek (1995), and Comment and Jarrell (1994). Using this criterion, the final sample consists of 78 non-diversified (single-segment) firms and 17,851 diversified firms.

Table 1 presents an overview of the sample and the level of diversification per year. In 1979, 49.16% of the total sample operates in a single segment and 50.82% in more than one segment (29.4% of the firms operate between 3 and 4 segments). Then after the 1991-1994 period, the percentage of single–segment firms in the sample declines from 10% for the 1995-1998 period to 8.80% for the 1999-2002 period. There is almost no difference between the 1999-2002 and 2003-2006 periods. From 1999 to 2006, diversification activity is greater for firms with five or more segments than for the lesser diversified firms.

Table 1: Percentage of Firms Operating in 1 to 7 or more Business Segments

	Periods						
Average No. of Segments	1979-1982	1983-1986	1987-1990	1991-1994	1995-1998	1999-2002	2003-2006
1	49.18%	59.38%	60.57%	60.47%	50.77%	41.97%	42.72%
2	6.97	7.07	6.98	7.52	13.50	8.33	4.96
3	18.04	15.87	16.16	16.36	15.73	15.75	16.30
4	11.37	8.28	7.65	7.34	9.96	11.29	11.00
5	6.03	4.31	3.90	3.80	4.77	7.79	7.68
6	4.26	2.68	2.60	2.45	2.64	5.94	5.79
>7	4.16	2.42	2.13	2.07	2.62	8.93	11.54
Total	100%	100%	100%	100%	100%	100%	100%
No. of Firms	4,063	6,125	6,417	6,903	8,886	8,691	6,679

Summary Statistics

Once firms are selected, they are included in a portfolio. Non-diversified and diversified portfolios are formed based on separate size and value characteristics. Market capitalization (MCAP) and book-to-market ratio (BM) are defined following Fama and French (1996). The first set of reference portfolios includes ten value-based portfolios. Each portfolio is rebalanced in December of each year. In December of year t-1, all firms are ranked on the basis of book-to-market ratios. Value deciles are then created based on these rankings for all the diversified firms as well as non-diversified firms reference portfolios. This is denoted by ND-1 and D-1 with the lowest book-to-market ratio for the non-diversified and diversified firm portfolios respectively whereas ND-10 and D-10 the portfolios with the highest book-to-market ratios. The second set of reference portfolios is ten size-based protfolios that were formed using the same procedure used to form the value-based portfolios.

Longitudinal studies are those where specified relationships among subjects or events are measured repeatedly on the same over time, with the objective of studying both the level and change in outcome across time as a function of subject characteristics. Longitudinal studies also have the virtue of being able to exclude time-invariant unobserved individual differences, and observing the temporal order of events. To test the influence of time over the diversification effect on firm performance, a sub-sample of firms is obtained from the previous sample. From the 78 non-diversified firms that are active at any moment during the full sample period, 39 are selected because they are continuously active during the1979-2006 period. From all multi-segment firms active continuously during the study period, 39 comparable firms with the single-segment firms were selected. Finally, these firms are ranked on the basis of book-to-market ratios (BM), and market capitalization (MCAP). In order to avoid changes in portfolio composition, once a firm is included in a portfolio, it cannot be reclassified to another. This allows for easier comparisons between firms and avoids problems due to differences in firm-specific characteristics. The sub-sample consists of five separate book-to-market quintiles for the non-diversified and diversified firm portfolios. Same amount of portfolios are formed based on market capitalization. This yields 25,272 firm-month observations, 324 firm-month observations per portfolio quintile, and 1,620 firm-month observations for the full period test, for each set of diversified and non-diversified firm portfolios.

Estimation Model

This study employs Carhart (1997) four-factor model, inspired by the Fama and French (1993) three-factor model, plus the momentum factor to estimate the effect of diversification on firm performance. This model contributes to control for other influencing factors on firm returns and adjusts for risk factors. Fama and French (1993) find that the three-factor model may explain the cross-sectional variation of stock returns better than other models, hence a better and more reliable firm performance measure. Carhart (1997) finds that the four-factor model substantially improves, on the average, pricing errors of the Capital Asset Pricing Model (CAPM) and Fama-French (FF) three-factor model.

These are some of the reasons that motive this study to use this four-factor model instead of the more often used methods such as Tobin's q and the Firm Excess Value (Berger and Ofek, 1995) to measure firm performance. The intercept term (α) from the estimated regression, Equation (1), should be positive and statistically significant if the portfolio outperforms the market; negative and statistically significant if the market does better than the observed portfolio. To test the diversificaton effect over firm performance, the alphas from non-diversified and diversified firm portfolios's estimations are compared.

Estimation of Portfolio Performance

Following the formation of the portfolios, the following equation is estimated:

$$Ri,t= \alpha + \beta_1 XMKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 UMD_t + \varepsilon_i \quad (1)$$

where $R_{i,\,t}$ is the monthly portfolio excess return and α is the estimated intercept term that measures the portfolio performance. The *XMKT* ($R_m - R_f$) represents the monthly excess return on the market portfolio.

SMB is intended to capture size effect and represents the monthly difference between the returns on small and big stock portfolios with the same approximate book-to-market equity. *HML* is intended to capture the book-to-market effect and represents the monthly difference in returns between a portfolio of high book-to-market firms and low book-to-market firms. *UMD* is the momentun factor constructed as the equal-weight average of firms with the highest 30 percent 11-month returns lagged one month minus the equal-weight average of firms with the lowest 30 percent eleven-month returns lagged one month. *UMD* is intended to capture cross-sectional return patterns (Carhart, 1997). The random errors are captured by ε_i.

This model is estimated using Ordinary Least Squares (OLS) techniques. The sample is divided into seven four-year periods. The first subperiod starts in 1979 and the last subperiod starts in 2003.
Finally, to measure the diversification effect on firm performance, a test for the equality of means is performed on each comparable set of non-diversified and diversified firm portfolios performance, as measured by their average estimated α's. Statistically significant difference between the diversified and non-diversified portfolios' α denotes the presence of a diversification effect on firm performance.

EMPIRICAL RESULTS

After controlling for other factors that may influence firm's performance, four-factor regression estimates suggest that on average, diversified (multi-segments) firms underperform comparable non-diversified (single-segment) firms. This fact is particularly evident for some specific study sub-periods for which the non-diversified firm performance is statistically significant and positively higher than the performance of the diversified firms. Additional empirical analysis shows that diversification effect on firm performance changes over time, since the diversification discount tends to decline for the second half of the sample period. Moreover, diversified firm performance is better than comparable non-diversified firm performance for particular periods and firms.

For the ten BM reference portfolios, excess returns of non-diversified firms in excess of the risk-free rate ($R_{it}-R_f$) are explained largely by the four-factor model. In these models, the regression coefficients medians of XMKT (R_M-R_f), *SMB*, and *HML* are 0.947, 0.705, and 0.571, respectively. But for the MCAP portfolios the values change to 0.941, 0.561 and 0.414, respectively. The momentum factor is not statistically different from zero for both sets of portfolios. The FF three factors have regression coefficients that are significantly different from zero at 5% significance level. The R^2 statistic median for the BM portfolios is 0.389 and 0.479 for the MCAP portfolios. Thus, the model captures a significant amount of the cross-sectional variation in average stock returns of non-diversified firms.

Estimated coefficients for the four-factor regressions model of the diversified firms show that portfolio excess returns in excess of the risk-free rate ($R_{it}-R_f$) are explained largely by the four-factor regression model. In these models, the median of the regression coefficients of (R_M-R_f), *SMB*, and *HML* are 1.059, 0.386, and 0.338, respectively for the BM reference portfolios. However, for the MCAP portfolios the coefficients are 1.113, 0.504, and 0.505, respectively. The momentum factor is not statistically different from zero for both sets of portfolios. All the FF three factors' regression coefficients are significantly different from zero at 5% significance level. The R^2 statistic median is 0.772 for BM reference portfolios and 0.754 for the MCAP reference portfolios. Thus, the model captures much of the cross-sectional variation of average stock returns of non-diversified firms. The four-factor model captures much of the cross-sectional variation of average stock returns of diversified firms and non-diversified firms. Thus, this factor model may be an effective means of controlling for influencing factors such as market condition, and firm specific characteristics on stock returns other than diversification.

Portfolio performance is assessed as the estimated intercept term from the four-factor regression model. The intercept term should be positive and statistically significant if the portfolio outperforms the market; negative and statistically significant if the market does better than the observed portfolio. Estimated intercept terms for the diversified and non-diversified portfolios are then compared to determine the effect of the diversification decision on firm performance.

Table 2 presents the intercept estimates (alphas) for the four-factor regression model for the whole sample of book-to-market (BM) portfolios and for the different sub-period portfolios. The first column shows the results for the whole sample period. The other columns show the results of the regressions' alphas for the seven four-year sub-periods. P-values of the intercept estimates (α) are reported in parentheses. Each BM portfolio is identified as non-diversified firm portfolio and diversified firm portfolio. For instance, ND-1 refers to the BM portfolio number one for the non-diversified set of firms and D-1 refers to BM portfolio number one for correspondent diversified set of firms.

The results in this table suggest that diversified firms tend to have a lower performance than the comparable non-diversified firms. Although there is no statistical difference between the means of the alpha estimates for the non-diversified and diversified portfolios for the full study period, the performance of the non-diversified firms tends to be better. This can be observed for the BM portfolios ND-2 vs. D-2, ND-4 vs. D-4, ND-5 vs. D-5 and ND-9 vs.D-9.

Some of the sample portfolios are not well specified by the four-factor regression model. These portfolios are ND-1, D-1, D-8 and D-10 from BM reference portfolios during the full period. Some models are not well specified for some sub-periods. When verified for the linear regression assumptions, the residuals of the models are non-normally distributed. Residual's normal probability plots for these models depart from the expected plot straight line (they exhibit a horizontal line). In addition, their histograms do not show a bell shaped form, characteristic of the Gaussian distribution. Non-normally distributed residuals distort the significance of tests resulting in the misspecification of the model. The rest of the estimated models follow the linear regressions assumptions. Estimated models for the MCAP reference portfolios, ND-5, and D-5, as well as several of the estimated models during the sub-periods, also present the same problem. Their residuals are not normally distributed, resulting in the misspecification of those models.

The intercept term estimates (alphas) for the portfolios based on market capitalization (MCAP), although to a lesser extent for the full sample period, present a similar pattern when compared to BM portfolios. Diversified firms tend to underperform non-diversified firms. This trend is only observed in portfolios ND-1 vs. D-1, and ND-9 vs. D-9. The alphas of the rest of the portfolios are not statistically different from zero.

Similar patterns can be observed by examining firm performance for the different four-year sub-periods. The diversified firm portfolios estimates show an inferior performance than the correspondent non-diversified firm portfolios for the MCAP reference portfolios during the 1983-1986, 1991-1994, 1995-1998 time periods, and for the BM portfolios during 2003-2006.
Table 3 presents the results of the test of equality of the means for the non-diversified (ND) and diversified (D) portfolios' estimated alphas. Mean differences for the comparable portfolios of non-diversified and diversified portfolios are reported for each four-year sub period (t-test probability is reported in parenthesis).

Table 2: Intercept Estimates (α's) from OLS Four-Factor Regression Model of the ten Book-to-Market (BM) Portfolios for the Non-Diversified Firms (ND-1 to ND-10) and for the Diversified Firms (D-1 to D-10). P-values are in parenthesis.

BM Portfolios	Four-Year Sub-Periods							
	1979-2006	1979-1982	1983-1986	1987-1990	1991-1994	1995-1998	1999-2002	2003-2006
ND-1	0.039[a]	0.014**	0.000	0.013	0.006	0.119[a]	0.038	0.043[a]
	(0.072)	(0.092)	(0.974)	(0.463)	(0.355)	(0.482)	(0.171)	(0.024)
D-1	0.027[a]	-0.003	-0.012*	-0.004	0.048[a]	0.002	-0.003	0.192[a]
	(0.282)	(0.751)	(0.032)	(0.397)	(0.264)	(0.734)	(0.534)	(0.344)
ND-2	0.016*	0.007	0.014*	0.008*	0.007*	0.010	0.056[a]	0.000
	(0.016)	(0.268)	(0.015)	(0.032)	(0.048)	(0.157)	(0.224)	(0.963)
D-2	0.006*	0.009*	0.007*	0.004	0.007*	0.004	0.009**	0.002
	(0.000)	(0.033)	(0.035)	(0.275)	(0.040)	(0.208)	(0.093)	(0.338)
ND-3	0.008	0.003	0.005	0.004	0.014	0.000	0.002	0.005
	(0.362)	(0.635)	(0.370)	(0.277)	(0.797)	(0.967)	(0.736)	(0.257)
D-3	0.003*	0.008*	0.005*	0.007*	0.002	0.004	0.004	0.001
	(0.022)	(0.016)	(0.018)	(0.015)	(0.352)	(0.275)	(0.392)	(0.738)
ND-4	0.006*	0.007	-0.001	0.008	0.008**	0.007	0.007	0.009*
	(0.010)	(0.302)	(0.833)	(0.125)	(0.089)	(0.224)	(0.341)	(0.070)
D-4	0.004*	0.005	0.009	0.006*	0.004*	0.001	0.006	-0.001
	(0.016)	(0.214)	(0.141)	(0.010)	(0.056)	(0.674)	(0.125)	(0.540)
ND-5	0.009*	0.007	0.005	0.011*	0.017*	-0.003	0.005	0.039[a]
	(0.007)	(0.105)	(0.412)	(0.032)	(0.010)	(0.686)	(0.540)	(0.029)
D-5	0.001	0.001	0.000	0.001	0.001	0.000	0.012*	0.003
	(0.286)	(0.735)	(0.863)	(0.588)	(0.581)	(0.950)	(0.014)	(0.334)
ND-6	0.004	0.004	-0.001	0.005	-0.001	0.005	0.015*	0.002
	(0.211)	(0.397)	(0.841)	(0.439)	(0.767)	(0.321)	(0.030)	(0.921)
D-6	0.002	-0.002	0.004	0.004	0.002	0.000	0.008*	0.000
	(0.249)	(0.561)	(0.154)	(0.176)	(0.456)	(1.000)	(0.030)	(0.991)
ND-7	0.002	0.005	-0.003	0.003	0.004	0.003	-0.004	0.013
	(0.364)	(0.362)	(0.612)	(0.663)	(0.392)	(0.575)	(0.491)	(0.107)
D-7	-0.002	-0.002	0.001	0.001	-0.002	-0.004	0.003	-0.004
	(0.149)	(0.537)	(0.723)	(0.788)	(0.596)	(0.102)	(0.450)	(0.223)
ND-8	0.003	-0.001	0.002	-0.006	0.008	0.004	0.014*	0.002
	(0.167)	(0.819)	(0.673)	(0.514)	(0.312)	(0.639)	(0.031)	(0.854)
D-8	0.367[a]	-0.004	0.001	0.002	-0.004	-0.001	0.000	4.129[a]
	(0.219)	(0.107)	(0.681)	(0.404)	(0.231)	(0.673)	(0.965)	(0.089)
ND-9	0.005	0.000	0.000	-0.006	0.003	-0.002	0.012	0.257[a]
	(0.316)	(0.953)	(0.941)	(0.355)	(0.775)	(0.773)	(0.575)	(0.473)
D-9	-0.006*	-0.007*	-0.008*	-0.004	-0.002	-0.008*	0.000	-0.010*
	(0.000)	(0.039)	(0.005)	(0.285)	(0.545)	(0.043)	(0.941)	(0.026)
ND-10	0.002	-0.017*	-0.013*	-0.006	0.008	0.006	0.016[a]	0.019*
	(0.635)	(0.003)	(0.075)	(0.514)	(0.499)	(0.536)	(0.260)	(0.054)
D-10	0.021[a]	-0.013*	-0.010*	-0.011*	0.003	-0.006	-0.008	0.140[a]
	(0.622)	(0.001)	(0.035)	(0.078)	(0.584)	(0.346)	(0.329)	(0.682)

*Note. * and ** denote at 5% and 10% significance level; [a] model is not well specified*

The evidence suggests that diversified (multi-segments) firms underperform their matched non-diversified (single-segment) firms. This is especially true during the above mentioned specific sub-periods (MCAP reference portfolios during the 1983-1986, 1991-1994, 1995-1998 time periods, and for the BM portfolios during 2003-2006), when the diversified and non-diversified performance differences are statistically significant. During these specific sub-periods the performance estimates for the non-diversified portfolios are better than those of the diversified portfolios.

The fact that the difference between estimated performance for the non-diversified and diversified portfolios is statistically significant for only some sub-periods, suggests that the diversification effect on firm performance varies over time. Thus, the second set of regressions test the influence of time over the diversification effect on firm performance. Evidently, it is conceivable that differences in the time frame covered by different studies could be a factor contributing to the observed results. It is important to remember that to test the diversification effect on firm performance over time, only firms that survived the 28 year study period are included in this sub-sample. This is done to avoid portfolio composition changes and to track the same firms the whole sample period and through the four-year sub-periods.
Is important to comment that the 'survivorship bias' may have influenced this results since only active firms were included for the 28 year sample period. Elton, Gruber, and Blake (1996) survivorship bias estimation method was used to estimate the survivorship bias for the sample. A survivorship bias of 15 basis points per annum is observed. This number is expected to be larger given the higher variance of the securities. Therefore, it is assumed that the survivorship bias is negligible for this sample results.

Table 3: Test Of Equality Of Means From Non-Diversified (ND) And Diversified (D) Portfolios Estimated Alphas.

	Mean difference between (t- Test Probability)						
1979-2006	1979-1982	1983-1986	1987-1990	1991-1994	1995-1998	1999-2002	2003-2006
	Book-to-Market Reference Portfolios						
0.0024	0.000	0.0019	0.0017	0.0021	0.0008	0.000	0.0039**
(0.247)	(1.000)	(0.509)	(0.403)	(0.310)	(0.343)	(1.000)	(0.057)
	Market Capitalization Reference Portfolios						
0.0036	0.0003	0.0021**	0.0025	0.0056*	0.0025**	0.0017	0.000
(0.139)	(0.377)	(0.089)	(0.151)	(0.008)	(0.084)	(0.171)	(1.00)

*Note. * and ** denote at 5% and 10% significance level*

Table 4 presents the intercept estimates (α's) from the OLS four-factor regression of the five BM portfolios for the non-diversified firms (ND-1 to ND-5) and for the diversified firms (D-1 to D-5). The results in this table provide evidence that the diversification effect on firm performance is time dependent and influenced by the market conditions. Although for the full sample period the difference between non-diversified and diversified performance means is not statistically different from zero, some interesting trends are observed during several sub-periods. Surprisingly, performance of the diversified firm portfolios is better than the comparable non-diversified firm performance for BM portfolios.

This is observed for ND-1vs. D-1 and ND-2 vs. D-2, especially for the sub-periods 1991-1994, 1995-1998, 1999-2002 and 2003-2006. These periods follow the economic recession of 1990-91 and coincide with the 10-year U.S. economic expansion of 1991-2001. These performance results are consistent with Hill (1983), Ciscel and Evans (1984), and Amit and Livnat (1988a). Relative diversified firm performance is better during expansionary periods. During the previous sub-periods, there is no significant difference between the non-diversified and diversified firm portfolios. Estimated performance for BM reference portfolios 3 and 4 are not statistically significant for both, the non-diversified and diversified firms.

Non-diversified and diversified portfolios, ND-5 and D-5 respectively, show negative performance results. This is consistent with the value versus growth investing strategies. The fifth portfolio is comprised of value stock firms that usually trade lower than their current intrinsic value. Hence, in comparison with the first and second set of portfolios (growth stock firms), these portfolios underperform. For the market capitalization (MCAP) reference portfolios, only three out of ten portfolios show statistically significant performance at a 10% significance level: ND-2, D-4, and ND-5. For the rest of the portfolios it is not statistically significant. Significant patterns or trends are not observed between the non-diversified and diversified firm performances, either for the full period or any sub-periods.

Table 4: Intercept Estimates (α's) from OLS Four-Factor Regression Model of the five Book-to-Market (BM) Portfolios for the Non-Diversified Firms (ND-1 to ND-5) and for the Diversified Firms (D-1 to D-5). P-values of estimated alphas (α) are in parenthesis.

BM Portf.[1]	Four-Year Sub-Periods							
	1979-2006	1979-1982	1983-1986	1987-1990	1991-1994	1995-1998	1999-2002	2003-2006
ND-1	0.013*	0.010	0.012	0.017*	0.016*	0.016*	0.015*	0.005
	(0.000)	(0.245)	(0.163)	(0.041)	(0.004)	(0.017)	(0.055)	(0.438)
D-1	0.011*	-0.011	0.005	0.017**	0.014*	0.022*	0.028*	0.017*
	(0.006)	(0.449)	(0.465)	(0.076)	(0.055)	(0.022)	(0.043)	(0.043)
ND-2	0.008*	0.008	0.013*	0.008	0.021*	-0.003	0.001	0.010*
	(0.007)	(0.465)	(0.092)	(0.140)	(0.002)	(0.662)	(0.001)	(0.024)
D-2	0.009*	0.015*	0.016*	0.009	-0.002	0.011*	0.018*	0.006
	(0.000)	(0.055)	(0.002)	(0.125)	(0.638)	(0.032)	(0.005)	(0.167)
ND-3	0.001	0.003	0.010	0.013*	-0.009	0.001	-0.003	-0.002
	(0.701)	(0.667)	(0.202)	(0.035)	(0.120)	(0.927)	(0.673)	(0.867)
D-3	0.003	0.007	0.011	0.007**	-0.002	-0.002	0.006	-0.003
	((0.360)	(0.300)	(0.460)	(0.071)	(0.630)	(0.623)	(0.432)	(0.589)
ND-4	0.000	0.004	-0.006	0.005	0.007	-0.012	0.007	-0.004
	(0.952)	((0.651)	(0.335)	(0.477)	(0.500)	(0.136)	(0.377)	(0.644)
D-4	-0.002	0.009	0.004	-0.002	0.005	-0.016*	-0.002	-0.008
	(0.317)	(0.326)	(0.482)	(0.719)	(0.422)	(0.000)	(0.491)	(0.124)
ND-5	-0.016*	-0.008	-0.011	-0.021	-0.022[a]	-0.007	-0.013*	-0.019
	(0.000)	(0.197)	(0.363)	(0.013)	(0.212)	(0.491)	(0.077)	(0.134)
D-5	-0.008**	-0.011*	0.005	-0.015*	-0.004[a]	0.007[a]	-0.026*	-0.026[a]
	(0.071)	(0.006)	(0.741)	(0.006)	(0.682)	(0.676)	(0.015)	(0.015)

*Note. [1] Once the portfolio is set the first year of the study (1979) it is not allowed to change through the subsequent sub-periods to detect any variation of the diversification effect on firm performance, controlling for firm specific characteristics. * and ** denote significance at 5% and 10% respectively. [a] denote that model is not well specified. N=324 observations for full period. N=48 observations for each 4-year sub-period. R^2 range = 0.604-0.187 (0.415 average).*

CONCLUSIONS

The debate between the benefits and the costs of diversification still continues. There is a large amount of literature providing evidence both in favor and against the diversification effect on firm performance.

Many studies suggest that diversification deteriorates firm value or firm performance (Berger & Ofek 1995; Lang & Stulz 1994; Servaes 1996). Many other researchers claim that refocusing creates value or improves firm performance (Berger & Ofek, 1999; Comment & Jarrell 1995, Daley, Mehrotra, & Sivakumar (1997); John & Ofek, 1995). Other studies simply argue that the aforementioned studies suffer from econometric problems and that the results of these studies are based on samples or methodologies that may not be adequate.

The costs of a reduction in firm performance of a diversified firm may arise from inefficient allocation of capital among divisions of a diversified firm (Lamont & Polk 2001; Scharfstein & Stein 2000, Rajan *et al.* 2000). Agency problems in a diversified firm can also generate costs of diversification. These problems, resulting from sub-optimal behavior of divisional managers, may occur in a diversified firm due to opportunistic behavior of divisional managers, information asymmetries between central management and divisional managers, and the difficulty of designing optimal incentive compensation schemes to eliminate agency costs (Aggarwal & Samwick, 2003; Denis *et al.,* 2002; Harris *et al.,* 1982; Jensen, 1988). Despite that several studies find that diversification may have a negative impact on firm performance, other studies find contradictory results.

The benefits that arise from diversification may come from different sources. For example, they may come from managerial economies of scale (Chandler, 1977) or from more efficient resource allocation through internal capital markets (Stein, 1997; Stulz, 1990). Other studies suggest that those benefits may appear due to the diversified firm's ability to internalize market failures (Khana & Palepu, 2000), or higher productivity of diversified firms (Schoar, 2002).

On the contrary, other studies concentrate on issues that shed doubt on the above justifications or on the existence of the "diversification discount". Some of these studies find that there are sample selection and measurement error problems associated to studies that examine the "diversification discount". Whited (2001), for example, demonstrates that there is a serious measurement error associated with Tobin's q, and that the investment-q regressions lead to an erroneous conclusion of inefficient internal capital markets. Mansi and Reeb (2002) find no losses associated to diversification; there is only a value transfer from shareholders to bondholders. Alternatively, the "diversification discount" may not be a result of diversification, but rather the results from merging activity between one or more "discounted" firms (Graham et al., 2002). This discount may have induced the firms to diversify in the first place, and thus the direction of causality is unclear (Matsusaka, 2001). Similarly, the evidence in Hubbard and Pahlia (1999) show that most conglomerate mergers in the 1960s involved financially distressed firms.

Because there is no consensus in the literature regarding the link between corporate diversification and firm performance, the purpose of this work was to empirically examine the marginal effect of diversification on firm performance. The four-factor model based on Fama and French (1993) three-factor model plus the momentum factor (Carhart, 1997) were used to estimate the diversification effect on firm performance and to control for other influencing factors over performance. The performance of the ten value reference portfolios and the ten size reference portfolios of separate diversified and non-diversified firms were compared using Jensen's alpha as the performance indicator. Furthermore, this work attempts to shed some light on the diversification time-varying effect.

Although for the full period, differences between non-diversified and diversified firm performance are not statistically different from zero, non-diversified firms show a tendency to outperform the diversified firms. When examining for the performance difference during different study sub-periods, statistical significance is observed between several portfolios at specific sub-periods. These results suggest a negative relationship between diversification and firm performance.

Longitudinal analysis results suggest that diversification effect may be different across time, depending on external factors that may influence the firm. Despite that for the full period there is no difference between non-diversified and diversified firm performance, estimated performance results from several of the study sub-periods show some interesting trends. It is observed that during the periods between 1995-1998, 1992-2002, and 2003-2006, diversified firms from the lower BM portfolios, outperform non-diversified firms. Precisely, these sub-periods coincide with the U.S. 10-year economic expansion period (1991-2001). This evidence suggests that during economy upturns, diversified firms tend to outperform non-diversified firms. These findings are consistent with Hill (1983) and Ciscel and Evans (1984).

Hill (1983) concludes that the performance of the conglomerates improves significantly more than that of non-conglomerates during the upturn. The author also finds that these firms deteriorate more rapidly during the downturn in comparison to the two non-conglomerate categories. Ciscel and Evans (1984) find that moderate levels of diversification improve relative performance in expansionary periods, while high levels of diversification generally hurt performance during recessionary periods.

The main contribution of this research is twofold. First, this study uses a larger and more recent sample of U.S. publicly traded firms. By using this sample, this study finds evidence that supports the postulated negative diversification-performance relationship. Second, it finds evidence on the diversification time-varying effect. Understanding the circumstances of diversification effects on firm performance is not only interesting for the academic point of view; it is important for investment markets, as well as for firm management. A better knowledge of the drivers of diversification and its effects on firm performance should allow investors to improve their strategic and tactical asset allocation decisions. Managerial or investment decisions must be carefully taken, considering temporal effects, market and economic conditions.

As in all studies, this research has its limitations. One of its main caveats arises from the limitation to use only the Compustat Segment Database. This database is not always clear about the reported segments for a firm (Villalonga, 2004; Graham et al. 2002). Limitations with respect to intra-segment information do not allow to estimate firm diversification level using more sophisticated and accurate measures, and to replicate other studies such as Berger and Ofek (1995).

Future research in this area can be pursued along several avenues. It is important to carefully continue evaluating the performance of diversified firms using a variety of samples and empirical methodologies. To test the hypothesis that the effect of diversification on firm performance is not a consequence of measurement errors, one sample should be analyzed using several of the most frequently used methodologies such as: Berger and Ofek (1995) firm excess value; Tobin's q; four-factor model, and propensity score matching (Villalonga 2004). In this way the issue of using different samples from different data sources is resolved, giving tests results more credibility.

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MULTI-FACTOR APPROACH FOR PRICING BASKET CREDIT LINKED NOTES UNDER ISSUER DEFAULT RISK

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ABSTRACT

This article proposes a multi-factor approach to incorporate issuer default risk into basket credit linked note (BCLN) pricing based on the Gaussian copula. The numerical analysis demonstrates that the issuer default risk increases the fair coupon rate. Contradicting the common belief that a positive default correlation between reference entities and an issuer increases the possibility of double losses and disfavors the BCLN holder, thereby driving up the BCLN coupon rate, analytical results reveal that a positively correlated issuer default mitigates this increase, while a negatively correlated issuer default increases the coupon rate further.

JEL: G01; G12; G13

KEYWORDS: Basket credit linked notes, issuer default risk, default correlation, factor copula, financial crisis

INTRODUCTION

Multi-name credit derivatives, which linked to a portfolio of underlyings subject to credit risk, recently have become popular. Basket credit linked note (BCLN) is one such product. BCLN is a note with a price or coupon linked to credit events of reference entities (obligations). The conventional form of BCLN is the kth-to-default BCLN. The BCLN holder (the protection seller) pays the notional principal to the BCLN issuer (the protection buyer) at the start of the contract and receives the coupon payments until either the kth default or the contract maturity, whichever occurs earlier. If the kth default occurs before contract maturity, the BCLN holder receives the recovered value of the reference entity from the BCLN issuer. Otherwise, the BCLN holder receives the notional principal back on contract maturity. In derivative markets, the issuer default risk is attracting considerable attention because of the recent financial turmoil and collapses of large financial institutions. If the BCLN issuer defaults, the BCLN holder will not receive the recovered value of the reference entity as the credit event happens, nor the notional amount at the contract maturity. The coupon payments also ceases due to the issuer default. Thus the issuer default results in a large loss. Therefore, it is important to incorporate issuer default risk in BCLN pricing to obtain a reasonable coupon rate.

This article focuses on how to incorporate issuer default risk into the BCLN pricing under the factor Gaussian copula framework. A new random variable corresponding to the issuer default time is introduced in this model. Numerical analysis reveals that issuer default risk increases the fair coupon rate and a negatively correlated issuer default increases the coupon rate further, while a positively correlated issuer default mitigates this increase. Moreover, considering the issuer default risk results in an asymmetric coupon rate curve and the asymmetry increases with the impact of the issuer default.

The remainder of this article is organized as follows. The Literature Review section reviews literature on the issuer default risk and the factor Gaussian copula model. The Methodology section describes the process for pricing a BCLN under the framework of factor Gaussian copula model and the proposed method for incorporating issuer default event into BCLN pricing. The Numerical Analysis and Simulation Results section summarizes the numerical analysis results and discusses the implication of the results.

Conclusions are finally drawn in the Concluding Comments section, along with recommendations for future research.

LITERATURE REVIEW

Two main approaches exist to model the default risk in the literature: the structural and reduced form models. The structural model was developed by Merton (1974), and defined default events as occurring when firm asset value falls below firm debt. The reduced form model, also known as the intensity model, was developed by Jarrow and Turnbull (1995). This model views the default event as an unexpected exogenous stochastic event and uses market data to estimate the default risk.

Hull and White (2000) provided a methodology for valuing credit default swap (CDS) without counterparty default risk when the payoff is contingent on the default of a single reference entity. Hull and White (2001) also developed a model of default correlations between different corporate or sovereign entities. The model of Hull and White is an extension of the structural model, sets a credit index variable for each reference entity, and selects correlated diffusion processes for the credit indexes. Their model defines default as the credit index falling below the predetermined default barriers. Monte Carlo simulation is used to calculate the vanilla CDS and basket default swap (BDS) spread given the possibility of seller default. Based on the reduced form model, Jarrow and Yu (2001) indicated that ignoring counterparty relationship causes the mispricing of the credit instruments.

Hui and Lo (2002) developed a model to price the single-name credit linked note (CLN) with issuer default risk using the framework of Merton's model. They demonstrated that the credit spreads of a CLN increase non-linearly with decreasing correlation between the reference entity and the issuer. Kim and Kim (2003) valued single-name CDS and BDS by considering counterparty default risk, as well as correlated market and credit risk. According to their results, the pricing error is substantial by ignoring the correlation between counterparty and reference credit. Leung and Kwok (2005) valued a single-name CDS with counterparty risk by using the reduced form model. According to their results, the swap premium becomes slightly lower when the protection seller has a higher correlation with the reference entity. Leung and Kwok (2009) analyzed the counterparty risk for multi-name CDS based on the Markov chain model with interactive default intensity. Their results indicated that the correlated risk between the protection seller and underlying entity can significantly impact swap rates under a high arrival rate of the external shock, which determines the default correlation and the increment of default intensities for various parties.

Pricing multi-name credit derivatives such as BCLN requires a joint distribution model of the reference entity default times. However, whether using the structural or reduced form models, valuing the multi-name credit derivative is computationally complex. Thus the copula function (Sklar, 1959), also known as the dependence function, which simplifies the estimation of the joint distribution, recently has been widely used to price the multi-name credit derivatives. Li (1999, 2000) first introduced the copula function to deal with the dependence structure in multi-name credit derivative pricing. Li assumed the default times of reference entities to be Poisson processed, and set the dependence structure as a Gaussian copula function. Finally, Li performed Monte Carlo simulation to obtain the default times. Mashal and Naldi (2003) applied Li's method to analyze how the default probabilities of the protection sellers and buyers affect BDS spread. While pricing the single-name CDS with counterparty risk based on the continuous-time Markov model, Walker (2006) indicated that using a time-dependent correlation coefficient can improve the market-standard Gaussian copula approach. By connecting defaults through a copula function, Brigo and Chourdakis (2009) found that when the counterparty risk is involved, both the default correlation and credit spread volatility impact the contingent CDS value.

However, the computational complexity of the Monte Carlo simulation with Gaussian copula increases with number of reference entities. The factor copula method, which makes the default event conditional on independent state variables, was introduced to deal with these problems. Andersen *et al*. (2003) found that one or two factors provide sufficient accuracy for the empirical correlation matrices one encounters in credit basket applications. Hull and White (2004) employed a multi-factor copula model to price the k th-to-default swap and collateralized debt obligation (CDO). Moreover, Laurent and Gregory (2005) used one factor Gaussian copula to simplify the dependence structure of reference entities, and applied this approach to price BDS and CDO. Wu (2010) developed three alternative approaches to price BCLN with issuer default risk using only one correlation parameter and showed that the impact of issuer default differs with changes in the correlation structure. On the other hand, acceleration techniques such as the importance sampling method and others are used to improve the simulation efficiency. Chiang *et al.* (2007) and Chen and Glasserman (2008) applied the Joshi-Kainth algorithm (Joshi and Kainth, 2004), and Bastide et al. (2007) used the Stein method (Stein, 1972) for the multi-name credit derivative pricing to reduce variance of the simulation results.

METHODOLOGY

Copula is a function which links the univariate marginal distributions $F_i(x_i),\ i = 1, 2, \ldots, N,$ to their full multivariate distribution $F(x_1, x_2, \ldots, x_N)$:

$$F(x_1, x_2, \ldots, x_N) = C(F_1(x_1), F_2(x_2), \ldots, F_N(x_N)) \tag{1}$$

where $F_i(x_i) \sim U(0, 1)$. The most widely used copula function is the Gaussian copula and its definition is as follows:

$$C^{Ga}(u_1, u_2, \ldots, u_n) = \Phi_R(\phi^{-1}(u_1), \phi^{-1}(u_2), \ldots, \phi^{-1}(u_n)) \tag{2}$$

where Φ_R denotes a multivariate cumulative normal (Gaussian) distribution, R represents the correlation coefficient matrix, and ϕ^{-1} is the inverse function of one dimensional cumulative normal distribution. Consider a credit portfolio which contains N reference entities, the default times of each reference entity are $\tau_1, \tau_2, \ldots, \tau_N$, respectively. According to the reduced form model, each reference entity default follows a Poisson process. The cumulative default probability before time t is:

$$F_i(t) = P(\tau_i \le t) = 1 - e^{-\lambda_i t}, \quad i = 1, 2, \ldots, N \tag{3}$$

where λ_i is the hazard rate of the reference entity i. Because $F_i(t) \sim U(0, 1)$, applying the Gaussian copula obtains the multivariate joint distribution of default times, as follows:

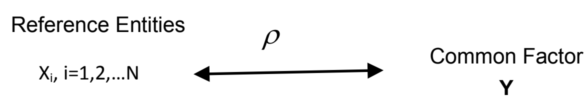
$$F(\tau_1, \tau_2, \ldots, \tau_N) = \Phi_R(\phi^{-1}(F_1(\tau_1)), \phi^{-1}(F_2(\tau_2)), \ldots, \phi^{-1}(F_N(\tau_N))) \tag{4}$$

Let X_i represent the normal random variable corresponding to the default time of the reference entity i. In the one factor model, the default time of reference entity i depends on a common factor Y and a firm specific risk factor ε_{X_i}. Y and ε_{X_i} are independent standard normal variables. Thus X_i can be created via Cholesky decomposition, as follows:

$$X_i = \rho_{X_iY} Y + \sqrt{1-\rho_{X_iY}{}^2}\,\varepsilon_{X_i}, \quad i = 1, 2, \ldots, N \tag{5}$$

where ρ_{X_iY} denotes the correlation coefficient between the reference entity X_i and the common factor Y. One factor Gaussian copula model with constant pairwise correlations has become the standard market model. In the standard market model, all ρ_{X_iY} in Eqn. (5) are equal to ρ, then the constant pairwise correlation $\rho_{X_iX_j}$ ($i \neq j$) will be ρ^2. The idea of one factor Gaussian copula is shown in Figure 1.

Figure 1: One Factor Gaussian Copula.



This figure shows the relationship between the reference entity variables X_i and the common factor Y in the one factor Gaussian copula. ρ denotes the correlation coefficient between the reference entity X_i and the common factor Y.

Let $X_1 = \phi^{-1}(F_1(\tau_1))$, $X_2 = \phi^{-1}(F_2(\tau_2))$, $\ldots$, $X_N = \phi^{-1}(F_N(\tau_N))$, by mapping τ_i and X_i, we can simulate the default time of the reference entity i using the following equation:

$$\tau_i = F_i^{-1}(\phi(X_i)) = \frac{-\ln(1-\phi(X_i))}{\lambda_i}, \quad i = 1, 2, \ldots, N \tag{6}$$

The conventional form of BCLN is the k th-to-default BCLN. Consider a k th-to-default BCLN involving N reference entities which the notional principal of each reference entity is one dollar. The coupon rate is c. The coupon (the notional principal multiplied by the coupon rate) is paid annually, and the payment dates are $t_i, i = 1, 2, \ldots, T$. The maturity date of the BCLN is t_T. Furthermore, τ_k is the k th default time, and $\tau_1 < \tau_2 < \cdots < \tau_N$. δ_k is the recovery rate of the k th default reference entity. Thus δ_k denotes the redemption proceeds (the notional principal multiplied by the recovery rate) which the issuer pays to the BCLN holder on the k th default. The discount rate is $r\%$. Finally, Q denotes the risk-neutral probability measure, and $I(\cdot)$ is an indicator function. The value of a k th-to-default BCLN can be represented as follows:

$$BCLN = E^Q\left[c \times \sum_{i=1}^{T} e^{-rt_i} I(t_i < \tau_k) + \delta_k \times e^{-r\tau_k} \times I(\tau_k \leq t_T) + e^{-rt_T} \times I(\tau_k > t_T)\right] \tag{7}$$

Let the above equation equals one, the equation can be rewritten as:

$$c \times E^{Q}\left[\sum_{i=1}^{T} e^{-rt_i} I(t_i < \tau_k)\right] = E^{Q}\left[1 - \delta_k \times e^{-r\tau_k} \times I(\tau_k \le t_T) - e^{-rt_T} \times I(\tau_k > t_T)\right] \tag{8}$$

Rearranging Eqn. (8) can yield the fair coupon rate at the start of the BCLN as follows:

$$c = \frac{E^{Q}\left[1 - \delta_k \times e^{-r\tau_k} \times I(\tau_k \le t_T) - e^{-rt_T} \times I(\tau_k > t_T)\right]}{E^{Q}\left[\sum_{i=1}^{T} e^{-rt_i} I(t_i < \tau_k)\right]} \tag{9}$$

By using W runs of Monte Carlo simulation to price the BCLN, the fair value of the coupon rate c is:

$$c = \frac{\sum_{s=1}^{W}\left[1 - \delta_k^s \times e^{-r\tau_k^s} \times I(\tau_k^s \le t_T) - e^{-rt_T} \times I(\tau_k^s > t_T)\right]}{\sum_{s=1}^{W}\left[\sum_{i=1}^{T} e^{-rt_i} I(t_i < \tau_k^s)\right]} \tag{10}$$

where δ_k^s denotes the recovery rate of the k th default reference entity at the s th simulation, and τ_k^s represents the k th default time at the s th simulation.

In order to incorporate the issuer default into the BCLN pricing, this article introduces a new normal random variable Z corresponding to the issuer default time. The default time of reference entity i now depends on the two common factors Y and Z, and a firm specific risk factor ε_{X_i}. Y, Z and ε_{X_i} are independent of each other. Thus X_i, which is the normal random variable corresponding to the default time of the reference entity i is obtained as follows:

$$X_i = \rho_{X_iY} Y + \rho_{X_iZ} Z + \sqrt{1 - \rho_{X_iY}^2 - \rho_{X_iZ}^2}\,\varepsilon_{X_i} \tag{11}$$

where ρ_{X_iZ} denotes the correlation coefficient between X_i and Z. To ensure that only the real number is applied in the above equation and use only one correlation coefficient ρ, this article proposes an improved model in which

$$\rho_{X_iY} = \sqrt{\alpha}\rho \tag{12}$$

$$\rho_{X_iZ} = \sqrt{1-\alpha}\rho \tag{13}$$

then

$$\sqrt{1-\rho_{X_iY}^2-\rho_{X_iZ}^2}=\sqrt{1-\rho^2} \tag{14}$$

Thus Eqn. (11) is modified as follows:

$$X_i=\sqrt{\alpha}\rho Y+\sqrt{1-\alpha}\rho Z+\sqrt{1-\rho^2}\varepsilon_{X_i} \tag{15}$$

The parameter α decides the proportional influences of the common factor Y and the issuer default Z. In the extreme case, when $\alpha=1$, the common factor Y and the firm specific risk factor ε_{X_i} together fully determine the default time of the reference entity as follows:

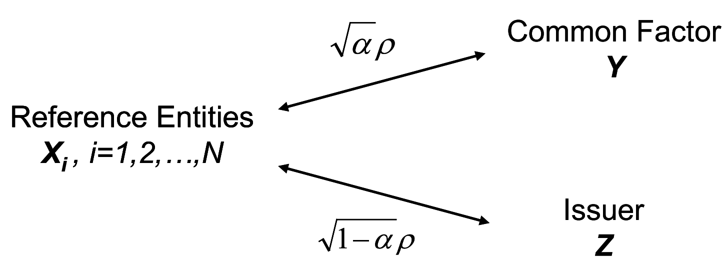
$$X_i=\rho Y+\sqrt{1-\rho^2}\varepsilon_{X_i} \tag{16}$$

On the other hand, when $\alpha=0$, the default time is solely determined by another common factor Z, which represents the issuer default event, and the firm specific risk factor ε_{X_i}:

$$X_i=\rho Z+\sqrt{1-\rho^2}\varepsilon_{X_i} \tag{17}$$

The relationships between X_i, Y and Z are shown in Figure 2.

Figure 2: Relationships between X_i, Y and Z in the Proposed Model.



This figure shows the relationship between the reference entity variables X_i, the issuer default variable Z and the common factor Y in the proposed model. The parameter α decides the proportional influences of the common factor Y and the issuer default variable Z.

In situations involving issuer default risk, it is necessary to consider whether the issuer default occurs before or after the kth default. This article defines $\hat{\tau}$ as the issuer default time and $\hat{\delta}$ as the issuer recovery rate. The BCLN holder gets back the recovered value of the reference obligation if the kth default occurs before both the issuer default time $\hat{\tau}$ and maturity date t_T. If the issuer default occurs before the kth default and maturity date, the issuer will not provide the BCLN holder with the redemption proceeds and stop the coupon payments. In this situation, the notional principal multiplied by the issuer recovery rate is returned to the BCLN holder. To obtain all of the notional principal back, both the kth default time and the issuer default time must be later than the contract maturity date. Thus, the value of a kth-to-default BCLN with issuer default risk is modified as follows:

$$BCLN = E^{Q}\left[\begin{array}{l} c \times \sum_{i=1}^{T} e^{-rt_i} I\big(t_i < \min(\tau_k, \hat{\tau})\big) + \delta_k \times e^{-r\tau_k} \times I\big(\tau_k < \min(\hat{\tau}, t_T)\big) \\ + \hat{\delta} \times e^{-r\hat{\tau}} \times I\big(\hat{\tau} < \min(\tau_k, t_T)\big) + e^{-rt_T} \times I\big(t_T < \min(\tau_k, \hat{\tau})\big) \end{array}\right] \quad (18)$$

Therefore, the fair value of the coupon rate c with issuer default risk is:

$$c = \frac{\sum_{s=1}^{W}\left[\begin{array}{l} 1 - \delta_k^s \times e^{-r\tau_k^s} \times I\big(\tau_k^s < \min(\hat{\tau}^s, t_T)\big) \\ - \hat{\delta} \times e^{-r\hat{\tau}^s} \times I\big(\hat{\tau}^s < \min(\tau_k^s, t_T)\big) - e^{-rt_T} \times I\big(t_T < \min(\tau_k^s, \hat{\tau}^s)\big) \end{array}\right]}{\sum_{s=1}^{W}\left[\sum_{i=1}^{T} e^{-rt_i} I\big(t_i < \min(\tau_k^s, \hat{\tau}^s)\big)\right]} \quad (19)$$

where δ_k^s and τ_k^s are defined as in Eqn. (10), and $\hat{\tau}^s$ represents the issuer default time at the sth simulation.

NUMERICAL ANALYSIS AND SIMULATION RESULTS

This article adopts a five-year BCLN with three reference entities as an example of numerical analysis. All three reference entities have notional principal one dollar, hazard rate 5% and recovery rate 30%. Furthermore, the coupon is paid annually, the hazard rate and recovery rate of the issuer is 1% and 30%, respectively. Sixty-thousand runs of Monte Carlo simulation are executed to calculate the coupon rates and the results are shown in Figure 3.

According to the proposed model, the correlation between the reference entities X_i and X_j, i.e. $\rho_{X_iX_j}$, is derived as follows:

$$\begin{aligned} \rho_{X_iX_j} &= corr\left(\sqrt{\alpha}\rho Y + \sqrt{1-\alpha}\rho Z + \sqrt{1-\rho^2}\varepsilon_{X_i}, \sqrt{\alpha}\rho Y + \sqrt{1-\alpha}\rho Z + \sqrt{1-\rho^2}\varepsilon_{X_j}\right) \\ &= \alpha\rho^2 + (1-\alpha)\rho^2 \\ &= \rho^2 \end{aligned} \quad (20)$$

ρ^2 is positively correlated to $|\rho|$. As shown in Figure 3(a), the coupon rate of the first-to-default is negatively correlated with $|\rho|$, because the probability of the first-to-default (k=1) occurring increases as $|\rho|$ decreases. Conversely, as shown in Figure 3(b) and (c), the coupon rate of the second (k=2) and third-to-default (k=3) is positively correlated with $|\rho|$, because the probability of the joint default increases as $|\rho|$ increases.

Figure 3: Comparisons for the k th-to-default BCLN Coupon Rates without and with Issuer Default Risk: (a) k =1; (b) k =2; (c) k =3.

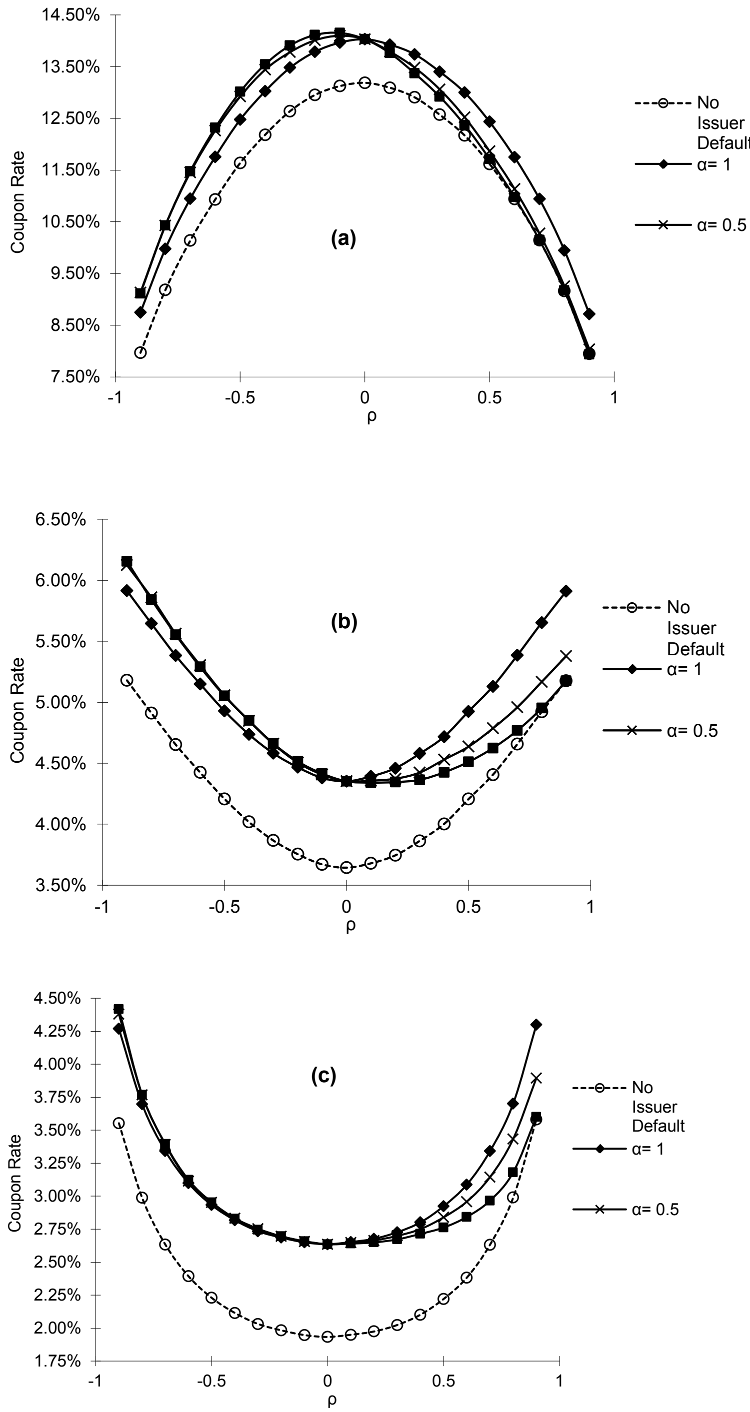


Figure 3(a) shows that the coupon rate of the first-to-default is negatively correlated with $|\rho|$*, because the probability of the first-to-default (*k *=1) occurring increases as* $|\rho|$ *decreases. Conversely, as shown in Figure 3(b) and (c), the coupon rate of the second (*k *=2) and third-to-default (*k *=3) is positively correlated with* $|\rho|$*, because the probability of the joint default increases as* $|\rho|$ *increases.*

Figure 3 indicates that coupon rates with issuer default risk exceed those without issuer default risk, while Table 1 to Table 3 present the relevant data. The maximum increments in coupon rates due to the existence of issuer default exceed 100bps in the first-to-default of Table 1, 90bps in the second-to-default of Table 2, and 80bps in the third-to-default in Table 3. The coupon rates raise mostly when ρ is negative and $\alpha = 0$. The issuer default risk appears to affect the three contracts similarly.

The coupon rate curves of different α intersect at the point $\rho = 0$. When ρ is negative, i.e. the correlation $\rho_{X_iZ}\ (= \sqrt{1-\alpha}\rho)$ between the reference entities and the issuer default is negative, the coupon rate increases as α approaches zero (the reference entities default time is only determined by Z and ε_{X_i}). On the other hand, when ρ is positive, i.e. ρ_{X_iZ} is positive, the coupon rate decreases as α approaches zero. This contradicts the common belief that the positive default correlation increases the possibility of double defaults of the reference entities and the issuer, thus disfavoring the BCLN holder and driving up the BCLN coupon rate.

Table 1: First-to-default BCLN Coupon Rates without and with Issuer Default Risk.

ρ	No Issuer Default	α = 0	α = 0.5	α = 1
-0.9	7.967%	9.113%	9.131%	8.747%
-0.8	9.181%	10.430%	10.430%	9.978%
-0.7	10.138%	11.477%	11.456%	10.947%
-0.6	10.933%	12.319%	12.265%	11.757%
-0.5	11.639%	13.015%	12.923%	12.476%
-0.4	12.183%	13.545%	13.443%	13.025%
-0.3	12.641%	13.912%	13.782%	13.481%
-0.2	12.954%	14.115%	14.012%	13.789%
-0.1	13.126%	14.154%	14.100%	13.967%
0	13.188%	14.032%	14.032%	14.032%
0.1	13.094%	13.765%	13.794%	13.928%
0.2	12.907%	13.370%	13.481%	13.739%
0.3	12.572%	12.921%	13.062%	13.403%
0.4	12.170%	12.372%	12.523%	13.000%
0.5	11.619%	11.713%	11.865%	12.434%
0.6	10.942%	10.977%	11.137%	11.750%
0.7	10.146%	10.148%	10.276%	10.941%
0.8	9.162%	9.174%	9.255%	9.947%
0.9	7.947%	7.931%	8.034%	8.716%

This table shows the first-to-default (k =1) BCLN coupon rates without and with issuer default risk under various correlation coefficients ρ and adjustment parameters α.

Table 2: Second-to-default BCLN Coupon Rates without and with Issuer Default Risk.

ρ	**No Issuer Default**	α **= 0**	α **= 0.5**	α **= 1**
-0.9	5.180%	6.156%	6.124%	5.915%
-0.8	4.911%	5.843%	5.860%	5.645%
-0.7	4.652%	5.553%	5.561%	5.382%
-0.6	4.424%	5.290%	5.303%	5.150%
-0.5	4.207%	5.051%	5.056%	4.928%
-0.4	4.018%	4.851%	4.848%	4.737%
-0.3	3.866%	4.661%	4.658%	4.581%
-0.2	3.754%	4.515%	4.506%	4.467%
-0.1	3.671%	4.415%	4.407%	4.380%
0	3.644%	4.352%	4.352%	4.352%
0.1	3.679%	4.341%	4.357%	4.392%
0.2	3.745%	4.345%	4.373%	4.459%
0.3	3.864%	4.364%	4.424%	4.579%
0.4	4.002%	4.425%	4.530%	4.717%
0.5	4.206%	4.511%	4.636%	4.925%
0.6	4.406%	4.624%	4.786%	5.130%
0.7	4.657%	4.769%	4.959%	5.385%
0.8	4.922%	4.952%	5.168%	5.653%
0.9	5.175%	5.175%	5.378%	5.910%

This table shows the second-to-default (k =2) BCLN coupon rates without and with issuer default risk under various correlation coefficients ρ and adjustment parameters α.

Table 3: Third-to-default BCLN Coupon Rates without and with Issuer Default Risk.

ρ	**No Issuer Default**	α **= 0**	α **= 0.5**	α **= 1**
-0.9	3.553%	4.418%	4.380%	4.269%
-0.8	2.988%	3.768%	3.768%	3.697%
-0.7	2.634%	3.395%	3.391%	3.342%
-0.6	2.393%	3.124%	3.114%	3.099%
-0.5	2.230%	2.953%	2.953%	2.933%
-0.4	2.115%	2.829%	2.832%	2.818%
-0.3	2.032%	2.745%	2.753%	2.735%
-0.2	1.983%	2.695%	2.695%	2.686%
-0.1	1.948%	2.659%	2.656%	2.651%
0	1.934%	2.636%	2.636%	2.636%
0.1	1.950%	2.641%	2.648%	2.653%
0.2	1.975%	2.650%	2.665%	2.677%
0.3	2.024%	2.673%	2.699%	2.727%
0.4	2.102%	2.714%	2.751%	2.802%
0.5	2.221%	2.762%	2.840%	2.924%
0.6	2.383%	2.843%	2.959%	3.088%
0.7	2.632%	2.966%	3.145%	3.341%
0.8	2.990%	3.181%	3.434%	3.702%
0.9	3.582%	3.601%	3.896%	4.300%

This table shows the third-to-default (k =3) BCLN coupon rates without and with issuer default risk under various correlation coefficients ρ and adjustment parameters α.

Figure 4: Different Time Sequences of the Issuer Default Time $\hat{\tau}$, the kth Reference Entity Default Time τ_k, and the BCLN Contract Maturity t_T.

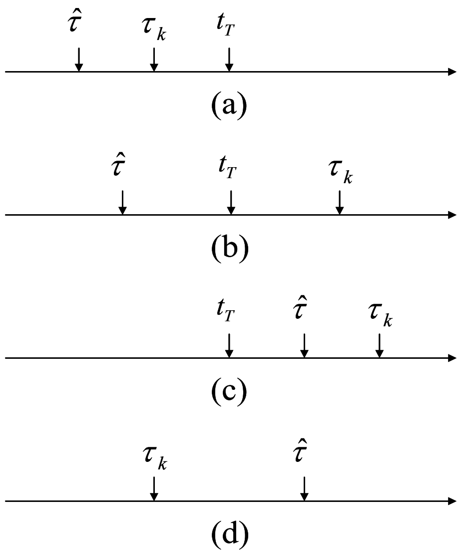


Figure 4(a) shows that the k th default occurs when the contract is still valid and the issuer defaults before the k th default. Figure 4(b) shows that the issuer defaults before contract maturity and the k th default occurs after contract maturity. Figure 4(c) shows that the k th and the issuer defaults both occur after the maturity. Figure 4(d) shows that the issuer default occurs after the k th default.

Following a careful survey, issuer default influences BCLN in three ways. In the first scenario, as shown in Figure 4(a), the kth default occurs when the BCLN contract is still valid and the issuer defaults before the kth default. The notional principal multiplied by the issuer recovery rate is returned to the BCLN holder and the subsequent coupon income ceases after the issuer default. The difference in the present value of the cash flow received by the BCLN holder between the cases with and without issuer default, i.e. Eqn. (18) minus Eqn. (7), is:

$$-c\times\sum_{i=1}^{T}e^{-rt_i}I\left(\hat{\tau}<t_i<\tau_k\right)+\left(\hat{\delta}\times e^{-r\hat{\tau}}-\delta_k\times e^{-r\tau_k}\right) \tag{21}$$

The former term of Eqn. (21) is due to the cessation of the coupon income (named the coupon cessation effect) and the last term is the loss of principal capital resulting from the issuer default (named the principal loss effect). The coupon cessation effect always disfavors the BCLN holder. Whether the principal loss effect disfavors the BCLN holder depends on whether the last term is negative or positive.

In the second scenario, as shown in Figure 4(b), the issuer defaults before contract maturity and the kth default occurs after contract maturity. The difference in the present value of the cash flow between the cases with and without issuer default is:

$$-c\times\sum_{i=1}^{T}e^{-rt_i}I\left(\hat{\tau}<t_i<t_T\right)+\left(\hat{\delta}\times e^{-r\hat{\tau}}-1\times e^{-rt_T}\right) \tag{22}$$

Again the former term of Eqn. (22) results from the coupon cessation effect, and the last term results from the principal loss effect. The coupon cessation effect always disfavors the BCLN holder. However, in the second scenario the principal loss effect generally disfavors the BCLN holder because that $\hat{\delta}$ is much less than one.

Finally, the scenarios that the k th and the issuer defaults both occur after the maturity, as shown in Figure 4(c), and the issuer default occurs after the k th default, as shown in Figure 4(d), are classified into the third way. In both scenarios, the cash flow is identical to that without issuer default and neither effect exists. The existence of issuer default risk does not alter the cash flow of the BCLN holder. Therefore, from the above discussion, the difference in the coupon rates between the cases with and without issuer default depends on the combined effect of the coupon cessation and the principal loss effects in the above four scenarios.

Figure 3 shows that all the coupon rates exceed those without issuer default. While the recovery rates of the issuer and the k th default entity are the same as the numerical example presented here, the combined effect disfavors the BCLN holder, resulting in a higher coupon rate than in the case without issuer default. When $\alpha = 1$, the default time of reference entities is decided by the common factor Y and firm specific risk factor ε_{X_i}, and the issuer default Z is independent of the reference entity defaults. Unlike the symmetric coupon rate curve with $\alpha = 1$, the other two coupon rate curves, with $\alpha = 0.5$ and $\alpha = 0$, are asymmetric. For the $\rho < 0$ side, the coupon rates considering correlated issuer default risk, i.e. $\alpha = 0.5$ and $\alpha = 0$, exceed those with independent issuer default risk, i.e. $\alpha = 1$. However, for the $\rho > 0$ side, the coupon rates considering correlated issuer default risk are lower than those with independent issuer default risk. The reason for this phenomenon is explained as follows.

When ρ is negative, the correlation between the reference entities and the issuer default, i.e. ρ_{X_iZ} ($=\sqrt{1-\alpha}\rho$), is also negative. As α approaches zero, resulting a more negative ρ_{X_iZ}, the default times of the issuer and the k th default become increasingly dispersed and the time interval between the issuer and the k th default increases. Therefore, the coupon cessation effect increases as α approaches zero, and the disfavorable situation increases the BCLN coupon rate. On the other hand, a positive ρ results in a positive ρ_{X_iZ}. As α approaches zero, the default times of the issuer and the k th default become increasingly concentrative and the time interval between the issuer and the k th defaults decreases. The coupon cessation effect decreases as α approaches zero, and the favorable situation reduces the BCLN coupon rate. In summary, when the default correlation between the reference entities and the issuer is negative, the BCLN coupon rate increases as the impact of the issuer default increases. While the default correlation is positive, the BCLN coupon rate decreases as the impact of the issuer default increases.

As α approaches zero, the impact of issuer default increases and so too does the coupon rate asymmetry. This demonstrates an increasing impact of a positive or negative default correlation between the reference entities and the issuer. In the extreme case $\alpha = 0$, the coupon rate curve is the most asymmetric.

CONCLUDING COMMENTS

Obtaining the most reasonable BCLN coupon rate requires considering issuer default risk. This article proposes a framework to incorporate issuer default risk into BCLN pricing based on a multi-factor Gaussian copula, and uses a parameter α to adjust the weights of the original common factor and issuer default factor. The proposed model is simulated to price a five-year BCLN with three reference entities. The analysis results demonstrate that issuer default risk increases the fair coupon rate. Furthermore, analytical results also reveal that a negative default correlation between the reference entities and the issuer increases the coupon rate as the impact of issuer default increases. However, a positive default correlation results in a decreasing coupon rate as the impact of issuer default increases. This is contradicting the common belief that a positive default correlation between the reference entities and the issuer increases the possibility of double losses, thus driving up the BCLN coupon rate. The proposed framework is easy to implement, and the issuer default risk is effectively reflected in the fair BCLN coupon rate.

This work adopts two parameters, i.e. the correlation coefficient and the adjustment parameter, to model the interaction between the reference entity defaults, issuer default and the common factor. The issuer default is independent of the common factor in the setting, thus the proposed model does not consider the correlation between the issuer default and the common factor. The author recommends that future research extend the proposed model to include this correlation.

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