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EVALUATION OF THE IMPACT OF DAY TRADING ON THE EGYPTIAN STOCK MARKET

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ABSTRACT

This paper investigates the effect of the introduction of day trading on the Egyptian stock market. We applied a GARCH (1, 1)–GED model on daily returns and volumes of 41 companies listed in the Egyptian Stock market for the period from 2004 to 2008. The results suggest that day trading decreases ex-post return, and ex-post and ex-ante risk. We also find no significant change in the coefficient of variation, which indicates that the return-to-risk relationship remains unchanged. The results of the paper further indicate that the introduction of day trading has no significant effect on the volatility clustering, volatility persistence, arrival of information and the liquidity of the market.

JEL: C22; G11; G15

KEYWORDS: GARCH; volatility clustering; day trading

INTRODUCTION

In recent years Cairo and Alexandria Stock Exchange (CASE), the only official stock exchange in Egypt, has been one of the most evolving emerging stock markets. In the year 2008, the value of trade of stocks and bonds reached 553.2 billion Egyptian pounds (103.3 Billion US Dollars) compared to 261.6 billion Egyptian pounds (48.8 billion US Dollars) in 2007. The average monthly value of trade in 2008 was 46.1 billion Egyptian pounds (8.6 billion US Dollars). CASE grew from a market capitalization of 602 billion Egyptian pounds (112.5 billion US Dollars) in 2007 to 813 billion Egyptian pounds in 2008(115.93 billion US Dollars). The market capitalization of 2008 represents 111% of the Egyptian Gross Domestic Product (GDP).

Based on the IFC financial report on risk and return in emerging markets, during the period from July 2007 to June 2008, Egypt was ranked number eight of 28 emerging countries with respect to return, and 18 out of 28 in terms of risk ranked from high to low. The annual market return was 29.7%, while the market risk was 6.94% for the same period. By the end of June 2008, Standard and Poor's and IFCG Indices for the price –earning ratio (P/E) for Egypt was 15.7 compared to an average P/E ratio of 26.4 for emerging markets. This indicates that the prices of stocks in the Egyptian market are on average relatively low compared to other emerging markets.

While developed stock markets can perform efficiently as they possess sound, deregulated structures, and the required technical and technological expertise; the emerging markets are still at large suffering from poor financial structures, which is reflected among others in the low liquidity of their stock markets (Singh,1999).

Like many other emerging stock markets, the Cairo and Alexandria Stock Exchange (CASE) has embarked on a restructuring program aiming to improve market operations by implementing a number of procedures. One of the recent developments by the CASE in August 2005 was the introduction of day trading. While some investors take long-term positions, relying on their confidence that their stock price will rise over time and provide them with long-term profits, other stock market investors, namely the day traders, take very short-term positions to profit from small fluctuations in share prices that occur between the opening and closing price of the same day. A day trader closes out all positions at the end of every day, profiting from small price fluctuations that occur during the time span of one trading day. It should be noted that day traders differ from intra-day traders who hold positions for several days or weeks aspiring to profit from larger price changes. The main aim of this strategy is the enhancement of liquidity, which is expected to lead to a reduction of the downside risk, and the decrease of the cost of investing in projects that do not pay off in the long term (Yartey and Adjasi, 2007). In a liquid market, the investors can easily and at a low cost sell their shares in a poor performing company, and shift to better performing companies (Bencivenga and Smith, 1991). This will lead to a better allocation of capital, through its mobility in the economy.

To be licensed for day trading in CASE, brokerage firms must apply a set of requirements enforced by the Capital Market Authority (CMA), which include depositing 5 million Egyptian pounds ($945,180) with a clearing bank as a margin deposit. Day trading is risky, thus regulations require brokerage firms to assure that clients understand this risk by signing an agreement. A day trader can only trade 1/10,000 (one over ten thousands) of the number of listed shares registered for the company in the Stock Exchange. Any listed company is allowed to be traded according to the day trading system if: (1) the minimum trading days of the stock is not less than 95% of the working days; (2) the average number of brokerage companies, which execute transactions on the stock, is more than 50 companies over the year; (3) the stock average number of transactions per day should be at least 1% of the total market average number of transaction per year; and (4) the minimum free float should be 15% of the total listed shares.

The evaluation of day trading on emerging stock markets has received little attention in financial literature, so this research, to the best of our knowledge, is our contribution to fill this gap. This research evaluates the effect of day trading on ex-post and ex-ante risk and return; and analyzes its impact on liquidity, volatility clustering and persistence, and the arrival of information effect. The remainder of this study is organized as follows: Section 2 provides a literature review. Section 3 describes the data used in our analysis. Section 4 presents the methodology that contains the diagnostic tests and the model. Section 5 provides the empirical results and a discussion of these results. Section 6 concludes.

LITERATURE REVIEW

The majority of published research on day trading deals with the U.S. market and other developed markets. Only a limited number of the recent studies have tackled the emerging markets. Day trading and Intra-day patterns in volatility were first documented by Wood, McInish and Ord (1985), Jain and Joh (1988) and Harris (1986). They find a high variance of returns at the beginning and at the end of the trading day. Foster and Viswanathan (1990) observe a U- shaped pattern in the variance of stocks price changes in the New York Stock Exchange (NYSE). Gerenty and Mulherin (1992) also report evidence of a U-shaped pattern in the intra-day volume for NYSE stocks.

Several authors have focused on developing models to document observed patterns, and usually they find a U-shape pattern in volume and volatility across the developed markets studied. Ozenbas, Schwartz and Wood (2002) have examined intraday share price volatility over the year 2000 for five markets, which include the New York Stock Exchange, NASDAQ, London Stock Exchange, Euronext Paris and Deutsche Bourse. They also found a U-shaped intraday volatility pattern, with a particularly sharp spike for the opening half hour. McInish and Wood (1990) report that for stocks traded on the Toronto Stock Exchange both returns and volume show a U-shaped pattern. Hamao and Hasbrouck (1993) find for the Tokyo Stock Exchange that the mean squared return and the bid-ask spread tend to be higher at the beginning and at the end of the two trading sessions during the day. Hillion and Spatt (1992) report for France a U-shaped pattern for volatility, i.e. high volatility at the open, declining thereafter with a slight rise at the close. Niemayer and Sandas (1993) witnessed a similar pattern on the Stockholm exchange. In a study on the Australian trading system, Aitken et.al (1993) provides evidence of similar intra-day regularities.

Before Amihud and Mendelson (1987), daily volatility was measured from close-to-close returns. For the first time in their study, they compared the variance of the open-to-open returns to the close-to-close returns of the stocks of the Dow Jones Industrial Index. They found that open-to-open returns had a higher variance compared to the close-to-close returns. Hasbrouk and Schwartz (1988) show that the variance estimated for the same data sample, however at different sampling frequencies, give a different result. This result differs from the random walk model of stock returns, were the sampling frequency does not change the number of variance. Almgren and Lorenz (2006) show that the trading horizon of one day is the usual manner institutions trade. This is consistent with the results of Breen, Hodrick and Korajczyk (2002) who found that 92.5% of the sample of institutional orders is completed the same day they are initiated. Campbell, Ramadorai, and Schwartz (2007), using quarterly intra-day trading data from the New York Stock Exchange, found that institutional trading is highly persistent. In other words, institutions buy or sell the same stocks on successive days.

The intra-day patterns of volume and volatility found in Wood, McInish, and Ord (1985), Harris (1986), Jain and Joh (1988), and Pagano, Peng, and Schwartz (2008) can be explained with models of discretionary liquidity trading. Another important explanation for these results was found in Tversky and Kahneman (1974) that behavioral biases can cause an over-reaction or under- reaction of traders to news, which will lead to return periodicity. Anderson and Bollersov (1997) who found substantial evidence of intra-day periodicity of return volatility confirmed this result. Another group of studies has tried to build models to explain time dependent patterns in security trading and forecast the trading patterns in the future. For example, Admanti and Pfeiderer (1988) present a theoretical microstructure model, which explains the trading behavior of liquidity traders, who trade in order to minimize their trading costs. On the other hand, the market closure model by Brock and Kleidon (1992) is based on the idea that an optimal portfolio is a function of the ability to trade. The two models predict different patterns in volume and volatility. The first model predicts a concentration of volume during the trading day, and a positive correlation between volume and volatility. They explain this result by asymmetric information, where there exist two groups of traders in the market, a group of informed versus a group of uninformed traders. However, the market closure model forecasts that volume will be U-shaped during the day and that volume is independent of volume. They explain this different result by the availability of uniform information to all traders in the market.

In addition to the evidence from the developed markets, there are very few studies that studied day trading in emerging markets, and most of them focused on the Asian stock exchanges. For example, Choe and Shin (1993) in their study about the Korean stock market (KSE) found that the close-to-close volatility is higher when the market closes in continuous trade than when it closes in call auction. On the same market Copeland and Jones (2002) find that the intraday effects in KSE translate is a U-shape pattern over the day. Bildik (2001) in his study on the Istanbul Stock Exchange finds a U- shaped pattern for the morning trading session followed by an L–shaped pattern for the afternoon session. To the best of our knowledge, there exists no literature examining the effect of day trading on African or Middle Eastern countries. This paper is the first to examine the effect of day trading on the Egyptian Stock Exchange.

DATA

We examine a sample of Egyptian stocks that were introduced to the day trading system. To be included in the sample each stock must trade between July 1, 2004 and March 1, 2008, and be listed in the Egyptian Stock market throughout the period. Our sample includes 41 companies out of 373 companies listed in CASE in the year 2008 (Table 1). The daily total volume of trade for these selected 41 companies represent on average 98% of the market daily total volume of trade (CASE, 2008). The data includes daily closing prices, which are the average prices weighted by the volume of trade, and the trading volume of the stocks.

Table 1: Data Description

Company	Date Price Limit was Removed	Date Day Trading was Introduced	Date Day Trading was Removed	Number of Obs. Before Day Trading	Number of Obs. After Day Trading	Total Number of Obs.
Alexandria Mineral Oils Company	2-Oct-05	4-Feb-07		326	366	692
Alexandria Spinning & Weaving	1-Feb-07	6-May-07		63	304	367
Arab Cotton Ginning	7-Aug-04	20-Oct-05		298	675	973
Arab Polvara Spinning & Weaving	7-Sep-03	20-Oct-05		306	677	983
ASEC Mining (ASCOM)		30-Jan-08		188	126	314
Commercial International Bank	20-Oct-05	20-Oct-05		305	676	981
Credit Agricole Egypt	31-Aug-06	8-Jul-07		204	263	467
Egyptian Company for Mobile Services	17-Jul-02	20-Oct-05	3-Aug-06	305	189	494
Egyptian Electrical Cables	17-Jun-07	30-Jan-08		148	125	273
Egyptian Financial Group-Hermes	7-Sep-03	20-Oct-05		306	674	980
Egyptian for Housing Development	17-Jun-07	30-Jan-08		145	124	269
Egyptian for Tourism Resorts		10-Feb-07		347	362	709
Egyptian Media Production City	17-Jul-02	20-Oct-05		311	672	983
El Ahli Investment and Development		4-Feb-07		592	366	958
EL Ezz Aldekhela Steel - Alexandria		20-Oct-05	3-Aug-06	156	189	345
El Ezz Porcelain (Gemma)	7-Feb-05	20-Oct-05		173	675	848
El Ezz Steel Rebars	26-Jan-06	2-May-06		63	552	615
El Nasr Clothes & Textiles (Kabo)		4-Feb-07		504	365	869
El Watany Bank of Egypt	17-Jul-02	20-Oct-05	3-Aug-06	306	190	496
Export Development Bank of Egypt	18-Jul-02	30-Jan-08		857	125	982
Extracted Oils	1-Feb-07	17-Sep-07		154	213	367
GB Auto		30-Jan-08		131	125	256
Housing & Development Bank	26-Jan-06	6-May-07		296	307	603
Medinet Nasr Housing	17-Jul-02	18-Mar-07	3-May-07	620	29	649
Misr Cement (Qena)	7-Apr-05	20-Oct-05	18-Dec-05	135	37	172
Misr Chemical Industries	7-Sep-03	20-Oct-05	4-Feb-07	304	309	613
Nile Cotton Ginning	26-Jan-06	2-May-06		62	550	612
Olympic Group Financial Investments	3-Aug-04	20-Oct-05	4-Jan-06	301	49	350
Orascom Construction Industries	17-Jul-02	20-Oct-05	15-Mar-07	306	340	646
Orascom Hotels And Development...	7-Feb-05	20-Oct-05		173	678	851
Orascom Telecom Holding	17-Jul-02	20-Oct-05		306	678	984
Oriental Weavers	7-Feb-05	18-Dec-05	15-Mar-07	212	300	512
Raya Holding For Technology	26-Jan-06	6-Aug-06		129	486	615
Remco for Touristic Villages Construction		3-Feb-08		193	114	307
Sidi Kerir Petrochemicals	26-Jun-05	6-Aug-06		272	487	759
Six of October Development & Investment	1-Feb-07	6-May-07		63	306	369
South Valley Cement		4-Feb-07		502	367	869
Telecom Egypt	13-Dec-05	4-Feb-07		274	367	641
United Housing & Development	26-Jan-06	4-Feb-07		248	361	609
Upper Egypt for Construction	17-Jun-07	30-Jan-08		150	124	274
Vodafone Egypt Telecommunications		20-Oct-05	3-Aug-06	190	280	470

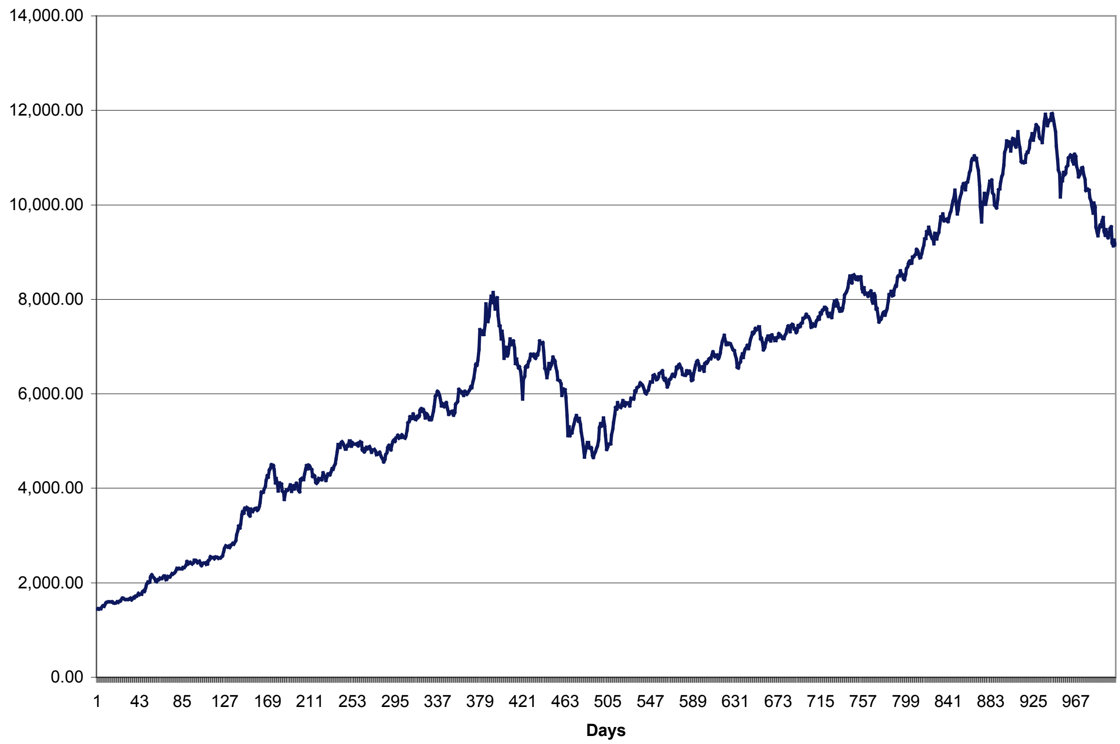
The above table describes the data. Column 1 shows the names of the companies in our sample. Columns 2, 3 and 4 represent the dates when the price limits were removed, day trading was introduced, and day trading was removed respectively. Columns 5 and 6 report the number of observations before the introduction of day trading and after the introduction respectively. Column 7 is the total number of observations for each company.

We calculate the daily total return as follows:

$$TR_t = \ln(P_t) - \ln(P_{t-1}) \qquad (1)$$

Where TR_t is the total daily return on the stock at time t; P_t and P_{t-1} is the daily stock price on trading day t and $t-1$ respectively. We account for corporate action in the calculation of total return. Table 1 describes the data used, highlighting for each company the dates when the day trading system was introduced and /or removed. It also shows the dates when the price limits were removed. To control for the effect of price limit removal, the starting date for each company is the date when price limits were removed, and the ending date for the data is July 31 2008, unless the company was removed from the day trading system before this date. As the study compares the effect of day trading before and after, Table 1 reports the number of observations before and after day trading for each of the 41 companies of the study. Figure 1 below represents CASE30 Index which shows that the data before and after day trading are balanced; in other words, the trends observed before day trading are repeated after day trading. This controls for the market effect in our analysis.

Figure 1: Cairo and Alexandria Stock Exchange Index for the Most Active 30 Companies During the Period July 1st 2004 to July 31st 2008



This figure shows the CASE 30 index (index for the 30 most actively traded stocks in the Egyptian Stock market) for the total time span before and after the introduction of day trading. The graph shows a balanced trend; in other words, the trends observed before day trading are repeated after day trading.

METHODOLOGY

The period of study is divided into two sub sets: (1) data before day trading and (2) data after day trading. We first examine the effect of the introduction of day trading on ex-post mean and volatility, then on ex-ante mean and volatility of the stocks. We also investigate its effect on volatility clustering and volatility persistence and market liquidity.

It is worth noting that there is no consensus in the literature about which is the preferred estimation method to be adopted by emerging markets. For an analysis of the two estimation methods, see Damodaran (1999) and Saabye (2003). We therefore apply the two methods first the historical approach (ex-post), and secondly the forward – looking approach (ex-ante).

In applying the first approach we examine the effect of day trading on ex-post mean return and volatility, we use the available historical data to calculate the traditional average return and standard deviation. The second approach rests on estimating ex -ante mean return and volatility, which represent the future expectations of the investors. Both ex- ante return and volatility are generated from the same model used in this paper. This model also estimates the volatility clustering and persistence and the arrival of news effects.

For specifying the model, diagnostic tests were run on the data. These tests determine the best model to fit the data and are represented in Tables 2 and 3. Table 2 summarizes the statistics for the daily total return for the whole sample, including the mean, median, standard deviation, Ljung-Box Q –statistics, Jarque-Bera test and Augmented Dickey Fuller (ADF) test on total return. The diagnostic tests highlight the following:

- The Ljung –Box Q Statistics reflects a significant autocorrelation in the total returns for 10 lags. It is significant for 35 out of 41 companies showing patterns of autocorrelation in the total returns.
- The high values of the Jarque-Bera test (Jarque and Bera, 1980) for normality decisively reject the hypothesis of a normal distribution for 39 out of 41 companies.
- The Augmented Dickey Fuller (ADF) test for the stationarity of the total return showed that the whole data is stationary.

These diagnostic tests resulted in the selection of an autoregressive process for the total return, described as follows:

$$TR_t = \alpha_0 + \alpha_1 TR_{t-1} + \alpha_2 Volume_t + \varepsilon_t \qquad (2)$$

Where TR_t is the total daily return on the stock at time t, and $Volume_t$ is the logarithm of the daily volume of trade at time t, while the error term is ε_t.

The Autoregressive Conditional Heteroskedasticity (ARCH) model, (Engle, 1982) and its generalization, the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model, (Bollerslev, 1986) is a widely used methodology applied on daily financial data. There are different representations for GARCH models: GARCH, GARCH-M, EGARCH and PGARCH. Other famous asymmetric GARCH models include Threshold GARCH (TGARCH) of Zakoian (1994), the Quadratic GARCH (QGARCH) of Sentana (1995), the Volatility Switching ARCH (VS-ARCH) of Fornari and Mele (1996), and Logistic Smooth Transition ARCH (LST-ARCH) of Gonzales-Rivera (1996) and Hagerud (1996).

We also find in the recent financial literature (Arago and Nieto, 2005) the application of GARCH models with a wide variety of densities (i.e. Normal, GED (Generalized Error Distribution), Student-*t*, GED with a fixed parameter, and Student-*t* with a fixed degree of freedom).

Table 2: Summary Statistics for the Daily Total Returns of Day Trading Companies for the Period July 1, 2004 Until July 31, 2008

Company	**Mean**	**Median**	**Standard Deviation**	**Ljung-Box Q-statistics (10) on TR_t (*p*-Value)**	**Jarque-Bera Normality Test on TR_t**	**ADF Test on TR_t**
Alexandria Mineral Oils Company	0.00022	-0.00095	0.02060	0.007	2218.0	-19.88
Alexandria Spinning & Weaving	-0.00217	-0.00367	0.02882	0.000	89.5	-15.92
Arab Cotton Ginning	0.00142	-0.00080	0.03620	0.000	475.6	-26.82
Arab Polvara Spinning & Weaving	0.00058	-0.00201	0.03846	0.000	602.1	-26.39
ASEC Mining (ASCOM)	0.00463	-0.00215	0.03554	0.000	17.8	-12.10
Commercial International Bank	0.00131	0.00077	0.02021	0.12**	670.6	-29.82
Credit Agricole Egypt	-0.00008	-0.00147	0.02163	0.056*	197.8	-20.12
Egyptian Company for Mobile Services	0.00149	0.00014	0.03141	0.086*	275.9	-20.51
Egyptian Electrical Cables	0.00224	0.00000	0.04274	0.017	178.9	-14.21
Egyptian Financial Group-Hermes	0.00278	0.00134	0.03221	0.000	377.4	-18.39
Egyptian for Housing Development	0.00247	-0.00384	0.05442	0.000	94.0	-13.19
Egyptian for Tourism Resorts	0.00599	0.00135	0.04119	0.000	25.5	-18.29
Egyptian Media Production City	-0.00056	-0.00266	0.02935	0.000	319.9	-21.56
El Ahli Investment and Development	0.00278	-0.00070	0.03693	0.000	84.0	-23.80
EL Ezz Aldekhela Steel - Alexandria	0.00272	0.00349	0.05007	0.006	18.4	-15.99
El Ezz Porcelain (Gemma)	0.00109	0.00000	0.03452	0.000	261.4	-24.25
El Ezz Steel Rebars	0.00010	0.00000	0.02809	0.000	326.0	-21.38
El Nasr Clothes & Textiles (Kabo)	0.00266	0.00000	0.03312	0.000	2.69	-22.76
El Watany Bank of Egypt	0.00230	0.00000	0.02826	0.162**	170.6	-20.84
Export Development Bank of Egypt	0.00125	0.00000	0.02785	0.000	647.1	-26.26
Extracted Oils	-0.00084	-0.00719	0.03699	0.000	538.6	-14.91
GB Auto	0.00018	-0.00013	0.02342	0.157**	116.3	-14.58
Housing & Development Bank	-0.00003	-0.00360	0.04391	0.000	339.3	-19.91
Medinet Nasr Housing	0.00172	0.00000	0.04530	0.061*	109.9	-23.63
Misr Cement (Qena)	0.00367	0.00103	0.02206	0.028	27.6	-11.08
Misr Chemical Industries	0.00104	0.00000	0.03411	0.002	115.1	-21.79
Nile Cotton Ginning	0.00161	-0.00191	0.04186	0.000	528.3	-16.60
Olympic Group Financial Investments	0.00255	0.00034	0.02848	0.215**	54.1	-17.43
Orascom Construction Industries	0.00273	0.00073	0.02208	0.006	137.0	-22.76
Orascom Hotels And Development...	0.00183	0.00110	0.03094	0.000	1443.5	-24.75
Orascom Telecom Holding	0.00153	0.00087	0.02101	0.000	306.4	-27.47
Oriental Weavers	0.00013	0.00000	0.02752	0.111**	239.4	-21.04
Raya Holding For Technology	-0.00102	-0.00161	0.02847	0.000	125.2	-20.99
Remco for Touristic Villages Construction	0.00061	-0.00320	0.03357	0.000	43.1	-14.38
Sidi Kerir Petrochemicals	0.00031	-0.00129	0.02207	0.000	250.7	-23.97
Six of October Development & Investment	-0.00007	0.00027	0.02005	0.036	9.99	-17.13
South Valley Cement	0.00462	0.00000	0.03022	0.000	1.96	-20.56
Telecom Egypt	-0.00042	-0.00059	0.02401	0.000	153.2	-18.23
United Housing & Development	0.00065	-0.00074	0.03627	0.003	194.5	-21.82
Upper Egypt for Construction	0.00024	-0.00514	0.04122	0.000	67.8	-12.92
Vodafone Egypt Telecommunications	0.00049	0.00000	0.02840	0.740**	2368.1	-21.28

*This table provides diagnostic tests .Columns 2,3 and 4 show the mean, median and standard deviations of daily total return (TR), TR=ln (Pt) – ln (Pt-1), where(Pt) is the daily closing price in time t . Column 5 demonstrates the significance level (p- value) for the Lijung –Box Q statistics (10), which tests for autocorrelation. ***, **and * indicate significance at the 1, 5 and 10 percent levels respectively. Column 6 shows the Jarque-Bera Normality Test on total return (TR). Column 7 shows the augmented Dickey Fuller test on TR which test for the stationarity of the data*

Table 3: Diagnostic Tests on the Residuals for Determining the Model That Fits the Daily Total Returns of Day Trading Companies for the Period July 1, 2004 Until July 31, 2008

Company	Breusch-Godfrey Serial Correlation LM Test on ε_t	Jarque-Bera Normality Test on ε_t	ARCH LM Test on ε_t
Alexandria Mineral Oils Company	21.2	1624.8	25.2
Alexandria Spinning & Weaving	13.9	142.6	6.1
Arab Cotton Ginning	36.6	583.8	69.5
Arab Polvara Spinning & Weaving	44.5	564.3	54.4
ASEC Mining (ASCOM)	3.6	11.0	8.8
Commercial International Bank	2.5	668.6	109.5
Credit Agricole Egypt	3.7	77.3	26.9
Egyptian Company for Mobile Services	2.8	259.9	11.2
Egyptian Electrical Cables	8.3	271.5	22.6
Egyptian Financial Group-Hermes Holding Company	13.3	423.1	108.2
Egyptian for Housing Development & Reconstruction	4.0	75.8	25.0
Egyptian for Tourism Resorts	29.9	35.6	23.5
Egyptian Media Production City	89.2	134.6	7.0
El Ahli Investment and Development	1.2	53.2	70.3
EL Ezz Aldekhela Steel – Alexandria	1.7	14.1	23.5
El Ezz Porcelain (Gemma)	39.6	366.1	21.3
El Ezz Steel Rebars	4.1	440.2	88.6
El Nasr Clothes & Textiles (Kabo)	1.2	7.9	21.8
El Watany Bank of Egypt	5.8	112.0	1.1
Export Development Bank of Egypt	10.0	299.7	58.4
Extracted Oils	3.8	401.8	29.7
GB Auto	0.95	119.3	3.2
Housing & Development Bank	18.8	330.2	69.4
Medinet Nasr Housing	12.6	83.8	19.4
Misr Cement (Qena)	8.7	8.3	0.55
Misr Chemical Industries	27.4	168.6	17.0
Nile Cotton Ginning	11.6	541.1	100.6
Olympic Group Financial Investments	26.7	58.4	7.4
Orascom Construction Industries	1.5	111.6	28.4
Orascom Hotels And Development...	0.4	1325.3	18.4
Orascom Telecom Holding	1.8	262.4	33.0
Oriental Weavers	0.07	242.1	42.4
Raya Holding For Technology And Communications	18.3	217.9	15.5
Remco for Touristic Villages Construction	3.5	106.3	55.2
Sidi Kerir Petrochemicals	36.1	157.2	45.2
Six of October Development & Investment	0.6	9.3	10.1
South Valley Cement	1.3	2.1	4.7
Telecom Egypt	7.8	146.2	24.3
United Housing & Development	10.5	202.5	25.1
Upper Egypt for Construction	9.2	36.1	12.3
Vodafone Egypt Telecommunications	0.9	2301.6	0.1

In this table we apply diagnostic tests on the residuals of the model $TRt = \alpha 0 + \alpha 1\ TRt\text{-}1 + \alpha 2\ Volumet + \varepsilon t$. TRt is the daily total return at time t while Volumet stands for the log of the daily volume of trade at time t. Column (2) shows the Breusch—Godfrey Serial Correlation (LM) test on the residual (εt) .Column (3) shows the results for the Jacque- Bera normality test on εt .Column (4) offers the results of the ARCH Lagrange multiplier (LM) Test on εt to test for the existence of the ARCH process.

To determine whether the error ε_t in equation 2 follows an autoregressive conditional heteroskedasticity model, we ran an ARCH Lagrange multiplier (LM) test on ε_t, to investigate whether the standardized residuals exhibit additional ARCH effects. The results in Table 3 showed that for the majority of companies in the study (37 out of 41) the error term ε_t follows an ARCH process. This confirms the legitimacy of using ARCH/GARCH type models.

Then we tested the normality of ε_t, using the Jarque-Bera test, which indicates that, with the exception of one company, ε_t for all companies is not normally distributed (See Table 3). Since skewness and kurtosis are important features in financial applications, the use of a GARCH model seems more appropriate. Therefore, this study applies a GARCH model with Generalized Error Distribution (GED), hence we add to the GARCH model the GED log-likelihood function for a normalized random error, (see Nelson (1991) and Hamilton (1994)).

We define the GARCH (1, 1)-GED model as follows:

$$TR_t = \alpha_0 + \alpha_1 TR_{t-1} + \alpha_2 Volume_t + \varepsilon_t \qquad (2a)$$

$$\sigma^2_{\varepsilon,t} = \beta_0 + \beta_1 \varepsilon^2_{t-1} + \beta_2 \sigma^2_{\varepsilon,t-1} \qquad (2b)$$

$$L_{GED} = \sum_{t=1}^{T} \left[\ln(\frac{v}{\lambda_v}) - 0.5 \left| \frac{z_t}{\lambda_v} \right|^v - (1 + v^{-1}) \times \ln(2) - \ln\Gamma(\frac{1}{v}) - 0.5\ln(\sigma_t^2) \right]$$

$$\lambda_v = \sqrt{\frac{\Gamma\left(\frac{1}{v} 2^{-2/v} \right)}{\Gamma\left(3/v \right)}} \qquad (2c)$$

For v (positive parameter for the thickness of the tails of the distribution) = two, constant λ = one, the GED becomes the standard normal distribution. To sum up, we used the above-mentioned GARCH (1, 1)-GED model to generate ex-ante return and volatility and to estimate volatility clustering, volatility persistence, and the effect of information arrival before and after day trading. Ex-ante return is the average of the forecasted returns from the mean equation in our GARCH (1, 1)-GED model (Equation 2a). The ex-ante risk is the ex-ante standard deviation which is the average of the square root of the variances generated from the variance equation of our GARCH (1, 1)-GED model (Equation 2b).

EMPIRICAL RESULTS

We estimated our GARCH (1,1)-GED model in equations 2a, 2b and 2c for each company before and after day trading. A modification of the GARCH model (Lamoureux and Lastrapes, 1990, Lee and Ohk, 1992) that we adopted in this study is to add the trading volume as a proxy for information arrival time. Literatures found that volatilities of daily return are positively related to the rate of daily information arrival. The marginal effect of news arrival on total returns is measured by α_2.

Table 4 and Table 5 report the estimated coefficients from our GARCH (1, 1) - GED model before and after day trading respectively. Z-statistics are placed under the estimated coefficients. The arrival of information, measure by α_2, has a significant positive effect on the total returns of 13 companies before, and 15 companies after day trading. The parameter estimates of all the GARCH models in Tables 4 and 5 show that the coefficients, β_1 and β_2, are mostly positive and statistically significant at 1% and 5%, strongly supporting the existence of ARCH and GARCH effect. The volatility clustering, which means high volatilities are followed by low volatilities and visa versa, is measured by β_2. The clustering in almost all companies before and after day trading is positive and significant ranging from 0.5 till1, indicating that volatilities of the stocks are not constant and change over time.

Table 4: Estimated Coefficients from the GARCH (1,1)-GED Model before Day Trading

Company	α_0	α_1	α_2	β_0	β_1	β_2
Alexandria Mineral Oils Company	-0.0798***	0.0386	0.0151***	0.000011	0.0912**	0.8954***
	(-4.88)	(0.89)	(4.78)	(0.95)	(2.00)	(20.67)
Alexandria Spinning & Weaving	-0.1606**	-0.0104	0.0108**	0.000048***	-0.1584***	1.0498***
	(-2.52)	(-0.10)	(2.50)	(16.47)	(-12.29)	(59.35)
Arab Cotton Ginning	-0.1170***	0.0536	0.0087***	0.000149**	0.2144**	0.7198***
	(-5.02)	(0.88)	(5.11)	(2.23)	(2.40)	(7.86)
Arab Polvara Spinning & Weaving	-0.0944	0.0952*	0.0076***	0.000018*	0.0558**	0.9364***
	(-4.63)***	(1.95)	(4.76)	(1.69)	(1.97)	(36.13)
ASEC Mining (ASCOM)	0.0184	0.3822***	-0.0011	0.000300	0.2069*	0.5790***
	(1.01)	(5.00)	(-0.68)	(1.20)	(1.71)	(2.84)
Commercial International Bank	-0.0537	-0.0952*	0.0044***	0.000012	0.1901**	0.8104***
	(-6.57)***	(-1.93)	(6.79)	(1.42)	(2.68)	(12.21)
Credit Agricole Egypt	-0.0528	0.0812	0.0039**	0.000054**	0.0820	0.7462***
	(-2.19)**	(1.13)	(2.15)	(2.17)	(1.37)	(9.18)
Egyptian Company for Mobile	-0.0271	0.0815	0.0026	0.000015	0.0775*	0.9073***
	(-1.20)	(1.51)	(1.32)	(1.02)	(2.16)	(22.78)
Egyptian Electrical Cables	-0.0474	0.2023**	0.0028	0.000392	0.1729	0.6328***
	(-0.78)	(2.44)	(0.73)	(1.42)	(1.28)	(3.54)
Egyptian Financial Group-Hermes	-0.1921	-0.0860	0.0137***	0.000146*	0.2373**	0.6218***
	(-6.14)***	(-1.42)	(6.43)	(1.79)	(2.12)	(4.12)
Egyptian for Housing Development	0.1313	0.0281	0.0096***	0.000078	0.0753	0.8628***
	(-2.88)***	(0.38)	(2.87)	(1.34)	1.51	14.89
Egyptian for Tourism Resorts	0.0212	0.0855***	-0.0013	0.000024**	0.0083	0.9683***
	(0.89)	(2.60)	(-0.84)	(2.35)	(0.55)	(68.44)
Egyptian Media Production City	-0.0658***	0.1547***	0.0052***	0.000198	0.2155	0.5713**
	(-2.78)	(2.91)	(2.77)	(1.62)	(1.62)	(2.55)
El Ahli Investment and Development	0.0038	0.0556	-0.0002	0.000875**	0.1355***	0.0738
	(0.59)	(1.46)	(-0.37)	(2.30)	(4.24)	(0.20)
EL Ezz Aldekhela Steel – Alexandria	-0.1103***	0.1667**	0.0125***	0.000133	0.1258	0.8210***
	(-2.93)	(2.13)	(3.11)	(1.14)	(1.54)	(8.35)
El Ezz Porcelain (Gemma)	-0.3078***	0.0761	0.0236***	0.000108	0.1139	0.8099***
	(-3.79)	(0.91)	(3.89)	(1.25)	(1.35)	(6.97)
El Ezz Steel Rebars	-0.1174	-0.0159	0.0089	0.000079	0.5073	0.5524***
	(-1.03)	(-0.11)	(1.09)	(0.62)	(1.41)	(3.11)
El Nasr Clothes & Textiles (Kabo)	0.0037	0.0995***	-0.0002	0.000006	0.0032	0.9874***
	(0.33)	(2.90)	(-0.20)	(1.55)	(0.65)	(448.17)
El Watany Bank of Egypt	-0.0608***	-0.0383	0.0050***	0.000031	0.1692**	0.7980***
	(-5.20)	(-0.82)	(5.31)	(1.56)	(2.28)	(9.29)
Export Development Bank of Egypt	-0.0176***	0.1245***	0.0016***	0.000077***	0.2796***	0.6462***
	(-2.88)	(3.64)	(2.94)	(3.52)	(4.51)	(11.41)
Extracted Oils	0.0357	-0.0636	-0.0034**	0.000568***	1.0561**	0.0012
	(1.57)	(-0.93)	(-2.02)	(3.09)	(2.41)	(0.03)
GB Auto	-0.0017	-0.0849*	0.0002	0.000013	0.0866	0.9215***

Company	α_0	α_1	α_2	β_0	β_1	β_2
	(-0.36)	(-1.69)	(0.37)	(0.79)	(0.96)	(12.85)
Housing & Development Bank	-0.0460**	0.1207*	0.0037**	0.000106	0.4784***	0.5985***
	(-2.51)	(1.81)	(2.25)	(1.63)	(3.48)	(7.33)
Medinet Nasr Housing	-0.0192***	0.0245	0.0018***	0.000087*	0.1730***	0.8059***
	(-3.09)	(0.71)	(3.26)	(1.86)	(3.13)	(15.45)
Misr Cement (Qena)	-0.0744***	0.0936	0.0078***	0.000030	0.0631	0.8372***
	(-6.30)	(1.38)	(6.61)	(0.74)	(0.84)	(4.56)
Misr Chemical Industries	-0.0802***	0.0310	0.0070***	0.000135**	0.2409***	0.6427***
	(-3.69)	(0.53)	(3.86)	(2.22)	(2.67)	(6.22)
Nile Cotton Ginning	0.2302	0.2176	-0.0171	0.002142***	0.6347***	-0.2235***
	(0.86)	(1.45)	(-0.92)	(3.81)	(2.82)	(-2.84)
Olympic Group Financial Investments	-0.0610***	0.0142	0.0057***	0.000189	0.1861**	0.5741**
	(-5.64)	(0.23)	(5.90)	(1.44)	(2.02)	(2.44)
Orascom Construction Industries	-0.0213	0.0098	0.0019*	0.000010	0.0773*	0.9053***
	(-1.57)	(0.20)	(1.72)	(0.95)	(1.77)	(17.20)
Orascom Hotels And Development...	-0.1351*	0.1299*	0.0101*	0.000063	0.0623	0.9032***
	(-1.81)	(1.70)	(1.93)	(0.58)	(1.13)	(11.85)
Orascom Telecom Holding	-0.0480***	0.0402	0.0038***	0.000021	0.0408	0.9209***
	(-2.71)	(0.78)	(2.90)	(1.46)	(1.43)	(20.40)
Oriental Weavers	-0.0048	0.1039*	0.0005	0.000114	0.2333	0.6805***
	(-0.53)	(1.92)	(0.61)	(1.32)	(1.41)	(3.88)
Raya Holding For Technology	-0.0857	0.0462	0.0064	0.000772	-0.0382	0.5669
	(-1.25)	(0.56)	(1.20)	(0.28)	(-0.36)	(0.35)
Remco for Touristic Villages	-0.0252	0.1665***	0.0021	0.000068	0.0799	0.7985***
	(-1.15)	(2.59)	(1.27)	(1.48)	(1.55)	(6.84)
Sidi Kerir Petrochemicals	-0.0327**	0.1493**	0.0024*	0.000176*	0.1911**	0.5540***
	(-1.98)	(2.20)	(1.92)	(1.80)	(2.16)	(3.15)
Six of October Development	-0.1666***	-0.0703	0.0140***	0.000021	-0.1599***	1.0689***
	(-2.95)	(-0.64)	(3.08)	(1.56)	(-12.72)	(31.84)
South Valley Cement	-0.0003	0.2736***	0.0003	0.000011	0.0137	0.9725***
	(-0.07)	(6.79)	(0.81)	(1.39)	(1.60)	(74.97)
Telecom Egypt	-0.1190***	0.1601***	0.0081***	0.000092	0.1667*	0.7261***
	(-3.30)	(2.62)	(3.31)	(1.52)	(1.87)	(5.52)
United Housing & Development	-0.1587***	0.0763	0.0126***	0.000055	0.2263***	0.7580***
	(-4.21)	(1.26)	(4.27)	(1.43)	(2.88)	(11.44)
Upper Egypt for Construction	-0.1358***	0.1425	0.0087***	0.000474**	0.4327*	0.2846
	(-3.63)	(1.56)	(3.55)	(2.14)	(1.67)	(1.16)
Vodafone Egypt Telecommunications	-0.0245***	0.0675***	0.0020***	0.000242	0.0832	0.2922
	(-5.22)	(2.78)	(4.84)	(0.70)	(0.65)	(0.33)

This Table reports the results of the estimation of the GARCH (1,1)-GED Model before the introduction of day trading:

$$TR_t = \alpha_0 + \alpha_1 TR_{t-1} + \alpha_2 Volume_t + \varepsilon_t$$

$$\sigma^2_{\varepsilon,t} = \beta_0 + \beta_1 \varepsilon^2_{t-1} + \beta_2 \sigma^2_{\varepsilon,t-1}$$

*Below the estimated coefficients you find the z statistic in parentheses. ***, **and * indicate significance at the 1, 5 and 10 percent levels respectively. α_2 represents the arrival of information., while β_2 stands for the volatility clustering and the volatility persistence is measure by the sum of β_1+ β2.,which is close to one for almost all companies.*

Table 5: Estimated Coefficients from the GARCH (1,1)-GED Model After Day Trading

Company Name	α_0	α_1	α_2	β_0	β_1	β_2
Alexandria Mineral Oils Company	-0.0134***	0.1082**	0.0028***	0.000012	0.1708**	0.7165***
	(-2.62)	(2.22)	(2.61)	(1.55)	(2.32)	(6.06)
Alexandria Spinning & Weaving	-0.1284***	0.0902	0.0091***	0.000060*	0.1939**	0.7211***
	(-5.76)	(1.56)	(5.87)	(1.71)	(2.56)	(6.50)
Arab Cotton Ginning	-0.1050***	0.1494***	0.0071***	0.000014**	0.1697***	0.8230***
	(-6.59)	(3.98)	(6.66)	(2.26)	(4.93)	(29.39)
Arab Polvara Spinning & Weaving	-0.0627***	0.1299***	0.0044***	0.000034*	0.3045***	0.7266***
	(-5.07)	(3.37)	(4.96)	(2.10)	(5.69)	(20.00)
ASEC Mining (ASCOM)	-0.0934***	0.0684	0.0074**	0.000101	0.2403*	0.6043**
	(-2.66)	(0.69)	(2.56)	(1.34)	(1.83)	(2.56)
Commercial International Bank	-0.0154**	0.0326	0.0013**	0.000023*	0.1564***	0.7879***
	(-1.97)	(0.90)	(2.11)	(2.23)	(3.74)	(15.25)
Credit Agricole Egypt	-0.0566***	-0.0309	0.0047***	0.000180*	0.2641**	0.3402
	(-4.10)	(-0.49)	(4.23)	(1.85)	(2.05)	(1.14)
Egyptian Company for Mobile	-0.0163	0.1056	0.0013	0.000588***	0.2566	-0.0806
	(-1.07)	(1.50)	(0.98)	(3.07)	(1.48)	(-0.43)
Egyptian Electrical Cables	-0.2694***	0.0662	0.0165***	0.000603	0.1265	0.3711
	(-3.21)	(0.68)	(3.26)	(0.66)	(0.63)	(0.43)
Egyptian Financial Group-Hermes	-0.0900***	0.1638***	0.0063***	0.000017**	0.1441***	0.8349***
	(-4.79)	(4.15)	(4.91)	(2.29)	(4.48)	(24.34)
Egyptian for Housing Development	-0.2409***	0.1621*	0.0169***	0.000274	0.3493**	0.6000***
	(-3.19)	(1.69)	(3.24)	(1.36)	(2.20)	(5.27)
Egyptian for Tourism Resorts	-0.1148***	0.1760***	0.0074***	0.000022*	0.1471***	0.8250***
	(-4.72)	(3.43)	(4.79)	(1.83)	(2.86)	(16.84)
Egyptian Media Production City	-0.0864***	0.1380	0.0065***	0.000088**	0.1315***	0.7558***
	(-6.32)	(3.47)***	(6.34)	(1.98)	(2.80)	(8.43)
El Ahli Investment and Development	-0.1505***	-0.0204	0.0122***	0.000018	0.1279***	0.8676***
	(-8.97)	(-0.45)	(9.13)	(1.30)	(3.00)	(24.06)
EL Ezz Aldekhela Steel	-0.0220	0.0982	0.0022	0.001140**	0.2217	0.2036
	(-0.64)	(1.22)	(0.63)	(1.97)	(1.62)	(0.61)
El Ezz Porcelain (Gemma)	-0.1440***	0.0327	0.0115***	0.000038**	0.1390***	0.8255***
	(-10.81)	(0.90)	(11.01)	(2.33)	(3.82)	(21.11)
El Ezz Steel Rebars	-0.0830***	0.1132***	0.0066***	0.000016***	0.1006***	0.8691***
	(-6.24)	(2.94)	(6.46)	(2.66)	(5.34)	(42.59)
El Nasr Clothes & Textiles (Kabo)	-0.0668***	0.1039**	0.0046***	0.000017	0.1631***	0.8331***
	(-4.26)	(2.13)	(4.29)	(1.28)	(2.63)	(14.93)
El Watany Bank of Egypt	-0.0901***	-0.0411	0.0072***	0.000331	0.0335	0.6716
	(-2.82)	(-0.54)	(2.96)	(0.36)	(0.43)	(0.77)
Export Development Bank	-0.0717	-0.0570	0.0068***	0.000060	0.4997*	0.5228***
	(-5.61)	(-0.84)	(5.53)	(1.32)	(1.89)	(2.89)
Extracted Oils	-0.0306*	0.1751	0.0019	0.000016	0.0912**	0.9036***
	(-1.69)	(2.88)***	(1.47)	(1.07)	(2.06)	(20.31)
GB Auto	-0.0367***	-0.1074	0.0032***	0.000069*	0.6039**	0.3294
	(-2.92) ***	(-0.97)	(2.91)	(1.91)	(2.09)	(1.53)
Housing & Development Bank	-0.0594	0.1042	0.0047***	0.000290***	0.3124**	0.2965*

Company Name	α_0	α_1	α_2	β_0	β_1	β_2
	(-3.58)	(1.79)*	(3.50)	(3.41)	(2.23)	(1.90)
Medinet Nasr Housing	-0.0526***	-0.0435	0.0051***	0.000091	0.1929	0.5938
	(-2.84)	-(0.36)	(2.95)	(0.38)	(0.45)	(0.67)
Misr Cement (Qena)	-0.0818**	0.0611	0.0081**	0.000014	-0.1224	1.0817***
	(-2.08)	(0.46)	(2.21)	(0.30)	(-1.09)	(15.30)
Misr Chemical Industries	-0.0887***	0.1170	0.0075***	0.000003	0.0310	0.9640***
	(-3.71)	(2.30)**	(3.72)	(0.29)	(1.24)	(30.48)
Nile Cotton Ginning	-0.0995***	0.0897**	0.0073***	0.000021**	0.1958***	0.8027***
	(-5.80)	(2.06)	(5.88)	(2.00)	(4.93)	(26.41)
Olympic Group Financial	-0.1228***	-0.0665	0.0111***	0.000166	-0.1670	0.8200**
	(-4.33)	(-0.90)	(4.55)	(0.95)	(-1.42)	(2.28)
Orascom Construction Industries	-0.0232**	0.1531***	0.0021**	0.000005	0.0834**	0.9077***
	(-2.14)	(2.99)	(2.27)	(1.00)	(2.54)	(27.51)
Orascom Hotels	-0.0319***	0.0340	0.0027***	0.000007*	0.0571***	0.9321***
	(-4.77)	(1.00)	(5.03)	(1.69)	(3.23)	(49.34)
Orascom Telecom Holding	-0.0346	0.1288	0.0027***	0.000189***	0.2861***	0.2163
	(-3.62)***	(2.98)***	(3.74)	(3.65)	(3.71)	(1.39)
Oriental Weavers	-0.0147	0.0650	0.0013	0.000011	0.1048**	0.8746***
	(-1.56)	(1.25)	(1.57)	(1.27)	(2.67)	(23.22)
Raya Holding For Technology	-0.1584***	0.0641	0.0121***	0.000101**	0.1585***	0.6175***
	(-10.65)	(1.55)	(10.76)	(1.98)	(2.77)	(4.19)
Remco for Touristic Villages	-0.0680***	0.0410	0.0049***	0.000283	0.4502	0.4636**
	(-3.42)	(0.56)	(3.38)	(1.50)	(1.27)	(2.09)
Sidi Kerir Petrochemicals	-0.0152**	0.1103***	0.0011**	0.000028**	0.1767***	0.7509***
	(-2.53)	(2.83)	(2.47)	(2.11)	(2.64)	(9.71)
Six of October Development	-0.0652***	0.0843	0.0055***	0.000087*	0.1580*	0.5964***
	(-5.81)	(1.48)	(5.87)	(1.67)	(1.87)	(3.22)
South Valley Cement	-0.1176***	0.0127	0.0087***	0.000118**	0.3391***	0.4786***
	(-7.21)	(0.24)	(7.40)	(2.56)	(2.93)	(3.55)
Telecom Egypt	-0.0809***	0.1221	0.0058***	0.000082**	0.3047***	0.4457**
	(-6.35)	(2.23)**	(6.50)	(2.21)	(2.67)	(2.56)
United Housing & Development	-0.1365***	0.0606	0.0108***	0.000027	0.1272**	0.8510***
	(-7.18)	(1.25)	(7.27)	(1.33)	(2.36)	(14.96)
Upper Egypt for Construction	-0.1470***	0.1330	0.0094***	0.000127	0.3311**	0.6348***
	(-3.41)	(1.29)	(3.41)	(1.18)	(2.24)	(4.24)
Vodafone Egypt	0.0000004***	0.000001	0.0000001***	0.197501	0.5342	0.6070
	(-629.38)	(-0.31)	(-542.95)	(0.33)	(0.02)	(0.56)

This Table reports the results of the estimation of the GARCH (1,1)-GED Model after the introduction of day trading:

$TR_t = \alpha_0 + \alpha_1 TR_{t-1} + \alpha_2 Volume_t + \varepsilon_t$

$\sigma^2_{\varepsilon,t} = \beta_0 + \beta_1 \varepsilon^2_{t-1} + \beta_2 \sigma^2_{\varepsilon,t-1}$

*Below the estimated coefficients, you find the z statistic in parentheses. ***, **and * indicate significance at the 1, 5 and 10 percent levels respectively.*

The sum of the ARCH β_1 and GARCH β_2 estimates is concentrated in the range between 0.8 and 1, which is an indication of a covariance stationary model with a high persistence and long memory in the conditional variance. In the GARCH (1, 1)-GED model, the sum of β_1 and β_2 is also an estimation of the rate at which the response function decays on a daily basis. Notice that in order to have a mean reverting variance process, the sum of the coefficients adds up to less than one. In our results, the sum $\beta_1 + \beta_2$ is close to one, which means that the process slowly reverts to its mean. Since the rate is high, the response function to shocks is likely to die slowly for the companies in this study.

Table 6 shows the ex-post means, volatilities and coefficient of variation (CV) before and after day trading. The results highlight that the ex-post means and volatilities before day trading are significantly higher than after day trading, indicating that day trading resulted in a reduction in ex-post means and volatilities. These findings can be explained by examining for example the ex-post mean and standard deviation results for Alexandria Mineral Oils Company .The mean increased from 0.0001 to 0.0003, while the standard deviation decreased from 0.0280 to 0.0103. A possible explanation can be that investors are impatient to wait for large increases in the stock price to sell, and large decreases to buy. This results in narrowing the range of the price movements of the stocks after day trading. However, the decrease in the ex- post mean was offset by the decrease of ex-post standard deviation keeping the ex-post coefficient of variation unchanged. Hence, the reward to risk ratio for the investors remained the same.

Ex-ante means and volatilities encompass the future expectations of the investors; which are important in portfolio allocation. Table 7 presents the ex-ante means, volatilities, and coefficient of variation before and after day trading. The results also show that ex-ante risk significantly decreased after day trading. Although the ex-post mean return significantly decreased after day trading, ex-ante mean return did not change significantly. In addition, day trading did not affect ex-ante CV, indicating that the ex-post and ex-ante reward to risk stayed the same.

From Tables 6 and 7, we conclude that ex- post means and volatilities are always higher than ex-ante means and volatilities before and after day trading. For example, the ex-post mean before day trading for Alexandria Mineral Oils Company stock is 0.0001 compared to the ex-ante mean before day trading equal to -0.00136.The ex-post volatility for the same stock before day trading is 0.02800 compared to an ex-ante volatility of 0.02677. The higher ex- post means relative to its ex-ante is explained by investors' tendency to expect returns less than the actual returns. Although ex-post volatility (total volatility) is higher than ex-ante volatility (unexplained volatility), the difference is insignificant, indicating that almost all the volatilities are unexplained (Pilotte and Sterbenz, 2006).

The average daily volume of trade as a proxy of liquidity increased in 25 companies after day trading, while it decreased in the remaining 16 companies (See Table 8). However, the day trading did not significantly affect market liquidity, which is tested in Table 9.

Table 9 provides the summary results by conducting significance tests for the equality of means and medians before and after day trading of (1) effect of information arrival; (2) persistence; (3) clustering; (4) ex-post mean; (5) ex-post standard deviation; (6) ex-post CV; (7) ex-ante mean return; (8) ex-ante standard deviation; (9) ex-ante CV; and (10) market liquidity (average daily volume).

Table 6: Ex-Post Mean and Volatilities for the Daily Total Returns of Day Trading (DT) Companies for the Period July 1, 2004 Until July 31, 2008

Company	Ex-post Mean before DT	Ex-post Mean after DT	Ex-post Standard Deviation before DT	Ex-post Standard Deviation after DT	Ex-post CV before DT	Ex-post CV after DT
Alexandria Mineral Oils Company	0.0001	0.0003	0.0280	0.0103	280.00	34.33
Alexandria Spinning & Weaving	-0.0064	-0.0013	0.0335	0.0277	-5.23	-21.31
Arab Cotton Ginning	0.0048	0.0001	0.0431	0.0328	8.98	328.00
Arab Polvara Spinning & Weaving	0.0026	-0.0003	0.0389	0.0383	14.96	-127.67
ASEC Mining (ASCOM)	0.0107	-0.0047	0.0391	0.0271	3.65	-5.77
Commercial International Bank	0.0023	0.0009	0.0207	0.0200	9.00	22.22
Credit Agricole Egypt	0.0001	-0.0002	0.0216	0.0217	216.00	-108.50
Egyptian Company for Mobile Services	0.0042	-0.0028	0.0340	0.0262	8.10	-9.36
Egyptian Electrical Cables	0.0031	0.0016	0.0475	0.0366	15.32	22.88
Egyptian Financial Group-Hermes	0.0071	0.0009	0.0315	0.0324	4.44	36.00
Egyptian for Housing Development	0.0012	0.0040	0.0512	0.0579	42.67	14.48
Egyptian for Tourism Resorts	0.0122	0.0001	0.0511	0.0274	4.19	274.00
Egyptian Media Production City	-0.0009	-0.0004	0.0297	0.0292	-33.00	-73.00
El Ahli Investment and Development	0.0019	0.0043	0.0368	0.0370	19.37	8.60
EL Ezz Aldekhela Steel - Alexandria	0.0068	-0.0002	0.0557	0.0450	8.19	-225.00
El Ezz Porcelain (Gemma)	0.0071	-0.0004	0.0403	0.0327	5.68	-81.75
El Ezz Steel Rebars	0.0014	-0.0001	0.0447	0.0256	31.93	-256.00
El Nasr Clothes & Textiles (Kabo)	0.0052	-0.0007	0.0356	0.0292	6.85	-41.71
El Watany Bank of Egypt	0.0026	0.0019	0.0235	0.0345	9.04	18.16
Export Development Bank of Egypt	0.0016	-0.0013	0.0280	0.0269	17.50	-20.69
Extracted Oils	-0.0008	-0.0010	0.0413	0.0336	-51.63	-33.60
GB Auto	0.0023	-0.0017	0.0242	0.0226	10.52	-13.29
Housing & Development Bank	0.0008	-0.0008	0.0559	0.0279	69.88	-34.88
Medinet Nasr Housing	0.0015	0.0078	0.0461	0.0242	30.73	3.10
Misr Cement (Qena)	0.0034	0.0058	0.0216	0.0245	6.35	4.22
Misr Chemical Industries	0.0035	-0.0012	0.0345	0.0337	9.86	-28.08
Nile Cotton Ginning	-0.0001	0.0019	0.0650	0.0385	-650.00	20.26
Olympic Group Financial Investments	0.0025	0.0036	0.0290	0.0257	11.60	7.14
Orascom Construction Industries	0.0045	0.0012	0.0224	0.0216	4.98	18.00
Orascom Hotels And Development...	0.0053	0.0010	0.0462	0.0256	8.72	25.60
Orascom Telecom Holding	0.0048	0.000050	0.0233	0.0197	4.85	394.00
Oriental Weavers	0.0018	-0.0010	0.0315	0.0243	17.50	-24.30
Raya Holding For Technology	-0.0053	0.0001	0.0412	0.0239	-7.77	239.00
Remco for Touristic Villages Const.	0.0013	-0.0003	0.0301	0.0387	23.15	-129.00
Sidi Kerir Petrochemicals	0.00032	0.00029	0.0281	0.0179	87.81	61.72
Six of October Development & Inv.	0.0038	-0.0010	0.0209	0.0199	5.50	-19.90
South Valley Cement	0.0057	0.0031	0.0335	0.0249	5.88	8.03
Telecom Egypt	-0.0017	0.0006	0.0299	0.0184	-17.59	30.67
United Housing & Development	0.0001	0.0010	0.0424	0.0314	424.00	31.40
Upper Egypt for Construction	-0.0001	0.0007	0.0396	0.0431	-396.00	61.57
Vodafone Egypt	-0.0004	0.0011	0.0198	0.0330	-49.50	30.00

This Table presents ex-post mean returns and ex-post standard deviations for the daily total return of day trading companies (DT) for the period July 1st until July31st 2008. Ex-post mean is the average of the total returns while ex-post standard deviation is the standard deviation of the total returns. Columns 2 and 3 show the ex-post mean returns before and after DT. Columns 4 and 5 demonstrate the ex-post standard deviation before and after DT. Columns 6 and 7 highlight the ex-post coefficient of variation, which is the ratio of standard deviation over average return, before and after DT

Table 7: Ex-ante Mean and Volatilities for the Daily Total Returns of Day Trading (DT) Companies for the Period July 1, 2004 until July 31, 2008

Company Name	Mean of Ex-ante Returns Before DT	Mean of Ex-ante Returns After DT	Mean of Ex-ante Standard Deviations Before DT	Mean of Ex-ante Standard Deviations After DT	Ex-ante CV Before DT	Ex-ante CV After DT
Alexandria Mineral Oils Company	-0.00136	0.0000009	0.02677	0.00997	-19.7	11077.8
Alexandria Spinning & Weaving	-0.00540	0.00080	0.02559	0.02501	-4.7	31.3
Arab Cotton Ginning	0.00462	0.00181	0.04064	0.02873	8.8	15.9
Arab Polvara Spinning & Weaving	0.00479	-0.00117	0.03627	0.03663	7.6	-31.3
ASEC Mining (ASCOM)	0.01054	-0.00470	0.03660	0.02449	3.5	-5.2
Commercial International Bank	0.00206	0.00115	0.01980	0.01886	9.6	16.4
Credit Agricole Egypt	-0.00112	0.00136	0.01906	0.02075	-17.0	15.3
Egyptian Company for Mobile Services	0.00298	-0.00185	0.03221	0.02619	10.8	-14.2
Egyptian Electrical Cables	-0.00267	0.00198	0.04418	0.03489	-16.5	17.6
Egyptian Financial Group-Hermes	0.00855	0.00287	0.02990	0.02765	3.5	9.6
Egyptian for Housing Development	-0.00283	0.00316	0.04427	0.05283	-15.6	16.7
Egyptian for Tourism Resorts	0.00286	0.00068	0.04451	0.02542	15.6	37.4
Egyptian Media Production City	-0.00020	-0.00043	0.02886	0.02707	-144.3	-63.0
El Ahli Investment and Development	0.00134	0.00359	0.03375	0.03246	25.2	9.0
EL Ezz Aldekhela Steel - Alexandria	0.00664	-0.00133	0.05164	0.04445	7.8	-33.4
El Ezz Porcelain (Gemma)	0.00737	0.00136	0.03684	0.02969	5.0	21.8
El Ezz Steel Rebars	0.00479	0.00121	0.04554	0.02278	9.5	18.8
El Nasr Clothes & Textiles (Kabo)	0.00194	0.00148	0.03547	0.02698	18.3	18.2
El Watany Bank of Egypt	0.00165	0.00228	0.02288	0.03370	13.9	14.8
Export Development Bank of Egypt	0.00068	-0.00100	0.02642	0.02538	38.9	-25.4
Extracted Oils	-0.01103	-0.00339	0.04009	0.03139	-3.6	-9.3
GB Auto	-0.00004	0.00012	0.02535	0.02113	-633.8	176.1
Housing & Development Bank	-0.00443	-0.00154	0.05450	0.02595	-12.3	-16.9
Medinet Nasr Housing	0.00147	0.00447	0.04561	0.02133	31.0	4.8
Misr Cement (Qena)	0.00357	0.00564	0.01804	0.02038	5.1	3.6
Misr Chemical Industries	0.00418	-0.00083	0.03143	0.03182	7.5	-38.3
Nile Cotton Ginning	-0.01361	0.00277	0.05802	0.03274	-4.3	11.8
Olympic Group Financial Inv.	0.00191	0.00179	0.02756	0.02123	14.4	11.9
Orascom Construction Industries	0.00221	0.00167	0.02190	0.02055	9.9	12.3
Orascom Hotels And Development	0.00670	0.00165	0.04453	0.02402	6.6	14.6
Orascom Telecom Holding	0.00343	0.00096	0.02285	0.01897	6.7	19.8
Oriental Weavers	0.00096	0.00045	0.03094	0.02281	32.2	50.7
Raya Holding For Tech. & Com.	-0.00565	0.00105	0.04092	0.02098	-7.2	20.0
Remco for Touristic Villages Const.	0.00222	-0.00103	0.02527	0.03820	11.4	-37.1
Sidi Kerir Petrochemicals	-0.00092	-0.00012	0.02643	0.01731	-28.7	-144.3
Six of October Develp. & Investment	0.00510	-0.00009	0.01979	0.01879	3.9	-208.8
South Valley Cement	0.00486	0.00330	0.03021	0.02312	6.2	7.0
Telecom Egypt	-0.00068	0.00172	0.02845	0.01713	-41.8	10.0
United Housing & Development	0.00021	0.00326	0.03969	0.02866	189.0	8.8
Upper Egypt for Construction	-0.00394	-0.00058	0.03738	0.03958	-9.5	-68.2
Vodafone Egypt Telecommunications	-0.00262	-0.0000001	0.01960	0.70776	-7.5	-7077

This table describes the ex-ante mean returns and standard deviation for the daily total return of day trading companies(DT) for the period July 1st till July31 2008. Columns 2 and 3 show the ex-ante mean returns before and after DT. Ex-ante mean return is the average of the returns generated from forecasting the mean equation of our GARCH (1,1)-GED in Equation 2. Columns 4 and 5 demonstrate the mean of the ex-ante standard deviations, which is the average of the square root of the forecasted variances from the variance equation in GARCH (1,1)-GED in Equation 2, before and after DT. Columns 6 and 7 highlight the ex-ante coefficient of variation, which is ex-ante mean of standard deviations over ex-ante, mean return, before and after DT.

Table 8: Average and Standard Deviation of Daily Volume Before and After Day Trading (DT) for the Period July 1, 2004 until July 31, 2008

Company Name	Average Volume Before DT	Average Volume After DT	Standard Deviation of Volume Before DT	Standard Deviation of Volume After DT
Alexandria Mineral Oils Company	187.94	141.18	65.26	82.46
Alexandria Spinning & Weaving	2,075,048	2,241,202	1,042,562	2,620,820
Arab Cotton Ginning	1,795,753	4,094,025	1,775,147	3,382,071
Arab Polvara Spinning & Weaving	647,363	1,928,312	561,023	2,372,184
ASEC Mining (ASCOM)	118,970	233,364	143,631	242,392
Commercial International Bank	488,829	749,325	460,154	700,855
Credit Agricole Egypt	677,307	408,424	735,461	553,969
Egyptian Company for Mobile Services	118,655	117,816	80,217	104,193
Egyptian Electrical Cables	11,520,195	17,553,271	7,900,323	11,807,505
Egyptian Financial Group-Hermes	2,879,779	3,406,020	1,706,500	2,831,891
Egyptian for Housing Development	1,088,801	2,339,816	1,173,836	1,878,883
Egyptian for Tourism Resorts	6,165,935	7,629,384	7,747,466	7,270,756
Egyptian Media Production City	443,533	852,155	342,314	990,592
El Ahli Investment and Development	231,052	431,914	322,662	356,675
EL Ezz Aldekhela Steel - Alexandria	18,885	17,604	55,094	28,290
El Ezz Porcelain (Gemma)	709,210	442,158	401,317	432,624
El Ezz Steel Rebars	972,617	483,251	528,551	401,048
El Nasr Clothes & Textiles (Kabo)	3,759,555	4,348,149	4,198,179	8,175,898
El Watany Bank of Egypt	412,845	563,621	434,241	601,257
Export Development Bank of Egypt	141,988	53,704	507,939	71,736
Extracted Oils	1,191,304	3,978,891	1,184,348	4,487,426
GB Auto	189,792	146,554	203,858	148,193
Housing & Development Bank	132,429	350,766	163,594	373,714
Medinet Nasr Housing	472,398	158,552	742,266	253,158
Misr Cement (Qena)	38,616	72,488	48,475	105,301
Misr Chemical Industries	221,524	174,023	202,385	175,779
Nile Cotton Ginning	1,708,365	1,539,261	759,259	1,264,614
Olympic Group Financial Investments	132,647	124,743	146,376	124,029
Orascom Construction Industries	241,599	191,438	204,448	161,246
Orascom Hotels And Development...	1,323,163	427,439	793,912	749,338
Orascom Telecom Holding	849,503	778,955	915,512	623,935
Oriental Weavers	71,015	185,406	91,730	285,674
Raya Holding For Technology	412,584	691,152	506,532	732,363
Remco for Touristic Villages Construction	816,612	1,233,643	838,568	1,268,767
Sidi Kerir Petrochemicals	1,266,520	1,444,859	2,989,379	5,647,094
Six of October Development & Investment	262,603	198,632	193,792	199,542
South Valley Cement	1,124,943	1,399,220	6,385,246	1,060,181
Telecom Egypt	2,931,980	1,950,650	2,328,208	1,680,932
United Housing & Development	351,084	630,875	250,844	623,967
Upper Egypt for Construction	6,030,695	10,389,813	5,592,799	11,340,800
Vodafone Egypt Telecommunications	135,560	16,278	176,990	88,495

This Table shows the average and standard deviation of daily volume before and after day trading for the period July 1st till July31st. Column 2 and 3 show the average of day volume before and after day trading, while columns 4 and 5 show the standard deviation of daily volume before and after day trading.

Table 9: Summary Results

Variables	Mean of the Variable Before DT	Mean of the Variable After DT	T-Statistics for Equal Means	Wilcoxon/Mann-Whitney Test for Equal Medians (tie-adj)
Effect of the Flow of News (α_2)	0.005166	0.006312	0.95	1.02
Persistence ($\beta_1 + \beta_2$)	0.866333	0.857956	-0.27	-0.21
Clustering (β_2)	0.697054	0.65822	-0.66	-0.95
Ex Post Mean	0.002461	0.00056	-2.90***	-3.32***
Ex Post Standard Deviation	0.035634	0.029063	-3.00***	-2.77***
Ex Post CV	22.06	10.72	-0.52	-0.96
Ex Ante Mean	0.001003	0.000842	-0.19	-0.85
Ex Ante Standard Deviation	0.033409	0.026751	-3.23***	-3.00***
Ex Ante CV	4.23	2.10	-0.26	-1.07
Liquidity (Average Daily Volume)	1,066,281	1,410,601	0.78	0.31

*This table provides the summary results by conducting significance tests for the equality of means and medians before and after day trading in columns 2 and 3. In column 4 you find the t statistics for testing the hypothesis of the equality of means before and after day trading. The last column shows the Wilcoxon /Mann-Whitney Test for equal in Medians (tie-adj). ***, **and * indicate significance at the 1, 5 and 10 percent levels respectively.*
Effect of the flow of news, persistence, and clustering are generated from the coefficients of our the GARCH (1,1)-GED Model:

$$TR_t = \alpha_0 + \alpha_1 TR_{t-1} + \alpha_2 Volume_t + \varepsilon_t$$

$$\sigma^2_{\varepsilon,t} = \beta_0 + \beta_1 \varepsilon^2_{t-1} + \beta_2 \sigma^2_{\varepsilon,t-1}$$

Ex post mean is the average of the total returns while ex post standard deviation is the standard deviation of the total returns. Ex ante mean return is the average of the returns generated from forecasting the mean equation of our GARCH (1,1)-GED while the ex ante standard deviation is the mean of the ex ante standard deviations, which is the average of the square root of the forecasted variances from the variance equation in GARCH (1,1)-GED. The ex post coefficient of variation is the ratio of ex post standard deviation over ex post mean. Ex ante coefficient of variation is the ratio of ex ante mean of standard deviations over ex ante mean return.

This Table reports the hypothesis tests for the difference between two means and the Wilcoxon/Mann-Whitney test for equal medians. We removed a few outliers before conducting the test for the significance difference between two means. It shows that there is a significant decline in ex-post mean return, ex-post volatility and ex-ante volatility. In contrast, there was no significant effect for day trading on information arrival, volatility clustering, volatility persistence, ex-post and ex-ante CVs, and market liquidity, confirming our previous findings. This highlights that day trading in general did not have a significant effect on investors, as both ex-post and ex-ante CVs did not significantly change after day trading. In addition, day trading had no effect on the market, as liquidity did not change significantly.

CONCLUSION

Motivated by the introduction of day trading in the Egyptian stock market, we studied the effect of this new system on the dynamics of stock returns and volatilities and market liquidity. We collected data on daily stock prices and volume of trade for all companies traded in the day trading system (forty-one companies), during the period from July 2004 until July 2008. We applied a GARCH (1, 1)-GED model to estimate the effect of news arrival, volatility clustering, volatility persistence and ex-ante means and volatilities before and after day trading. Our results show no significant change in volatility clustering and persistence, effect of news arrival, and market liquidity after day trading. Although ex-post means and ex-post volatilities significantly decreased after day trading, ex-post coefficient of variation showed insignificant change, indicating that applying this new system did not affect the reward to risk of investors in the Egyptian stock market. We also estimated the ex-ante means and volatilities, showing that ex-ante means did not significantly change, while the ex-ante volatility significantly dropped after day trading; however, ex- ante CV like ex- post CV did not significantly change.

Our objective was to evaluate the impact of day trading on the Egyptian Stock Market, which is one of the evolving emerging markets that have received little attention in the financial literature. Our results, however, cannot be generalized as they are focused on the Egyptian Stock market where the number of day trading companies is limited (41 companies). Further research can study the impact of the other trading mechanisms introduced recently in the Egyptian Stock market, which include short selling and margin trading. In conclusion, day trading had no effect on the investors in terms of reward to risk, or on the market in terms of liquidity.

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THE REAL EXCHANGE RATE VOLATILITY AND U.S. EXPORTS: AN EMPIRICAL INVESTIGATION

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ABSTRACT

This paper investigates effects of exchange rate volatility on U.S. exports, using disaggregated sectoral data on U.S. exports to its major trading partners. In this paper, we use a generalized ARCH-type model (GARCH) to generate a measure of exchange rate volatility which is then tested in a model of U.S. exports. The analysis uses monthly trade data for the period from January 1990 through December 2007. Testing sectoral trade data allows us to detect whether the direction or magnitude of the impact of volatility differs depending on the types of goods that are traded. The results obtained in this paper suggest that the increase in the volatility of exchange rate exert a negative effect upon export demand in majority of the products: the study finds evidence for significant negative effects in six of ten export products, and significant positive effects in four products.

JEL: F14, F31

KEYWORDS: exchange rate volatility, U.S. Exports, Real exchange rate

INTRODUCTION

The consequences of exchange rate volatility on real exports have long been at the center of debate among researchers. There has been a considerable research concerning the impact of exchange rate volatility on the volume of international trade since the advent of flexible exchange rates in 1973. The interest in this field was incited by two main developments: (a) both the real and nominal exchange rates have undergone periods of substantial volatility since 1973; and (b) during the same period, international trade declined significantly among industrialized countries. Despite the large number of studies conducted, no real consensus has emerged regarding the impact of exchange rate volatility on trade flows.

The empirical literature reveals that the effects of exchange rate volatility on exports are ambiguous. While a large number of studies find that exchange rate volatility tends to reduce the level of trade, others find either weak or insignificant or positive relationships. For example, Onafowara and Owoye (2008), Byrne, Darby, and MacDonald (2008), Choudhry (2005), Bahmanee-Oskooee (2002), Arize, *et al.* (2000), Arize (1995), Chowdhury (1993), Pozo (1992), Bahmani-Oskooee and Ltaifa (1992), Bini-Smaghi (1991), Perée and Steinheir (1989), and Koray and Lastrapes (1989) find evidence for negative effects. On the other hand, Doyle (2001), Chou (2000), McKenzie and Brooks (1997), Qian and Varangis (1994), Kroner and Lastrapes (1993), and Asseery and Peel (1991) find evidence for a positive effect for volatility on export volumes of some developed countries. In addition, Aristotelous (2001), Oskooee and Payestch (1993), Bahmani-Oskooee (1991), and Hooper and Kohlhagen (1978) have reported no significant relationship between exchange rate volatility and exports. Majority of these studies have focused on developed countries while developing countries have received little attention.

Exchange rate volatility may have a direct effect on trade through uncertainty and adjustment costs. Further, it may have an indirect effect through its effect on the structure of output and investment and on government policy. While the empirical research on the nexus between exchange rate volatility and volume of trade is inconclusive, a growing body of literature points towards exchange rate volatility causing a decline in trade. If exchange rate volatility tends to deter volume of exports, the volume of trade could be considerably higher in a more stable exchange rate setting. Those who argue that exchange rate volatility promotes exports point out that exchange rate volatility makes exporting more attractive.

In this paper, we investigate the effects of exchange rate volatility on top ten categories of exports by the United States to its top ten trading partners (Canada, China, Mexico , Japan, Germany, the United Kingdom, South Korea, France, Netherlands, and Brazil), during the period from January 1990 to December 2007. Past studies on the impact of exchange rate volatility on the U.S. exports include Byrne, Darby, and MacDonald (2008), Choudhry (2005), Sukar and Hassan (2001), Arize (1995), Belanger, *et al.* (1992), Klein (1990), Lastrapes and Koray (1990), Koray and Lastrapes (1989), and Cushman (1988). The use of the U.S. monthly trade data is by no means unique to this paper as some previous studies have also used similar data. However, the methodology used in this study incorporates many of the recent developments in the literature which may help to uncover the nature of the relationship. For example, the study tests for the stationarity of the financial and macroeconomic time-series data used in the study and uses cointegration technique to establish a long-run relationship among variables and error-corrections models to establish a short-run dynamics of the model. In addition, GARCH models are used to generate the exchange rate volatility variable which is used in the study.

The remainder of the paper is organized as follows: Section 2 provides a brief literature review. In Section 3, the empirical framework of the current study is set out by specifying model. Section 4 discusses the variable definitions and outlines the data sources. Empirical results of unit root tests, cointegration tests, and error-correction model estimates are presented in Section 5. Section 6 presents a summary and a brief conclusion as to the results obtained in this study.

LITERATURE REVIEW

In this section we present a brief overview of some related work. Although there has been considerable research concerning the impact of exchange rate volatility on trade, we only present findings of studies that analyze the effects of exchange rate volatility on U.S. trade flows.

A study conducted by Byrne, Darby, and MacDonald (2008) analyze the impact of exchange rate volatility on the volume of bilateral U.S. trade flows using sectoral data. The study utilizes annual data over the period 1989-2001 for a cross section of 6 countries and 22 industries. The study finds that pooling all industries together provides evidence of a negative effect on trade from exchange rate volatility. Moreover, the effects of exchange rate volatility on trade is negative and significant for differentiated goods but insignificant for homogeneous goods suggesting that sectoral differences do exist in explaining the different impact of volatility on trade.

Choudhry (2005) investigates the influence of exchange rate volatility on real exports of the U.S. to Canada and Japan using aggregate monthly data ranging from January 1974 to December 1998. The study uses conditional variance from the GARCH (1, 1) model as exchange rate volatility. The study finds significant and mostly negative effects of the exchange rate volatility on real exports.

Sukar and Hassan (2001) investigate the relationship between the U.S. trade volume and exchange rate volatility using cointegration and error-correction models. The study uses quarterly aggregate data covering the period 1975Q1 – 1993Q2 and a GARCH model was used to measure the exchange rate volatility. The study finds evidence for a significantly negative relationship between U.S. export volume and exchange rate volatility. However, the short-run dynamics of the relationship shows that the effect of exchange rate volatility is insignificant.

Arize (1995) analyzes the effects of real exchange rate volatility on the proportions of bilateral exports of nine categories of goods from the United States to seven major industrial countries. The data are monthly series over the period February 1978 to June 1986. The volatility measure used is the standard deviation of the monthly percentage change in the bilateral exchange rate between the U.S. and the importing country over the period t and t-12. The study finds different effects of exchange rate volatility across categories of exports. The study also concludes that exchange rate uncertainty has a negative effect on U.S. real exports, and that it may have major impact on the allocation of resources.

Lastrapes and Koray (1990) investigate the relation between exchange rate volatility, international trade and the macro economy in the context of a VAR model. The model is estimated for U.S. multilateral trade over the floating rate period and includes a moving standard deviation measure of real exchange volatility. The study finds some evidence of a statistically significant relationship between volatility and trade, but the moving average representation of the system suggests that the effects are quantitatively small. The study also finds that exchange rate volatility is influenced by the state of the economy.

A study by Klein (1990) analyze the effects of exchange rate volatility on the proportions of the bilateral exports of nine categories of goods from the United States to seven major industrial countries using fixed effects framework. The data are monthly series over the period February 1978 to June 1986. The study finds mixed evidence on the effects of exchange rate volatility on exports. In six categories the volatility of real exchange rate significantly affects the volume of exports and in five of these categories the effect is positive.

Koray and Lastrapes (1989) investigates the relationship between real exchange rate volatility and bilateral imports from five countries, namely, the United Kingdom, France, Germany, Japan, and Canada, using a vector autoregression (VAR) model. The study uses aggregate monthly data from January 1959 to December 1985. The findings of the study suggest that the effects of volatility on imports is weak, although permanent shocks to volatility do have a negative impact on imports, and those effects are relatively more important over the flexible rate period.

Finally, Cushman (1988) conducted a study to test for real exchange rate volatility effects on U.S. bilateral trade flows using annual data for the period 1974-1983. The study finds evidence for significant negative effects in five of six import flows, and in two of six U.S. export flows with one export flow showing a significant positive effect.

The current study uses the U.S. monthly disaggregated trade data covering the period from January 1990 to December 2007 focusing on the top ten export products to top ten trading partners. The methodology used in this study incorporates many of the recent developments in the literature, namely, cointegration and error-correction models, which may help to uncover the nature of the relationship. In addition, GARCH models are used to generate the exchange rate volatility variable which is used in the study.

MODEL SPECIFICATION

As indicated in the previous section, the main objective of this study is to assess the effects of exchange rate volatility on the disaggregated U.S. sectoral exports to its major trading partners. Previous studies that have investigated the influence of exchange rate volatility on exports have used a measure of exchange rate volatility (or risk) as an explanatory variable in aggregate export demand function.

Drawing on the existing empirical literature in this area, we specify a standard long-run export demand function for commodity i may take the following form (see, for example, Choudhry, 2005, 1993; Klaasses, 2004; Arize, 1998, 1995; Pozo, 1992; Asseery and Peel, 1991; Kenen and Rodrik (1986); and Goutor, 1985):

$$\ln X_{it} = \beta_0 + \beta_1 \ln Y_t + \beta_2 \ln P_{it} + \beta_3 \ln V_t + \varepsilon_t \quad (1)$$

where X_{it} is real export volume of commodity i in period t, Y_t is the real foreign income in period t, P_{it} is the relative price of exports of commodity i in period t, V_t is a measure of exchange rate volatility, and ε_t is a white-noise disturbance term.

Economic theory suggests that the real income level of the trading partners of the domestic country would affect the demand for exports positively. Therefore, *a priori*, it is expected that $\beta_1 > 0$. On the other hand, if the relative prices rise (fall), it would cause the domestic goods to become less (more) competitive than foreign goods and, therefore, the demand for exports will fall (rise). Therefore, *a priori*, it is expected that that $\beta_2 < 0$. This variable measures the competitiveness of U.S. exports. The last explanatory variable is a measure of exchange rate volatility. Various measures of real exchange rate volatility have been proposed in the literature. Some of these measures include (1) the averages of absolute changes, (2) the standard deviations of the series, (3) deviations from trend, (4) the squared residuals from the ARIMA or ARCH or GARCH processes, and (5) the moving sample standard deviation of the growth rate of the real exchange rate. The effect of exchange rate volatility on exports is ambiguous and the international empirical evidence on the influence of volatility on exports is mixed. As Bredin, *et al.* (2003) points out, the effects of exchange rate volatility on exports is also ambiguous from a theoretical point of view. Therefore, β_3 is expected to be either positive or negative.

In order to establish whether there is a long-run equilibrium relationship among the variables in Equation (1), this study uses the cointegration and error-correction models developed by Engle and Granger (1987). Some of the previous studies that used this methodology include Onafowara and Owoye (2008), Choudhry (2005), Bredin, *et al.* (2003), Sukar and Hassan (2001), Fountas and Aristotelous (1999), Arize (1995, 1998), Holly (1995), Lastrapes and Koray (1990), and Koray and Lastrapes (1989). The cointegration approach requires testing the time-series properties of individual variables in Equation (1) for stationarity using unit root tests. If all variables in Equation (1) are integrated of the same order, then the equation is estimated by employing the multivariate cointegration methodology suggested by Johansen (1988) and Johansen and Juselius (1990).

DATA SOURCES AND VARIABLES

Monthly data for the period from January 1990 to December 2007 were used for estimation. The analysis focuses on top ten export products of the U.S. to major markets for U.S. exports, namely, Canada, China, Mexico, Japan, Germany, the United Kingdom, South Korea, France, Netherlands, and Brazil. Monthly data on real export volume and prices were taken from the Global Trade Information Services, *World Trade Atlas Database*. Monthly data on real export volumes and prices were converted into export volume indices and export price indices with year 2000 as the base year. Thus the export volume index and export price index take the value of 100 in the base year. The study focuses on the top ten export commodities defined at the 2-digit Harmonized System (HS) codes level. They are: Machinery (HS 84); Electrical Machinery (HS 85); Passenger Vehicles (HS 87); Aircraft and Spacecraft (HS 88); Optical and Medical Instruments (HS 90); Plastic (HS 39); Mineral Fuel and Oil etc (HS 27); Precious Stones and Metals (HS 71); Organic Chemicals (HS 29); and Pharmaceutical Products (HS 30).

The real foreign income variable is proxied by the trade-weighted average of the industrial production indices (2000=100) of the U.S.'s major export partners. The underlying series were obtained from the International Monetary Fund's *International Financial Statistics database* and from the Organization for Economic Cooperation and Development (OECD)'s online database. The trade-weighted average of the industrial production index of the U.S.'s 10 major export partners was calculated as:

$$Y_t = \sum_{j=1}^{10} EX_{jt}^{w} \times Y_{jt} \qquad (2)$$

where Y_t is the real foreign income at time t, EX_{it}^{w} is a weight of U.S. exports (or export share) to the jth country at time t, and Y_{jt} is the industrial production index of the jth country at time t. The top 10 export partner countries of the U.S. are: Canada, China, Mexico, Japan, Germany, the United Kingdom, South Korea, France, Netherlands, and Brazil.

The relative price ratio for U.S. exports was calculated as the ratio of the export price index of each commodity to the world price level, which is proxied by a trade-weighted average of the consumer price index of the 10 major export partners of the United States. The consumer price indices for the major export trading partners were also obtained from the International Monetary Fund's *International Financial Statistics database*. The trade-weighted average of the consumer price index of the U.S.'s 10 major export partners was calculated as:

$$P_t^{w} = \sum_{j=1}^{10} EX_{jt}^{w} \times P_{jt} \qquad (3)$$

where P_t^{w} is the world price level at time t, EX_{it}^{w} is a weight of U.S. exports (or export share) to the jth country at time t, and P_{jt} is the consumer price index (2000=100) of the jth country at time t. The trade-weighted average of the consumer price index was also converted into a new series with the base year 2000.

Following Sekkat and Varoudakis (2000), the trade-weighted real exchange rate, RER_t, was constructed as,

$$RER_t = \sum_{j=1}^{10} EX_t^{w} \times \left(\frac{ER_{jt} \times P_{jt}}{P_t^{US}} \right) \qquad (4)$$

where RER_t is the real exchange rate, ER_{jt} is the bilateral nominal exchange rate (the home currency price of a unit of foreign currency, for example, the number of Japanese Yens per US $) with country j at time t, and EX_{it}^{w} is a weight of U.S. exports (or export share) to the jth country at time t, P_{jt} is the consumer price index (2000=100) of the jth country at time t, and P_t^{US} is the consumer price index (2000=100) of the U.S. The monthly data on nominal exchange rates were taken from the IMF, *International Financial Statistics database*.

Finally, the series of exchange rate volatility were obtained using the estimated $\mathrm{GARCH}(1,1)$ model. We make use of real as opposed to nominal exchange rates in the measurement. As Choudhry (2005) points out, unlike other measures of exchange rate volatility which can potentially ignore information on the stochastic processes by which exchange rates are generated, ARCH-type models capture the time-varying conditional variance as a parameter generated from a time-series model of the conditional mean and variance of the growth rate, and thus are very useful in describing volatility clustering.

The $\mathrm{GARCH}(1,1)$ model we estimate is based on an autoregressive model of order 2 ($\mathrm{AR}(2)$) of the first difference of the real exchange rate and it takes the following form:

$$\ln RER_t = \beta_o + \beta_1 \ln RER_{t-1} + \beta_2 \ln RER_{t-2} + e_t, \qquad \text{where} \quad e_t \sim N(0, u_t^2) \tag{5}$$

$$u_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \alpha_2 u_{t-1}^2 \tag{6}$$

The estimated conditional variance (u_t^2) from Equation (7) is used as our measure of exchange rate volatility.

EMPIRICAL RESULTS

We first estimate Equations (5) and (6) for the period January 1990-December 2007, and the results are shown in Table 1. The coefficients of α_0 , α_1, and α_2 are all positive and $\alpha_1 + \alpha_2 = 0.85 < 1$. These results ensure that conditional variance is strictly positive, thus satisfying the necessary conditions of the ARCH model in Equation (6). These findings show that the estimated coefficients of e_{t-1}^2 and u_{t-1}^2 are statistically significant at the 10% and 1% levels, respectively. Therefore, significant ARCH and GARCH effects appear to exist in the data. The predicted value of Equation (6) provides a measure of real exchange rate volatility.

Table 1: Estimation of Real Exchange Rate Variance as a GARCH (1, 1) Process

$$\ln RER_t = -0.00107 + 0.44051 \ln RER_{t-1} + 0.24243 \ln RER_{t-2}$$
$$(-0.200) \quad (6.411)^* \qquad (3.001)^*$$

$$u_t^2 = 0.00089 + 0.07792\, e_{t-1}^2 + 0.78092\, u_{t-1}^2$$
$$(1.301) \quad (1.850)^{**} \qquad (7.489)^*$$

Log L = 242.77 N = 213

***Note**: This table shows the estimated results of the GARCH (1, 1) model. The predicted value of this model is used as the measure of exchange rate volatility. The figures in parentheses are t-statistics. * and ** indicate the statistical significance at the 1% and 10% level, respectively.*

Before we estimate equation (1), all the variables must be tested for the presence of unit roots. We use the Augmented Dickey-Fuller (ADF) test suggested by Fuller (1976) and Dickey and Fuller (1981) to test for unit roots. The ADF test was performed on the time series of $\ln X$, $\ln Y$, $\ln P$ and $\ln V$, and the test results together with optimal lag lengths are presented in Table 2. The ADF test was conducted on both the level and the first difference of the variables. The results show that all the variables have unit roots. However, the $\ln V$ variable is stationary at levels.

Having tested for unit roots, we then performed the trace test and the maximum eigenvalue test for the presence of cointegrating vectors for each model specification. The results of the cointegration tests are presented in Table 3 while the normalized cointegrating vectors are presented in Table 4. Both the trace test and the maximum eigenvalue test indicate that there is at least one cointegrating vector in each case. All the specifications yielded correct signs for the coefficients. All of the coefficients are statistically significant either at 1% or 5% level of significance. Hence, we interpret these specifications as the long-run export demand relationships for the United States for the period covered in this study. Of the ten products, six of them have negative signs for the exchange rate volatility variable indicating that exchange rate volatility tends to deter exports in the long-run, for these six products.

Table 2: Unit-Root Tests: Augmented Dickey-Fuller (ADF) Test Statistics

	Level				First Difference			
Variable	ADF_1	(k)	ADF_2	(k)	ADF_1	(k)	ADF_2	(k)
Real foreign income	-1.1363	(13)	-2.8479	(13)	-3.1767**	(14)	-3.4415**	(14)
Volatility	-4.3065*	(0)	-4.1955*	(0)	-13.9624*	(0)	-13.9707*	(0)
Exports of Mineral Fuel	-2.3614	(2)	-3.1241	(2)	-18.1346*	(1)	-18.0959*	(1)
Exports of Org. Chemicals	-1.9935	(2)	-2.5246	(1)	-16.0117*	(1)	-15.9730*	(1)
Exports of Pharmaceuticals	-2.1321	(1)	-2.8049	(1)	-13.5611*	(1)	-13.5980*	(1)
Exports of Plastic	-0.9631	(4)	-2.0838	(4)	-11.9828*	(3)	-11.9583*	(3)
Exports of Precious Stones	-1.8590	(2)	-2.1748	(1)	-15.7109*	(1)	-15.7044*	(1)
Exports of Machinery	-2.3497	(12)	-1.1742	(12)	-3.0464**	(11)	-3.6485**	(11)
Exports of Electric. Machinery	-1.0420	(2)	-0.3598	(3)	-19.8627*	(1)	-11.5919*	(2)
Exports of Passenger Vehicles	-1.4999	(14)	-2.1226	(14)	-4.2144*	(13)	-4.1891*	(13)
Exports of Aircraft	-2.5092	(1)	-2.5847	(1)	-20.5778*	(1)	-20.8064*	(1)
Exports of Optical Instruments	-2.0736	(4)	-2.0763	(3)	-11.4371*	(3)	-11.5790*	(3)
Price of Mineral Fuel	-2.0929	(3)	-2.0810	(3)	-14.3813*	(2)	-14.4860*	(2)
Price of Org. Chemicals	-1.2995	(1)	-1.3059	(1)	-13.5280*	(2)	-13.5048*	(2)
Price of Pharmaceuticals	-1.4364	(5)	-2.5653	(5)	-12.3426*	(4)	-12.3129*	(4)
Price of Plastic	-2.3146	(1)	-2.5025	(1)	-15.3488*	(1)	-15.3223*	(1)
Price of Precious Stones	-1.3684	(1)	-1.8529	(1)	-16.2793*	(1)	-9.2976*	(5)
Price of Machinery	-2.1364	(12)	-2.8020	(12)	-4.9147*	(11)	-4.9497*	(11)
Price of Electrical Machinery	-1.7631	(3)	-1.7132	(3)	-13.8375*	(2)	-13.8232*	(2)
Price of Passenger Vehicles	-1.6179	(2)	-2.7900	(1)	-15.5532*	(1)	-15.5683*	(1)
Price of Aircraft	-0.9489	(2)	-1.5181	(2)	-13.9744*	(1)	-14.1004*	(1)
Price of Optical Instruments	-1.0394	(1)	-2.7373	(1)	-13.7852*	(1)	-13.7717*	(1)

*This table shows the results of the Augmented Dickey-Fuller test for unit roots at both level and first difference. The figures in parentheses are optimal lag lengths (k) as determined by Schwarz Information Criterion (SIC). * and ** denote statistical significance at the 1% and 5% levels, respectively.*

ADF_1 tests H_0: $\theta_1 = 0$ in

$$\Delta \ln X_t = \beta_0 + \theta_1 \Delta \ln X_{t-1} + \sum_{j=1}^{m} \beta_j \ln X_{t-j} + \varepsilon_t \quad (8)$$

ADF_2 tests H_0: $\theta_2 = 0$ in

$$\Delta \ln X_t = \alpha_0 + \alpha_1 t + \theta_2 \Delta \ln X_{t-1} + \sum_{j=1}^{m} \alpha_j \ln X_{t-j} + \varepsilon_t \quad (9)$$

The critical values of ADF_1 statistics are -3.46 and -2.87 at 1% and 5% levels of significance, respectively. The critical values of ADF_2 statistics are -4.00 and -3.43 at 1% and 5% levels of significance, respectively.

Table 3: Results from Cointegration Tests for the Series: X, Y, P and V

	Maximum Eigenvalue Test				Trace Test			
Product	$r = 0$	$r \le 1$	$r \le 2$	$r \le 3$	$r = 0$	$r \le 1$	$r \le 2$	$r \le 3$
Mineral Fuel	30.95*	20.43	9.97	3.24	64.60*	33.64*	13.21	3.24
Org. Chemicals	28.67*	14.94	11.04	2.94	57.61*	28.93	13.99	2.94
Pharmaceuticals	28.14*	19.96	8.51	3.11	59.72*	31.58*	11.61	3.11
Plastic	28.58*	12.65	9.61	3.29	54.14*	25.55	12.90	3.29
Precious Stones	32.45*	12.70	10.04	3.33	65.52*	33.07*	13.37	3.33
Machinery	28.53*	14.15	9.34	3.74	55.78*	27.25	13.09	3.74
Elec. Machinery	28.01*	13.50	8.50	3.18	53.21*	25.20	11.69	3.18
Passeng. Vehicles	35.71*	12.93	10.89	3.36	62.90*	27.19	14.26	3.36
Aircraft	29.82*	9.87	6.11	2.71	48.52*	18.70	8.83	2.71
Optic. Instruments	28.12*	12.91	8.81	3.25	53.10*	24.98	12.06	3.25
Critical value	27.58	21.13	14.26	3.84	47.85	29.79	15.49	3.84

This table summarizes the results of cointegration tests, namely, the Maximum Eigenvalue Test and Trace Test. Critical values for the Maximum Eigenvalue Test and Trace Test are critical values at the 5% level of significance.

The Short-Run Dynamics

The short-run dynamics of the long-run export demand functions can be examined by estimating error-corrections models for each case. For this we follow Hendry's (1987) general-to-specific modeling strategy. The process involves regressing the first-difference of $\ln X$ on the current and lagged values of first-differences of each of the explanatory variables in Equation (1), lagged values of $\ln X$, and one period lagged residuals from Equation (1). According to the Engle and Granger (1987) Representation

Theorem, the presence of cointegration in a system of variables implies that a valid error-correction representation exists. The error-correction model for the cointegrating vector ($\ln X$, $\ln Y$, $\ln P$, $\ln V$) can be written as:

$$\Delta \ln X_t = \alpha_0 + \alpha_1 EC_{t-1} + \sum_{i=1}^{n} \beta_i \Delta \ln X_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta \ln Y_{t-i} + \sum_{i=0}^{n} \delta_i \Delta \ln P_{t-i} + \sum_{i=0}^{n} \eta_i \Delta \ln V_{t-i} + \omega_t \qquad (7)$$

where EC_{t-1} is the lagged error-correction term and is the residual from the cointegration regression Equation (1). The error-correction term EC_t represents the error-correction mechanism and α_1 gives the speed of adjustment towards the system's long-run equilibrium. If the variables have a cointegrating vector, then $EC_t \sim I(0)$ represents the deviation from equilibrium in period t. Generally, the error-correction term indicates how the system converges to the long-run equilibrium implied by the cointegrating regressions. The error-correction model enables us to distinguish between the short-run and long-run real exports functions.

Table 4: Normalized Cointegrating Vectors

Product	Constant	Y	P	V
Mineral Fuel	0.0052	2.2334*	-1.2800*	0.0013*
		(0.681)	(0.182)	(0.003)
Organic Chemicals	-0.0965	3.6653*	-0.8493*	-0.0176*
		(0.497)	(0.200)	(0.022)
Pharmaceuticals	-0.0225	3.0408*	-5.8188*	0.0160*
		(0.341)	(0.425)	(0.001)
Plastic	-0.0272	4.4972*	-0.1336*	-0.0029*
		(0.408)	(0.022)	(0.001)
Precious Stones	-1.7780	3.4230*	-2.4242*	-0.3335*
		(0.574)	(0.556)	(0.024)
Machinery	0.0869	3.5193*	-0.6728*	0.0187*
		(0.631)	(0.134)	(0.002)
Electrical Machinery	0.2902	3.2012**	-4.0082*	-0.0592*
		(1.681)	(0.260)	(0.011)
Passenger Vehicles	0.2462	4.4915*	-0.5221*	-0.0462**
		(0.478)	(0.184)	(0.022)
Aircraft	0.0163	3.2748*	-0.7108*	0.0049*
		(0.712)	(0.081)	0.002)
Optical Instruments	-0.0409	3.3541*	-0.0881**	-0.0064**
		(0.819)	(0.041)	(0.003)

*This table summarizes the normalized cointegrating vectors relating the dependent variable and independent variables. Figures in parentheses in normalized cointegrating vectors are standard errors. * and ** denote statistical significance at the 1% and 5% levels, respectively.*

The results of the estimated error-correction models are presented in Table 5. The results presented in Table 5 indicate that in all ten cases the error-correction term has the appropriate (negative) sign and is statistically significant. This result confirms the validity of an equilibrium relationship among the variables in the cointegrating equation and implies that the underlying dynamic structure of the model would have misspecified if the cointegration among the variables were overlooked. The speed of adjustment term (α_1) varies from -0.139 for product HS 85 to -0.938 for product HS 84, indicating that adjustment ranges from about 13.9% for product HS 85 to 93.8% for product HS 84 toward the long-run equilibrium. In general, estimated models for all ten products provide satisfactory results.

The estimated coefficients on exchange rate volatility variable have the expected negative sign in the majority of the cases. Further, it is statistically significant in seven out of ten products. Thus, in general, it appears that the measure of exchange rate volatility has a significant and negative impact on exports of United States at either the 5% or 1% level of significance. For all products, except for machinery (HS 84), electrical machinery (HS 85), passenger vehicles (HS 87), and aircrafts and spacecraft (HS 88), exchange rate volatility has a significantly negative impact on exports.

Table 5: Regression Results for Error-Correction Models

		Variables				
Product	Lag	EC_{t-1}	ΔX	ΔY	ΔP	V
Mineral Fuel	0				-1.569* (-8.93)	
and Oil	1	-0.636* (-4.03)		2.633* (6.56)		-0.232* (-2.18)
	2		0.245* (6.24)			
	3			1.020* (3.40)	-0.273* (-2.35)	
Organic	0		-0.336* (-2.69)			-0.212* (-3.15)
Chemicals	1	-0.549*(-8.11)			-0.710* (-5.37)	
	2		-0.267* (-2.33)	1.987* (6.21)	-0.396* (-2.97)	
	3			0.943* (4.53)		
Pharmaceu.	0				-2.230* (-4.82)	
Products	1	-0.410*(-4.41)		1.072* (4.11)		
	2		-0.928* (-6.62)	0.775* (3.55)	-1.427* (-3.66)	
	3		-0.518* (-4.07)		-0.599* (-2.22)	-0.498** (-1.97)
Plastic	0		-0.877* (-8.76)			
	1	-0.597*(-4.98)		1.535* (3.97)	-0.349* (-2.68)	-0.092* (-2.16)
	2		-0.562* (-3.95)			
	3			0.865* (3.27)	-0.281** (-1.86)	
Precious	0			1.305* (6.32)		
Stones and	1	-0.296*(-7.05)	-0.877* (-8.76)		-0.575* (-4.40)	
Metals	2		-0.562* (-3.95)	0.688* (3.82)		
	3					-0.227 (-1.19)
Machinery	0		-0.226* (-2.59)			
	1	-0.938*(-9.50)	-0.207* (-2.42)		-0.576* (-9.94)	0.029 (1.51)
	2				-0.473* (-7.80)	
	3			1.265* (6.45)		
Electrical	0			1.574* (4.76)		
Machinery	1	-0.139*(-3.23)			-0.344* (-2.65)	
	2		-0.448* (-6.25)		-0.142* (-2.48)	
	3					0.179 (1.33)
Passenger	0		-0.127 (-1.68)			
Vehicles	1	-0.226*(-7.52)		0.917* (6.48)	-0.068** (-1.98)	0.276* (2.06)
	2			0.585* (6.36)		
	3					
Aircraft and	0		-0.262** (1.94)			
Spacecraft	1	-0.296*(-4.77)		1.398* (3.40)		
	2				-0.464* (-4.20)	0.234* (2.37)
	3				-0.192* (-3.01)	
Optical and	0			0.830* (8.62)		
Medical	1	-0.340*(-9.36)			-0.073** (-1.92)	
Instruments	2					-0.092* (-2.46)
	3		-0.412** (-1.89)			

*This table summarizes the results of the error-correction models. The results are used to analyze the short-run dynamics of the model. The figures in parentheses are t-values for the regression coefficients. * and ** denote statistical significance at the 1% and 5% levels, respectively.*

SUMMARY AND CONCLUSIONS

In this paper we have examined the dynamic relationship between exports and exchange rate volatility in United States in the context of a multivariate error-correction model. Estimates of the long-run export demand functions were obtained by employing Johansen and Juselius maximum likelihood cointegration technique to quarterly date for the period 1990-2007.

The cointegration results clearly show that there exists a long-run equilibrium relationship between real exports and real foreign economic activity, real exchange rate, and real exchange rate volatility, in all ten commodities selected. All the specifications yielded correct signs for the coefficients. All of the coefficients are statistically significant either at 1% or 5% level of significance. Of the ten products, six of them have negative signs for the exchange rate volatility variable indicating that exchange rate volatility tends to deter exports in the long-run, for these six products. The error-correction results indicate that exchange rate volatility has a significantly negative impact on exports of United States in six of the ten products.

Although the results of this study tend to suggest that exchange rate volatility has a negative effect for majority of the products analyzes, in order to find strong evidence, we need to analyze more export products. Future research can include longer time period and broader product coverage. Such study can also use analytical tools such as variance decomposition and impulse response models to understand the effects of exchange volatility on exports.

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CREDIT RISK MODELS: AN ANALYSIS OF DEFAULT CORRELATION

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ABSTRACT

This paper examines one of the major problems in credit risk models widely used in the financial industry to forecast future defaults and bankruptcies. We find that even after proper calibration, a representative credit risk model can severely underestimate default correlation. We further find that a likely reason for the underestimation of default correlation is the problematic common practice in the financial industry of using observable equity correlation as a proxy for unobservable asset correlation when the model is applied to predict default correlation. However, our results show that this proxy in common practice is not valid.

JEL: G01; G21; G31

KEYWORDS: Credit risk model, default correlation, model risk, financial crisis

INTRODUCTION

The current financial crisis has shaken the whole financial market and profoundly affected the global economy. Numerous innovative financial instruments have been blamed for causing the crisis, such as Collateralized Debt Obligations (CDOs), Mortgage Backed Securities (MBS), and Credit Default Swaps (CDS), although these instruments were originally devised to manage credit risk and implement risk-sharing efficiently, thereby improving the stability of the financial markets.

In contrast, these innovative financial instruments fail to attain their original goals. One of the major reasons is the incorrect pricing of credit risk in these financial instruments. For example, the credit risk models used by American International Group (AIG), which wrote billions of CDS to provide insurance for mortgages, grossly underestimate the credit risk of insured mortgages. When unexpected multiple defaults on mortgages happen simultaneously, as they did in the recent financial crisis, the CDS claims AIG owed significantly exceeded the premiums the company received from CDS. Subsequently, AIG became nearly insolvent and the US Government had to bail it out. Similarly, the credit risk models used by rating agencies such as Fitch, Moody's, and Standard and Poor's, all failed to predict the default rates of subprime mortgages and greatly overrated subprime mortgage-backed securities. The modeling error led to write-downs of more than $500 billion subprime-related securities by financial firms around the world.

The above evidence shows that the use of flawed credit risk models has brought significantly unfavorable outcome to financial firms. In modern financial markets, financial firms rely heavily on models for pricing financial instruments or managing risks. In particular, in the past decade, the success of quantitative financial modeling has made the decision-making process in financial firms more reliant on (sophisticated) quantitative models. Financial researchers and practitioners developed the increasing belief that risk was under control to the extent that many, for example, de Chassart and Firer (2004), believed that it was not as difficult as once thought to forecast and outperform the volatile market. However, past success by no means guarantees future success. A number of studies on the current financial crisis have addressed the problems with credit risk models the financial industry uses. For example, Chancellor (2007) and Jameson (2008) argue that some false assumptions make risk models dysfunctional. Buchanan (2008) claims the existing credit risk models tend to underestimate the probability of sudden large events. Lohr (2008) and Mollenkamp et al. (2008) believe that human factors cause the risk models to be incorrectly applied.

However, one of the critical problems in credit risk models, which is the inability of the models to accurately predict default correlation, has not been widely noted in studies on the current financial crisis. If a credit risk model cannot estimate default correlation accurately, the estimated joint default rates of the securities are problematic. For example, one of the reasons behind the fallout of AIG is that its credit risk model underestimated the correlation between defaults on insured mortgages, thereby greatly underpredicting the joint default rates of the mortgages. Consequently, AIG suffered record losses from selling CDS.

In this study, we revisit a representative default correlation model, Zhou's credit risk model (2001), to examine the ability of the model to predict default correlations between bonds of different ratings. Zhou's model is built on a first-time-passage structural framework that specifies default as an event that occurs when the firm's asset value falls below the default boundary for the first time. Default correlation is generated by the correlation between two firms' underlying assets. Along the same line, financial practitioners proposed other structural credit risk models, such as Moody's KMV model, JP Morgan's CreditMetrics™ risk model, and Fitch's VECTOR. However, the difficulty in implementing structural credit risk models is that the value of firm assets is unobservable due to the unobservable components of firm value, i.e. tax shields and expected bankruptcy costs. To get around this difficulty, the common practice is to use observable equity correlation as a proxy for unobservable asset correlation. For instance, Zhou (2001) assumed equal asset and equity correlations, and picked a constant equity correlation (i.e., 0.4) for all bond ratings. To utilize the KMV model, the CreditMetrics™ model, and Fitch's VECTOR model, financial practitioners commonly pick an asset correlation or set the asset correlation equal to equity correlation. For example, Fitch Ratings point out that the direct measurement of asset correlation between firms is impossible given that historical firm value time series are generally not available; consequently, Fitch uses equity correlation to approximate asset correlation when implementing its VECTOR model (see Global Rating Criteria for Collateralized Debt Obligations, 2003, Fitch Ratings).

This practice has three major flaws. First, equity correlation and asset correlation can differ substantially. In particular, as financial leverage increases, equity deviates more from asset and the difference between equity correlation and asset correlation widens. Second, equity correlation is likely to vary, rather than remain constant, for different ratings. Third, it is inappropriate to use an *ad hoc* number (e.g., 0.4) for equity (or asset) correlation. While the *ad hoc* number may make the model fit historical default correlations well, it cannot provide useful information on *ex post* predictions of default correlation.

Our analysis shows that Zhou's structural credit risk model significantly underestimates default correlation between differently rated bonds. Our results suggest that while structural credit risk models can adequately predict default rates of a single risky bond, they fail to predict joint default rates if multiple defaults happen simultaneously. A major reason is the improper common practice that approximates asset correlation with equity correlation when financial practitioners use the model to predict default correlation.

The remainder of the paper is organized as follows: Section 2 briefly reviews the relevant literature. Section 3 explains the relation between default correlation and estimation of joint default rates. Section 4 describes the data and Zhou's structural credit risk model (2001). Section 5 provides analysis and discussions of estimation results, and Section 6 concludes the paper.

LITERATURE REVIEW

To better understand the problems inherent in credit risk models, we briefly review the two families of credit risk models in the finance literature: reduced form models and structural models. Reduced form models treat default as a process determined by exogenous state variables. Albeit easier to implement, this type of models cannot be used to estimate default correlation based on the correlation between firm characteristics (see among others, Duffie and Singleton, 1997, 1999; Jarrow et al., 1997; Jarrow and Turnbull, 1995; Lando, 1998; Madan and Unal, 1998, 2000).

Structural models, in contrast, use firm characteristics, such as financial leverage and asset return volatility, to predict default probability and default correlation between two firms. The model assumes that default is triggered when firm value falls below some threshold (default boundary). The structural model was pioneered by the seminal works of Black and Scholes (1973, B-S hereafter) and Merton (1974). Their models assume that default can only happen at debt maturity. As illustrated by recent mortgage default, this is not a realistic assumption, and this unrealistic assumption results in the underestimation of default probability. To allow for default before debt maturity, Black and Cox (1976) introduced the first-passage-time (FPT) model that specifies default as an event when the firm's asset value crosses the default boundary for the first time. A great number of empirical works have shown that the FPT model is superior to the B-S and Merton models in predicting bond yield and credit risk of a single risky bond. At present, the FPT model is widely used to estimate credit risk in the financial industry.

Based on the FPT structural framework, Zhou (2001) developed a seminal model for default correlation generated by the correlation between two firms' underlying assets. To account for contagious credit risk effects, Giesecke (2003, 2006) derived a model by assuming correlated default boundaries in addition to correlated firm values. The idea is that default boundaries are uncertain. When one firm defaults, another firm's default boundary is revealed. The original purpose of the model was to boost default correlation prediction. However, we note that this mechanism could also decrease default correlation prediction because if the revealed second firm's default boundary is below what is expected, the model would generate a lower default correlation. Meanwhile, financial practitioners also proposed various credit risk models using the structural framework, including Moody's KMV model, JP Morgan's CreditMetrics™ risk model, and Fitch Ratings VECTOR.

The basic idea in Moody's KMV model is that a firm will default on its debt obligations if the firm value drops below its default point, which is defined as the sum of the value of short-term debt and the value of a portion of long-term debt. An important feature of the KMV model is that a single measure of default risk – distance-to-default is calculated to estimate default probability. Distance-to-default is calculated as the difference between the firm value and the default point divided by the size of one standard deviation move in the firm value (see Crosbie and Bohn, 2003).

JP Morgan's CreditMetrics™ is the first model for assessing credit risk in portfolios due to changes in debt value caused by changes in obligor credit quality. This model includes changes in value caused not only by possible default events, but also by upgrades and downgrades in credit quality. Also, this model assesses the value-at-risk (VaR), not just the expected losses and, as a result, the model enables a firm to have an integrated view of credit risk across its entire organization (see Gupton et al., 1997).

Fitch's VECTOR default model allows users to estimate the effect of rating transition. It is Fitch's core CDO modeling tool that allows users to analyze rating transition risk and spread migration in leveraged super-senior (LSS) transactions in addition to the traditional default and recovery risks normally associated with CDO transactions. LSS transaction was considered one of the most successful innovative derivative products on Wall Street in 2005. For example, in a LSS transaction with 10 times leverage, a

5% change in the value of the underlying super senior tranche is equivalent to a 50% change in the market value of the funded investment (see DerivativeFitch, 2004). However, a common problem in implementing structural credit risk models is that the value of firm assets is unobservable. To deal with this difficulty, the common practice is to use the observable equity correlation as a proxy for unobservable asset correlation. In the following sections, we show that this common practice is problematic.

DEFAULT CORRELATION

Default events are rarely independent and it is not uncommon for multiple defaults to be triggered at the same time. For example, plummeting housing prices and climbing interest rates triggered an unprecedented number of defaults on subprime mortgages across the country over the same period. Therefore, to price credit risk accurately and perform risk management effectively, we need to estimate default rates of multiple defaults (or joint default probability). In this section, we use a simple numerical example to demonstrate how default correlation affects the estimation of joint default probability.

Denote the default status of two firms over a given horizon T as

$$\omega_i(T) = \begin{cases} 1 & \text{if firm } i \text{ defaults by } T \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

The joint default probability is written as

$$\begin{aligned} P(\omega_1(T)=1 \text{ and } \omega_2(T)=1) &= E\left[\omega_1(T)\cdot\omega_2(T)\right] \\ &= E\left[\omega_1(T)\right]\cdot E\left[\omega_2(T)\right] + \rho_D\sqrt{Var\left[\omega_1(T)\right]Var\left[\omega_2(T)\right]} \end{aligned} \tag{2}$$

Because $\omega_1(T)$ and $\omega_2(T)$ are Bernoulli binomial random variables, we have

$$\begin{aligned} E\left[\omega_i(T)\right] &= P(\omega_i(T)=1) \\ Var\left[\omega_i(T)\right] &= P(\omega_i(T)=1)\cdot\left[1-P(\omega_i(T)=1)\right] \end{aligned} \tag{3}$$

and ρ_D stands for default correlation.

Suppose that the default probability of the bond issued by firm A is 8%, i.e. $E\left[\omega_1(T)=1\right]=8\%$, and that of the bond issued by firm B is 5%, i.e. $E\left[\omega_2(T)=1\right]=5\%$. If the defaults of bond A and bond B are independent, the joint default probability $(P\left(\omega_1(T)=1 \text{ and } \omega_2(T)=1\right)$ should be equal to 8% × 5% = 0.4%. However, if the default correlation between bonds A and B is 0.4, the joint default probability is equal to

$$P(\omega_1(T)=1 \text{ and } \omega_2(T)=1) = 8\%\times 5\% + 0.4\sqrt{8\%(1-8\%)5\%(1-5\%)} = 2.77\%.$$

The numerical example shows that if these two defaults are correlated but the correlation is ignored, the joint default probability can be underestimated by a factor of seven. In practice, the model error could create huge losses for the financial firms. In the following section, we examine the ability of the structural credit risk models to predict default correlation. Specifically, we test Zhou's default correlation model.

DATA AND METHODOLOGY

To test the ability of structural credit risk models to predict default correlation, we first estimate equity correlation that is commonly used as a proxy for asset correlation, which is a key input variable in the default correlation model. Next, we present our methodology by describing Zhou's default correlation model.

Data Description

We use daily stock returns to estimate equity correlation for firms across different ratings during the period 1970 to 1993. The reason we chose the sample period of 1970 to 1993 is to compare the estimated default correlations by Zhou's model (2001) with the historical default correlations reported by Lucas (1995), who only reports the historical default correlations over this sample period. We obtain daily stock returns from CRSP and firms' long-term ratings from Compustat. After excluding firms without the rating information, we end up with 60 Aa-rated firms, 269 A-rated firms, 388 Baa-rated firms, 214 Ba-rated firms, and 141 B-rated firms over the sample period.

First, we calculate the correlations between daily returns of any two pairs of stocks within and across ratings given per annum for the sample period 1970 to 1993. If there are n firms with the same rating, $n(n-1)/2$ pairs of correlations between two firms within the rating are calculated in a given year. If there are n firms with one rating and m firms with another rating, $n \times m$ pairs of correlations across the two ratings are calculated in a given year. Table 1 reports the summary statistics of equity correlations between pairs of stock returns within and across ratings. The statistics include the number of observations, the minimum, the maximum, the first quantile, and the third quantile of equity correlations.

Table 1: Summary Statistics of Equity Correlation

Rating1	Rating2	No. of Observations	Min	Max	Q1	Q3
AA	AA	21,683	-0.2858	0.8138	0.0676	0.2404
AA	A	99,701	-0.3288	0.8160	0.0560	0.2216
AA	BBB	134,039	-0.3536	0.7919	0.0496	0.2039
AA	BB	66,325	-0.3218	0.7562	0.0379	0.1821
AA	B	37,234	-0.2909	0.6903	0.0355	0.1843
A	A	481,143	-0.4390	0.8788	0.0511	0.2085
A	BBB	650,277	-0.4291	0.8472	0.0446	0.1929
A	BB	325,039	-0.3494	0.8020	0.0336	0.1743
A	B	184,535	-0.2846	0.7982	0.0331	0.1755
BBB	BBB	734,993	-0.4593	0.7933	0.0391	0.1790
BBB	BB	373,276	-0.3197	0.7485	0.0282	0.1610
BBB	B	209,601	-0.4124	0.7399	0.0282	0.1616
BB	BB	180,373	-0.3450	0.7867	0.0212	0.1467
BB	B	101,963	-0.3004	0.7549	0.0215	0.1487
B	B	64,946	-0.3046	0.7730	0.0219	0.1527

This table reports the summary statistics of equity correlations calculated from daily stock returns within and across different ratings given per annum for the sample period 1970 to 1993. Min and Max stand for the minimum and maximum of equity correlations during the sample period. Q1 and Q3 stand for the first quantile and the third quantile of equity correlations during the sample period.

Next, we calculate the equally weighted average of equity correlations for each pair of ratings. Table 2 reports the average equity correlations and the standard errors. First, we find that, on average, equity correlation is higher for firms of the same rating than those across the ratings. As the gap between two ratings widens, equity correlation decreases. The results suggest that the equity returns of firms with similar quality tend to move together. In contrast, movement of equity returns between high quality and low quality firms is quite discrepant. For example, the average correlation between daily stock returns of Aa firms is 16.51% but the correlation is only 11.78% between Aa and B firms. Second, equity correlation within the same rating decreases as rating deteriorates. For instance, equity correlation between Aa firms is 16.51%, but it declines to 13.95% between A firms, 11.71% between Baa firms, 9.21% between Ba firms, and 9.62% between B firms. The results indicate that, on average, stock returns of high quality firms are more likely driven by common factors than those of low quality firms. Put another way, firm-specific factors seem to have more impact on fluctuations of stock returns of low quality firms.

Table 2: Equally Weighted Average of Equity Correlation

	Aa	A	Baa	Ba	B
Aa	16.51				
	(0.0010)				
A	14.85	13.95			
	(0.0004)	(0.0002)			
Baa	13.54	12.77	11.71		
	(0.0003)	(0.0001)	(0.0001)		
Ba	11.89	11.29	10.29	9.21	
	(0.0005)	(0.0002)	(0.0002)	(0.0003)	
B	11.78	11.30	10.30	9.31	9.62
	(0.0006)	(0.0003)	(0.0002)	(0.0003)	(0.0004)

This table reports the mean (in percentage) of equity correlations calculated from daily stock returns within and across different ratings given per annum during the sample period 1970 to 1993 and the standard errors (in parentheses).

Methodology

After obtaining the data of equity correlations, we next examine the ability of Zhou's structural credit risk model to predict default correlation. Zhou's model (2001) is based on the first-passage-time (FPT) concept of a firm defaulting once its firm value drops below some boundary. The default boundary of firm i is defined as a time-dependent value $C_i(t)$ where the firm continues to operate if the firm value is greater than $C_i(t)$. $C_i(t)$ takes the exponential form of $C_i(t) = e^{\lambda_i t} k_i$, where λ_i is the growth rate of firm i's debts and k_i is the face value of all debts. The default boundary stands for the minimum firm value required by the safe debt covenants. If the firm value falls below the default boundary, the firm is forced to go bankrupt and bondholders gain ownership of the firm's assets.

Let V_1 and V_2 denote the total assets of firm 1 and firm 2, respectively. The dynamics of V_1 and V_2 are given by the following stochastic process:

$$dlnV = \mu dt + \sum dw, \tag{4}$$

Where $\ln V = (\ln V_1, \ln V_2)$, $\mu = (\mu_1, \mu_2)$, and $w = (w_1, w_2)$. μ_1 and μ_2 are are instantaneous expected rates of return of firms per unit of time and w_1 and w_2 are independent standard Brownian motions. $\ln V_1$ and $\ln V_2$ are correlated with each other with correlation coefficient ρ and volatilities σ_1 and σ_2,

$$\rho = \frac{\operatorname{cov}(\ln V_1, \ln V_2)}{\sqrt{\operatorname{var}(\ln V_1)\operatorname{var}(\ln V_2)}} . \tag{5}$$

Σ denotes the variance-covariance matrix and

$$\Sigma \cdot \Sigma' = \begin{bmatrix} \sigma_1^2 & \rho\sigma_1\sigma_2 \\ \rho\sigma_1\sigma_2 & \sigma_2^2 \end{bmatrix}.$$

Apparently, Zhou (2001) models default correlation by assuming correlated asset processes between two firms. If the default status of two firms over a given horizon T is defined as in equation (1), the default correlation is equal to

$$\rho_D = \frac{E[\omega_1(T)\cdot \varpi_2(T)] - E[\omega_1(T)]E[\omega_2(T)]}{\sqrt{Var[\omega_1(T)]Var[\omega 2\ T()]}}. \tag{6}$$

Assume that the growth rate of debt (λ_i) is equal to the growth rate of firm value (μ_t), which implies a constant debt to equity ratio in a steady state. The expected default probability is given as

$$E[\omega_i(T)=1] = P[\omega_i(T)=1] = 2\cdot N\left(-\frac{\ln(V_{i,0}/K_i)}{\sigma_i\sqrt{t}}\right) = 2\cdot N\left(-\frac{Z_i}{\sqrt{t}}\right). \tag{7}$$

where $Z_i \equiv \ln(V_{i,0}/K_i)/\sigma_i$ is the standardized distance of firm i to its default boundary and $N(.)$ is the cumulative normal distribution function. The variance of the default probability is

$$\text{var}[\omega_i(T)] = P[\omega_i(T)=1]\{1 - P[\omega_i(T)=1]\}, \tag{8}$$

and the joint default probability is

$$E[\omega_1(T)\cdot \omega_2(T)] = E[\omega_1(T)] + E[\omega_2(T)] - P[\omega_1(T)=1 \text{ or } \omega_2(T)=1]. \tag{9}$$

The probability of at least one firm defaulting is

$$P[\omega_1(T)=1 \text{ or } \omega_2(T)=1] = 1 - \frac{2r_0}{\sqrt{2\pi t}}e^{-\frac{r_0^2}{4t}}\cdot \sum_{n=1,3,\dots}\frac{1}{n}\cdot \sin\left(\frac{n\pi\theta_o}{\alpha}\right)\cdot\left[I_{\frac{1}{2}(\frac{n\pi}{\alpha}+1)}\left(\frac{r_0^2}{4t}\right) + I_{\frac{1}{2}(\frac{n\pi}{\alpha}-1)}\left(\frac{r_0^2}{4t}\right)\right],$$

where $I_v(z)$ is the modified Bessel function I with order v and

$$\alpha = \begin{cases} \tan^{-1}\left(-\frac{\sqrt{1-\rho^2}}{\rho}\right) & if \quad \rho < 0 \\ \pi + \tan^{-1}\left(-\frac{\sqrt{1-\rho^2}}{\rho}\right) & otherwise, \end{cases} \tag{10}$$

$$\theta_o = \begin{cases} \tan^{-1}\left(\frac{Z_2\sqrt{1-\rho^2}}{Z_1 - \rho Z_2}\right) & if \quad \rho < 0 \\ \pi + \tan^{-1}\left(\frac{Z_2\sqrt{1-\rho^2}}{Z_1 - \rho Z_2}\right) & otherwise, \end{cases} \tag{11}$$

$$r_o = \frac{Z_2}{\sin(\theta_o)}. \tag{12}$$

By substituting equations (7)-(12) into equation (6), we can compute default correlation between two firms. For a more detailed discussion on the model, please refer to Zhou (2001). As explained earlier, Zhou (2001) assumes that equity correlation is equal to asset correlation and chooses an *ad hoc* number of 0.4 as asset correlation for differently rated bonds. Since Zhou does not calibrate the model properly, the results may not reveal the true performance of the FTP model to predict default correlation. We adopt the common practice in the financial industry of using equity correlation as a proxy for asset correlation. In this way, we can test the ability of the model to predict default correlation appropriately.

RESULTS

Panel (A) of Table 3 reports the estimated default correlations within and across ratings for different time horizons based on equation (6), where asset correlations are approximated by the estimated equity correlations in Section 4.1. The values of other input variables are the same as those in Zhou (2001). For brevity's sake, we report only default correlations for time horizons of 2, 4, 6, 8, and 10 years. The results for other time horizons are available upon request. We find that for a given time horizon, the default correlation is much higher between low rated firms than between high rated firms. For example, for the four-year time horizon, the default correlation is 0.01% between Aa firms, but rises as high as 5.23% between B firms. For given ratings of firms, the default correlation increases as the time horizon increases. The default correlation between B firms for the two-year time horizon is only 3.95% but increases to 5.23% for the four-year time horizon. The results suggest that default correlation is not a negligible factor.

Panel (B) of Table 3 reports the historical default correlations calculated by Lucas (1995) using default information provided by Moody's Investors Service from 1970 to 1993. When comparing the estimated default correlations with the historical default correlations, we find that Zhou's credit risk model substantially underestimates default correlations. Moreover, the model errors get larger as rating declines. For example, for the two-year time horizon, the model underestimates the default correlation between Aa firms by 0.01%, but it underestimates that between B firms by 12.05 percentage points (= 16% – 3.95%). The underestimation is more pronounced when the horizon increases. For the 10-year horizon and B-B bonds, the model predicts a meager 5.6% default correlation compared to the observed 38%.

The results suggest that if the financial industry relies heavily on this or similar quantitative models to price credit risk or perform risk management, management may believe risk is under control and that their decisions based on models are sound. For example, in December 2007, at a meeting with investors of AIG, the company's CEO told investors concerned about exposure to credit-default swaps that models helped give AIG "a very high level of comfort" (see Mollenkamp et al., 2008). Unfortunately, their model failed to accurately model reality and misled the decision-making process.

A further question is raised: "What are the possible reasons for the failure of the structural credit risk models to predict default correlation?" A likely reason is the problematic common practice of approximating asset correlation by equity correlation. Since asset correlation is a key input variable in the default correlation model, any error in this input variable could seriously distort the estimated default correlations.

First, we perform a sensitivity analysis using equation (6) to show how sensitive the estimated default correlations are to the input of asset correlation. Similarly, we take the same values for other input variables as Zhou (2001). Table 4 reports the simulation results with B-rated firms for two- and 10-year time horizons. For the two-year horizon, if the asset correlation is 0.1, the default correlation is 4.12%. For other given inputs, if the asset correlation increases to 0.2, the default correlation increases to 8.73%. At the higher levels of asset correlation, the estimated default correlation is even more sensitive to the inputs of asset correlation. For instance, if the asset correlation is 0.8, the default correlation is 52.21%. The pattern is similar for the 10-year time horizon. The simulation results confirm that asset correlation is a critical input variable to estimate default correlation, regardless of time horizons. This also demonstrates the importance and necessity of model calibration.

Table 3: Estimated Default Correlation versus Historical Default Correlation

	Aa	A	Baa	Ba	B
Panel 1. Two year default correlation (%)					
(A) Estimated default correlation by Zhou's model (2001)					
Aa	-0.01				
A	0.00	0.00			
Baa	0.00	0.00	0.00		
Ba	0.00	0.00	0.04	0.73	
B	0.00	0.01	0.08	1.59	3.95
(B) Historical default correlation by Lucas (1995)					
Aa	0.0				
A	0.0	0.0			
Baa	0.0	0.0	0.0		
Ba	1.0	1.0	1.0	6.0	
B	1.0	1.0	2.0	10.0	16.0
Panel 2. Four year default correlation (%)					
(A) Estimated default correlation by Zhou's model (2001)					
	Aa	A	Baa	Ba	B
Aa	0.01				
A	0.02	0.04			
Baa	0.03	0.09	0.27		
Ba	0.07	0.23	0.73	2.53	
B	0.08	0.26	0.90	3.47	5.23
(B) Historical default correlation by Lucas (1995)					
Aa	0.0				
A	1.0	1.0			
Baa	1.0	1.0	0.0		
Ba	2.0	3.0	3.0	13.0	
B	2.0	4.0	5.0	22.0	27.0
Panel 3. Six year default correlation (%)					
(A) Estimated default correlation by Zhou's model (2001)					
	Aa	A	Baa	Ba	B
Aa	0.11				
A	0.17	0.30			
Baa	0.28	0.53	0.99		
Ba	0.41	0.86	1.76	3.65	
B	0.41	0.89	1.90	4.31	5.55
(B) Historical default correlation by Lucas (1995)					
Aa	1.0				
A	1.0	1.0			
Baa	1.0	1.0	0.0		
Ba	3.0	4.0	3.0	15.0	
B	4.0	7.0	7.0	25.0	29.0
Panel 4. Eight year default correlation (%)					
(A) Estimated default correlation by Zhou's model (2001)					
	Aa	A	Baa	Ba	B
Aa	0.41				
A	0.55	0.82			
Baa	0.76	1.20	1.85		
Ba	0.95	1.61	2.64	4.30	
B	0.90	1.58	2.68	4.72	5.61
(B) Historical default correlation by Lucas (1995)					
Aa	0.0				
A	1.0	2.0			
Baa	1.0	1.0	0.0		
Ba	3.0	5.0	2.0	10.0	
B	5.0	11.0	7.0	23.0	37.0
Panel 5. Ten year default correlation (%)					
(A) Estimated default correlation by Zhou's model (2001)					
	Aa	A	Baa	Ba	B
Aa	0.88				
A	1.08	1.47			
Baa	1.37	1.93	2.64		
Ba	1.55	2.31	3.32	4.69	
B	1.42	2.19	3.26	4.93	5.60
(B) Historical default correlation by Lucas (1995)					
Aa	1.0				
A	2.0	2.0			
Baa	1.0	1.0	0.0		
Ba	3.0	4.0	2.0	8.0	
B	8.0	9.0	6.0	17.0	38.0

Panel (A) of this table reports the estimated default correlations based on Zhou's default correlation model when equity correlations proxy for asset correlations. Equity correlations are estimated by daily stock returns within and across different ratings given per annum over the sample period 1970 to 1993. The average of equity correlations over the sample period is used in estimation of default correlations by Zhou's model. Panel (B) reports the historical default correlations estimated by Lucas (1995) using default data provided by Moody's Investors Service from 1970 through 1993.

Table 4: Sensitivity of Model-predicted Default Correlation to Asset Correlation

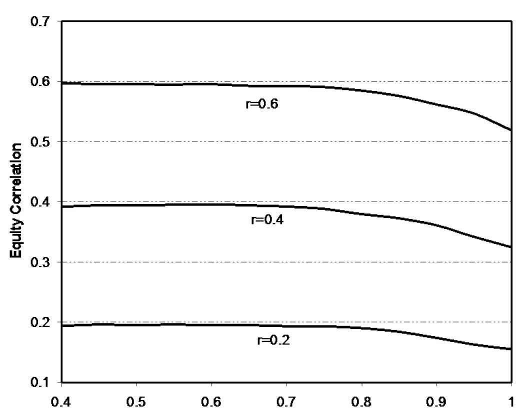
Panel 1. Two year asset correlation vs. default correlation									
Asset Correlation	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Default Correlation (%)	4.12	8.73	13.87	19.62	26.06	33.39	41.9	52.21	65.93
Panel 2. Ten year asset correlation vs. default correlation									
Asset Correlation	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Default Correlation (%)	5.82	11.77	17.93	24.37	31.22	38.65	46.94	56.66	69.23

This table shows how default correlation between B-rated firms changes as the input of asset correlation changes for two and ten years.

Next, we conduct a Monte Carlo simulation to analyze the problem with this common practice of using equity correlation to approximate asset correlation. We apply the Merton model (1974), the seminal work of the structural credit risk model, to perform the simulation because it has the closed form solution. In later discussion, we argue that the results from the Merton model are still applicable to the FTP model (e.g. Zhou's model). In Merton's framework, the equity of a firm is treated as a European call option on the firm's assets and the firm's debt is the option's strike price. The equity value is the maximum between zero and the difference in value of firm assets and firm debt. When the assets of two firms are correlated, the equities of the two firms are also correlated. To perform the Monte Carlo simulation to examine the relation between asset correlation and equity correlation, we first fix the asset correlation and next change the debt level (strike price) and simulate the equity returns. Finally, we compute the correlation coefficient of the two equities.

Figure 1 shows the simulation results for equity correlation given the asset correlation of 0.2, 0.4, and 0.6 respectively. Regardless of the level of asset correlation, as debt ratio increases, equity correlation gradually becomes lower than asset correlation. For a given debt ratio, the difference between two correlations gets higher for high levels of asset correlation. The results suggest that it is not proper to use equity correlation to approximate asset correlation. In particular, the error is large for firms with high debt ratios. This provides a plausible explanation for the large model error in predicting the default correlation between low rated bonds. In general, firms with high debt ratios issue low rated bonds. Because equity correlation is significantly lower than asset correlation for firms with high debt ratios, approximation of asset correlation by equity correlation makes the model underestimate default correlation substantially. While the results of Monte Carlo simulation are derived from the Merton model (1974), they are also applicable to the FTP model. The Merton model assumes that default can only occur on maturity of firm debt. Even if the firm value falls below the face value of debt, the firm can continue to operate. In contrast, the FTP model assumes that a firm stops operating to go bankrupt once firm value falls below a default boundary. Hence, *ceteris paribus*, the difference between asset correlation and equity correlation predicted by the FTP model is larger than that predicted by the Merton model.

Figure 1: Equity Correlation versus Asset Correlation



This figure shows the relation between equity correlation and asset correlation (r) as debt-asset ratio changes.

CONCLUSION

Over past decades the financial industry, particularly in the area of credit risk management, has increasingly relied on quantitative models in its decision-making processes. Consequently, the modeling of this risk itself becomes an important source of risk for financial firms because inappropriate models can mislead management to believe that risks are well managed and that subsequent decisions are made correctly. While the causes of the current financial turmoil are debatable, the failure of quantitative models may partially responsible for the crisis.

In this paper, we demonstrate a major problem in the credit risk models that are widely used in the financial industry. We find that a representative credit risk model (Zhou's default correlation model, 2001) significantly underestimates the default correlation between debts. Since default correlation is an important determinant of the joint default probability of multiple defaults, the joint default rates are substantially underestimated. This is one of the important reasons behind the failure of a good number of financial firms in this crisis.

Our work sheds new light on the study of the modeling of credit risk in several ways. First, we demonstrate a major problem in the credit risk models, and illustrate the possible responsibility of model risk in the current financial crisis. Second, our study provides a direction to improve the existing credit risk models and enhance managing model risk in the future. Third, our results suggest that financial practitioners should incorporate model management into their businesses. They should systematically evaluate and monitor models in different circumstances. To make proper decisions based on models, decision makers should be wary of the assumptions behind models and understand the ability of models to predict and manage risk in different circumstances.

However, our conclusions may be limited to the availability of data. We cannot test the ability of the structural credit risk models to predict default correlations from 1994 through 2008 due to a lack of historical default correlations that serve as a benchmark for comparison. In turn, this limitation provides a direction for future research. Our study can be extended if more recent data are available. Another direction for future research is to establish a link among equity correlation, asset correlation, and default correlation in a structural framework to improve the ability of existing structural credit risk models to predict default correlation.

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THE TIMELINESS OF ANNUAL REPORTS IN BAHRAIN AND THE UNITED ARAB EMIRATES: AN EMPIRICAL COMPARATIVE STUDY

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ABSTRACT

The main purpose of this study is to examine empirically the determinants of audit delay in two developing countries, the UAE and Bahrain. This study utilizes a sample of 83 firms using the accounting and market data available for 2004. The sample firms are all listed in either the UAE or Bahraini Stock Markets. Cross-sectional regression analysis is employed to test the hypotheses of the study. The results of this study show that four variables (profitability, debt ratio, sector type, and dividend payout ratio) examined in Bahrain appear to have a strong influence on the timeliness of annual reports (audit delay). However, another three variables (audit type, firm size, and price earnings ratio) are found to have a weak effect on the audit delay. In the UAE, the study concludes that two variables (debt ratio and audit type) appear to have a strong influence on audit delay, while the other variables were found not to have a significant effect on it. These results may help users of financial information to assess the impact of such variables on improving the timeliness of annual reports.

JEL: M4, M41, M42

Keywords: audit delay, United Arab Emirates, Bahrain, timeliness, annual reports, firm size, sector type, audit type, debt ratio, profitability, price earnings ratio, dividend payout ratio

INTRODUCTION

The term 'timeliness', in relation to financial reporting, is an important qualitative characteristic of accounting information, and it may affect whether the information is useful to those who read financial statements. Its importance has been stressed in the Statement of Financial Accounting (SFAC 2, FASB 1976, in Delaney, Epstein, Adler, & Foran, 1997). The timeliness of audited corporate annual financial reports is considered to be a critical and important factor affecting the usefulness of information made available to external users (Almosa et al., 2007).

The accounting profession has recognized that the timeliness of reports is an important characteristic of financial accounting information for the users of accounting information, and for regulatory and professional agencies (Soltani, 2002). Karim et al., (2005) found that audit delays could be reduced by effective regulatory change. Timeliness requires that information be made available to users as rapidly as possible (Carslaw and Caplan, 1991) and before it loses its ability to influence decision-makers (Delaney et al., 1997, p. 24, US GAAP).

It is recognized in the literature that the shorter the time between a company's financial year-end to the date of the auditor's report, the more benefit can be obtained from the audited financial statements (Courtis, 1976; Gilling, 1977; Davies and Whittred, 1980; Abdulla, 1996). However, it is not acceptable to publish financial statements unless a certified public accountant first audits them. It has been argued that the time lag in publishing the audit report is a critical factor in emerging and newly developed capital markets where the audited financial statements in the annual report are the only reliable source of information available to investors (Leventis et al., 2005). The usefulness of the information conveyed in the financial statements will diminish as the time lag increases. Many studies have investigated the relationship between audit delay and a range of company characteristics (Davies and Whittred, 1980; Ashton, Willingham and Elliot, 1987; Ashton, Graul and Newton, 1989; Newton and Ashton, 1989; Carslow and Kaplan, 1991; Courteau and Zéghal, 1999/2000).

The main purpose of this study is to examine empirically the determinants of audit delay in the two developing countries (Bahrain and the UAE). This study contributes to the literature, first, by conducting a comparative study of two countries in the Gulf. According to the knowledge of the researchers, there are few studies about timeliness of financial reporting in developing countries. This encouraged the authors to conduct this comparative research in the region. In addition, the study can greatly assist policy makers in the UAE and Bahrain by promoting better management practices, effective control and accounting systems, stringent monitoring, and effective regulatory mechanisms. The empirical results of this study show that four variables (profitability, debt ratio, sector type, and dividend payout ratio) examined in Bahrain appear to have a strong influence on the timeliness of annual reports (audit delay). In the UAE, the study concludes that two variables (debt ratio and audit type) appear to have a strong influence on audit delay.

The remainder of this paper is divided into five sections. A brief review of the economic background is presented in Section 2. Section 3 discusses the main contributions in the relevant literature and the theoretical background. Section 4 presents the methodology of the empirical research, including data and main measures. Section 5 summarizes the empirical results. The last section offers a summary of the research and conclusions.

ECONOMIC BACKGROUND

This study was conducted in the United Arab Emirates (UAE) and the Kingdom of Bahrain. The UAE is a developing country situated in the Western region of Asia, which has an open economy with a high per capita income and a sizable annual trade surplus. It borders the Gulf of Oman, the Arabian Gulf, the Sultanate of Oman, and the Kingdom of Saudi Arabia. It is composed of seven Emirates, namely Abu Dhabi, Dubai, Sharjah, Ras Al-Khaimah, Ajman, Umm Al-Qaiwain, and Fujairah. Its economic philosophy is based on the adoption of a market economy and liberalization of trade, which makes it capable of adopting its own local laws in line with those of its international counterparts (Aljifri, and Khasharmeh, 2006).

There are three main regulatory authorities in the UAE corporate sector: the Ministry of Economy and Planning, the Central Bank, and the Emirates Securities and Commodities Authority (ESCA). The corporate compulsory disclosure requirements state that each listed company must prepare income statements, balance sheets, statements of cash flow, statements of changes in equity, and notes to accounts. In addition, the Accountants and Auditors Association is the body representing the accounting profession in the country. However, this association has not issued any national standards as it has no official role in regulating the profession. The conclusion from this is that the accounting profession is not well organized locally and UAE firms and auditors comply with International Financial Reporting Standards. In 1999, the Central Bank issued Circular No. 20/1999 which requires all banks and financial institutions to adopt International Accounting Standards (IAS). Since then, all firms prepare their financial statements in accordance with IAS or IFRS.

Bahrain, like the UAE, is a developing country situated in the Western region of Asia, which has an open economy with a high per capita income and a sizable annual trade surplus. Accounting policies in Bahrain are regulated by various laws: Bahrain Monetary Agency Law No. 23, 1973; Commercial Companies Law No. 28, 1975; Bahrain Stock Exchange Law No. 4, 1987; Commerce Law No. 7, 1987; the Auditors Law No. 26, 1996; the Labor Law for the Private Sector No. 1976; the Bankruptcy and Composition Law, No. 11, 1987; the Insurance Companies and Organizations Law No. 17, 1987, amended in 1996;

Commercial Agency Law No. 10, 1992, amended by Decree No. 8, 1994; the Commercial Companies Law No. 21, 2001 and the Central Bank of Bahrain (CBB) issued by Decree No. 61, 2006. The commercial laws require that each listed company must prepare income statements, balance sheets, statements of cash flow, statements of changes in equity, and notes to accounts.

Most of the principal types of business entities in Bahrain are governed by the Law of Commercial Companies, Decree 28 of 1975, as amended. This decree contains the law relating to companies, partnerships and branches. In addition, Ministerial Order 25 of 1977 created a specific entity known as 'the exempt company', an offshore company introduced in order to encourage foreign companies to locate their regional headquarters in Bahrain. In line with Bahrain's goal of being the regional financial center, many of the offshore entities are banking units and investment banks.

In order to establish a joint-stock company, limited liability company, or partnership in Bahrain, at least 51 percent of the capital must be owned by Bahraini nationals. The laws and regulations governing the establishment of offshore exempt companies and offshore banking companies significantly relax the usual restrictions against foreign ownership. Currently, listed companies in Bahrain are required to publish quarterly reports, in addition to annual reports, within three months from the financial year-end. There is now improved investor awareness of the importance of corporate reports, as more intellectual investors have become active in the stock market (Al-Ajmi, 2008). In 1996, the Central Bank of Bahrain (CBB), formerly the Bahraini Monetary Agency, decided that banks needed to comply with the International Accounting Standards. Subsequently, the Ministry of Industry and Commerce expanded this requirement to cover non-Banks as well. In December 2003, the CBB, the market regulator, issued disclosure requirements for all listed companies.

THEORITICAL BACKGROUND AND LITERATURE REVIEW

In emerging economies the provision of timely information in corporate reports assumes greater importance, since other non-financial statement sources such as media releases, news conferences and financial analysts' forecasts are not well developed and the regulatory bodies are not as effective as in Western developed countries (Wallace, 1993). Users of financial information should be able to reach information they need in a timely manner in order that they can make reasonable decisions. Within this context, the timing of information is at least as important as its content for financial information users. In addition, stock values of publicly held companies are assumed to be based on such disclosed information. Disclosure of financial results, which are important indicators of a firm's performance, is a determining factor of firm value formed in the market (Dogan et. al., 2007).

Timing of the disclosure of financial information is also important for preventing trading activities of insiders, unofficial disclosure of news and market rumors (Ansah, 2000). As compared with developed markets, protective measures and sanctions regarding prevention of trading activities can be inadequate in emerging markets. Companies in emerging markets disclose less information. Consequently, the timing of financial reporting should be expressly designed to minimize such activities, which damage the efficacy of the market in emerging contexts (Leventis and Weetman, 2004).

Many studies have been conducted to identify the determinants of audit delay. Dyer and McHugh (1975) studied three company characteristics (company size, the year-end closing date, and profitability) as major explanatory factors of audit delay. The study revealed that only company size had an impact upon audit delay. Others have argued that some explanatory variables such as extraordinary items, changes in accounting techniques, audit firm size and audit opinion are important variables to be taken into account (Davies and Whittred, 1980).

Ashton, Willingham and Elliott (1987) examined 14 corporate attributes. They found that audit delay is significantly longer for companies with qualified audit opinions, that operate in the industrial sector, are publicly traded, have a fiscal year-end other than December 31, have poorer internal controls, use less complex technology for data-processing or have a relatively greater amount of audit work performed after the year-end.

Newton and Ashton (1989) examined the relationship between audit delay and audit technology. They found that firms using structured audit approaches have greater mean delay than firms using unstructured approaches. Ashton et al. (1989) examined the relationships between some company attributes and audit delay over six years (1977-1982) for 465 Canadian public companies. They found that the variables (client industry, type of audit opinion, presence of extraordinary items, loss for the year) were significant for at least four of the six years, and three other variables (log of total assets; fiscal-year-end and audit firm) had consistent signs across the six years.

Ng and Tai (1994) conducted an empirical study to examine the relationship between audit delay and ten company attributes of listed companies in Hong Kong for the years 1990 and 1991. The results showed that the log of turnover and the degree of diversification were significantly related to audit delay in both years. However, they found changes in EPS to be significant in 1990 and significant for reporting extraordinary items in 1991.

Abdulla (1996) empirically examined the association between the time lags in disclosure and five corporate attributes of 26 Bahraini companies. The study showed a significant negative relationship between timeliness of publication and the firm's profitability, dividend distributed and size, and a non-significant relationship between timeliness and industry membership. Jaggi and Tshi (1999) empirically examined the association between the audit report lag, auditor business risk, and audit firm technology for Hong Kong companies. The results show that there is a positive association between the audit report lag and the financial risk index for Hong Kong companies, suggesting that companies that are financially weak are associated with longer audit delays. The results also showed that companies audited by audit firms using a structured audit approach have longer audit delays.

In his 2000 study, Owusu-Ansah investigated empirically the timeliness of annual reporting by 47 non-financial companies listed on the Zimbabwe Stock Exchange. The results identified company size, profitability and company age as statistically significant predictors of the differences in the timeliness of annual reports issued by the sample companies. In addition, the results indicated that audit reporting lead-time is significantly associated with the timeliness with which sample companies release their preliminary annual earnings announcements, but not with the timeliness of the audited annual reports. Soltani (2002) examined the timeliness of corporate and audit reports in the French context, using data from French listed companies for each year in the period 1986-1995. He found empirical evidence of an improvement in timeliness of corporate and audit reporting. His study also showed that the existence of a qualified audit tends to lengthen the delay.

Leventis, Weetman , and Caramanis (2005) examined the audit report lag of companies listed on the Athens Stock Exchange at the time of Greece's transition from an emerging market to a newly developed capital market. The study found a statistically significant association between audit report lag and the type of auditor, audit fees, number of remarks in the audit report, the presence of extraordinary items, and an expectation of uncertainty in the audit report. The results suggest that audit report lag is reduced by appointing an international audit firm or paying a premium audit fee.

Russ (2005) conducted a study to test the theory that earnings management takes time. The study also aimed to examine the question of market recognition of earnings management. The results of the study suggest a positive relationship between earnings management and the time of filing annual reports.

Dogan, Coskun, and Celik (2007) examined the relationship between a set of explanatory variables (such as good or bad news, financial risk, size and industry) and the timing of annual reports released in companies listed on the Istanbul Stock Exchange (ISE). They found that timeliness in reporting by ISE listed companies is influenced by their profitability. Good news firms (measured by ROE and ROA) release their annual reports earlier than bad news firms. They also found that the timing of annual report releases is affected significantly by company size, increased financial risk, and the timing policy of previous years.

Almosa and Alabbas (2007) investigated the determinants of audit delay for listed joint stock companies in Saudi Arabia. Annual reports for the years 2003–2006 were examined in the study. Multiple regression analysis was applied to model audit delay as a function of many explanatory variables. These variables included company attributes such as corporate size, company profitability and industry sector and auditor attributes such as type of audit firm, and type of audit opinion. The study found that audit delay was positively associated with total assets and negatively associated with income. In the Saudi context, Aljabr (2007), mentioned in Almosa and Alabbas (2007), empirically examined the relationship between the timing of the financial information announcements and some attributes of joint stock companies over the period 2001-2005. The results showed that a firm's debt leverage was negatively associated with the timing of information release.

Al-Ajmi (2008) investigated the timeliness of annual reports of an unbalanced panel of 231 firms-years of financial and non-financial companies listed on the Bahrain Stock Exchange. The study aimed to identify the determinants of the timeliness of Bahraini annual reports during the period 1999-2006. Specifically, it tested the relationship between auditors' and auditees' specific characteristics, including corporate governance, with respect to both the timeliness of annual reports and the audit delay. The study found that the determinants of timeliness of annual reporting are company size, profitability, and leverage. No evidence was found to support the effect of auditor type.

Conover, Miller and Szakmary (2008) examined financial reporting lags, the incidence of late filing, and the relationship between reporting lags, firm performance and the degree of capital market scrutiny. Their study focuses upon whether the incidence of late filing, and the relationship between reporting days and other variables, differs systematically between common law and code law countries. They found that timely filing is less frequent in code law countries. Poor firm performance and longer reporting lags are more strongly linked in common law countries. They also found that whereas greater capital market scrutiny and more timely filing are related, there is less support for a relationship between the level of debt financing and timely filing in code law countries.

Bonsón-Ponte, Escobar-Rodríguez and Borrero-Domínguez (2008) examined the factors that determine delays in the signing of audit reports. According to their definition, the delays are measured as a function of the number of days that elapse from the closure of the accounting period until the date when the audit report is signed. The study was conducted in Spain, in 105 companies of the Spanish market, from 2002 to 2005. The results demonstrate that sectors that are subject to regulatory pressure, such as the financial and energy sectors, and the size of company relative the average for its sector, reduce audit delay. Variables such as audit firm, qualifications or regulatory change show no significant relationship with audit delay in the Spanish context.

Previous studies in developing countries have considered only firms from one country at the time. The comparative feature of the present study derives from the desire to add an interesting dimension to the literature by conducting a study in developing countries (comparing the UAE and Bahrain). The authors believe this may distinguish the present study from previous studies. Such comparison is considered a useful factor as investing decisions that are becoming more global as financial markets integrate.

METHODOLOGY

This section describes the sample selection and discusses the development of the hypotheses. It includes two subsections: Sample of study and Hypotheses development.

Sample of study

The sample for this study covers the listed Bahraini and UAE companies for the year 2004. The total number of available annual reports published by companies listed on the Bahrain Stock Exchange Market was 34. Of these, 32 companies were included in the study (i.e., 94 percent of the population). Similarly, 51 companies from the United Arab Emirates Stock Exchange Market were reviewed (i.e., 82 percent of the population). The audit delay for each of the sample companies was taken from their annual report. The balance sheet date represents the year and date for which the financial reports were prepared. The date of audit reports was obtained from the auditors' reports shown in the balance sheets. The time lag has been calculated as the interval, in days, between the balance sheet date and the date of the auditor's report (Newton and Ashton, 1989; Carslaw and Kaplan, 1991; Bamber et al., 1993; and Lawrence and Glover, 1998; Ettredge, Li and Sun, 2005). The data relating to company attributes were extracted from their annual reports.

Hypotheses development

The current study examines a number of factors, which have featured in the literature as likely to affect audit delay for Bahraini and UAE listed companies for the year 2004. For the purpose of this study, audit delay is defined as the length of time from a company's fiscal year-end to the date of the auditor's report. It is argued that the length of an audit is recognized as the single-most important determinant affecting the timing of earnings announcements (Givoly and Palmon, 1982; Whittred, 1980; and Carslaw and Kaplan, 1991). Thus, understanding the determinants of audit delay may provide some insights into audit efficiency, and possibly our understanding of market reactions to earnings releases (Bamber et al., 1993; Ashton et al., 1989).

A model of audit delay is developed consisting of seven explanatory variables. Multivariate analysis is used to evaluate the effects of the explanatory variables upon audit delay. The model of audit delay is developed based on a previous model used by Ashton et al. (1989), and Carslow and Kaplan (1991).
A backward regression analysis was used to test the hypotheses of this study. The regression model is:

$$TDS = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9$$

where:
X_1 = Debt equity ratio
X_2 = 1, for big four, X_2 = 0, otherwise
X_3 = 1, for Insurance firms, X_3 = 0, otherwise
X_4 = 1, for Service firms, X_4 = 0, otherwise
X_5 = 1, for Industrial firms, X_5 = 0, otherwise
X_6 = Natural logarithm of the company's assets
X_7 = Price earnings ratio
X_8 = Profitability
X_9 = Dividend payout ratio

Table 1: Proposed Relationships between the Explanatory Variables and Audit Delay

Explanatory Variable	Explanation	Expected signs
Company size	Total assets of company	Negative
Sector type	Banks; Insurance; Industrial; Service (including hotels)	Negative/positive[1]
Audit type	Big four assigned 1; otherwise 0.	Negative
Debt ratio	The proportion of debt to total assets	Negative
Profitability	Net income by net sales	Negative
Dividend payout ratio	Dividend per share as a percentage of the earnings per share	Positive
Price earnings ratio	Market per share divided by earnings per share	Negative

This table shows the explanatory variables used in the model of this study with explanations of how they were measured and their expected signs
[1]Since financial firms are more regulated than non-financial firms, it is assumed that they make their annual reports available to the public in a short time compared to non-financial firms.

The expected signs of the explanatory variables shown in Table 1 represent a consensus among studies in the literature review. The following presents a discussion of the underlying rationale behind the hypothesized relationship between each of the independent variables used in this study and audit delay.
In this study, we develop hypotheses about the association between the level of audit delay and seven firm characteristics, which might affect disclosure decisions of UAE companies. These characteristics are firm size, sector type, audit type, debt ratio, profitability, price earnings ratio, and dividend payout ratio.

Firm Size

The majority of the previous studies have used total assets as a measure of company size (Courtis, 1976; Gilling, 1977; Davies and Whittred, 1980; Garsombke, 1981; Ashton et al., 1989; Newton and Ashton, 1989; Carslaw and Kaplan, 1991; Abdulla, 1996 and Leventis et al. 2005). Very few studies have used turnover as a measure of size (Chan; Ezzamel; and Gwilliam; 1993). In this study, total assets refer to the sum of current assets, fixed assets, investments and advances and intangible assets.

In most of these studies, there is found a negative relationship between audit delay and the company size. Several factors may account for this relationship. Large companies tend to have strong internal systems with the consequence that auditors spend less time in conducting compliance and substantive tests (Owusu-Ansah, 2000). Carslaw and Kaplan (1991, p. 23) pointed out that, "*larger companies may have stronger internal controls, which in turn should reduce the propensity for financial statement errors to occur and enable auditors to rely on controls more extensively and to perform more interim work. Also, larger companies may be able to exert greater pressures on the auditor to start and complete the audit in a timely fashion*". Furthermore, larger companies have more resources to pay relatively higher audit fees and are able to settle the fees soon after the company's year-end. They also have more accounting staff and sophisticated accounting information systems that result in more timely annual reports (Owusu-Ansah, 2000). In addition, large companies tend to be followed by a relatively large number of financial analysts who usually rely on the timely release of financial reports to confirm and revise their expectations of companies' present and future economic prospects (Owusu-Ansah, 2000). Finally, management of larger companies may have incentives to reduce both audit delay and reported delay since they may be monitored more closely by investors, trade unions and regulatory agencies, and thus face greater external pressure to report early (Dyer and McHugh, 1975). Thus, it is likely that the audit-reporting lag of larger companies is less than that of smaller ones.

However, other studies found that company size does not appear to have any bearing on audit delay (Karim and Ahmed, 2005). Based on the above discussion, the following hypothesis is developed:

H1: There is a significant negative association between firm size and the audit report delay.

Sector Type

This study classifies the companies into financial and non-financial industries based on Bahrain Stock Exchange and the UAE Stock Exchange classifications. In this study, and based on the classifications of Ashton et al., (1989) and Carslaw and Kaplan (1991), financial companies are coded one and others are coded zero. Audit delay for financial service companies is expected to be shorter than for non-financial companies because financial service companies have little or no inventory. The argument is that the lower the level of inventory in relation to other assets, the lower the audit delay (Ahmed and Kamarudin, 2003). The hypothesis to be tested is as follows:

H2: The audit report delay differs significantly among firms in the four sectors.

Audit Type

Auditors are classified into two groups: Big four and non-Big-four (Ahmed and Kamarudin, 2003). The Big-four refers to KPMG Peat Marwick, Ernst and Young, Pricewaterhouse Corporation and Deloitte & Touche. It is expected that the audit delay for Big-four firms will be less than the audit delay for other firms (Carslaw and Kaplan, 1991 and Leventis et al. 2005). This may be due to the fact that the large firms are assumed to be able to audit more efficiently and effectively and have greater flexibility in scheduling the audits so that they can be completed on time (Carslaw and Kaplan, 1991).

Ashton, Willingham and Elliott (1987, p.602) pointed out that *"It may be reasonable to expect that larger audit firms would complete audits on a more timely basis because of their experience … Large firms may be able to audit such companies more efficiently than small audit firms".* However, other studies found that companies associated with international firms in Bangladesh have longer audit delays (Imam, Ahmed and Khan, 2001). In the current study, auditors are classified into two groups: international auditing firms, including the Big-four and domestic audit firms. International auditing firms are assigned a value of 1, and others are assigned zero. The hypothesis to be tested is as follows:

H3: The audit report delay of firms engaging with one of the Big four is significantly less than that of firms engaging with other auditing firms.

Debt Ratio

The proportion of total liabilities to total assets is expected to relate positively to audit delay. According to (Carslaw and Kaplan, 1991), a high ratio of debt to total assets will increase a company's likelihood of failure and may raise in the auditor's mind additional concerns that the financial statements may be less reliable than normal. Further, the audit of debt may take a longer time than the audit of equity (Ansah, 2000: 244). However, other studies found that a firm’s debt ratio was negatively associated with the timing of information release (Aljabr, 2007, Deloof and Weet, 2003). In the current study, total liabilities refer to the sum of current liabilities and long-term liabilities. The hypothesis to be tested is as follows:

H4: Audit report delay for firms with high debt ratios is significantly less than those of firms with low debt ratios.

Profitability

Many researchers have discussed this variable as a factor related to bad or good news (Bamber et al., 1993; Abdulla, 1996). In some reviews of the literature, it is found that there is a positive relationship with audit delay (Dyer and McHugh, 1975; Carslaw and Kaplan, 1991; Bamber et al., 1993, Almosa and Alabbas 2007), while other studies found a negative relationship (Abdulla, 1996).

Companies reporting a profit for the period are expected to minimize audit delay. There are several reasons that explain why this variable should be negatively associated with audit delay. First, profitability is considered an indication of good or bad news resulting from the year's operations (Ashton et al., 1987). If the company experiences losses, management might wish to delay the corporate annual report in order to escape the effects of its 'bad news'. Second, a company with a loss may ask the auditor to schedule the start of the audit later than usual, while companies with 'good news' would be expected to ask the auditor to start audit engagement early to release their audited financial statements quickly (Hossain and Taylor, 1998). Based on the above discussion, the following hypothesis is developed:

H5: Audit report delay for firms with high profitability is significantly less than those of firms with low profitability.

Price Earnings Ratio

The presence of a high price earnings ratio has been considered a significant factor in the probability of having a good market reaction. The price earnings ratio (P/E) is a standard means by which to show how a company's earnings relate to its stock price. The higher the P/E ratio, the more earnings growth investors are expecting and the higher premium they will be willing to pay for that anticipated growth. The P/E ratio is considered one of the most widely watched measures of both the stock market as whole and individual stocks. Previous research has found that the market reacts to annual report filings (Asthana et al., 2001), and in the case of late annual filings, the market reacts negatively (Griffin, 2003). Alford et al. (1994) found that are small and/or financially troubled tend to file late. Typically, those firms are also experiencing negative market adjusted stock returns. Givoly and Palmon (1982) found that bad news reporting was delayed and the market reaction to the bad news was reduced by the duration of the delay. Bad news is defined as earnings being lower than expected.

The P/E is expected to have a negative relationship with the audit delay since the timeliness of annual reports is affected by good news (Dogan; Coskun and Celik, 2007). This depends, of course, on firms and the public considering a high price earnings ratio as good news, which is the case in developing countries like UAE and Bahrain. However, this variable has not been used widely in empirical research into the timeliness of annual reports. Based on the above discussion, the following hypothesis is developed:

H6: Audit report delay for firms with a high price earnings ratio is significantly less than for firms with a low price earnings ratio.

Dividend Payout

The dividend payout ratio is the fraction of net income a firm pays to its stockholders in dividends. The dividend payout ratio is a proxy for cash flow measurement used by investors to determine if a company is generating an adequate level of cash flow to ensure a continued stream of dividends to them. It is also a measurement of the amount of current income paid out in dividends rather than retained by the business. This ratio is useful in projecting the growth of a company as well. Its inverse, the retention ratio (the amount not paid out to stockholders in the form of dividends), can help project a company's growth.
If the dividend payout ratio is low, this means that the company pays a low dividend to stockholders. It can be assumed that the firm's management believes that profits are better spent reinvesting them in the firms activities rather than making a cash payout to shareholders. In fact, a majority of corporations have elected to pay out less of their earnings as dividends, perhaps because corporate rates of return on reinvested capital are higher, but it could also be that dividends are doubly taxed in some jurisdictions. However, other investors seek high current income and limited capital growth, and thus they prefer companies with high dividend payout ratio.

It is argued that paying out more dividends exposes firms to more monitoring (Easterbrook, 1984). Thus, based on the above discussion, a positive association between dividend payout ratio and audit delay is expected. Payout ratio is calculated as the dividend per share as a percentage of the earnings per share (Bohren and Odegaard, 2003). The hypothesis to be tested is as follows:

H7: There is a positive association between the firm's dividend payout ratio and audit delay.

RESULTS AND DISCUSSION

This section discusses the empirical methods used to examine the research hypotheses of the study and reports the results. It covers two statistical methods: a descriptive analysis and a regression analysis.

Descriptive Analysis

Table 2 reports the minimum, maximum, mean and standard deviation for the continuous variables in the sample data set for Bahrain. It provides some information about delay in publishing the audit report, which ranges from 24 to 82 days and has a mean of 51.71 days and a standard deviation of 15.15. A broad range of variation is evident in the sample. The assets (logarithm of total assets) range from 8 to 16 with a mean of 11.27 and a standard deviation of 1.84. The profitability ranges from 0.00 to 0.29 with a mean of 0.06 and a standard deviation of 0.07, while the price earnings ratio ranges from 1.42 to 30.46 with a mean of 13.44 and standard deviation of 6.19. For the dividend payout ratio, the results reveal a range from 0.00 to 0.19 with a mean of 0.02 and a standard deviation of 0.03. The debt ratio ranges from 0.03 to 0.85 with a mean of 0.41 and a standard deviation of 0.34. Table 2 also shows that 44 percent of the firms in the sample are banks, 16 percent insurance firms, 6 percent industrial firms and 34 percent service firms.

Table 2: Descriptive Statistics (Bahrain)

Description	N	Minimum	Maximum	Mean	Std. Deviation
Days required for publication	32	24.00	82.00	51.71	15.15
Firm size	32	8	16	11.27	1.84
Profitability	32	00.	29.	06.	07.
Price earnings ratio	32	1.42	30.46	13.44	6.19
Dividend payout ratio	32	00.	19.	02.	03.
Debt ratio	32	03.	85.	41.	34.
Description	**N**	**Number**	**Percentage**		
Banks (X_4)	32	14	44%		
Insurance firms	32	5	16%		
Industrial firms	32	2	6%		
Service firms (including hotels)	32	11	34%		

This table provides descriptive analysis for the continuous variables and the dummy variables. It shows minimum, maximum, mean, and standard deviation for each continuous variable. It represents a summary of data for the Bahrain sample. The number of the companies used in this study is also included. Size is measured by the natural logarithm of total assets in the regression model used in this study.

The minimum, maximum, mean and standard deviations for the continuous variables in the sample data set for UAE are reported in Table 3. Information about the delay in publishing the audit report ranges from 10 days to 100 with a mean of 43.50 and a standard deviation of 24.15, with a broad range of variation evident in the sample. The range of the assets (logarithm of total assets) is from 18 to 25 with a mean of 21.27 and a standard deviation of 1.65. The profitability ranges from 0.01 to 0.66 with a mean of 0.33 and a standard deviation of 0.17, while the price earnings ratio ranges from 6.02 to 143.79 with a mean of 24.72 and standard deviation of 20.96. The results for the dividend payout ratio reveal that it ranges from 0.00 to 1.17 with a mean of 0.28 and a standard deviation of 0.26. This is an interesting result in the sense that the maximum value of the dividend payout ratio (1.17) is 10 percent of that firm's paid up capital. This gives an indication of how much the sample firms can pay as dividends to their shareholders. The debt ratio ranges from 0.04 to 0.91 with a mean of 0.46 and a standard deviation of 0.30. Table 3 also shows that 29 percent of the firms in the sample are banks, 31 percent insurance firms, 10 percent industrial firms and 10 percent service firms.

Table 3: Descriptive Statistics (UAE)

Description	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Days required for publication	51	10.00	100.00	43.50	24.15
Firm size	51	18.00	25.00	21.27	1.65
Profitability	51	01.	66.	33.	17.
Price earnings ratio	51	6.02	143.79	24.72	20.96
Dividend payout ratio	51	00.	1.17	28.	26.
Debt ratio	51	04.	91.	46.	30.
Description	N	Number	Percentage		
Banks (X4)	51	15	29%		
Insurance firms	51	16	31%		
Industrial firms	51	10	20%		
Service firms (including hotels)	51	10	20%		

This table provides descriptive analysis of the continuous variables and the dummy variables. It shows minimum, maximum, mean, and standard deviation for each continuous variable. It represents a summary of data for the UAE sample. The number of the companies used in this study is also shown. Size is measured by the natural logarithm of total assets in the regression model used in this study.

Regression Analysis

Tolerance values are calculated using ($1-R^2$) for each variable and are presented in Tables 6 and 7. Since all values are more than 0.10, there is no issue of multi-colinearity between the independent variables (Menard, 1995). Alternatively, all of the variance inflation factors (VIF) for the independent variables are less than 10, suggesting that there is no multi-colinearity between these variables (Myers, 1990).

For Bahrain, the details of the backward elimination procedure for fitting the regression equation are provided in Table 4a. In Model 1, where all variables (except banks, the reference category) were included in the regression equation, adjusted R^2 = 0.32, F = 3.39, and p-value = 0.011 < .05. A review of Model 2 shows that, after removing firm size from the equation, adjusted R^2 = 0.35, F = 3.71, p-value = 0.008 < .01. This indicates that removing firm size from the equation improved the values of adjusted R^2 and F. For Model 3, after removing audit type, the values of adjusted R^2 and F are increased to 0.37 and 4.11 respectively, with a p-value = 0.005 < .01. In Model 4, an increase in F value (4.54) and an increase in adjusted R^2 (0.38) are evident after removing the price earnings ratio from the regression equation. For Model 5, after removing service vs. banks, adjusted R^2 = 0.38, F = 5.27, p-value = 0.002< .01. In Model 6, adjusted R^2 = 0.33, F = 6.03. The results suggest that more than one third of the variability in the timeliness of annual reports is predicted by the profitability, debt ratio, sector type (banks, insurance, and industry) and dividend payout ratio. This is a statistically significant contribution as indicated by the p-value of 0.002 < .01.

The details of the backward stepwise elimination procedure for fitting the regression equation for the UAE are provided in Table 4b. Where all variables (except banks, the reference category) were included in the regression equation, as presented in Model 1, adjusted R^2 = 0.23, F = 1.99, and p-value = 0.09 > .05. A review of Model 2 shows that adjusted R^2 = 0.26, F = 2.35, p-value = 0.05 after removing service vs. banks from the equation, which improved the values of adjusted R^2 and F. After removing the price earnings ratio in Model 3, the values of adjusted R^2 and F are increased to 0.29 and 2.79 respectively, with a p-value = 0.03 < .05. In Model 4, a significant increment in F value (3.18) and an increase in adjusted R^2 (0.30) are found after removing the firm size from the regression equation. For Model 5, adjusted R^2 = 0.29, F = 3.46, p-value = 0.02 and for Model 6, adjusted R^2 = 0.30, F = 4.15, p-value = 0.01. An adjusted R^2 = 0.27, F = 4.64. The results reported in Model 7 suggest that almost one third of the variability in the timeliness of annual reports is predicted by the sector type (banks, insurance, and industry) and dividend payout ratio. This is a statistically significant contribution as indicated by the p-value of 0.01.

Table 4: Model Summary

MODEL	R	R SQUARE	ADJUSTED R SQ.	F	P-VALUE
PANEL A: BAHRAIN					
1[a]	71.	50.	32.	3.387	**011.
2[b]	71.	50.	35.	3.707	***008.
3[c]	71.	50.	37.	4.108	***005.
4[d]	(70.	48.	38.	4.540	***004.
5[e]	68.	46.	38.	5.268	***002.
6[f]	63.	40.	33.	6.032	***002.
PANEL B: UAE					
1[a]	.55	.30	.15	1.95	.07*
2[b]	.55	.30	.17	2..24	.04**
3[c]	.54	.30	.18	2.59	.02**
4[d]	.54	.29	.19	2..96	.02**
5[e]	.52	.27	.19	3..35	.01**
6[f]	.51	.26	.19	4.01	.007***
7[g]	.49	.24	.19	4.98	.004***
8	.48	.23	.19	7.21	.002***

This table shows the significant independent variables used in the model and which variables were removed as they did not make a statistically significant contribution to the performance of the model. After removing the non-significant variables, the contribution of the remaining predictors is reassessed. *** and ** indicate significance at the 1 and 5 percent levels respectively.

a Predictors: (Constant), Price Earnings ratio, Audit Type, Service vs. banks, Industry vs. banks, Dividend payout ratio, Debt ratio, Insurance vs. banks, Profitability, Firm size
b Predictors: (Constant), Price Earnings ratio, Audit Type, Service vs. banks, Industry vs. banks, Dividend payout ratio, Debt ratio, Insurance vs. banks, Profitability
c Predictors: (Constant), Price Earnings ratio, Service vs. banks, Industry vs. banks, Dividend payout ratio, Debt ratio, Insurance vs. banks, Profitability
d Predictors: (Constant), Service vs. banks, Industry vs. banks, Dividend payout ratio, Debt ratio, Insurance vs. banks, Profitability
e Predictors: (Constant), Industry vs. banks, Dividend payout ratio, Debt ratio, Insurance vs. banks, Profitability
f Predictors: (Constant), Dividend payout ratio, Debt ratio, Insurance vs. banks, Profitability
g Dependent Variable: Days required for publication

Regression coefficients and their p-values are presented in Table 5 which displays the contribution of the independent variables to the model by comparing models with and without each variable. For Bahrain, the results provide evidence that the four variables (profitability, debt ratio, sector type, and dividend payout ratio) have significant impact on audit report delay. The results reveal that the impact of profitability on the audit report delay is significant at p < 0.05. One possible explanation for the results presented in the table is that firms with high profitability would tend to disclose their financial information in a timely way in order to convey a positive message to stakeholders. This information usually includes plans and projects which could trigger strong reactions from the market. Regarding the debt ratio, the results indicate that firms with a high debt ratio are more likely to disclose their financial information in a short time compared to those with a high debt ratio. It is argued that firms with a high debt ratio are considered a much higher risk by lenders. Therefore, such companies would pay attention to the timeliness of financial statements to reduce their financial costs from their negotiated credit agreements.

Table 5: The Effect of the Selected Variables on the Timeliness of Annual Reports (Bahrain)

Model	Unstandardized		Standardized			Colinearity Stats	
	B	Std. Err.	Beta	t	Sig.	Tolerance	VIF
(Constant)	44.459	22.686		1.96	0.064		
Firm size	1.975	2.047	0.26	0.965	0.346	0.273	3.657
Profitability	-98.916	44.388	-0.471	-2.228	.037**	0.443	2.256
Debt ratio	-26.426	12.261	-0.579	-2.155	.044**	0.275	3.641
Audit Type	-5.095	4.71	-0.165	-1.082	0.292	0.85	1.176
Insurance vs. banks	22.259	7.937	0.587	2.804	.011**	0.453	2.209
Service vs. banks	8.19	6.264	0.232	1.307	0.206	0.631	1.585
Industry vs. banks	13.898	9.545	0.245	1.456	0.161	0.699	1.431
Dividend payout ratio	200.062	71.36	0.486	2.804	.011**	0.66	1.515
Price earnings ratio	-0.489	0.459	-0.21	-1.065	0.3	0.511	1.958
(Constant)	63.585	11.022		5.769	0		
Profitability	-98.548	44.314	-0.469	-2.224	.037**	0.443	2.255
Debt ratio	-18.262	8.861	-0.4	-2.061	.052*	0.524	1.908
Audit Type	-4.566	4.671	-0.148	-0.978	0.339	0.862	1.16
Insurance vs. banks	19.028	7.185	0.501	2.648	.015**	0.551	1.816
Service vs. banks	6.964	6.124	0.197	1.137	0.268	0.658	1.52
Industry vs. banks	12.39	9.4	0.219	1.318	0.202	0.718	1.393
Dividend payout ratio	223.208	67.099	0.542	3.327	.003***	0.744	1.344
Price earnings ratio	-0.495	0.458	-0.213	-1.082	0.292	0.511	1.958
(Constant)	61.686	10.838		5.691	0		
Profitability	-99.353	44.262	-0.473	-2.245	.035**	0.444	2.255
Debt ratio	-19.855	8.701	-0.435	-2.282	.033**	0.543	1.843
Insurance vs. banks	19.366	7.169	0.51	2.701	.013**	0.552	1.812
Service vs. banks	6.839	6.117	0.193	1.118	0.276	0.658	1.519
Industry vs. banks	10.172	9.113	0.179	1.116	0.276	0.762	1.311
Dividend payout ratio	211.07	65.874	0.512	3.204	.004***	0.77	1.298
Price earnings ratio	-0.509	0.457	-0.218	-1.112	0.278	0.511	1.956
(Constant)	51.221	5.403		9.481	0		
Profitability	-73.157	37.662	-0.348	-1.942	.064*	0.619	1.616
Debt ratio	-18.233	8.622	-0.399	-2.115	.045**	0.558	1.791
Insurance vs. banks	24.006	5.859	0.633	4.097	.000***	0.835	1.198
Service vs. banks	5.946	6.095	0.168	0.976	0.339	0.67	1.493
Industry vs. banks	12.723	8.865	0.224	1.435	0.165	0.814	1.228
Dividend payout ratio	221.22	65.572	0.537	3.374	.003***	0.785	1.273
(Constant)	52.231	5.297		9.86	0		
Profitability	-60.123	35.178	-0.286	-1.709	0.1	0.708	1.413
Debt ratio	-20.087	8.401	-0.44	-2.391	.025**	0.587	1.704
Insurance vs. banks	23.467	5.827	0.618	4.027	.000***	0.842	1.187
Industry vs. banks	11.045	8.688	0.195	1.271	0.216	0.846	1.182
Dividend payout ratio	228.462	65.086	0.555	3.51	.002***	0.796	1.257
(Constant)	55.201	4.813		11.47	0		
Profitability	-71.513	34.434	-0.341	-2.077	.048**	0.757	1.321
Debt ratio	-23.804	7.972	-0.521	-2.986	0.006	0.668	1.498
Insurance vs. banks	23.097	5.891	0.609	3.921	0.001	0.845	1.184
Dividend payout ratio	232.004	65.822	0.563	3.525	0.002	0.797	1.255

This table shows the significant independent variables used in the model and which variables were removed as they did not contribute to the performance of the model. After removing the non-significant variables, the contribution of the remaining predictors is then reassessed.
****, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.*

Likewise, they may disclose such information to reassure shareholders and reduce risk premiums in required rates of return on equity.

The results also show that the contribution of the dividend payout ratio ($p < 0.05$) is statistically significant. Moreover, there is a significant difference between insurance and banking sectors ($p < 0.01$), and a marginally significant difference between the industrial and banking sectors ($p = 0.06$). The direction of the first coefficient (dividend payout) suggests that companies with high dividend payouts are more likely to have a longer audit delay compared to those with low dividend payouts. Bohren and Odegaard (2003) argued that dividends do not have the theoretically expected disciplining role. However, this result can be interpreted in different scenarios. It is argued that firms that have high payout ratios are more likely to use their opportunities to reinvest for future growth. In other words, the higher the payout ratio, the less the retained earnings, and hence, the lower the growth rate. This makes the process of approval and preparation of annual reports and audit take more time. Another argument is that the significant positive effect of the payout ratio on audit delay may expose firms to more monitoring (Easterbrook, 1984).

The results reveal that only two sectors (insurance and banking) have a significant difference in their effect on the audit delay. It is surprising to find that the other sectors (service and industrial) do not differ significantly from the financial sector. This is because the banking sector, for example, is more regulated than other sectors and was expected to be significantly different in its effect on audit delay from other sectors. However, the results show that audit delay in the banking sector is significantly different (lower) than that in the insurance sector.

On the other hand, the variables firm size, audit type, and price earnings ratio are found not to have a significant impact on the timing of disclosure. This is in contrast to hypotheses (H1, H3, and H6) related to these variables. However, these results are consistent with a number of studies that find no significant association between these variables and timeliness of financial reporting. For example, Courtis (1976), Ahmed et al. (2003) and Bonson-Ponte, Escobar-Rodriguez and Borrero-Dominguez (2008) find non-significant relationships between the timeliness of financial reporting and auditor size. Givoly and Palman (1982) find no significant relationships between audit delay of financial reporting and company size. Carslaw and Kaplan (1991) and Abdulla (1996) find no significant relationships between audit delay of financial reporting and the debt–equity ratio. Other studies found that a firm's debt leverage was negatively associated with the timing of information release (Deloof and Weet, 2003, Aljabr, 2007, Conover M.C; Miller R.E. and Szakmary A. 2008). Almosa and Alabbas (2007) found no significant relationship between the profitability, sector type and the timeliness of financial reporting.

Regarding the UAE, the results indicate that firms with a high debt ratio are more likely to have a short audit delay. This is probably because such firms would prefer to share the relevant information with their creditors. It is argued that lenders consider firms with a high debt ratio as much higher risk. Therefore, in order to reduce their financial costs from negotiated credit agreements, such companies would tend to publish their annual report quickly. Likewise, they may disclose relevant information through their annual report to reassure shareholders and reduce risk premiums in required rates of return on equity. It is important to note that the association between the debt ratio and the timeline of financial reporting is still ambiguous.

Another significant variable found is the audit type ($p < 0.05$). It is argued that the auditor can play an important role in improving a firm's overall reporting strategy (Hail, 2002). Empirical findings suggest that companies reviewed by larger audit firms provide higher quality financial statements, ceteris paribus (Becker *et al*., 1998).

Table 6: The Effect of the Selected Variables on the Timeliness of Annual Reports (UAE)

	Unstandardize				Colinearity Stats.	
	B	Std. Error	t	.Sig	Tolerance	VIF
(Constant)	173.956	78.121	2.227	032.		
Debt ratio	-21.004	19.862	-1.057	296.	299.	3.348
Audit Type	-18.794	10.760	-1.747	*088.	558.	1.793
Insurance vs. banks	-13.721	14.467	948.-	348.	226.	4.426
Service vs. banks	-2.794	13.282	210.-	834.	366.	2.731
Industry vs. banks	-6.932	15.304	453.-	653.	276.	3.626
Price earnings	273.-	212.	-1.287	205.	525.	1.906
Firm size	-3.849	3.454	-1.114	272.	320.	3.128
Dividend payout ratio	-11.806	15.412	766.-	448.	667.	1.500
Profitability	-45.094	30.460	-1.480	146.	561.	1.784
(Constant)	171.702	76.497	2.245	030.		
Debt ratio	-18.470	15.611	-1.183	243.	473.	2.116
Audit Type	-19.085	10.549	-1.809	*078.	567.	1.763
Insurance vs. banks	-11.782	11.023	-1.069	291.	380.	2.630
Industry vs. banks	-5.283	12.992	407.-	686.	374.	2.675
Price earnings	290.-	194.	-1.492	143.	611.	1.636
Total Assets	-3.842	3.414	-1.125	267.	320.	3.128
Dividend payout ratio	-10.640	14.217	748.-	458.	765.	1.306
Profitability	-46.404	29.475	-1.574	123.	585.	1.709
(Constant)	155.104	64.064	2.421	020.		
Debt ratio	-17.914	15.399	-1.163	251.	476.	2.100
Audit Type	-16.741	8.749	-1.914	*062.	809.	1.237
Insurance vs. banks	-9.125	8.790	-1.038	305.	586.	1.705
Price earnings	268.-	185.	-1.450	154.	661.	1.513
Total Assets	-3.289	3.102	-1.060	295.	380.	2.633
Dividend payout ratio	-10.496	14.074	746.-	460.	766.	1.306
Profitability	-44.998	28.986	-1.552	128.	593.	1.686
(Constant)	159.371	63.486	2.510	016.		
Debt ratio	-15.718	15.039	-1.045	302.	494.	2.023
Audit Type	-16.213	8.676	-1.869	*068.	814.	1.229
Insurance vs. banks	-8.821	8.737	-1.010	318.	588.	1.702
Price earnings	255.-	183.	-1.393	171.	667.	1.499
Total Assets	-3.780	3.016	-1.253	217.	398.	2.515
Profitability	-37.767	27.178	-1.390	172.	668.	1.497
(Constant)	126.945	54.775	2.318	025.		
Debt ratio	-15.289	15.036	-1.017	315.	495.	2.022
Audit Type	-19.094	8.196	-2.330	**024.	913.	1.096
Price earnings	218.-	180.	-1.215	231.	695.	1.439
Total Assets	-2.326	2.651	877.-	385.	515.	1.942
Profitability	-38.143	27.181	-1.403	167.	668.	1.497
(Constant)	79.871	11.029	7.242	000.		
Debt ratio	-24.084	11.180	-2.154	**037.	890.	1.123
Audit Type	-19.814	8.134	-2.436	**019.	922.	1.085
Price earnings	182.-	174.	-1.044	302.	734.	1.363
Profitability	-30.696	25.758	-1.192	239.	740.	1.351
(Constant)	74.079	9.540	7.765	000.		
Debt ratio	-27.338	10.747	-2.544	**014.	965.	1.036
Audit Type	-19.218	8.122	-2.366	**022.	926.	1.080
Profitability y	-17.959	22.704	791.-	433.	955.	1.048
(Constant)	69.976	7.975	8.774	000.		
Debt ratio	-27.912	10.680	-2.613	**012.	970.	1.031
Audit Type	-17.860	7.907	-2.259	**028.	970.	1.031

*This table shows the significant independent variables used in the model and which variables were removed as they did not contribute to the performance of the model. After removing the non-significant variables, the contribution of the remaining predictors is then reassessed. **, and * indicate significance at the 5 and 10 percent levels respectively.*

Table 7: Comparison between the Two Countries in Terms of the Significant Variables and Hypotheses*

Variables	Coefficients		*P*-value		Hypotheses	
	Bahrain	UAE	Bahrain	UAE	Bahrain	UAE
Profitability	-71.513	-	.048**	-	Supported	Not Supported
Debt ratio	-23.804	-27.912	.006***	.012**	Supported	Supported
Insurance vs. banks	23.097	-	.001***	-	Supported	Not Supported
Div. payout ratio	232.004	-	.002***	-	Supported	Not Supported
Audit Type	-	17.860	-	.028**	Not Supported	Supported

*This table includes only the final significant variables in model No. 6 (Bahrain) and model No. 7 (UAE). The two variables of company size and price earnings ratio were found not to be significant and therefore their hypotheses were rejected. This table summarizes the independent variables found to have a significant effect on timeliness in the two countries. In addition, it reveals which hypotheses were supported and which hypotheses rejected. The significance levels used in this study are 1% and 5%. *** and ** indicate significance at the 1and 5 percent levels respectively.*

In contrast with this, the variables firm size, sector type, profitability, price earnings ratio, and dividend payout ratio are found not to have a significant impact on the timeliness of financial reporting. This is in contrast with our hypotheses (H1, H3, H5, H6 and H7) related to these variables. However, these results are consistent with a number of studies which find no significant association between these variables and timeliness of financial reporting. For example, Courtis (1976), Ahmed et al. (2003), and Bonson-Ponte et al. (2008) find no significant relationships between the timeliness of financial reporting and audit type. Almosa and Alabbas (2007) find an no significant relationship between profitability, sector type and the timeliness of financial reporting.

CONCLUSIONS

This study concludes that four variables (profitability, debt ratio, sector type, and dividends payout ratio) examined in Bahrain appear to have a strong influence on the timeliness of annual reports. The null hypotheses of no significant relationship between firm performance and the four variables (profitability, debt ratio, sector type, and dividends payout ratio) were rejected. However, another three variables (audit type, firm size, and price earnings ratio) are found to have little or no effect on the timeliness of annual reports (see Table 7).

It should be noted that the impact of profitability is significant at $p < 0.05$. Profitability is considered an indication of good or bad news resulting from the year's operations (Ashton et al., 1987). If the company experiences losses, management might wish to delay the corporate annual report in order to avoid the effect of its 'bad news'. The results show that the impact of debt ratio, sector type, and dividends payout ratio are significant at $p < 0.01$. This can be seen as evidence that companies with a high debt ratio show greater care in disclosing financial statements in a timely manner than companies with a low debt ratio. In addition, if the debt ratio is high, the possibility of company failure will increase and thus auditors will make a careful and long-term audit in order to minimize legal liability due to the increasing possibility of failure (Ansah, 2000). Regarding the effect of dividend payout ratios, it is argued that paying out more dividends forces the firm into the new issue market more frequently and so exposes it to more monitoring (Easterbrook, 1984). This may motivate firms to take more time in preparing their annual reports.

This study concludes that the audit delay in the banking sector is less than in other sectors because it is the most regulated sector. However, it is found that there is no significant difference in audit delay between the banking sector and the service and industrial sectors. Aljifri (2008) examines the effect of four variables (sector type, size, debt equity, and profitability) on the level of financial disclosure. He uses denominator-adjusted disclosure-indexes (using a list of 73 financial items). The extent of corporate disclosure is calculated and compared among firms and between sectors. Aljifri (2008) finds significant differences in disclosing financial information between sectors. However, size, debt equity, and profitability are not found to have a significant association with the level of disclosure. This leads to an important conclusion - the factors that affect the level of accounting information disclosure may be different from those that affect financial statement timeliness.

The debt ratio, a common variable in the two countries, is shown to have a significant effect on the timeliness of financial statements. A possible explanation for this is the demand for a high-quality audit service from companies with a high debt ratio to satisfy the needs for long- term creditors and to remove suspicion of debt holders about wealth transfer (Chow, C.W 1982, Ashbaugh and Warfield, 2003).
In the UAE, the study also concludes that two variables (debt ratio and audit type) appear to affect the timeliness of annual reports (see Table 7). The null hypotheses of no significant relationship between the timeliness of annual reports and the two variables, debt ratio and audit type, were rejected. The results provide evidence that the two variables have significant impact on the timeliness of annual reports. The demands of highly geared companies for high quality audit may be similar to those with a high debt ratio (Chow, C.W 1982, Ashbaugh and Warfield, 2003). Regarding the audit type, a high-quality audit service results in decreasing the audit delay of corporate annual reports. This result is explained by the fact that large multi-national audit firms are expected to take less time to conduct audit work because they have more resources and use more qualified auditing staff. In addition, internationally affiliated firms would be more efficient as they employ superior audit technology (Leventis et al., 2005). It should be noted that the impact of debt ratio and audit type is significant at the $p < 0.05$ level. However, another five variables (profitability, firm size, sector type, dividend payout ratio and price earnings ratio) are found to have little or no influence on the timeliness of annual reports.

The findings of this study seem to indicate differences between the two countries. Given that the two countries share similar social, political and economic environments, the source of such differences is probably the considerable range and differences in the means that exist in the variables used in this study (see Tables 2 and 3). This indicates that the UAE has a wide variety of firm size compared to that in Bahrain and consequently this variable can have an effect on the level of profitability and dividends payout ratio in the two countries. However, where the mean was close in the two countries (debt ratio), the findings were almost the same. The results show that the debt ratio variable has a negative relationship in both countries. Examining the findings closely, the influence of the profitability variable (for the UAE) has the same direction as that in Bahrain even though it is not significant in the former case. The sector type variable was found to have a significant effect in Bahrain but not in the UAE. This is probably because of the different variety of firm size that was found to exist in the two countries. The audit type was found to have a significant effect on timeliness because of the positive role of big firms in the UAE that supports financial and non-financial firms in the preparation of their annual report in a timely way. Regarding the dividend payout ratio variable, it is found to be significant for Bahrain and have a positive impact on audit delay, whereas it is found to have negative effect on audit delay, although not significant, in the UAE. This is because of the magnitude of dividends of firms in the UAE which motivate them to disclose such information in a timely way.

It is hoped that this study will improve the understanding of some of the variables that have an effect on the timeliness of annual reports. The study extends the literature to the effect of firm-specific variables on the timeliness of annual reports in Bahrain and the UAE. These results may help users of financial information to assess the impact of such variables on improving the timeliness of annual reports.
The authors conclude that policymakers in Bahrain and the UAE should develop legal and regulatory frameworks appropriate for Bahrain and the UAE business environments while remaining within the International Financial Reporting standards. It is expected that such developments will contribute to improved efficiency, effectiveness and governance in both the Bahrain and the UAE stock markets.
Certain limitations of this study must be recognized. First, the delay in publishing audit reports used in this study is measured in terms of days rather than man-hours spent on audit work. This may create a

measurement problem if an audit firm spends more than the usual intensity of work on an audit. Second, there could other factors, such as processes of administrative approval within the home office, which affect audit lag but have not been included in the model. Third, the results may be different if the number of company characteristics was increased or another set of variables were examined. This might make possible further improvement of the regression model used in this study. Finally, this study considers the annual reports for a single year. Further research could be undertaken to measure audit delay longitudinally to determine whether there is a trend in audit delay over time, and whether there are firm specific influences.

Future research should be conducted taking into consideration some important corporate governance variables such as structure of the audit committee, level of ownership concentration, the percentage of the outside board members (if differences exist), insider ownership, voting coalitions and product-market competition. Additional research might also be directed towards determination of the effect of timeliness of annual reports of Bahrain and UAE firms using larger samples and longer time series.

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CAN MISPRICING OF ASSET GROWTH EXPLAIN THE ACCRUALS ANOMALY?

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ABSTRACT

Recent research suggests that the mispricing of asset growth can explain the accruals anomaly. We reexamine this issue by focusing on the role of accounting manipulations in stock mispricing. Specifically, we hypothesize that accounting manipulations are at the root of the accruals anomaly but play an insignificant role in the asset growth anomaly. Our large sample results strongly support our hypothesis, suggesting that investors can benefit from exploiting both anomalies instead of one.

JEL: G10, M4

KEYWORDS: Accruals anomaly, growth anomaly, value-glamour, growth in long-term net operating assets

INTRODUCTION

Since Sloan's (1996) seminal study, academic research has documented a strong inverse relationship between accounting accruals and future stock returns, which is often referred to as the accruals anomaly. Another line of research finds that asset growth, such as growth in net operating assets, exhibits return predictability similar to accruals. Because total accruals can be viewed as growth in *short-term* net operating assets, it is natural to ask how the accruals anomaly and the asset growth anomaly are related. Fairfield et al. (2003) find that the market seems to equivalently misprice total accruals and growth in *long-term* net operating assets, and posit that the accruals anomaly may be a specific manifestation of a more general growth anomaly. Their conclusion has important implications for investors. Portfolio theory suggests that investing in two closely related strategies reduces the benefit of diversification and over-exposes investors to unidentified fundamental economic risks. In this study, we reexamine the relationship between the accruals anomaly and the asset growth anomaly.

Our study is motivated by both theoretical and methodological considerations. From a theoretical perspective, existing evidence suggests that the accruals anomaly and the asset growth anomaly may arise for different reasons. In particular, prior studies suggest that accounting manipulations play an important role in explaining the accruals anomaly. However, the asset growth anomaly literature does not view accounting manipulations as an important reason for the anomaly. For example, Fairfield et al. (2003) argue that investors misprice growth in net operating assets because they fail to understand the negative effect of investments on earnings due to conservative accounting and diminishing marginal return on investments. Similarly, Titman et al. (2004) hypothesize that excess capital expenditure is negatively associated with future stock returns because investors underreact to empire building. Thus, the significantly different role of accounting manipulations in these two types of anomalies suggests that they are different from each other.

From a methodological point of view, Fairfield et al. (2003) draw their conclusion from the Mishkin test (Mishkin, 1983). The Mishkin test is a rational expectations framework that requires specifications of both an earnings expectations model and a pricing model. Because the Mishkin test is highly sensitive to the choice of variables included in the models (e.g., Kraft et al., 2007) and there is no consensus on the correct specification for the earnings expectation model, we reexamine the relationship between the accruals anomaly and the asset growth anomaly using more robust tests.

Our study differs from prior studies in several important ways. First, we emphasize the different roles played by accounting manipulations in accruals and asset growth anomalies. Specifically, Fairfield et al. (2003) focus on total accruals, but prior research suggests that the abnormal accruals, which result from accounting manipulations, are more informative of future stock returns (e.g., Xie, 2001; Chan et al., 2006). In this study, we provide original evidence on the relationship between abnormal accruals and the asset growth anomalies. In our view, these are stronger tests of the assertion that the accruals anomaly is an asset growth anomaly in disguise. Second, we also compare the excess capital expenditure anomaly (Titman et al., 2004) with the accruals anomaly. The excess capital expenditure anomaly is closely related to the growth in long-term net operating assets anomaly in Fairfield et al. (2003). If Fairfield et al.'s theory is correct, we should find that the accruals anomaly and the excess capital expenditure anomaly are indistinguishable as well. According to our knowledge, there is no research on this issue. Lastly, we use both portfolio and regression tests, which are robust techniques commonly used in the empirical asset pricing literature. Not only they avoid the problems of the Mishkin test, they also simulate real trading and hence are more relevant to investors.

Using a large cross-sectional sample of U.S. firms from 1973 to 2005, we find strong evidence suggesting that the accruals anomaly is distinct from the asset growth anomaly. Specifically, we find that the performance of the total accruals and abnormal accruals strategies are largely independent of the level of growth in long-term net operating assets or excess capital expenditure. Moreover, we find that, compared to the total accruals strategy, the abnormal accruals strategy earns higher risk-adjusted returns and is more independent from the asset growth strategies. Our results are robust to industry effects and various estimations of abnormal accruals. The important message of our research is that investors can earn higher risk-adjusted returns from exploiting both accruals and asset growth anomalies.

In the next section, we review recent literature. In the following section, we discuss sample and methodology. Next, we discuss our empirical results and robustness tests. In the last section, we conclude.

LITERATURE REVIEW

The accruals anomaly was first documented by Sloan (1996). He finds that stocks with high accounting accruals tend to underperform stocks with low accounting accruals, and this phenomenon cannot be explained by common risk factors such as beta, size and book-to-market ratio. Pincus et al. (2007) find that the accruals anomaly is not unique to the U.S. market. They document the existence of the accruals anomaly in Australia, Canada, and the UK.

Sloan (1996) explains the accruals anomaly from the perspective of different persistence of accruals and operating cash flows with respect to future earnings. Specifically, he shows that accruals are less persistent than operating cash flows. If investors fail to recognize the lower persistence of accruals, they will tend to overestimate (underestimate) future earnings of firms with high (low) accruals and hence overvalue (undervalue) such firms. The accruals anomaly thus reflects the price correction with respect to this particular bias of investors.

Although this reasoning is very compelling, some researchers remain doubtful of the existence of the accruals anomaly. A natural question to ask is whether the accruals anomaly is simply another familiar anomaly in disguise. Collins and Hribar (2000) compare the accruals anomaoly with the well-known post-earnings-announcement-drift anomaly and find that the two anomalies are distinct from each other. Another concern is that the accruals anomaly may just be a different manifestation of the traditional value/glamour anomaly such as the book-to-price and earnings-to-price ratios. Desai et al. (2004) show that the traditional value-glamour strategies do not explain the accruals anomaly either, although they find that operating-cash-flows-to-price ratio seems to capture the accruals anomaly.

Recently, some studies find that asset growth, measured in various ways, is negatively associated with future stock returns. For example, Titman et al. (2004) document that excessive capital expenditure is inversely associated with future stock returns. Penman and Zhang (2002) and Hirshleifer et al. (2004) show that growth in net operating assets is a negative predictor of future returns. Fairfield et al. (2003) decompose growth in net operating assets into growth in *current* and *long-term* net operating assets, where growth in *current* net operating assets is equivalent to Sloan's (1996) total accruals. They find that both growth in *current* (i.e., accruals) and *long-term* net operating assets have similar negative correlations with future stock returns. They posit that the negative return predictability of both growth in current and long-term net operating assets comes from investors' failure to understand the implication of investment (i.e., growth in operating assets) on one-year-ahead earnings. Investment has negative impact on near-term earnings and can be attributable to both conservative accounting and the law of diminishing marginal returns. Conservative accounting makes firms record immediate expenditures associated with the investment, but not its benefits. And the law of diminishing marginal returns suggests that, in equilibrium, firms' future investments should always be less profitable than their earlier investments. In sum, Fairfield et al. (2003) argue that their evidence supports the view that the accruals anomaly is just a special case of a more general growth phenomenon.

The growth explanation of the accruals anomaly has its merits, but it conflicts with the earnings persistence argument put forth by Sloan (1996). More importantly, past research shows that the lower persistence of accruals is primarily due to earnings manipulation. For example, Xie (2001) decomposes accruals into discretionary and non-discretionary components and finds that the accruals anomaly only exists for discretionary accruals. This finding is important because discretionary accruals are usually viewed as the result of accounting manipulations. Chan et al. (2006) and Richardson et al. (2006), using different methodologies and samples, draw similar conclusions. Moreover, Bradshaw et al. (2001) show that sophisticated financial statement users do not seem to understand the negative implication of accruals for future earnings, supporting the view that the accruals anomaly reflects mispricing due to investors' failure to see through earnings manipulations.

DATA AND METHODOLOGY

We conduct our analysis using all domestic stocks traded on NYSE, AMEX and NASDAQ from 1973 to 2005, with available data from Compustat and CRSP. To ensure that our results are not driven by a liquidity premium, we remove observations with prices below \$1, market values less than \$10 million, or book value of equity less than \$10 million when portfolios are formed. We also remove ADRs, closed-end funds, and REITs. For each sample firm, we require sufficient data to compute accruals. Lastly, to exclude firm-year observations that induce noise in the measurement of accruals, where: (1) Compustat estimates working capital components, or (2) managers make voluntary accounting changes that affect operating income or working capital accounts, or (3) goodwill increases from year to year. The final sample is comprised of 55,239 firm-year observations.

Following the literature, we use annual data to compute total accruals (TACC) and define it as growth in operating working capital accounts (GrWC) less current-period depreciation and amortization expense (DEPAMORT), deflated by average total assets (the firm subscript, i, is suppressed hereafter): $TACC_t = (GrWC_t - DEPAMORT_t)/([TA_t + TA_{t-1}]/2)$, and $GrWC_t = (\Delta AR_t + \Delta INV_t + \Delta OTHERCA_t) - (\Delta AP_t + \Delta OTHERCL_t)$, where ΔAR is change in accounts receivable, ΔINV is change in inventories, ΔOTHERCA is change in other current assets, ΔAP is change in accounts payable, ΔOTHERCL is change in other current liabilities, DEPAMORT is depreciation and amortization expense, and TA is total assets.

Abnormal accruals (AACC) are estimated using an augmented modified Jones model that further controls for profitability and growth (e.g., Kothari et al., 2005). The model is as follows: $TACC_t = \beta_1 1/AVGTA_t + \beta_2 (\Delta SAL_t - \Delta AR_t)/AVGTA_t + \beta_3 PPE_t/AVGTA_t + \beta_4 ROA_t + \beta_5 SALGRO_t + \varepsilon_t$, where $AVGTA_t = [TA_t + TA_{t-1}]/2$, SAL is sales, PPE is net plant, property and equipment, ROA = earnings available to common shareholders / $AVGTA_t$, and SALGRO is the average sales growth for the past three years. We estimate the model every year and the regression residual, ε_t, is the firm-year specific estimate of abnormal accruals (AACC).

We select two measures of growth: growth in long-term net operating assets and excess capital expenditures. We select these two measures because they both have been shown to predict future stock returns. Following Fairfield et al. (2003), we define growth in long-term net operating assets (GrLTNOA) as the difference between growth in net operating assets (GrNOA) and accruals (TACC): $GrLTNOA_t = GrNOA_t - TACC_t$, where GrNOA is the annual change in net operating assets, deflated by average total assets: $GrNOA_t = (NOA_t - NOA_{t-1})/([TA_t + TA_{t-1}]/2)$, and $NOA_t = AR_t + INV_t + OTHERCA_t + PPE_t + INTANG_t + OTHERLTA_t - AP_t - OTHERCL_t - OTHERTL_t$, where INTANG is intangibles, OTHERLTA is other long-term assets, and OTHERTL is other long-term liabilities. Following Titman et al. (2004), we define excess capital expenditure (EXCAPX) as the ratio of current year's capital expenditure divided by the average of last three years' capital expenditure minus one: $EXCAPX = CAPX_t/(CAPX_{t-1} + CAPX_{t-2} + CAPX_{t-3}) - 1$, where CAPX is capital expenditure.

We form trading portfolios at the beginning of July every year from 1973 to 2005. To ensure financial data are available to investors when trading portfolios are formed, we require at least four months between the fiscal year-end and July. We sort firms into equal size quintile portfolios, based on TACC, AACC, GrLTNOA and EXCAPX. For all strategies, the trading rule is to buy firms in the bottom quintile and simultaneously short-sell firms in the top quintile. Hedge returns of the trading strategy are the total returns of the long and short positions. We hold the trading positions for twelve months and then liquidate the positions to form new portfolios.

We measure abnormal returns as characteristics-adjusted returns, where characteristics are book-to-market equity, size and price momentum (Daniel et al., 1997; Titman et al., 2004). The procedure is as follows. First, at the beginning of July of year t, we sort all firms into five portfolios based on firm size at the end of June of year t. The breakpoints for size portfolios are based on the quintile breakpoints of NYSE firms. Next, in each size portfolio, we sort all firms into equal-size quintiles based on book-to-market ratio at the end of June of year t. Finally, in each size/book-to-market portfolio, we sort all firms into equal-size quintiles based on their prior-year stock performance, skipping the most recent month. Overall, 125 size/book-to-market/momentum benchmark portfolios are formed. The abnormal return of a firm is the difference between the return of the firm and the value-weighted return of the benchmark portfolio it belongs to: $AR_{i,t} = R_{i,t} - R_{b,t}$, where $AR_{i,t}$ is the characteristics-adjusted abnormal return of firm i for period t, $R_{i,t}$ is the return of firm i for period t, and $R_{b,t}$ is the return of characteristics benchmark b that firm i belongs to for period t.

EMPIRICAL RESULTS

Table 1: Descriptive Statistics

Variable	Mean	Standard Deviation	First Quartile	Median	Third Quartile
ROA	0.093	0.136	0.053	0.102	0.159
TACC	-0.027	0.086	-0.071	-0.031	0.012
AACC	-0.005	0.076	-0.044	-0.003	0.037
GrLTNOA	0.096	0.117	0.034	0.071	0.129
EXCAPX	0.463	0.364	0.261	0.383	0.549

This table presents descriptive statistics for the 55,239 firm-year observations in our sample (NYSE, AMEX, NASDAQ) from 1973 to 2005.

Table 1 provides descriptive statistics for our key variables. To mitigate the influence of outliers, we winsorize each variable at the top and bottom 1%. The mean (median) ROA for the sample is 0.093 (0.102), while the mean (median) total accruals (TACC) are -0.027 (-0.031). TACC is on average negative because depreciation and amortization usually outweigh working capital accruals. Abnormal accruals (AACC) are about 20% the magnitude of TACC: mean (median) AACC is -0.005 (-0.003). Growth in long-term net operating assets (GrLTNOA) is much larger than TACC, with a mean (median) of 0.096 (0.071). The mean and median excess capital expenditure (EXCAPX) show that on average firms increase their capital expenditure by about 46% relative to their three-year average; this is comparable to figures reported in prior studies (e.g., Fairfield et al., 2003; Titman et al., 2004).

Table 2: Pearson and Spearman Correlations

	ROA	TACC	AACC	GrLTNOA	EXCAPX
ROA	-	0.256	-0.021	0.224	0.271
TACC	0.251	-	0.811	-0.027	0.198
AACC	0.024	0.888	-	0.060	0.122
GrLTNOA	0.126	-0.029	0.041	-	0.526
EXCAPX	0.090	0.174	0.127	0.436	-

Pearson (Spearman) correlation coefficients are reported below (above) the diagonal.

Table 2 presents correlations among our main variables. TACC is highly correlated with ROA, GrLTNOA and EXCAPX. Firms with higher profitability tend to grow faster and the strong growth can lead to higher total accruals. TACC is slightly negatively correlated with GrLTNOA, but has a positive correlation with EXCAPX. Overall, the evidence does not support the view that TACC and asset growth are fundamentally related. Lastly, the correlation between AACC and ROA is much smaller than that between TACC and ROA, reflecting the fact that ROA has been controlled when we estimate abnormal accruals. AACC is also positively correlated with both asset growth measures; high growth firms are in greater need to manage earnings so they will not spoil the market's high expectations of them.

Next, to confirm the relationships between our accruals and asset growth variables and future stock returns, we sort each of the four variables into equal-size quintile portfolios. Quintile 1 (Quintile 5) represents the 20 percent of stocks with the lowest (highest) value of the sorting variable. The trading rule is to buy stocks in Q1 and short stocks in Q5. Returns for Q1, Q5 and Q1-Q5 are all equal-weighted.

Table 3: Univariate Results

	Strategies			
	TACC	AACC	GrLTNOA	EXCAPX
Q1 (Buy)	0.42%	2.11%	-0.41%	-1.19%
Q2	1.07%	0.49%	0.11%	0.68%
Q3	-0.28%	-0.55%	0.18%	0.53%
Q4	-0.37%	-0.94%	-0.42%	0.33%
Q5 (Short)	-3.41%	-3.95%	-2.28%	-3.20%
Q1-Q5 (Hedge)	3.83%	6.06%	1.87%	2.01%

*The numbers reported are characteristics-adjusted returns (t-statistics are reported in the parentheses). Q1 is the bottom quintile and Q5 is the top quintile. *, **, and *** denote significance levels of 0.1, 0.05 and 0.01 from a two-tailed test, respectively.*

Table 3 reports univariate results. For each trading strategy we report the characteristics-adjusted returns for its five quintile portfolios, as well as the hedge portfolio, Q1-Q5. For the TACC and AACC strategies, we confirm the results of Sloan (1996) and Xie (2001) using our more-recent data; this provides out-of-sample evidence on the robustness of prior findings. The average annual abnormal returns earned by the TACC hedge strategy is 3.83%, significant at the 0.01 level but weaker than that reported in Sloan (1996). This difference is probably due to several reasons. First, we sort firms into quintiles instead of deciles. The annual return of the TACC strategy increases to 5.25% when deciles are used. Second, we measure the abnormal returns adjusted for size, book-to-market and price momentum factors, while Sloan only considers the size factor. Third, the TACC strategy has been adopted by many investment funds in recent years and our sample includes data from recent years. The AACC strategy earns much higher abnormal returns than the TACC strategy (6.06% vs. 3.83%), supporting the view that the return predictability of total accruals is primarily driven by its proxy for accounting manipulations (e.g., Xie, 2001). Moreover, returns from Q1 to Q5 decrease monotonically for the AACC strategy, but this pattern is weaker for the TACC strategy.

The two asset growth strategies, however, do not yield significant abnormal returns in our quintile specification (1.87% for GrLTNOA strategy and 2.01% for EXCAPX strategy). Untabulated results reveal that a decile-portfolio specification results in both strategies earning significant abnormal returns (3.97% for GrLTNOA [t-stat=2.11] and 3.62% for EXCAPX [t-stat=2.08]). Overall, our results are consistent with Fairfield et al. (2003) and Titman et al. (2004), but we find that the returns to the asset growth strategies have weakened in recent years. Finally, for all strategies the returns are dominated by the short quintile portfolio (i.e., Q5), suggesting that the information content of these variables is asymmetrically distributed.

The main goal of our study is to determine whether the performance of accruals-based strategies depends on asset growth variables. Specifically, can the TACC and AACC strategies earn significant abnormal returns if we control for the level of asset growth? If the accruals-based anomalies are truly a manifestation of a more general asset growth anomaly, we expect to find that the TACC and AACC strategies cease to perform once the level of asset growth is controlled for. On the other hand, if accruals-based strategies do not largely overlap with asset-growth strategies, we expect to find that the TACC and AACC strategies continue to perform regardless of the level of asset growth.

Following the literature, we use two approaches to examine the performance of accruals-based strategies conditional on the level of asset growth. The first approach is a portfolio test, while the second approach is a regression test. We independently sort stocks into quintiles based on the accruals and asset growth measures. Since our focus is on stocks in the top or bottom quintiles, we merge the middle three quintiles (Q2, Q3 and Q4) into one portfolio. Thus, for every strategy, we have three portfolios: low (Q1), medium (Q2-Q4) and high (Q5). The interaction between any two strategies generates nine portfolios (3 x 3).

Table 4: Portfolios Tests

Panel A: Total Accruals and Growth in Long-Term Net Operating Assets Strategies

		TACC			
		Low (Q1)	Medium (Q2-Q4)	High (Q5)	Low - High
GrLTNOA	Low (Q1)	1.49%	0.16%	-4.52%	6.01% (2.50)**
	Medium (Q2-Q4)	1.11%	0.40%	-2.56%	3.67% (1.90)*
	High (Q5)	-1.92%	-2.05%	-3.84%	1.92% (1.25)
	Low - High	3.42% (1.32)	2.21% (1.21)	-0.70% (-0.38)	

Panel B: Abnormal Accruals and Growth in Long-Term Net Operating Assets Strategies

		AACC			
		Low (Q1)	Medium (Q2-Q4)	High (Q5)	Low - High
GrLTNOA	Low (Q1)	2.76%	-1.03%	-3.88%	6.64% (2.60)**
	Medium (Q2-Q4)	1.79%	0.38%	-3.76%	5.55% (4.01)***
	High (Q5)	1.47%	-2.52%	-4.53%	6.00% (3.91)***
	Low - High	1.29% (0.54)	1.50% (1.40)	0.65% (0.26)	

*The numbers reported are characteristics-adjusted returns (t-statistics are reported in the parentheses). Q1 is the bottom quintile and Q5 is the top quintile. *, **, and *** denote significance levels of 0.1, 0.05 and 0.01 from a two-tailed test, respectively.*

We first examine the interaction between the TACC and GrLTNOA strategies. Results are reported in Table 4, Panel A. The last column reports the hedge returns of the TACC strategy, conditional on different levels of GrLTNOA. The last row reports the hedge returns of the GrLTNOA strategy, conditional on different levels of TACC. We find that the TACC strategy generates significant abnormal returns for all GrLTNOA levels except when GrLTNOA is high. For example, when GrLTNOA is low (medium), the abnormal returns of the TACC strategy is 6.01% (3.67%). The insignificant abnormal return of the TACC strategy when GrLTNOA is high is primarily driven by the low return of the Low TACC / High GrLTNOA portfolio (-1.92%). As before, both TACC and GrLTNOA strategies are dominated by the negative abnormal returns earned by firms with high TACC or GrLTNOA. When TACC and GrLTNOA rankings disagree, the ranking with negative information dominates.

In Panel B of Table 4, we report the interactions of the AACC strategy and the GrLTNOA strategy. We find that the AACC strategy generates large, significant abnormal returns regardless of the level of GrLTNOA. For example, the AACC strategy generates 6.64%, 5.55% and 6.00% annual abnormal returns when GrLTNOA is low, medium and high, respectively. These returns are much larger than the corresponding returns for the TACC strategy conditional on GrLTNOA (6.01%, 3.67% and 1.92%, respectively). The results in Table 4 strongly suggest that, contrary to the conclusion of prior studies, both TACC and AACC strategies are distinct from the GrLTNOA strategy. Moreover, the difference between the accruals-based strategy and the asset growth strategy is accentuated when we focus on abnormal instead of total accruals, potentially because total accruals are a noisier proxy than abnormal accruals for the economic variable underlying the accruals anomaly.

Our general conclusion does not change when we use excess capital expenditure (EXCAPX) to proxy for asset growth. Table 5, Panel A reports the conditional analysis results for the TACC strategy and the EXCAPX strategy. Similar to results in Table 4, we find that the TACC strategy is effective when the level of EXCAPX is either low or medium. When the EXCAPX level is high, the TACC strategy does not earn significant abnormal return because the Low TACC / High EXCAPX is dominated by the negative information in high EXCAPX (-3.17%).

Table 5: Portfolio Tests: Excess Capital Expenditure Strategies

Panel A: Total Accruals and Excess Capital Expenditure Strategies

		TACC			
		Low (Q1)	Medium (Q2-Q4)	High (Q5)	Low - High
EXCAPX	Low (Q1)	-1.05%	-0.08%	-6.21%	5.16%
					(2.38)**
	Medium (Q2-Q4)	2.36%	0.59%	-2.09%	4.45%
					(3.89)***
	High (Q5)	-3.17%	-2.39%	-4.72%	1.55%
					(0.76)
	Low - High	2.12%	2.31%	-1.50%	
		(0.97)	(1.57)	(-0.74)	

Panel B: Abnormal Accruals and Excess Capital Expenditure Strategies

		AACC			
		Low (Q1)	Medium (Q2-Q4)	High (Q5)	Low - High
EXCAPX	Low (Q1)	1.63%	-1.33%	-4.43%	6.05%
					(2.24)**
	Medium (Q2-Q4)	2.94%	0.76%	-2.84%	5.78%
					(5.40)***
	High (Q5)	0.56%	-2.84%	-5.83%	6.40%
					(3.85)***
	Low - High	1.06%	1.50%	1.41%	
		(0.60)	(1.13)	(0.42)	

*The numbers reported are size-adjusted returns (t-statistics are reported in the parentheses). Q1 is the bottom quintile and Q5 is the top quintile. *, **, and *** denote significance levels of 0.1, 0.05 and 0.01 from a two-tailed test, respectively.*

Table 5, Panel B reports that the AACC strategy not only earns significant abnormal returns regardless of the levels of EXCAPX, it also earns larger returns than the TACC strategy at the same EXCAPX level. Specifically, the AACC strategy earns 6.05%, 5.78% and 6.40% per annum when the EXCAPX level is low, medium and high, respectively. The corresponding numbers for the TACC strategy are 5.16%, 4.45% and 1.55%. Collectively, results in Table 5 corroborate those in Table 4, strongly supporting the view that the accruals anomaly is different from the asset growth anomaly.

Our portfolio tests measure the abnormal return of a stock as the difference between its return and the value-weighted return of its corresponding size/book-to-market/momentum benchmark portfolio. The advantage of this approach is that it does not assume any specific return distribution; however, it ignores the differences of firms in the same benchmark portfolio. An alternative method to measure abnormal returns is to use a formal asset pricing model to compute expected returns. Of course, the effectiveness of this approach is only as good as the model inputs and the reasonableness of assumptions (e.g., linearity). The dominant empirical asset pricing model in the literature is the four-factor model (Fama and French, 1993; Carhart, 1997). It has the following form: $R_{i,t} - R_{f,t} = \alpha_{i,t} + \beta_1 * MMF_t + \beta_2 * SMB_t + \beta_3 * HML_t + \beta_4 * UMD_t + \varepsilon_{i,t}$, where $R_{i,t}$ is the return of firm i for period t, $R_{f,t}$ is the risk-free return for period t, MMF, SMB, HML and UMD are the beta, size, book-to-market and momentum factor returns. The intercept of the regression, $\alpha_{i,t,}$ is the abnormal return estimated from the four-factor model. We form nine interaction portfolios (3 x 3) in the same manner we did for the above portfolio tests. We estimate the model using calendar month data for each of the nine interaction portfolios.

In Table 6, Panel A we report the regression results for the interactions between the TACC and GrLTNOA strategies. As we observed in the portfolio tests (Table 4), the TACC strategy earns significant abnormal returns at all levels of GrLTNOA except when GrLTNOA is high. Also, it appears that the insignificant return of the TACC strategy when GrLTNOA is high is due to the low return earned by stocks in the Low TACC / High GrLTNOA portfolio. Results in Panel B of Table 6 are also comparable to those in Panel B of Table 4, but slightly weaker. The AACC strategy earns significant returns when GrLTNOA is low or medium, but not when GrLTNOA is high.

Table 6: Regression Tests: Growth in Long-Term Net Operating Assets Strategies

Panel A: Total accruals and growth in long-term net operating assets strategies

		TACC			
		Low (Q1)	Medium (Q2-Q4)	High (Q5)	Low - High
GrLTNOA	Low (Q1)	0.208	0.154	-0.237	0.445 (3.26)***
	Medium (Q2-Q4)	0.318	0.218	-0.224	0.542 (5.23)***
	High (Q5)	-0.290	-0.165	-0.312	0.215 (0.13)
	Low - High	0.498 (2.80)***	0.319 (2.88)***	0.075 (0.50)	

Panel B: Abnormal accruals and growth in long-term net operating assets strategies

		AACC			
		Low (Q1)	Medium (Q2-Q4)	High (Q5)	Low - High
GrLTNOA	Low (Q1)	0.405	0.106	-0.368	0.773 (5.55)***
	Medium (Q2-Q4)	0.441	0.158	-0.162	0.603 (6.57)***
	High (Q5)	-0.066	-0.293	-0.169	0.104 (0.76)
	Low - High	0.471 (2.83)***	0.399 (3.66)***	-0.198 (-1.21)	

*All variables are sorted into equal-size quintiles each year within each industry (two-digit SIC code).The numbers reported are the intercepts from a four-factor regression model. t-statistics are reported in parentheses. Q1 is the bottom quintile and Q5 is the top quintile. *, **, and *** denote significance levels of 0.1, 0.05 and 0.01 from a two-tailed test, respectively.*

Table 7 reports the results for the interactions between the TACC and AACC strategies with the EXCAPX strategy. Again, the results are highly consistent with those reported in the portfolio tests (Table 5). Specifically, the TACC strategy is effective except when EXCAPX is high, while the performance of the AACC strategy is completely independent of the level of EXCAPX. Overall, the regression tests provide evidence that is consistent with that from the portfolio tests. Results of both tests strongly suggest that the accruals-based anomalies are distinct from the asset-growth-based anomalies.

Table 7: Regression Tests: Excess Capital Expenditure Strategies

Panel A: Total accruals and excess capital expenditure strategies

		TACC			
		Low (Q1)	Medium (Q2-Q4)	High (Q5)	Low - High
EXCAPX	Low (Q1)	0.118	0.098	-0.395	0.513 (3.59)***
	Medium (Q2-Q4)	0.258	0.215	-0.251	0.508 (5.40)***
	High (Q5)	-0.163	-0.055	-0.167	0.004 (0.02)
	Low - High	0.281 (1.50)	0.153 (1.50)	-0.227 (-1.56)	

Panel B: Abnormal accruals and excess capital expenditure strategies

		AACC			
		Low (Q1)	Medium (Q2-Q4)	High (Q5)	Low - High
EXCAPX	Low (Q1)	0.395	-0.020	-0.278	0.673 (4.92)***
	Medium (Q2-Q4)	0.399	0.133	-0.132	0.531 (6.02)***
	High (Q5)	0.128	-0.078	-0.300	0.428 (2.85)***
	Low - High	0.267 (1.49)*	0.057 (0.55)	0.021 (0.15)	

*All variables are sorted into equal-size quintiles each year within each industry (two-digit SIC code). The numbers reported are the intercepts from a four-factor regression model. t-statistics are reported in parentheses. Q1 is the bottom quintile and Q5 is the top quintile. *, **, and *** denote significance levels of 0.1, 0.05 and 0.01 from a two-tailed test, respectively.*

ROBUSTNESS TESTS

There is no consensus on the correct specification of the model that estimates abnormal accruals. We consider two alternative models. First, we estimate the model used in Xie (2001), which excludes the last two terms of our model (i.e., ROA and SALGRO). Second, we estimate the performance-adjusted model used in Kothari et al. (2005), which includes the ROA term, but excludes the SALGRO term. Third, we estimate we also consider operating cash flows in lieu of balance sheet data to calculate total accruals (e.g., Hribar and Collins, 2002). Our results are qualitatively unchanged when we consider each of these alternative tests. Lastly, to control for industry effects, we re-estimate abnormal accruals and re-sort all key variables within industry (two-digit SIC code) each year. Untabulated results show that this industry adjustment increases the returns earned by the TACC, GrLTNOA and EXCAPX strategies, but decreases the returns of the AACC strategy. Overall, the industry adjustment improves the strategies' performance since the average returns of the GrLTNOA and EXCAPX strategies are now significant. We replicate our main tests using the industry-adjusted variables and find little change in the tenor of our earlier results.

CONCLUSION

Prior research finds that asset growth and accruals exhibit similar return predictability (Sloan, 1996; Penman and Zhang, 2002; Fairfield et al., 2003; Hirshleifer et al., 2004; Titman et al., 2004). Using the Mishkin test, Fairfield et al. (2003) suggest that the accruals anomaly is an asset growth anomaly in disguise. Although their result is intriguing, it is subject to two concerns. First, there is evidence suggesting that the accruals anomaly and the asset growth anomaly arise for fundamentally different reasons. In particular, accounting manipulations play a central role in the accruals anomaly, but are rather unimportant for the asset growth anomaly. Second, the Mishkin test is sensitive to the specification of the earnings expectation model, but there is no consensus on the correct specification of the model.

In this study, we compare two accruals-based anomalies, TACC and AACC, with two asset growth anomalies, GrLTNOA and EXCAPX. We include AACC because it is a better proxy for accounting manipluations than TACC. We include EXCAPX so we can test Fairfield et al.'s conclusion using a different asset growth anomaly. To avoid the methodological problems of the Mishkin test, we use portfolio and regression tests.

Our evidence does not support the view that the accruals anomaly is a manifestation of the asset growth anomaly. In contrast, we find that both TACC and AACC perform well after controlling for GrLTNOA or EXCAPX. Moreover, consistent with the view that accounting manipulations are at the core of the accruals anomaly, we find that AACC outperforms TACC, and is more independent of the asset growth anomalies than TACC. Overall, our results suggest that investors should view accruals-based strategies and asset growth-based strategies as two different types of strategies. Moreover, the correlation between the two types of strategies can be further reduced (so diversification benefit can be augmented) if investors focus on abnormal accruals instead of total accruals.

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THE PERFORMANCE OF ASSET PRICING MODELS BEFORE, DURING, AND AFTER AN EMERGING MARKET FINANCIAL CRISIS: EVIDENCE FROM INDONESIA

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ABSTRACT

Due to the dynamic nature of stock market risk and return measurement, financial practitioners and academics are continuously concerned with the development of asset pricing studies. Moreover, validity of the existing theories in the recent Asian financial crises years stimulates additional challenges to the discipline. This paper investigates the ability of Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) in explaining excess returns of portfolios of stocks traded on the Jakarta Stock Exchange (JKSE). The study assesses the theories using data from 3 different periods: the pre-crisis period (1992-1997), the crisis period (1997-2001), and the post-crisis period (2001-2007). Our finding show that Beta does not single handedly explain portfolio excess returns. The, APT is able to explain the portfolio excess returns in the observation periods were excess return averages are found to be consistently negative. We also find that spread between the central bank rate and commercial bank rate is a constantly significant variable, while risk-premiums vary over the observation periods.

JEL: G12

KEYWORDS*:* CAPM, APT, Financial Crisis

INTRODUCTION

The transformation in financial science and practice has engendered significant advancement in asset pricing approaches. This progress has been proven to be much influenced by the dynamic phenomena of macroeconomic indicators. Since most of the invented asset pricing models are constructed and re-examined using financial and macroeconomic data of developed economies, which is more stable and predictable than that of developing economies, performance of the models using developing economies' data remains questionable. To be more specific, the recent, unanticipated destructive Asian financial crisis has provided more tough challenges to the validity of the models in emerging markets.

Two popular asset-pricing models, namely the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT), had been well accepted by financial practitioners and academics in emerging economies prior to the Asian financial crises. Both models certainly show some strengths and weaknesses. Nevertheless, the models and the associated assumptions have been theoretically and empirically proven to be highly accurate and are generally accepted. This acceptance occurs because of the models' ability to identify dominant factors in asset pricing.

In this study, we examine how valid the two models are in three different periods based on Indonesian economic performance. In particular, the study is aimed at revealing the validity of CAPM and APT before, during, and after the Asian crisis affected the Indonesian economy. In this study, we conduct tests using Indonesian macroeconomic data, as well as data of stocks traded on the Jakarta Stock Exchange (JKSE). The observation periods include a before-crisis period (1992-1997), during-crisis period (1997-

2001), and after-crisis period (2001–2007). The total number of observations used for each period of ranges between 40,159 and 67,012. In this research, we investigate whether there are linear and positive relationships between Beta of economic factors and the expected excess return, and whether APT is effective in pricing assets in the three different periods. Indonesia is chosen as the subject of the study as its economy was the most affected by the crises. The more important reason is that Indonesian stock market development has been influenced by banking industry circumstances and regulation change, which were widely believed to be the main mechanism for the contagious crisis.

The remainder of the paper is organized as follows. In session 2, we briefly summarize the CAPM and APT principles, and reveal some relevant studies conducted in Asian markets. In session 3, we explain the division of data and periods of observation, as well as the research methodology. We use rolling period mechanism to overcome some obstacles from the transaction data. In session 4, we explain the empirical results and findings. We describe validation of CAPM and APT in the three different periods. At the end, we conclude with a brief discussion.

LITERATURE REVIEW

Sharpe (1961) proposed the Capital Asset Pricing Model (CAPM) and revised his theory in 1964. This model was supported by Lintner (1965). The basic tenet of the model is in line with a theory proposed by Markowitz, in which covariance of an asset related to market index is defined as beta. Following the invention, some academics and practitioners tried to empirically test the model, such as Roll (1977, 1978) who criticizeded the model, and Merton (1973) who offered an alternative concept (i.e. Inter-temporal CAPM). Another asset-pricing model was introduced by Ross (1976), namely Arbitrage Pricing Theory (APT).

In the CAPM theory, the market model is used to estimate beta. The market model of Fama (1976: 132) is formulated as $\tilde{R}_{it} = \tilde{a}_i + \tilde{b}_i.\tilde{R}_{mt} + \tilde{e}_{it}$, where t=1,2,3,…,T. When the joint distribution of $\tilde{R}_{it}$ and $\tilde{R}_{mt}$ is Bivariate Normal then $E(\tilde{R}_{it} \vert \tilde{R}_{mt})$ is a linear function of: $E(\tilde{R}_{it} \vert R_{mt}) = \alpha_i + \beta_i.R_{mt}$, where α_i and β_i is constant; a_i and b_i are random variables as they are unobserved determined from a probability distribution. If $\tilde{R}_{it}$ and $\tilde{R}_{mt}$ are a known sample then we move from the estimator arena to the estimation arena, where all Tilde signs are removed, and a_i and b_i are estimators of α_i , β_i and $\tilde{e}_{it}$ (residual).

In the CAPM tests, two pass regressions are conducted, i.e. Time Series Regression (First Pass), and Cross Sectional Regression (Second Pass). In the first pass, the calculation is aimed at estimating beta, resulting from regression between actual returns of stock *I* and market return, as well as at investigating the suitability between the data and the model through examination of the excess returns ($\mu_j - r_f$ and $\mu_m - r_f$). In the second pass, the calculation involves average excess returns of each asset and estimation beta obtained from the first pass. The objective is to estimate the Security Market Line (SML). To estimate the line, the following regression equation is employed:

$$r_i = \gamma_0 + \gamma_1 \beta_j + \eta_j \quad (1)$$

where j = 1,2,3,...n, γ_0 is the excess return that can be expected from a zero beta portofolio and γ_1 is the excess return that can be expected from a market portofolio less the excess return expected from zero beta portofolio.

Alternatively, we can utilize the Fama and Machbeth (1973*)* equation:

$$R_{it} = \gamma_{it} + \gamma_{2t} \beta_{im} + \eta_{it} \quad (2)$$

where j = 1,2,3,...n, γ_{it} is the intercept of a standard zero-beta portfolio[E(R_{om})] return with conditions of: $\sum_{i=1}^{n} X_{i1} = 1$ and $\sum_{i=1}^{n} X_{i1}\beta_{im} = 0$, γ_{2t} is the return of a zero Investment portfolio [E(R_m)-E(R_{om})] and that with $\beta_{pm} = 1{,}0$, under the conditions of: $\sum_{i=1}^{n} X_{i2} = 0$ and $\sum_{i=1}^{n} X_{i2}\beta_{im} = 1$. If the test were done on portfolio, the equation would be:

$$R_{pt} = \gamma_{it} + \gamma_{2t}\ \beta_{pm,\,t-1} + \eta_{pt} \tag{3}$$

where j = 1,2,3,...n

The APT was initiated by Ross (1976, 1977). This approach is used to assess the equilibrium relationship between risk and expected return. In the middle of his critique on the CAPM, Roll (1977, 1978), Ross (1976) developed APT as an alternative that can explain problems in the CAPM. In contrast to Sharpe (1963) that introduced a Single Index Model (SIM), through APT, Ross (1976, 1977) suggested a Multi Factor Model for measuring systematic risk. Multiple Factor Models indicate a linear relationship between return of asset *I* and *N* influencing specific factors, through the following formula:

$$R_i = b_{i0} + b_{i1} I_1 + b_{i2} I_2 + \ldots + b_{ij} I_j + \ldots bi_F I_F + e_i \tag{4}$$

Where I_j is a factor from *I* to F, b_{i0} is an unsystematic predictable constant component, e_i is a component of unpredictable unsystematic return that is normally distributed with zero average and constant variance. The value of bij is the beta of asset *I* on factor *j*, I = 1,2,3,…and *N* is the number of assets. In APT calculations, it is necessary to consider variables of time-series observation, such as interest, yield spread, inflation, and other economic variables that influence asset returns. Therefore, APT reveals the effects of combination of all possible risk factors.

Among several popular studies on CAPM, Fama and French (1992) find that the relationship between beta and portfolio return is flat, and that size effects exist. Result of a study done by Jaganathan and Wang (1993) contradict that of Fama and French (1992), as they find that the relationship is positive and significant, as long as beta is allowed to be non-constant due to the business cycle. Meanwhile, on the APT side, Chen Roll and Ross (1986), testing APT, using unpredictable macroeconomic variables, find that some of the respective variables are significantly negatively or positively correlated with portfolio returns. However, there has been debatable whether CAPM or APT is better in explaining expected returns. Bower and Logue (1984), using 1971-1979 data on utility stocks, find that the APT outperforms the CAPM. In contrast, Husnan (1990), who compares performances of the two models on the Jakarta Stock Exchange, find that CAPM outperforms the APT and summarizes seven factors influencing returns.

Similar studies using data from stock markets in some Asian countries show varied conclusions. A study done in China shows that beta exists, and idiosyncratic variance variable and firm size have no effect on the returns. Meanwhile, similar studies in Taiwan and Singapore show that the size effect and book to market value are correlated with portfolio returns. In the Philippines, beta is found to explain stock returns. Hossari (1994), employing Kuala Lumpur Stock Exchange's 1989-1990 data, finds that the APT fails to explain stock returns.

DATA AND METHODOLOGY OF THE STUDY

Data employed in this study includes monthly data of closing price, outstanding number, and dividend of stocks traded on the Jakarta Stock Exchange during the period of 1992:7 – 2007:6. We extraxt the necessary data from the JSX's monthly publication and annual report of the Indonesian Capital Market

Supervisory Agency. We also gather relevant information regarding the stocks, such as stock split, delisted stocks, and suspended stocks from the same sources. Only actively traded stocks are selected for analysis, so that thin trading and non-synchronous trading effects are minimized. Such effects may result in autocorrelation in stock returns. We also employ a rolling period mechanism, due to limited number of transactions and large number of inactively traded stocks. The authors utilize some macroeconomic variables (risk factors) in the analysis. The time-series variables, include unpredictable factors of inflation, $index_{ew}$, production index, exchange rate, and spread (balance between 1-month deposit rate and 1-month central bank rate/*SBI*). The spread is the only variable that has never been used in previous studies.

The calculated stock returns are divided into 2 categories. In the first category, stock returns are used to estimate pre-beta (up-dated in 3-year periods). Stock returns in the second category are calculated using a portfolio formation formula (up-dated in 1-year periods). To observe the consistency level of the models, we separate the observation time frame into some rolling periods, by which we up-date the data to the following 1-month period. This process produces rolling period 1 (1992:07 - 1997:06), period 2 (1997:07 - 2001:06), and period 3 (2001:07 - 2007:06). In this study, we conduct beta estimation three times in searching for an estimated portfolio beta. By doing so, we expect that we can reduce bias from estimated individual stock betas. In testing the two asset pricing models, we utilize approaches that have been used by earlier studies, such as approaches used by Sharpe and Lintner (SL, 1965), Black Jensen and Scholes (BJS, 1972), Fama and Macbeth (FM, 1973), Fama and French (FM, 1992), as well as Chen, Roll and Ross (CRR, 1986).

In this study, we also consider market capitalization value to assess the existence of a size effect in both CAPM and APT validation tests. To check for a surprise factor in the macroeconomic variables, we employ Auto-regressive Integrated Moving Average (ARIMA) model. Through the model, we check the white noise residual (autocorrelation-free residual). The analysis is started from descriptive analysis. Next we use an F-test, t-test, as well as the classical assumption tests (multicollinearity, heteroscedasticity and autocorrelation). In addition to that, we estimate ordinary least square (OLS) and generalized least square (GLS) in our regression to reduce autocorrelation that frequently occurs in pooling data.

EMPIRICAL RESULTS AND FINDINGS

We identify several anomalies taking place in Indonesian economy, particularly in JKSE. From the observed rolling periods, only 65% of the samples satisfy the criterion of being actively traded, meaning that the other 35% of the stocks are not active (not traded at least once a month). We observe portfolios that are constructed based on rolling periods of data.

In size effect context, another anomaly is revealed. The average beta of stocks with large capitalization is higher than that with small capitalization. This finding stands out against findings of previous studies carried out both in Indonesia and overseas. In those studies, stocks with large capitalization are found to have less average beta than that of stocks with small capitalization, since the latter stocks are mostly less liquid. Thus, we can infer that during our study observation period, largely capitalized stocks in JKSE are less liquid. The rationale behind this finding is that during the Asian crisis, USD-denominated debts of the largely capitalized listed companies ballooned without appropriate hedging. This finding further suggests that the long accepted theory of high risk for high return did not hold. In this case, during the crisis, investors realized a poor return on their high-risk stock investment. Another important finding is that stock price movement was quite sensitive to interest rate (spread variable) changes during the crisis. We find that portfolio excess return is less than the market risk premium, which is also negative, demonstrating that portfolio excess return (ERP) is not always greater than market excess return (ERM), violating the CAPM principle (ERP>ERM).

Table 1: Results Cross Sectional Regression Test on CAPM Using Data in 3 Different Periods (FF 1992a)

Fama and French Model $E(r_{pt}) - r_f = y_0 + y_1\hat{\beta}_{pt} + n_{pyz}$					
	Y_0	***Y_1***	***R^2***	***Obs*R^2***	***Prob***
PERIOD - 1					
OLS	-0.089***	0.054****	0.293		
	(-7.635)	(-4.710)			
White Test				9.501	0.009
LM Test				46.631	0.000
GLS - AR(2)	-0.154	0.008	0.916		
	(-1.982)	-1.436			
White Test				0.872	0.647
LM-Test				2.049	0.163
PERIOD - 2					
OLS	-0.135***	0.067***	0.584		
White Test	(-11.87)	-8.053		23.731	0.010
LM Test					
GLS - AR(2)	-0.064	0.01	0.812		
	(-1.924)	(-1.562)			
White Test				0.342	0.843
LM Test				2.640	0.267
PERIOD - 3					
OLS	-0.096***	0.050***	0.586		
White Test	(-5.781)	-5.772		0.578	0.749
LM Test				10.185	0.001
GLS - AR(1)	-0.113	0.013**	0.940		
	(-1.180)	(2..213)			
White Test				8.772	0.012
LM Test				0.337	0.712

The resulting regression coefficients show that the model passes assumption tests of Multicollinearity, Heteroskedasticity and Autocorrelation at significance level of 10% (*), 5 %(**) and 1 %(***). The asterix signs show the associated t-statistics. One period = 100 Portfolios.

Table 2: Results Cross Sectional Regression Test on CAPM Using Data in 3 Different Periods (FF 1992b)

Fama and French Model $E(r_{pt}) - r_f = y_0 + y_1\hat{\beta}_p + y_2 MV_p + \delta_p$						
	Y_0	*Y_1*	*Y_2*	*R^2*	*Obs*R^2*	*Prob*
PERIOD - 1						
OLS	-0.086***	0.036****	-7.10E-17	0.268		
	(-7.635)	(-4.910)	(-0.125)			
White Test					16.859	0.001
LM Test					48.597	0.000
GLS - AR(2)	-0.0662	0.0082	6.33E-15			
	(-0.677)	(-1.591)	(-0.301)			
White Test					7.542	0.110
LM-Test					2.260	0.152
PERIOD - 2						
OLS	-0.161***	0.060***	2.19E-14			
	(-6.405)	(-5.096)	(-1.086)			
White Test						
LM Test						
GLS - AR(2)	-0.006	0.008	-6.65E-15	0.897		
	(-0.215)	(-1.036)	(-0.530)			
White Test					12.675	0.167
LM Test					3.689	0.159
PERIOD - 3						
OLS	-0.113	0.069***	-4.79E-14	0.595		
	(-0.265)	(-5.758)	(-1.572)			
White Test						
LM Test						
GLS - AR(1)	0.05	0.043	-2.93E-14**	0.932		
	(-1.878)	(-0.340)	(-2.268)			
White Test					9.305	0.128
LM Test					1.767	0.515

The resulting regression coefficients show that the model passes assumption tests of Multicollinearity, Heteroskedasticity and Autocorrelation at significance level of 10% (*), 5 %(**) and 1 %(***). The asterix signs show the associated t-statistics. One period = 100 Portfolios.

In addition, the market return is less than the risk-free rate, represented by the 1-month Indonesian central bank rate (BI rate). On average, returns on individual stocks were also less than the BI rate, which was much higher than interest rates in most of other economies at the time. When the BI rate showed down trend, market return was consistently below the BI rate, implying a negative market risk premium. The reward required by investors should be higher when an economic downturn occurs, so the risk premium should have been positive ($R_M > R_f$). The rationale is that investment in Indonesian stock markets was not as attractive as investment in banking services. Meanwhile, investors' high dependence on banking in accessing capital in Indonesia has been demonstrated to be the main factor to induce the crisis. Therefore, this finding may suggest the urgent need for more progressive stock market development in Indonesia, to avoid the reoccurrence of the crisis.

Table 3: Results Cross Sectional Regression Test on CAPM Using Data in 3 Different Periods (FM 1973**)**

Fama and Macbeth Model	$E(r_{p,t})-r_f=\hat{\gamma}_{0,t}+\hat{\gamma}_{1,t}\ddot{\beta}_{p,t}+\hat{\gamma}_{2,t}\ddot{\beta}^2{}_p+\hat{\gamma}_{3,t}S_{ep}\eta_{i,t}$						
PERIOD -1	Y_{0t}	Y_{1t}	Y_{2t}	Y_{3t}	R^2-*Adj*	*Obs**R^2	*Prob*
OLS	-0.0152	-0.008	0.014	-4.265**	0.362		
	(-0.563)	(-0.322)	(-1.776)	(-2.747)			
White Test						9.349	0.096
LM Test						44.973	0.000
GLS - AR(2)	-0.056	0.009	0.000	-0.051			
	(-1.756)	(-0.823)	(-0.083)	(-0.034)			
White Test						10.580	0.060
LM-Test						2.156	0.340
PERIOD - 2							
OLS	-0.155	0.122	-0.017	-2.295	0.636		
	(-4.536)	(-3.744)	(-1.940)	(-1.716)			
White Test						9.113	0.105
LM Test						20.550	0.000
GLS - AR(2)	-0.073	0.016	-0.002	0.533	0.797		
	(-1.784)	(-0.942)	(-0.388)	(-0.285)			
White Test						12.758	0.026
LM Test						2.808	0.256
PERIOD - 3							
OLS	-0183***	-0.087***	-0.015**	14.241***	0.85		
	(-8.477)	(-3.972)	(-2.711)	(-5.254)			
White Test						6.246	0.657
LM Test						1.567	0.443

The resulting regression coefficients show that the model passes assumption tests of *Multicollinearity*, *Heteroskedasticity* and *Autocorrelation* at significance level of 10% (*), 5 %(**) and 1 %(***). The asterix signs show the associated t-statistics. One period = 100 Portfolios.

In this study, we also clarify factors that are related to the portfolio excess return through the CAPM and APT tests. Validation process of CAPM and APT are carried out through two stages, i.e. time series regression and cross sectional regression. The former is aimed at assessing the relationship among variables in one period. The latter is intended to see the relationship in multiple periods. Results gained from the models of SL 1965, BJS 1972 and FM 1973 are not adequate, as can be seen in Tables 1, 2, and 3. Therefore, this study is focused on models of FF 1992 and CRR 1986, whose results are explained in this section.

The results show that the CAPM is not effective when JKSE data and Indonesian macroeconomic indicators are used, since beta is not the only factor that explains portfolio excess return. Meanwhile, the finding shows the existence of a size effect, meaning that market capitalization is significant variable (please see Table 2 and 3). The findings also show that the residual variable (variance) in a model, which is positively and significantly correlated with portfolio excess return and the CAPM formula, is not linear. This is indicated by a negative and significant regression coefficient. However, in predicting potential risk, the CAPM is able to explain portfolio excess return in all different rolling periods. In these different economic circumstances, the CAPM model results in R^2-adj ranging from 42.82% to 94.00% (see Table 1, 2, and 3), where almost all regression coefficients of beta (risk premium) are positive.

Table 4: Results Cross Sectional Regression Test on APT Using Data in 3 Different Periods (CRR 1986a)

Chen, Roll and Ross Model	$E(R_{pt}) - r_f = \lambda_{0t} + \lambda_1 bp_{1t} + \lambda_2 bp_{2t} + \lambda_3 bp_{3t} + \lambda_4 bp_{4t} + \lambda_5 bp_{5t} + \varepsilon_{pt}$									
	λ_0	λ_{UI}	λ_{UIEW}	λ_{UIP}	λ_{UK}	λ_{URS}	R^2	$R^2 - adj$	$Obs * R^2$	Prob
PERIOD - 1										
OLS	-0.096***	0.001	0.073***	-0.023**	-0.009	0.002***	0.574	0.523		
	(-5.225)	(-1.699)	(-5.788)	(-2.587)	(-1.036)	(-3.735)				
White Test									6.178	0.822***
LM Test									16.134	0.000
GLS - AR(2)	-0.056**	0.001	0.010	-0.016	-0.0227	0.003*	0.926	0.902		
	(-1.657)	(-0.433)	(-1.422)	(-1.862)	(-0.724)	(-1.876)				
PERIOD - 2										
OLS	-0.084**	0.001	0.060	-0.021	0.016	0.015	0.592	0.479		
	(-2.343)	(-0.907)	(-2.126)	(-1.045)	(-1.073)	(-2.302)				
GLS - AR(1)	-0.092**	0.001	0.035	-0.023	0.02	0.014**	0.755	0.671		
	(-2.374)	(-0.962)	(-1.400)	(-0.959)	(-0.634)	(-2.588)				
White-Test									14.849	0.138***
LM-Test									5.508	0.064
PERIOD - 3										
OLS	-0.040*	0.002	0.0186**	-0.040**	-0.059***	0.027***	0.790	0.722		
	(-1.597)	(-0.767)	(-2.271)	(-2.512)	(-5.132)	(-4.813)			9.930	0.043***
White Test									0.176	0.675***

The resulting regression coefficients show that the model passes assumption tests of Multicollinearity, Heteroskedasticity and Autocorrelation at significance level of 10% (*), 5 %(**) and 1 %(***). The asterix signs show the associated t-statistics. 1 period = 100 Portfolios

In order to get the cross sectional APT test result, we include five different variables that are not anticipated. The result only shows higher risk or vice versa when a lesser period is anticipated. Most significant variables associated with the excess returns of portfolio would be the production index and spread. During the assessment of the risk premium variables or portfolio beta, the overall regression coefficient are significant with a positive sign, which means that the beta variables still exist even though all the variables are included in the APT model. I_{ew} and spread variables (see Table 4, 5, and 6) are still significant and associated positively. From the above statements, it can be inferred that the three variables mentioned could be used to predict the excess returns of the portfolio. When we add a market value variable to the model (see Table 8), our calculation result shows that the variable is positively correlated and significant in the three different periods. Similar procedures were applied to the spread variable and exchange rate with the finding that the two variables are also significant and consistent in the three different periods. The exchange rate variable forms the highest risk in the third period. However, the risk would decrease proportionately with the time duration. In this case, Indonesia needs a more stable exchange rate rather than lower exchange rates.

The changes in the exchange rates would be better at a safe range, since almost all manufacturing industries still rely on USD-denominated, imported raw materials. High volatility of exchange rates lead to production uncertainty and weakens the overall performance of the industries, which in turn ruins their stocks performance. Furthermore, the matter would affect the JKSE listed companies whose debts are in USD but revenues are in IDR. Nevertheless, the employment of these six variables with the exclusion of the market risk premium variable shows that all independent variables are significant, and the residual is very small and not correlated with the portfolio excess return. This is shown by the results of several cross sectional tests in three different periods.

Table 5: Results Cross Sectional Regression Test on APT Using Data in 3 Different Periods (CRR 1986b)

Chen, Roll and Ross Model $E(R_{pt}) - r_f = \lambda_0 t + \lambda_1 bp_{1t} + \lambda_2 bp_{2t} + \lambda_3 bp_{3t} + \lambda_4 bp_{4t} + \lambda_5 bp_{5t} + \lambda_6 bp_{6t} + \varepsilon_{pt}$

	λ_0	λ_{PR}	λ_{ui}	λ_{uiew}	λ_{uip}	λ_k	λ_{urs}	R^2	R^2 - adj	*Obs*R²*	Prob
PERIOD -1											
OLS	-0.122	0.026***	0.001**	0.064***	-0.039	-0.004	0.012***	0.763	0.738		
	(-9.627)	(-9.633)	(-1.754)	(-8.227)	(-0.592)	(-0.723)	(-4.382)				
White Test										10.897	0.54***
LM Test										3.575	0.06*
PERIOD - 2											
OLS	-0.145***	0.064**	0.001	0.057*	0.006	0.001	0.018***	0.708	0.605		
	(-5.125)	(-2.625)	(-0.681)	(-2.536)	(-0.415)	(-0.082)	(-3.260)				
White Test										18.403	0.10***
LM Test										0.428	0.51***
PERIOD - 3											
OLS	-0.045*	0.031*	-0.002	0.033**	-0.013	-0.033***	0.016***	0.842	0.786		
	(-1.792)	(-2.140)	(-0.498)	(-2.995)	(-1.214)	(-4.132)	(-3.554)				
White Test										8.172	0.77***
LM Test										0.271	0.61***

The resulting regression coefficients show that the model passes assumption tests of Multicollinearity, Heteroskedasticity and Autocorrelation at significance level of 10% (*), 5 %(**) and 1 %(***). The asterix signs show the associated t-statistics. 1 period = 100 Portfolios

Spread variables or the spread factor is the only variable that is consistently significant in all periods of observations (as can be seen on Table 4, 5, 6, 7, and 8). The balance of 1-month deposit rate and BI certificate rate is a variable that has not been tested in Indonesia. Both rates mature in 1 month. The balance of both rates has had a dominating influence on investors' preference changes in Indonesia. Theoretically, assuming the risk-free rate is constant; the increase in deposit rates would inevitably lead to a mass investment transfer from the stock market to banks, and vice versa. However, in Indonesia, our study shows that an increase in deposit rates leading to larger spread is also followed by an increase in portfolio excess return. This phenomenon is possible when most investors in the two markets are the same players. In this case, the negative correlation between interest rate and stock excess return only holds temporarily. The rise in deposit interest rates stimulates some of the investors to sell their stocks and transfer to bank deposits, which puts more pressures on stock prices. Stock prices fall at the beginning until speculators and scalpers take advantage on the lower stock prices. As the speculation grows, the prices rebound to a particular level that is enough to provide higher excess return.

The APT is found to be valid in JKSE, which is indicated by the finding that all regression coefficients are significant in the third period (see Table 6) and the residual variable is not correlated with the expected portfolio return. There are two interesting points in this finding. Firstly, when the risk premium, which is also the beta in the CAPM, is excluded, the APT becomes the valid model in JKSE. Secondly, the cross sectional regression test on the CAPM shows that the regression coefficient of residual (variance) is 14.24 and significant (see Table 3). This implies that there are unknown variables that are positively correlated with the portfolio excess returns. This is by some means in line with the results of the APT cross sectional regression in the third period. The unknown variables in CAPM test are identified by the results of the APT cross sectional regression, which show that the five regression coefficients are positively associated with the portfolio excess return (see Table 6). The APT model can explain the level of excess returns in the three different observation periods with R^2-adj ranging from 48.63% to 90.07% (see Table 4, 5, 6, 7, and 8). It is worth noting that, in this study, the longer the time interval used in risk estimation, the better the APT model explains the portfolio excess return.

Finding of this study shows that APT model is more effective in explaining portfolio excess return in JKSE than is CAPM. R^2-adj maximum of APT model test is 94%, which is higher than that of CAPM (90.07%).

Table 6: Results of Cross Sectional Regression Test on APT Using Data in 3 Different Periods (CRR 1986c)

Chen, Roll and Ross Model $E(R_{pt}) - r_f = \lambda_0 t + \lambda_1 bp_{1t} + \lambda_2 bp_{2t} + \lambda_3 bp_{3t} + \lambda_4 bp_{4t} + \lambda_5 bp_{5t} + \varepsilon_{pt}$

	λ_0	λ_{ui}	λ_{uiew}	λ_{uip}	λ_{uk}	λ_{URS}	R^2	R^2 - adj	$Obs*R^2$	Prob
PERIOD-1										
OLS	-0.024*	-0.002**	0.009	-0.025**	0.008	0.005	0.227	0.135		
	(-1.859)	(-2.057)	(-0.944)	(-2.257)	(-0.782)	(-1.064)				
White Test									25.227	0.003
LM Test									33.813	0.000
GLS - AR(2)	-0.002	0.000	0.003	-0.003	0.002	0.003*	0.925	0.9121		
	(-0.399)	(-0.924)	(-0.613)	(-0.342)	(-0.539)	(-1.860)				
White Test									20.542	0.124***
LM Test									1.780	0.183***
PERIOD - 2										
OLS	-0.095***	-0.001**	0.000	0.012	0.023**	0.021***	0.598	0.475		
	(-3.875)	(-1.591)	(-0.054)	(-0.873)	(-2.125)	(-3.203)				
White Test									10.659	0.487***
LM Test									0.953	0.329***
PERIOD - 3										
OLS	0.005	-0.003**	0.018*	-0.039**	-0.042***	0.020***	0.802	0.756		
	(-0.535)	(-2.292)	(-1.981)	(-2.675)	(-5.880)	(-4.355)				
White Test									10.365	0.409***
LM Test									0.227	0.635***

The resulting regression coefficients show that the model passes assumption tests of Multicollinearity, Heteroskedasticity and Autocorrelation at significance level of 10% (*), 5 %(**) and 1 %(***). The asterix signs show the associated t-statistics. 1 period = 100 Portfolios

Table 7:Results Cross Sectional Regression Test on APT Using Data in 3 Different Periods (CRR 1986d)

Chen, Roll and Ross Model $E(R_{pt}) - r_f = \lambda_0 t + \lambda_1 bp_{1t} + \lambda_2 bp_{2t} + \lambda_3 bp_{3t} + \lambda_4 bp_{4t} + \lambda_5 bp_{5t} + \varepsilon_{pt}$

	λ_0	λ_{PR}	λ_{UI}	λ_{UIP}	λ_{UK}	λ_{URS}	R^2	R^2-ADJ	Obs*R^2	Prob
Period-1										
OLS	-0.625***	0.028***	-0.001	-0.015	-0.002	0.004	0.374	0.299		
	(-3.781)	-3.329	(-1.086)	(-1.439)	(-0.217)	(-1.008)				
White Test									20.684	0.023*
LM Test									26.603	0.322***
GLS - AR(2)	-0.053	0.002	-0.000	-0.001	-0.004	0.001	0.907	0.890		
	(-1.350)	(-0.465)	(-0.234)	(-0.186)	(-0.797)	(-0.291)				
White –Test									17.958	0.056*
LM-Test									2.265	0.322***
PERIOD - 2										
OLS	-0.100***	0.004	-0.001	0.023	0.03	0.021***	0.606	0.496		
	(-3.923)	(-0.055)	(-0.487)	(-0.885)	(-1.345)	(-3.165)				
White Test									12.373	0.262***
LM Test									0.482	0.497***
PERIOD - 3										
OLS	-0.001	0.008	-0.002	-0.027*	- 0.054***	0.019***	0.762	0.691		
	(-0.048)	(-0.484)	(-0.960)	(-1.899)	(-5.515)	(-3.699)				
White Test									6.404	0.780**
LM Test									0.084	0.772***

The resulting regression coefficients show that the model passes assumption tests of Multicollinearity, Heteroskedasticity and Autocorrelation at significance level of 10% (*), 5 %(**) and 1 %(***). The asterix signs show the associated t-statistics. 1 period = 100 Portfolios

Table 8: Results Cross Sectional Regression Test on APT Using Data in 3 Different Periods (CRR 1986e)

Chen, Roll and Ross Model $E(R_{pt}) - r_f = \lambda_0 t + \lambda_1 bp_{1t} + \lambda_2 bp_{2t} + \lambda_3 bp_{3t} + \lambda_4 bp_{4t} + \lambda_5 bp_{5t} + \lambda_6 bp_{6t} + \lambda_7 bp_{7t} + \varepsilon_{pt}$

	λ_0	λ_{PR}	λ_{UI}	λ_{UIEW}	λ_{UIP}	λ_{UK}	λ_{URS}	λMV	R^2	R^2-adj	*Obs x R*	*Prob*
OLS	-0.18***	0.062***	0.001	0.052***	-0.001	-0.007	0.014***	0.00**	0.796	0.762		
	(-6.84)	(-7.32)	(-1.43)	(-5.95)	(-0.19)	(-0.1)	(-5.21)	(-2.55)				
White											19.354	0.15***
LM											3.068	0.09**
P - 2												
OLS	-0.40***	0.016	0.001	-0.008	0.029*	0.03*	0.024***	0.00***	0.857	0.761		
	(-5.54)	(-0.66)	(-1.12)	(-0.34)	(-0.75)	(-2.39)	(-5.33)	(-3.82)				
White											16.313	0.31***
LM											0.083	0.77***
P - 3												
OLS	-0.09	0.02	-0.0007	0.045*	-0.032	-0.04***	0.021**	0.00***	0.791	0.741		
	(-1.74)	(-1.25)	(-0.57)	(-2.31)	(-1.39)	(-4.22)	(-3.13)	(-0.96)				
White											6.992	0.95***
LM											0.764	0.40***

The resulting regression coefficients show that the model passes assumption tests of Multicollinearity, Heteroskedasticity and Autocorrelation at significance level of 10% (*), 5 %(**) and 1 %(***). The asterix signs show the associated t-statistics. 1 period = 100 Portfolios. P-1, P-2, and P-3 are period-1, period-2, and period-3 respectively. White and LM are tests

However, the models' ability to explain portfolio excess return depends on particular characteristic of the macroeconomic circumstances. The CAPM is more useful during the economic downturn, indicated by the fall of JKSE index. The APT is also useful during the economic crisis, if the crisis is defined by the poor performance of macroeconomic indicators (e.g., high inflation and interest rate, and highly volatile exchange rate).

If we face a situation, in which all the four macroeconomic indicators (JKSE index, inflation rate, interest rate, and exchange rate) are poor, then it is more appropriate to test whether the CAPM is more competent in estimating future risk level than the APT. The accuracy of the CAPM's prediction also depends on the chosen market index proxy. For instance, a study may choose JKSE index, or Surabaya Stock Exchange (SSE), or new index based on the equally weighted portfolio of the two markets as the proxy for the Indonesian case. However, it would be more difficult, if not impossible, for an Indonesian case study if the study should follow the CAPM's perfect assumption that the Indonesian market index should be a representation of all Indonesian wealth anywhere. In this case, adoption of the relevant assumption is more appropriate. Meanwhile, application of APT highly relies on the ability to determine factors influencing portfolio/stock excess return the most.

CONCLUSION

This paper is aimed at examining the ability of the CAPM and APT in explaining excess returns of a portfolio of stocks traded in an emerging market, i.e. Jakarta Stock Exchange (JSX). We test validation of the theories using data from 3 different periods around the Asian crisis, i.e. pre-crisis period (1992-1997), crisis period (1997-2001), and post-crisis period (2001-2007). From the tests, we find that overall the APT is a better model of trading behavior and process in the Indonesian stock market. The CAPM has been less effective in the Indonesian stock market. While the APT is able to explain the returns in the three different research periods, beta is not the variable in the estimation activities. We also notice that two variables, i.e. exchange rate, and spread between the central bank rate and the commercial bank rate, are consistently significant in all APT test results. Investors in the JSX should pay careful attention to these two variables, since they consistently influence variability of returns of JSX stocks.

In conducting the CAPM model test, there are usually limitations emerging from several assumption requirements. One of ways to overcome the obstacles is to employ historical data for the model, instead of expected data. The market portfolio proposed by CAPM includes all wealth in the universe, which is impossible to calculate. Thus, this study assumes that the CAPM portfolio is the one consisting of all stocks consistently in the market. In addition to that, most risk premiums calculated in this study are negative in all periods of observation, especially during the crisis. This is because the rate of Bank Indonesia exceeds most rates of returns for JSX stocks. The number of not-actively traded stocks during the observation period is quite large, i.e. approximately 30% of all listed stocks. Largely capitalized stocks dominantly influence the market index, while their number is quite small, i.e. around 11%. All these characteristics of JSX may not be found in other emerging markets in Asia, which were also hit by the Asian crisis. Thus, similar studies conducted in other emerging markets in Asia may result in different findings and implications. We suggest the use of more frequent stock data (e.g., daily or weekly data) and the maximum likelihood estimation (MLE) to enhance accuracy of the parameter estimation.

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DIVIDEND POLICY IN SAUDI ARABIA

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ABSTRACT

We examine dividend policy in a unique environment in Saudi Arabia, where (1) firms distribute almost 100% of their profits in dividends, (2) firms are highly levered mainly through bank loans, and (3) there are no income or capital gains taxes. Some common factors that affect dividend policy of both financial and non-financial firms, we found some factors that affect only non-financial firms. In particular, the common factors are profitability, size, and business risk. Government ownership, lavergae, and age have a significant impact on the dividend policy of non-financial firms but no effect on financial firms. Our results also show that agency costs are not a critical driver of dividend policy of Saudi firms. We also find that the factors that influence the probability to pay dividends are the same factors that drive the amount of dividends paid for both financial and non-financial firms.

JEL: G35

KEYWORDS: Dividends, Saudi Arabia

INTRODUCTION

Although "a number of theories have been put forward in the literature to explain their pervasive presence, dividends remain one of the thorniest puzzles in corporate finance" (Allen, Bernardo, and Welch (2000, p.2499) .The question of "Why do corporations pay dividends?" has puzzled researchers for many years. Despite the extensive research devoted to solve the dividend puzzle, a complete understanding of the factors that influence dividend policy and the manner in which these factors interact is yet to be established. The fact that a major textbook such as Brealey and Myers (2003) lists dividends as one of the "Ten unresolved problems in finance" reinforces Black's (1976, p.5) statement "The harder we look at the dividend picture, the more it looks like a puzzle, with pieces that just don't fit together.

Other researchers made efforts to understand the dividend controversy. Among them, Brennan (1970 and 1973), Litzenberger and Ramaswamy (1979 and 1980) showed that it is not optimal for the investors to receive dividends if their marginal tax rate is greater than zero, and investors' after-tax expected rate of return (discount rate) depends on the dividend yield and systematic risk. Black and Scholes (1974) argued however that tax effect is not uniform for all investors, because different investors are subject to different tax rates depending on the level of their wealth and income. This leads to an idea that at least dividend might have some tax-induced effect on the share prices. Average investors, subject to their personal tax rates, would prefer to have less cash dividend if it is taxable: size of optimal dividend inversely related to personal income tax rates (Pye, 1972). Hence, stocks prices tend to decline after announcement of dividend increase. Recently Dhaliwal *et al* (2005) dividend yield has impact on the cost of equity of firms hence share value may be affected. However, we suggest that tax-induced dividend effect on share value should not exist in a non-tax economy like Saudi Arabia.

LITERATURE REVIEW

Several rationales for corporate dividend policy are proposed in the literature, but there is little consensus among researchers. Overall, the literature focuses on several strands of hypotheses of dividend policy. The seminal Miller-Modigliani's irrelevance theory supported and tested by Black and Scholes (1974), Miller and Scholes (1982), Miller (1986), Conroy et al. (2000), Baker and Farrelly reported contrary evidence (1988) and Baker et al. (2006). Black and Scholes (1974) found mixed results for the tax hypothesis, Litzenberger and Ramaswamy (1980), Miller and Scholes (1982), Poterba and summers (1984), Keim (1985), and Kalay and Michaely (2000)). The agency cost based hypothesis argues that dividend payout helps align the interest of managers and shareholders by reducing the free cash flow for use at the discretion of managers (Jensen and Meckling (1976), Rozeff (1982), Easterbrook (1984), Jensen (1986), Jensen et al. (1992), Lang and Litzenberger (1989), DeAngelo, DeAngelo and Stultz (2006)). While the literature is voluminous, and still evolving, the results continue to be inconclusive. In this context, Saudi Arabia is a unique case to revisit the dividend issue. In Saudi Arabia, there are no taxes on dividends and capital gains. The absence of taxes may provide a 'clinical' or uncluttered environment to re-examine the dividend puzzle.

Although literature tend to suggest that dividend *per-se* does not have any effect on shareholders' value, empirical studies showed mixed evidence, using the data from the US, Japan and Singapore markets. A number of studies found that stock price has a significant positive relationship with the dividend payment [Gordon (1959), Ogden (1994), Stevens and Jose (1989), Kato and Loewenstein (1995), Ariff and Finn (1986), and Lee (1995)], while others found a negative relationship [Loughlin (1989) and Easton and Sinclair (1989)]. A negative relationship between dividend announcement stock returns is expected due to tax effect, but researchers tended to relate the positive relationship between the stock returns and dividend announcement with the information effect of dividend. There are three main objectives of this paper which are, first, to identify the factors that determine the amount of dividends, second, to examine the decision to pay dividends, and third, to outline the potential differences in dividend policy between financial and non-financial firms.

There are many important motives for this study. First and foremost, Saudi firms distribute almost 100% of their profits in dividends which led the Capital Market Authority to issue a circular (number 12/2003) arguing that firms should retain some of their earnings for "rainy days". This practice provides an opportunity to examine the characteristics of firms that pay dividends. Second, the study will be conducted in a unique environment where there are no taxes on dividends and capital gains. Tax differentials are a major part of the dividend puzzle. Third, one explanation for paying dividends is to minimize agency problems. However, Saudi firms are highly levered through bank loans, which reduce the role of dividends in alleviating agency problem. Fourth, the determinants of dividend policy are controversial and there is no unanimity among researchers on the factors that affect dividend policy. This controversy motivates this research to provide some new evidence as to the factors that affect dividend policy. Fifth, most previous research excludes non-dividend paying firms which may create a selection bias (Kim and Maddala (1992), Deshmukh (2003), among others). We include non-dividend paying firms in our experimental design. Finally, there are some studies that report differences between dividend policy of financial and non-financial firms (Naceur, Goaied, and Belanes (2005)). We examine this issue for Saudi Arabia. Apart from the fact there has been no study of dividend policy in Saudi Arabia, this paper contributes additional evidence to contrast the dividend policies in emerging and developed markets.

Our research provides a number of interesting results on dividend policy. First, we show that there are common factors that affect the dividend policy of both financial and non-financial firms, and there are others that affect only non-financial firms. For example, there are six determinants of dividend policy for non-financial firms, while there are only three factors that affect the dividend policy of financial firms. The common factors are profitability, size, and business risk. Government ownership, leverage, and age have a strong influence on the dividend policy of non-financial firms but no effect on financial firms. On the other hand, agency costs, tangibility, and growth factors do not appear to have any impact on the dividend policy of both financial and non-financial firms.

Second, we find that the determinants of the decision to pay dividends are consistent with those reported for the determinants of dividend policy. In particular, we find that the factors that influence the probability of paying dividends are the same as those that determine the amount of dividends paid.
The remainder of the paper proceeds as follows. Section 2 briefly discusses the potential determinants of dividend policy and develops testable hypothesis. Section 3 describes the data, develops the regression specifications, presents summary statistics for the payment of dividends, and reports some descriptive statistics for the sample. Section 4 presents the results for the determinants of dividend policy. In section 5, we provide the results for the determinants of the likelihood to pay dividends. Section 6 concludes the paper.

FACTORS THAT INFLUENCE DIVIDEND POLICY

Based upon the determinants of corporate previously dividend policy theoretical identified by empirical studies and the availability of data from Saudi Arabian Monetary Agency (SAMA).

Profitability: Profits have regarded as the primary indicator of a firm's capacity to pay dividends. Since dividends usually paid from the annual profits, it is logical that profitable firms are able to pay more dividends. To examine whether the profitability of the firm influences its dividend policy, we use the ratio of earnings before interest and taxes to total assets as our surrogate for profitability. We expect to find a positive relationship between dividends and profitability.

Firm Size: Variables such as size have the potential to influence a firm's dividend policy. Larger firms have an advantageous position in the capital markets to raise external funds and are therefore less dependent on internal funds. Furthermore, larger firms have lower bankruptcy probabilities and therefore should be more likely to pay dividends. This implies an inverse relationship between the size of the firm and its dependence on internal financing. Hence, larger firms expected to pay more dividends. As a surrogate for firm size, we use the natural logarithm of sales.

Leverage: Leverage may affect a firm's capacity to pay dividends because firms that finance their business activities through borrowing commit themselves to fixed financial charges that include interest payments and the principal amount. Failure to make these payments by the due time subjects the firm to risk of liquidation and bankruptcy. Higher leverage might thus result in lower dividend payments. Furthermore, some debt covenants have restrictions on dividend distributions. Thus, we expect a negative relationship between dividends and leverage. We use the debt ratio as our proxy for leverage.

Agency Costs: The separation of ownership and control results in agency problems. Distributing dividends can reduce agency costs (Rozeff (1982), Easterbrook (1984), Jensen et al. (1992), among others). In this vein, dividends paid out to stockholders in order to prevent managers from building unnecessary empires to be used that are in their own interest. In addition, dividends reduce the size of internally generated funds available to managers, forcing them to go to the capital market to obtain external funds (Easterbrook (1984)). Furthermore, dividend payments used to reduce the free cash flow problem (Jensen (1986)).

As explained in Rozeff (1982), firms with a larger percentage of outside equity holdings are subject to higher agency costs. The more widely spread is the ownership structure, the more acute the free rider problem and the greater the need for outside monitoring. Hence, these firms should pay more dividends to control the impact of widespread ownership. Consequently, we expect to find a positive association between the number of shareholders and the agency problem. We use the logarithm of the number of shareholders to account for the dispersion of ownership, which used as a proxy for agency costs.

In the case of Saudi Arabia, where most firms are highly levered, banks play a pivotal financing role, and agency problems should be less severe. Jensen (1986) argues that debt could serve as a substitute for dividends in reducing agency problems. This should reduce the importance of dividends in alleviating agency problems.

Business Risk: Business risk is a potential factor that may affect dividend policy. High levels of business risk make the relationship between current and expected future profitability less certain. Consequently, firms with higher levels of business risk are expected lower dividend payments. Furthermore, Michel and Shaked (1986), Bar-Yosef and Huffman (1986), and others argue that the uncertainty of a firm's earnings may lead it to pay lower dividends because volatile earnings materially increase the risk of default. In addition, field studies using survey data (e.g., Lintner (1956), Brav et al. (2005)) report compelling evidence that risk can affect dividend policy. In these surveys, managers explicitly cite risk as a factor that influences their dividend choice. As a surrogate for business risk, we use the standard deviation of return on investment. We expect to find a negative relationship between dividends and business risk.

Ownership structure is an important factor that may influence a firm's dividend policy (Maury and Pajuste (2002)). Different types of owners have different preferences for dividends. For example, in family-controlled firms where managers are the owners there is less need for dividends to reduce agency conflicts. In contrast, firms with large government ownership may have greater agency problems, because, in firms where there is large government ownership, there is "*a double* principal-agent problem" (Gugler (2003, p.1301)). Dividend payments can help alleviate the agency problem in these firms. The above analysis implies a positive association between dividends and government ownership. To control for government ownership, we use a dummy variable, which is equal to one for firms where the government is the controlling shareholder, and zero otherwise. To identify the ultimate owner of the firm, we use a 10% threshold level of ownership. For instance, if the government owns 10% or more of a firm's shares, the firm considered government owned. This is the criteria used by the SAMA. La Porta et al. (1999), Faccio et al. (2001), Maury and Pajuste (2002) also use this approach, among others.

Maturity: Grullon et al. (2002) suggest that as firms mature they experience a contraction in their growth which results in a decline in their capital expenditures. Consequently, these firms have more free cash flow to pay as dividends. Similarly, Brav et al. (2005) suggest that more mature firms are more likely to pay dividends. In contrast, younger firms need to build up reserves to finance their growth opportunities requiring them to retain earnings. We use age as a proxy for a firm's maturity. We define age as the difference between the calendar year of the observation and the firm's year of incorporation reported in the "Share-Holding Guide of SAMA Listed Companies". We expect a positive association between dividends and the age of the firm.

Tangible asset: tangibility may have an effect on dividend policy because firms with high level of tangible assets can use these as collateral for debt (Booth et al. (2001)). Consequently, such firms tend to rely less on retained earnings implying that these firms can distributes more cash in dividends. This suggests a positive association between asset tangibility and dividends.

In contrast, Aivazian et al. (2003) find that firms operating in emerging markets with high levels of tangible assets tend to have lower dividends. This is because firms in emerging markets face more financial constraints when short-term bank financing is a major source of debt. Hence, firms with high levels of tangible assets will have fewer short-term assets that can be hold as collateral to obtain the necessary financing. In Saudi Arabia, firms are highly levered with short-term bank debt playing a pivotal role in financing. In this case, Aivazian et al. (2003) analysis implies that we should observe a negative association between dividends and tangibility. To test for the above hypothesis, we use the ratio of total assets minus current assets divided by total assets as a surrogate for tangibility. We predict a negative association between dividends and asset tangibility.

Growth Opportunities: Firms experiencing substantial success and rapid growth require large additions of capital. Consequently, growth firms expected to pursue lower dividend payout policies. Similarly, the pecking order theory predicts that firms with a high proportion of their market value accounted by growth opportunities should retain more earnings so that they can minimize the need to raise new equity capital. Free cash flow theory also predicts firms with high growth opportunities will have lower free cash flow and will pay lower dividends. To account for growth opportunities, we use the market-to-book ratio. We expect a negative relationship between dividends and growth opportunities.

DATA COLLECTION AND METHODOLOGY

The data for this study are obtained from SAMA which published by the Saudi Securities Market. The data set comprise all publicly traded firms listed at the SAMA. In the sample, firms come from all three sectors that comprise the SAMA namely, banks and investment sector, services sector, and industry sector. We split this sample into financial and non-financial firms. Financial firms include banks, leasing, and investment holdings while non-financial firms include poultry, fisheries, agriculture, oil, and manufacturing firms.

The number of firms included in the study changes from one year to another, with a range from 14 to 37 for financial firms and a range from 37 to 105 for non-financial firms. This results in a data set of an unbalanced panel containing 413 firm-year observations for financial firms and 1,057 firm-year observations for non-financial firms. The fact that we are using panel data gives "more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency" (Baltagi (2001, p.6)).

These data are time series cross-sectional variables, which collected over the entire life of the SAMA from 1989 to 2004. We checked the accuracy of the data by comparing the figures from the SAMA Guide with the data from the firm's financial statements available on the internet, whenever possible. The empirical literature on dividend policy has largely ignored firms that do not pay dividends. If value-maximizing firms choose not to pay dividends, a sample that contains only dividend paying firms will be subject to a selection bias. An econometric analysis of such a sample will yield biased and inconsistent estimates. To address this selection bias, we use both dividend paying and non-dividend paying firms. In this vein, Kim and Maddala (1992) demonstrate that it is important to allow for zero observations on dividends in the estimation of models of dividend behavior. Likewise, Deshmukh (2003, p.353) states "If firms find it optimal to not pay dividends, then their exclusion from any empirical analysis may create a selection bias in the sample, resulting in biased and inconsistent estimates of the underlying parameters".

Based on the previous description of our proxies for the potential factors that may affect dividend policy, we estimate the following model:

$$DIVYLD = \beta_0 + B_1 PROFIT + \beta_2 LOGS + \beta_3 DR + \beta_4 STOCK + \beta_5 DROI + \beta_6 GOVOWN$$

$$+ \beta_7 AGE + \beta_8 TANG + \beta_9 MB + \varepsilon \qquad (1)$$

Where:

DIVYLD = Dividend yield;

PROFIT = Ratio of earnings before interest and taxes to total assets;

LOGS = Log of sales;

DR = Ratio of total debt to total assets;

STOCK = Natural Log of the number of stockholders;

DROI = Standard deviation of return on investment;

GOVOWN = Dummy equal one if firm owned by government or its agencies and zero otherwise;

AGE = the difference between the current year of the observation and the year of incorporation;

TANG= Total assets minus current assets divided by total assets; and

MB = Ratio of a firm's market value of equity dividend by the book value of its assets.

We use dividend yield as the dependent variable. As a robustness check, we also employ the same measure of dividend policy used by Fama and French (2002), Aivazian et al. (2003), and Barclay et al. (2007), which is dividend-to-asset ratio. The distribution of dividends truncated with a zero dividend the lower bound. This necessitates the use of Tobit analysis, which is a robust method for dealing with a truncated distribution. Furthermore, in Saudi Arabia as well as in other countries, some firms do not pay dividends. Even those that pay dividends do not pay them continuously. This creates a censoring problem (Kim and Maddala (1992)) and requires the use of Tobit (Anderson (1986), Kim and Maddala (1992), and Huang (2001a, 2001b)). Tobit regression been used extensively in previous research (i.e., Kim and Maddala (1992), Barclay et al. (1995), Dickens et al. (2002), among others).

Payment of Dividends: Saudi firms tend to attract investors by distributing large dividends. Most of the profitable Saudi firms distribute dividends as a means of rewarding investors for holding their securities. Stock repurchase is a rare phenomenon in Saudi Arabia; however, some firms supplement their cash dividends distributions with stock dividends. In Saudi Arabia, most profitable companies distribute 100% of their profits as cash dividends. As with other Arab countries, Saudi investors seem to prefer to receive periodic income in the form of dividends (Bolbol and Omran (2004)). For the entire sample, Panel A of Table 1 shows that the average payout ratio is around 46%. When the zero dividend observations removed, the average payout ratio increases significantly to 122% (Panel B). This is considerably higher than the payout ratio reported by Fazzari, Hubbard, and Petersen (1988), Kaplan and Zingales (1997), and Aivazian et al. (2006) samples of US firms. Note also that the payout ratio for non-financial firms is higher than that for financial firms. The standard deviation of the payout ratio exhibits a similar pattern.

Table 2 indicates Saudi firms have an average dividend yield of 3.18%. However, it is worth noting that the dividend yield is calculated from a sample that contains both dividend paying and non-dividend paying firms which may underestimate it. The profitability of non-financial Saudi firms as reflected in the ratio of earnings before interest and taxes to total assets is around 11.37%.

The figures reported show that non-financial Saudi firms are highly levered with a debt ratio of around 63.80%. This is much higher than the debt ratio for most of the countries reported in Aivazian et al. (2003) including the U.S. However, business risk (standard deviation for return on investment) in Saudi Arabia is similar to the emerging countries reported in Aivazian et al. (2003). Table 2 provides summary statistics.

Table 1: Dividend Payout Ratio for Firms over the Period 1989-2004

Panel A: Dividend Payout Ratio for All firms						
Year	All		Financials		Non-Financials	
	Mean	StDev	Mean	StDev	Mean	StDev
1989	42%	44%	47%	30%	40%	48%
1990	66%	205%	94%	279%	36%	42%
1991	43%	43%	49%	47%	39%	41%
1992	47%	82%	32%	39%	55%	96%
1993	134%	701%	46%	35%	171%	837%
1994	52%	85%	45%	34%	56%	98%
1995	41%	55%	49%	49%	39%	58%
1996	39%	75%	37%	35%	40%	87%
1997	32%	46%	19%	30%	37%	51%
1998	29%	177%	20%	31%	32%	206%
1999	29%	162%	25%	59%	30%	186%
2000	63%	400%	24%	49%	76%	466%
2001	35%	181%	15%	30%	42%	209%
2002	49%	249%	33%	52%	54%	289%
2003	34%	142%	60%	142%	25%	141%
2004	57%	262%	58%	139%	56%	295%
Overall period	46%	182%	41%	67%	48%	197%
Observations	1514		437		1077	
Panel B: Dividend Payout Ratio for Dividend Paying Firms						
Year	All		Financials		Non-Financials	
	Mean	StDev	Mean	StDev	Mean	StDev
1989	70%	35%	60%	19%	76%	41%
1990	117%	263%	149%	343%	72%	30%
1991	71%	33%	80%	32%	66%	33%
1992	86%	94%	72%	18%	91%	111%
1993	225%	902%	65%	20%	312%	1121%
1994	90%	95%	62%	22%	106%	115%
1995	76%	54%	70%	44%	80%	60%
1996	73%	90%	58%	26%	81%	110%
1997	63%	48%	43%	32%	70%	51%
1998	159%	394%	55%	25%	281%	571%
1999	185%	378%	96%	81%	258%	504%
2000	256%	787%	70%	62%	371%	991%
2001	130%	333%	49%	37%	166%	396%
2002	122%	385%	55%	58%	166%	492%
2003	86%	218%	123%	187%	69%	232%
2004	151%	412%	138%	189%	157%	481%
Overall period	122%	283%	78%	75%	151%	334%
Observations	806		261		545	

This table presents the mean and the standard deviation for firms listed at the SAMA for each year from 1989-2004. The table also shows the mean and standard deviation for financial and non-financial firms during the same period. In panel A, we present the results for all firms including both dividend paying and non-paying firms. In panel B, we report the results for dividend paying firms.

Table 2: Descriptive Statistics for Sample Firms

Panel A: Non Financial Firms					
Variable	Mean	Median	Standard Deviation	Minimum	Maximum
DIVYLD	0.0318	0.0000	0.0779	0.0000	0.7565
DIV/TA	0.0226	0.0000	0.0423	0.0000	0.2903
PROFIT	0.1137	0.0647	0.2623	-1.2994	3.4059
LOGS	6.3180	6.3845	0.7677	2.6532	8.5063
DR	0.6380	0.5641	0.5975	0.0003	8.1240
STOCKS	2.5045	2.4829	0.5877	0.6990	4.4273
DROI	0.0599	0.0208	0.1315	0.0000	1.5080
GOVOWN	0.1608	0.0000	0.3676	0.0000	1.0000
AGE	9.7133	8.0000	7.1324	0.0000	30.0000
TANG	0.3591	0.2816	0.4415	0.0000	0.9521
MB	1.5475	1.2844	4.2188	-33.2831	49.2872
Panel B: Financial Firms					
Variable	Mean	Median	Standard Deviation	Minimum	Maximum
DIVYLD	0.0339	0.0000	0.0582	0.0000	0.6940
DIV/TA	0.0178	0.0000	0.0296	0.0000	0.1694
PROFIT	0.0519	0.0450	0.2299	-1.1177	3.1833
LOGS	6.3609	6.4294	0.8510	2.5855	8.0593
DR	0.6266	0.5982	0.8276	0.0010	9.1872
STOCKS	2.7932	2.8633	0.5521	1.1139	4.4760
DROI	0.0769	0.0134	0.2837	0.0000	5.0525
GOVOWN	0.1501	0.0000	0.3576	0.0000	1.0000
AGE	9.4165	7.0000	7.1388	0.0000	31.0000
TANG	0.0365	0.0033	0.1316	0.0000	0.9273
MB	1.4082	1.0848	2.3499	-14.7437	31.3345

The table presents descriptive statistics for all financial and non-financial firms listed at the SAMA for the years 1989-2004. The observations are 1057. The variables are dividend yield (DIVYLD), dividend-to-asset ratio (DIV/TA), profitability (PROFIT), firm size (LOGS), leverage (DR), agency costs (STOCKS), business risk (DROI), government ownership (GOVOWN), maturity of the firm (AGE), tangibility (TANG), and growth opportunities (MB).

The table also describes the sample for financial firms. The figures reported show that the dividend yield is slightly higher for financial firms with a value of 3.39%. Similarly, the standard deviation of return on investment is larger for financial firms. However, government ownership in financial firms is smaller than that for non-financial firms. Likewise, the profitability and growth of financial firms is less than that for non-financial firms. The results also show that financial firms are highly levered with a debt ratio of 62.66% is similar to that reported for non-financial firms (Tables 3 and 4).

There are some notable differences to those reported for non-financial firms. For instance, most financial firms distribute dividends. The percentage of financial firms that pay dividends (62%) is higher than that for non-financial firms (50%). The lowest percentage of paying dividends non-financial firms occur in 1998, the lowest for financial firms occur in 1992. The highest percentage occurs in 2003.

We employed a Tobit regression to examine the determinants of dividends policy using dividend yield as the dependent variable. As a robustness check, we re-estimated our Tobit model using the ratio of the aggregate dividend to total assets instead of the dividend yield. The results are insensitive to this measure of dividend policy. To further check the robustness of our results, we also estimate a random effects Tobit regression. The results are qualitatively similar to those obtained using Tobit regression.

Table 3: Number and Fraction of Firms Paying and not Paying Dividends

Panel A: Non-Financial Firms					
Year	No Dividend	Percentage	Dividend	Percentage	Total
1989	16	0.4848	17	0.5152	33
1990	16	0.5000	16	0.5000	32
1991	14	0.4118	20	0.5882	34
1992	14	0.4000	21	0.6000	35
1993	18	0.4500	22	0.5500	40
1994	21	0.4773	23	0.5227	44
1995	29	0.5179	27	0.4821	56
1996	30	0.5085	29	0.4915	59
1997	23	0.3651	40	0.6349	63
1998	60	0.6522	32	0.3478	92
1999	60	0.6000	40	0.4000	100
2000	59	0.5900	41	0.4100	100
2001	51	0.5313	45	0.4688	96
2002	50	0.5319	44	0.4681	94
2003	35	0.3846	56	0.6154	91
2004	30	0.3409	58	0.6591	88
Observations	526		531		1057
Panel B: Financial Firms					
Year	No Dividend	Percentage	Dividend	Percentage	Total
1989	3	0.2143	11	0.7857	14
1990	5	0.2941	12	0.7059	17
1991	7	0.3889	11	0.6111	18
1992	10	0.5556	8	0.4444	18
1993	5	0.2941	12	0.7059	17
1994	5	0.2778	13	0.7222	18
1995	6	0.2727	16	0.7273	22
1996	10	0.3846	16	0.6154	26
1997	13	0.4643	15	0.5357	28
1998	12	0.3529	22	0.6471	34
1999	15	0.4054	22	0.5946	37
2000	17	0.4857	18	0.5143	35
2001	18	0.5294	16	0.4706	34
2002	8	0.2424	25	0.7576	33
2003	6	0.2000	24	0.8000	30
2004	16	0.5000	16	0.5000	32
Observations	156		257		413

The table reports summary statistics on cash dividends for non-financial and financial firms for each year from 1989-2004. In most cases, the number of non-financial firms that pay cash dividends changes from one year to the next with the highest number of firms paying cash dividends in 2004 and the lowest in 1990. Overall, around 50% of the firm-year observations have zero dividends

Table 5 reports the results for the factors that explain dividend policy for the non-financial firms. We find that all of the variables are statistically significant except for agency costs, tangibility, and growth factors. Profitable firms hypothesized to be more able to pay dividends. Our results are in line with our hypothesis. In particular, the coefficients on profitability (*PROFIT*) are positive and statistically significant at the one percent level whether we use dividend yield or dividend-to-asset ratio. Larger firms have easier access to capital markets and face lower transaction costs compared to smaller firms. Accordingly, we hypothesized a positive relationship between dividends and size. Our results are consistent with this prediction. Highly levered firms depend on external financing largely than those with lower leverage ratios, because leverage produces fixed charge requirements. Consequently, levered firms should pay fewer dividends. As predicted, the coefficients on leverage (*DR*) are negative and statistically significant at the one percent level (Table 5).

Table 4: Tobit Regression for the Determinants of Dividend Policy for Non-Financial and Financial Firms

Panel A **Variable**	**Dividend Yield**		**Dividend-to-Asset Ratio**	
	Coefficient	**T-Statistic**	**Coefficient**	**T-Statistic**
C	-0.5147***	-7.8937	-0.2648***	-7.8420
PROFIT	0.1128***	2.7588	0.0947***	4.5006
LOGS	0.0898***	7.8297	0.0434***	7.3029
DR	-0.0823***	-3.9707	-0.0677***	-5.9694
STOCKS	-0.0338	-1.4866	-0.0052	-0.8543
DROI	-0.4370***	-4.6890	-0.2529***	-5.2399
GOVOWN	0.0008**	2.0981	0.0003*	1.6406
AGE	0.0016*	1.7280	0.0015***	3.1758
TANG	-0.0199	-1.2222	-0.0116	-1.3573
MB	-0.0008	-0.4706	0.0010	1.2529
No of Observations		1,057		1,057
Log Likelihood		-102.8745		123.5742
Wald Test [χ^2 (9)][a]		214.3100		291.7900
P-value		0.0000		0.0000
Panel B: Financial Firms **Variable**	**Dividend Yield**		**Dividend-to-Asset Ratio**	
	Coefficient	**T-Statistic**	**Coefficient**	**T-Statistic**
C	-0.2621***	-4.8914	-0.1003***	-3.3994
PROFIT	0.1958***	3.3637	0.2004***	5.6068
LOGS	0.0446***	4.5957	0.0191***	3.6007
DR	-0.0035	-0.5396	0.0002	0.0459
STOCKS	-0.0110	-0.9763	-0.0090	-1.4456
DROI	-0.2298***	-2.8843	-0.1384***	-3.0355
GOVOWN	0.0001	0.2748	-0.0001	-0.3533
AGE	0.0009	1.0127	-0.0006	-1.2642
TANG	-0.0733	-1.3227	-0.0449	-1.4645
MB	-0.0009	-0.3848	0.0027	1.2238
No of Observations		413		413
Log Likelihood		75.8372		158.1734
Wald Test [χ^2 (9)][a]		97.0100		101.2400
P-value		0.0000		0.0000

*The table shows estimated Tobit regressions for all non-financial and financial firms listed at the MSM during 1989-2004. The dependent variables are the dividend yield and the dividend-to-asset ratio. The explanatory variables are the profitability (PROFIT), firm size (LOGS), leverage (DR); agency costs (STOCKS), business risk (DROI), government ownership (GOVOWN), maturity of the firm (AGE), tangibility (TANG), and growth opportunities (MB). The table shows the variable, their coefficients, and their corresponding t-statistics.**, **, and *** represents significance at the 10, 5, 1 percent levels, respectively. [a] the number in parenthesis is the degrees of freedom.

Mature firms experience a contraction in their growth that may result in a decline in capital expenditure. As a result, these firms should have more free cash flow to pay in dividends. Hence, we should observe a positive association between dividends and maturity. Consistent with our predictions, the coefficients for age are positive and significant. Panel B shows results for the factors that influence dividend policy of financial firms. There are three significant determinants of dividend policy of financial firms, these being profitability, size, and business risk. Other factors such as leverage, agency costs, government ownership, age, tangibility, and growth do not have any significant impact on dividend policy of financial firms. The three significant factors have the hypothesized signs.

Table 5: Probit Regressions to Explain Which Non-Financial and financial Firms Pay Dividends

Variable	Coefficient	T-Statistic
C	-4.0045***	-8.9004
PROFIT	0.7110**	2.5546
LOGS	0.6858***	8.5343
DR	-0.9218***	-6.0088
STOCKS	-0.1319	-1.5297
DROI	-3.6518***	-5.4014
GOVOWN	0.0054*	1.7301
AGE	0.0222***	3.3317
TANG	-0.1523	-1.3056
MB	-0.0003	-0.0234
No of Observations	1,057	
Log Likelihood	-537.3487	
Wald Test [χ^2 (9)][a]	295.300	
P-value	0.000	
Panel B		
Variable	**Coefficient**	**T-Statistic**
C	-2.6748***	-4.1903
PROFIT	2.2372***	3.4718
LOGS	0.5411***	4.6679
DR	0.0644	0.6742
STOCKS	-0.2596	-1.5432
DROI	-2.2082***	-2.6152
GOVOWN	0.0087	1.1521
AGE	-0.0055	-0.4975
TANG	-0.9364	-1.4410
No of Observations	413	
Log Likelihood	-238.5700	
Wald Test [χ^2 (9)][a]	95.5700	
P-value	0.000	

Table 5 show the estimate regressions for all non-financial firms listed at the SAMA during 1989-2004. The dependent variable is a binary variable that equals to one if the firm pays dividends and zero otherwise. The explanatory variables are the profitability (PROFIT), firm size (LOGS), leverage (DR); agency costs (STOCKS), business risk (DROI), government ownership (GOVOWN), maturity of the firm (AGE), tangibility (TANG), and growth opportunities (MB). The table shows the variable, their coefficients, and their corresponding t-statistics. *, **, and *** represents significance at the 10, 5, 1 percent levels, respectively.[a] the number in parenthesis is the degrees of freedom.

We examine the likelihood that a firm will pay dividends. In order to do so we estimate probit regressions, where the dependent variable is binary variable equal to one if the firm pays dividends and zero otherwise. As regressor, we employed the same variables as described above. Our results for the determinants of the decision to pay dividends are consistent with those reported for the determinants of dividend policy. In particular, we find that the factors that influence the probability to pay dividends are the same factors that determine the amount of dividends paid. As a robustness check, we also estimated a random effects probit regression and find similar results to those obtained using probit regression.

Non-Financial Firms

The results presented in Panel shows that all the factors considered for examination are significant except for agency costs, tangibility, and growth. We previously find six factors that influencing the amount of dividends paid which are the same factors that affect the likelihood to pay dividends. For example, the coefficient on size is significant at all reasonable levels with a positive sign indicating that larger firms are more likely to pay dividends. Likewise, factors including profitability, government ownership, and age are all significant with a positive sign. On the other hand, risky firms and firms with high debt ratios are less likely to pay dividends.

Financial Firms

We estimated the probit model of the likelihood to pay dividends on our sample of financial firms. The results presented in Table 9 shows that profitability, size, and business risk are three factors that influence the likelihood to pay dividends, i.e.,. These factors are the same as the one reported for the determinants of the amount of dividends. The coefficients on leverage, agency costs, government ownership, age, tangibility, and growth variables are not statistically significant.

We estimated probit regressions for all financial firms listed at the SAMA during 1989-2004. The dependent variable is a binary variable that equals to one if the firm pays dividends and zero otherwise. The explanatory variables are the profitability (PROFIT), firm size (LOGS), leverage (DR); agency costs (STOCKS), business risk (DROI), government ownership (GOVOWN), maturity of the firm (AGE), tangibility (TANG), and growth opportunities (MB). The table shows the variable, their coefficients, and their corresponding *t*-statistics. [A] the number in parenthesis is the degrees of freedom.

A comparison between the factors that influence the probability of paying dividends in the financial and non-financial firms reveal that there are three common factors. These factors are profitability, size, and business risk. Leverage, government ownership, and age have a strong impact on the decision to pay dividends for non-financial firms and no effect on financial firms. On the other hand, agency costs, tangibility, and growth do not appear to have any impact on both financial and non-financial firms. As mentioned previously, the fact that we find agency cost is not important driver of Saudi firm's dividend policy is not surprising since Omani firms have high bank loans, which reduce the role of dividends in alleviating agency problems. In sum, the factors that influence the amounts of dividends are the same factors that drive the decision to pay dividends for both financial and non-financial firms.

CONCLUSION

We investigated dividend policy in a unique environment where firms distribute almost 100% of their profits in dividends and firms are highly levered. We used a panel data on a sample of Saudi firms and take account of the zero observations using Tobit and Probit models. Our study has three main objectives, namely (1) to identify the factors that determine the amount of dividends, (2) to examine the likelihood that firm’s pay dividends, and (3) to outline the potential differences in dividend policy between financial and non-financial firms.

Our results show that there are some common both financial and non-financial have common factors that determine dividend policy, and there are other factors affect dividends policy for non-financial firms only. Specifically, there are six determinants of dividend policy for non-financial firms, while there are only three factors that influence the dividend policy of financial firms. The common factors are profitability, size, and business risk. Government ownership, leverage, and age have a strong impact on the dividend policy of non-financial firms but no effect on financial firms. Agency costs, tangibility, and growth do not appear to have any effect on the dividend policy of either financial or non-financial firms. The fact that agency costs is not an important determinant of dividend policy is not surprising given that Saudi firms are highly levered via bank debt where the role of dividends in alleviating the agency problems is less important. Our findings for the determinants of the decision to pay dividends are consistent with those reported for the determinants of dividend policy. In particular, we find that the factors that influence the probability to pay dividends are the same factors that drive the amount of dividends paid.

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BIOGRAPHY

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INTERNATIONAL TRANSMISSION OF STOCK RETURNS: MEAN AND VOLATILITY SPILLOVER EFFECTS IN INDONESIA AND MALAYSIA

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ABSTRACT

This paper examines the mean return and volatility spillover effects from the three influential stock markets of the US, Japan, and China to the two emerging stock markets of Indonesia and Malaysia over the sample period from 2005 to 2007. By analyzing GARCH models, we verify that there are significant mean spillover effects from the three major markets to the two emerging markets. The magnitude of the mean spillover from the US market is the most significant compared to the Japanese and Chinese markets. This would be consistent with the conventional wisdom in which the US market is believed to be the most influential market in the world. In terms of the volatility spillover, the empirical results reveal that the US market is more influential to Indonesia, but less to Malaysia, and recently growing Chinese market has a significant influence to both of the two emerging markets.

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JEL: F36; G15

KEYWORDS: Indonesian and Malaysian stock markets; mean and volatility spillover effects

INTRODUCTION

The Association of South East Asian Nations (ASEAN) has recently made tremendous progress toward economic integration through forming a free trade area (ASEAN Free Trade Area – AFTA) and an investment zone (ASEAN Investment Area - AIA). Even though the 1997 Asian financial crisis might have discouraged some fast-growing economies in the region, it has been widely acknowledged that financial integration with rapidly growing stock markets in the area plays a crucial role in achieving more efficient allocation of capital, and thus promoting economic development.

The on-going liberalization of capital mobility along with technological progress of network systems has caused international financial markets to become highly integrated and interdependent. One important aspect of integration is international transmissions among stock markets, as anecdotes often emphasize co-movements associated with a significant impact of major markets. This paper provides some empirical evidences of international transmissions from major stock markets toward recently developing stock markets (Indonesia and Malaysia) in ASEAN. In particular, we examine the mean and volatility spillover effects of stock returns from the US and Japanese markets toward each of the two emerging markets, partly following the two-stage GARCH method as in Liu and Pan (1997).

As an extension, we also incorporate the transmission from the Chinese market into the model. The reason for this extension is that the Chinese market seems to affect other emerging markets because of its large economic scale and impressive economic growth, as well as its close relationship with ASEAN countries in terms of trade and FDI. Given the fact that the stock markets in the region are attracting many investors with global portfolio diversification, understanding the interdependence of the stock markets would be crucial to implement appropriate financial policies.

By using GARCH models, we first capture the residuals for the US, Japan, and China markets with the consideration of their interdependence. After that, the residuals are employed to analyze the international transmission from the three large markets to each emerging market of Indonesia and Malaysia. The results verify that there could be a significant mean spillover effect of the US market on the two emerging markets. The Japanese and Chinese markets also present the significant mean spillovers. The results further reveal that the magnitude of the mean spillover from the US market is the most significant compared to the Japanese and Chinese markets. This would be consistent with the findings in most previous studies in which the US market is believed to be the most influential market in the world. Concerning the volatility spillover effects, the empirical results reveal that the US market is more influential to Indonesia but less influential to Malaysia. It is also shown that recently growing Chinese market has clear transmission to both of the two emerging markets.

The rest of the paper is organized as follows. The next section reviews previous studies on international transmission of stock returns. The third section explains our empirical methodology of the ARMA-GARCH-in-mean, partly following the idea of Liu and Pan (1997), and then presents empirical results. The last section provides some conclusions of this paper.

LITERATURE REVIEW

Many studies have been done on international transmission of stock returns in the context of the mean and/or volatility spillover effects. Most of them show some evidences of international transmission from major markets, such as the US and Japanese markets, toward the other developed and emerging markets. For example, empirical works by Hamao, Masulis and Ng (1990), King, Sentana and Wadhwani (1994), Karolyi (1995), Becker, Finnerty and Friedman (1995), and Baur and Jung (2006) observe some spillovers in terms of both returns and their volatilities from the US to some developed equity markets like the U.K., Japan, Canada, Germany, and France. The transmission from developed markets to emerging markets in Asia is also detected by various studies, such as Park and Fatemi (1993), Kim and Rogers (1995), Hu, Chen, Fok, and Huang (1997), and He (2001).

As studies particularly focusing on the discussions related to emerging ASEAN markets, Park and Fatemi (1993) find a weak linkage between the stock markets of Pacific Basin countries (including two ASEAN countries – Thailand and Singapore) and those of the US, the UK, and Japan. Janakiramanan and Lamba (1998) examine the linkages between some developed markets and three ASEAN developing markets (Indonesia, Malaysia, and Thailand) and find that the US market influences all other markets except for Indonesia. Tan and Tse (2002) investigate the linkages among the US, Japan, and seven Asian stock markets. They find that while the US is the most influential one to Asian markets, Japan's influence is increasing. Moreover, many other papers focus on integration and linkages of ASEAN stock markets after the 1997 financial crisis (see Sharma and Wongbangpo, 2002; Wongbangpo and Sharma, 2002; Click and Plummer, 2005; and Abdul-Rahim and Nor, 2007).

To examine the relationships between short-term fluctuations in stock returns, some researches apply the VAR and/or the GARCH models. For example, Eun and Shim (1989), Janakiramanan and Lamba (1998), and Cha and Oh (2000) apply VAR models to explore the international transmission mechanism of stock market movements. While many other scholars rely on GARCH and some modification of GARCH models to investigate the international transmission effects among markets (see, e.g., Cheung and Mak, 1992; Kim and Rogers, 1995; Liu and Pan, 1997; Ng, 2000; and Kim, 2005), some studies like Antoniou, Pescetto and Violaris (2003) use the combination of VAR and GARCH models. Moreover, Lee (2002) develops a new testing technique based on the wavelet transform to explore returns and volatility spillover effects across markets.

EMPIRICAL ANALYSIS

Data employed in this paper are daily closing stock market indices for two developed stock markets (the

U.S. and Japan) and three emerging stock markets (China, Indonesia, and Malaysia). The indices used are Standard & Poor 500 Index (the U.S.), Nikkei 225 (Japan), Shanghai Stock Exchange Composite Index (China), Jakarta Composite Index (Indonesia), and Kuala Lumpur Stock Exchange Composite Index (Malaysia) over the sample period from January 2005 to December 2007.

The data are retrieved from Yahoo Finance. For each market, the daily market index is measured in local currency terms. The indices are transformed to a daily rate of return as $r_t = \ln(p_t) - \ln(p_{t-1}) = \ln(p_t / p_{t-1})$, where p_t and p_{t-1} are the price index value at time t and t-1.

Table 1 presents the summary statistics for the daily stock index returns of the five markets from January 2005 to December 2007. The mean return and the volatility are the highest for the Chinese stock market among all of five markets, and the Indonesian stock market follows. The characteristics of the two emerging markets seem to be consistent with the argument that distinguishing features are high risk and high returns (see, e.g., Harvey, 1995). In contrast, the Malaysian stock market is relatively stable and less volatile compared to the other markets. Furthermore, the results of Kurtosis test suggest that their daily return series would be "peaked" and have "fat tailed" distribution.

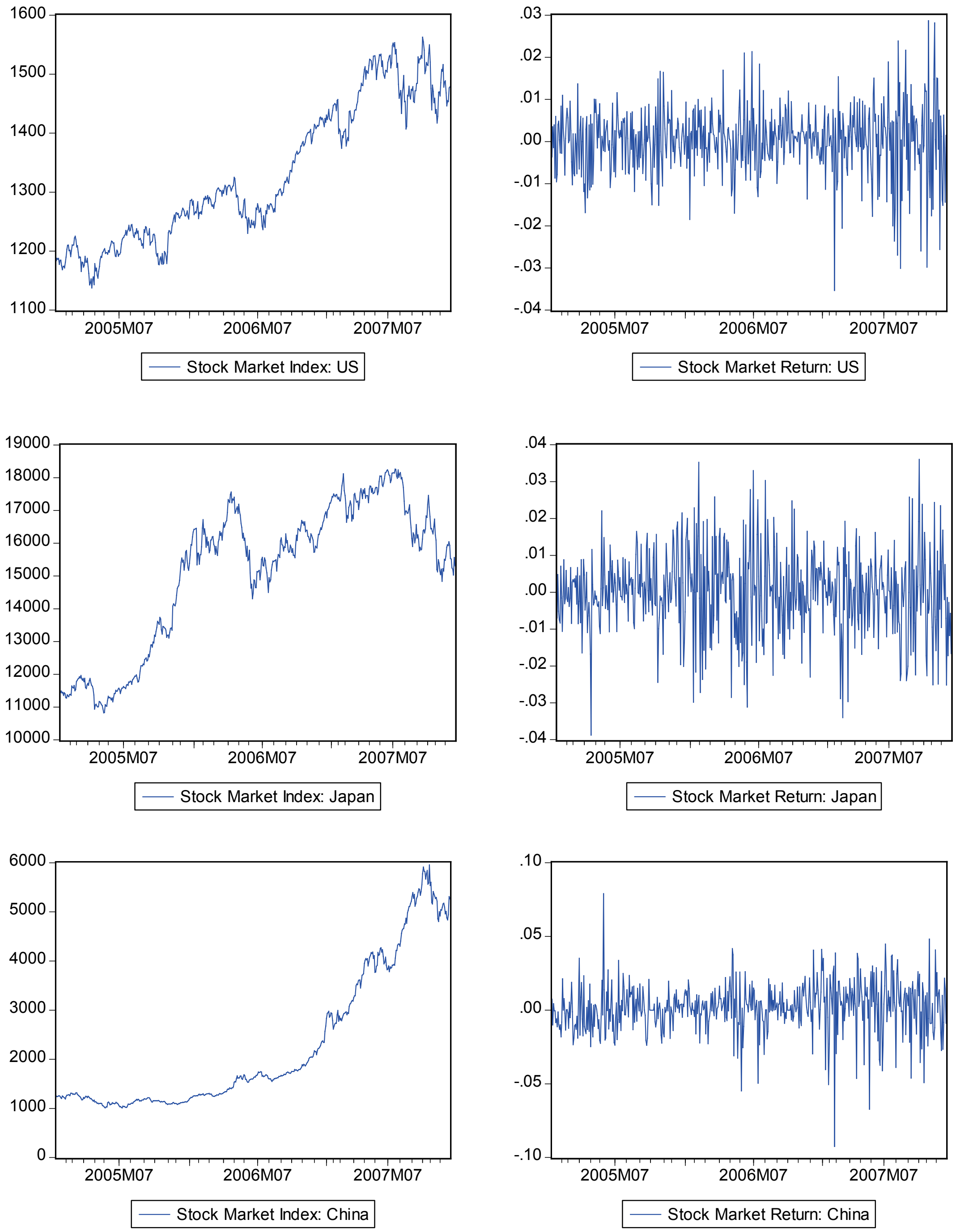
Table 1: Summary Statistics for Daily Stock Index Returns

	Indonesia	Malaysia	US	Japan	China
Mean	0.0010	0.0002	0.0002	0.0000	0.0016
Median	0.0021	0.0006	0.0009	0.0000	0.0019
Maximum	0.0532	0.0260	0.0287	0.0360	0.0789
Minimum	-0.0665	-0.0475	-0.0353	-0.0388	-0.0926
Std. Dev.	0.0135	0.0075	0.0080	0.0112	0.0167
Skewness	-0.9402	-1.2486	-0.4591	-0.0969	-0.5114
Kurtosis	7.3647	9.4273	5.1232	3.6703	6.4845
Ljung-Box Q-Statistics					
Daily Returns					
LB(12)	14.40	27.86*	19.04	16.33	4.57
LB(24)	37.50*	45.76*	33.62	34.69	18.37
Squared Daily Returns					
LB(12)	120.68*	307.39*	168.45*	70.18*	33.95*
LB(24)	134.15*	312.21*	184.95*	96.04*	57.23*

Sample period is January 2005 to December 2007. LB(k) is the Ljung-Box Q statistic for k order serial correlation.
** indicates significance at the 5 percent level.*

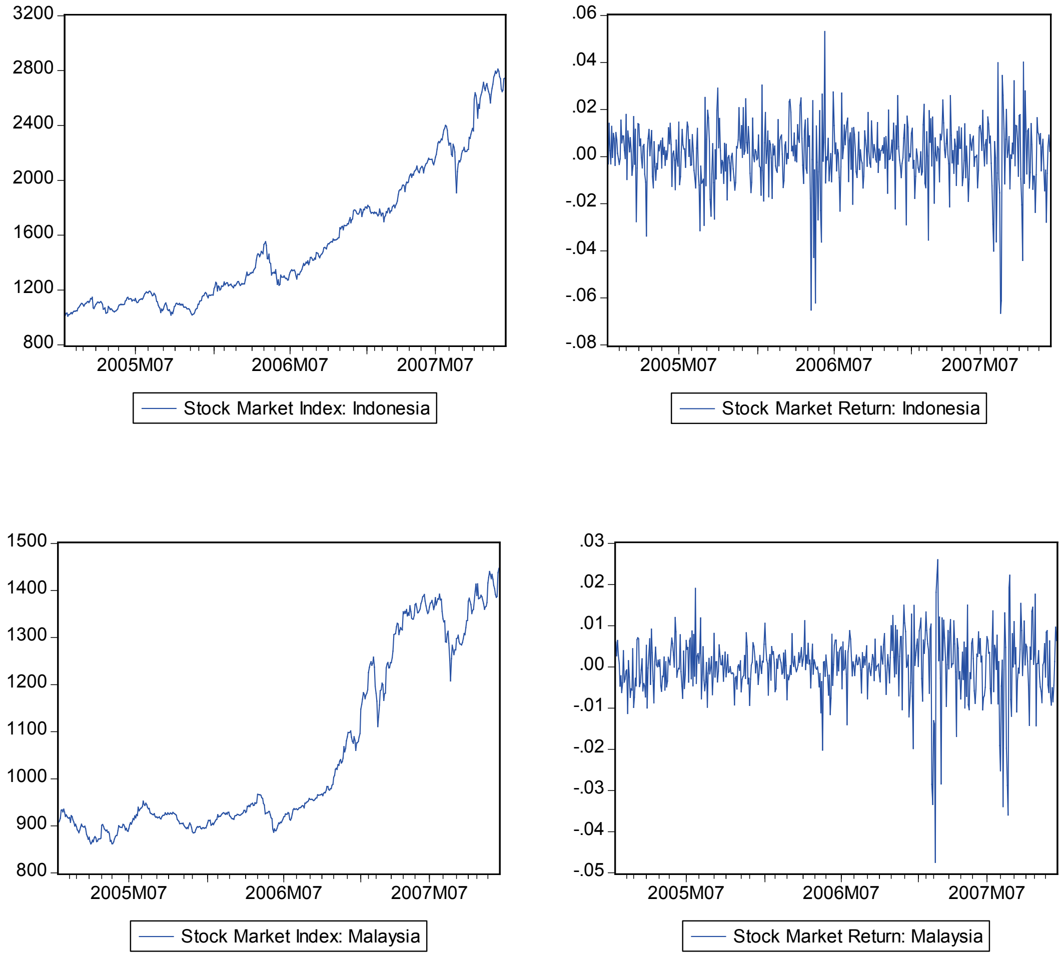
Figures 1 and 2 show the stock market index series p_t and the corresponding returns series r_t of the five stock markets. Each national stock market operates in different time zones with different opening and closing times, so that the daily rates of return represent the returns in different real time periods. All the Asian stock markets are closed when the US market opens, and vice versa.

Figure 1: Stock Market Indices and Daily Returns in the U.S., Japan, and China



The figures in the left-hand side show the stock market index, and the figures in the right-hand side show the daily returns of the stock market index. Sample period is from January 2005 to December 2007.

Figure 2: Stock Market Indices and Daily Returns in Indonesia and Malaysia



The figures in the left-hand side show the stock market index, and the figures in the right-hand side show the daily returns of the stock market index. Sample period is from January 2005 to December 2007.

Table 2 reports the correlations of stock index returns. Notice that the correlations between returns of Asian countries and the previous day's returns of the US are higher than the corresponding correlations with the same-day US returns. Moreover, as expected, the correlations between returns of Asian markets and that of previous day of the US are all positive. These could support the conjecture that the U.S. market is influential to other markets.

Since the introduction of the work of Engle (1982) on the Autoregressive Conditional Heteroskedasticity (ARCH) model, there has been a large body of literature on volatility forecast (see Bollerslev, Chou, and Kroner, 1992, for summaries of this family's models). Although empirical evidences are rather mixed as to which volatility model performs best, the ARCH models are widely applied to capture the fat-tailed nature of the stock return distribution with time-dependent volatility. For example, the work of Akgiray (1989) on the U.S. stock markets finds that the GARCH (1,1) model outperforms more traditional technical analysis. Brailsford and Faff (1996) suggest that the ARCH class of models provide superior forecasts of volatility. However, the various model rankings are shown to be sensitive to the error statistic used to assess the accuracy of the forecasts.

Table 2: Correlation Matrix of Daily Stock Index Returns

	China	Indonesia	Japan	Malaysia	US	US (-1)[b]
China	1.0000	0.1514	0.1687	0.2298	0.0580	0.0878
Indonesia	0.1514	1.0000	0.4960	0.5425	0.0872	0.3684
Japan	0.1687	0.4960	1.0000	0.4398	0.1190	0.3951
Malaysia	0.2298	0.5425	0.4340	1.0000	0.0344	0.3772
The U.S	0.0580	0.0872	0.1190	0.0344	1.0000	-0.0875
The U.S (-1)[b]	0.0878	0.3684	0.3951	0.3772	-0.0875	1.0000

Sample period is January 2005 to December 2007. b indicates the one-day lagged return in the U.S. market

Empirical Models

This subsection employs the idea of the two-stage GARCH model in Liu and Pan (1997) to examine the international transmissions of the mean and volatility from the major stock markets (the US, Japan, and China) to each of the two emerging stock markets (Indonesia and Malaysia). The GARCH models allow us to observe the "conditional" volatility of the stock return, once the influence of various factors is controlled. They provide information to explain the factors underlying the movements of the stock return.

At the first stage, the short-run fluctuations of the stock returns of three major markets of the US, Japan, and China are derived through estimating the residual series of the GARCH model. At the second stage, the international transmission of the stock returns from the major markets to the two emerging markets is estimated by incorporating the residuals derived at the first stage into the GARCH model. Notice that our model specification assumes that the major markets could influence the emerging markets, but the emerging markets never influence the major markets (see, e.g., Janakiramanan and Lamba, 1998, for the case of Pacific-Basin stock markets). Moreover, we also assume that there is no transmission within the emerging countries. Ideally, these assumptions should be examined carefully by appropriate empirical analysis. However, given the conventional argument that small markets do not affect other markets significantly, it would be reasonable to make the above assumptions for the purpose of our analysis on the international transmission.

Major Markets: the US, Japan, and China

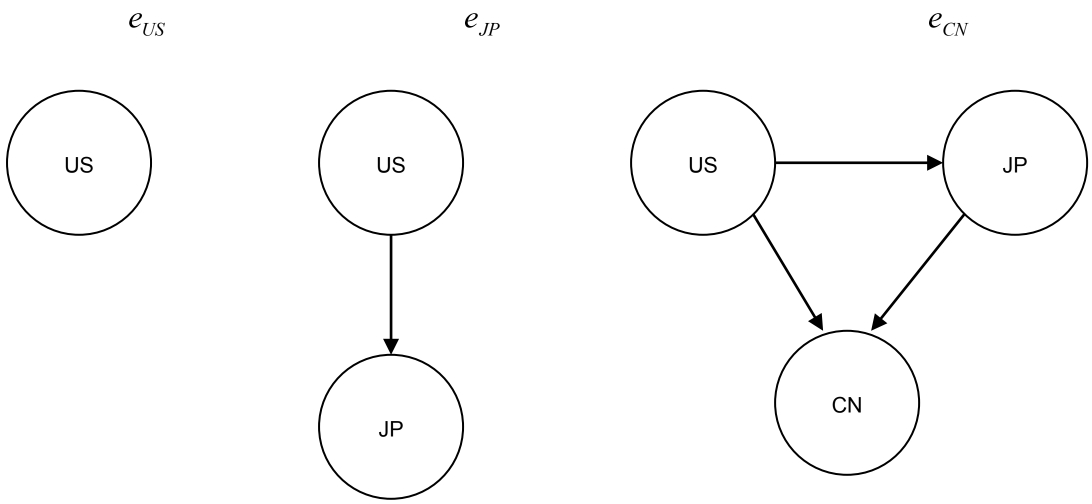
To obtain the short-term fluctuations of the stock returns of three major markets (the US, Japan, and China), the ARMA-GARCH-type of the model is applied (see Figure 3 for the general process). The US stock market returns are estimated through the following ARMA-GARCH model with the mean and variance equations:

$$r_t = \varphi_0 + \varphi_1 r_{t-1} + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum_{j=1}^{4} d_j D_{j,t} + \varepsilon_t \quad (1)$$

$$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2, \quad (2)$$

where r_t is the daily stock index return; $D_{j,t}$s are dummy variable for Monday, Tuesday, Wednesday and Thursday, respectively; and ε_t is the residual which has standard properties with mean zero and variance v_t ($\varepsilon_t = \sqrt{v_t}\eta_t, \eta_t \sim N(0,1)$). The stock returns series for the US market is modeled as the MA(1) model ($\varphi_1 = 0$) according to the Akaike Information Criterion (AIC) with the adjustment for possible serial correlation. The model specification assumes that the US market is never affected by other markets, i.e., no international transmission exists. The residual series captures the short-term fluctuations of the stock returns of the US market.

Figure 3: First Stage



For the Japanese market, we consider the case where the international transmission from the US market could exist in terms of the mean and volatility effects. To capture this, we estimate the following ARMA-GARCH model:

$$r_t = \varphi_0 + \varphi_1 r_{t-1} + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum_{j=1}^{4} d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \varepsilon_t , \quad (3)$$

$$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 + \gamma_{US} e_{US,t-1}^2 , \quad (4)$$

where $e_{US,t-1}$ and $e_{US,t-1}^2$ are the residual and the square of the residual for the US market estimated in equations (1) and (2). The coefficient λ_{US} captures the mean spillover effect from the US, and the coefficient γ_{US} captures the volatility spillover effect. Notice that the lag of the residuals is used since the US stock returns in current date could influence the Japanese market in next date, due to different time zones between the US and Japan. Similar to the residuals of the US, the residual series derived from the model captures the short-term fluctuations of the stock returns of the Japanese market. The stock return series for the Japanese market is also modeled as the MA(1) model ($\varphi_1 = 0$) according to the AIC with the adjustment for possible serial correlation.

Concerning the short-run fluctuation of the stock returns of the Chinese market, we assume that the Chinese market could be affected by both the US and Japanese markets, i.e., the international transmission from the US and Japanese markets to the Chinese market. The mean and volatility effects are estimated through substituting the residual and its square of the US market derived from equations (1) and (2) and the residual and its square of the Japanese market derived from equations (3) and (4) into the following ARMA-GARCH model:

$$r_t = \varphi_0 + \varphi_1 r_{t-1} + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum_{j=1}^{4} d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \lambda_{JP} e_{JP,t} + \varepsilon_t , \quad (5)$$

$$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 + \gamma_{US} e_{US,t-1}^2 + \gamma_{JP} e_{JP,t}^2 . \quad (6)$$

where $e_{JP,t}$ and $e_{JP,t}^2$ are the residual and the square of the residual for the Japanese market estimated in equations (3) and (4). The coefficients, λ_{US} and λ_{JP}, capture the mean spillover effect from the US and Japan, and the coefficients, γ_{US} and γ_{CN}, capture the volatility spillover effect from the US and Japan. The stock returns series of the Chinese market is modeled as MA(1). Similar to the residuals for the US and Japan, the residual series, denoted by $e_{CN,t}$, captures the short-term fluctuations of the stock returns of the Chinese market.

The estimation results from the ARMA-GARCH models on the stock returns of the US, Japan, and China markets are shown in Table 3. The Ljung Box (LB) Q-statistics at lag *k* is a test statistic for the null hypothesis that there is no autocorrelation among residuals up to order *k*. The LB Q-statistics at lags 12 and 24 is not significant at the 5% level, which could mean no serial correlation. The result suggests that the model has taken care of most of the fat-tails and time-varying volatility in the data.

Furthermore, Table 3 presents some results of the international transmission. In terms of the mean spillover effects, the coefficient of $e_{US,t-1}$ (λ_{US}) is significantly positive for the Japanese and Chinese markets. This implies that the international transmission of stock returns could exist from the US market to the Japanese and Chinese markets. The coefficient of $e_{JP,t}$ (λ_{JP}) is significantly positive for the Chinese markets, which implies that the significant mean spillover effect could exist from the Japanese market to the Chinese market. On the other hand, in terms of the volatility spillover, the coefficient of $e^2_{US,t-1}$ (γ_{US}) in the variance equations is significantly positive for the Japanese market, but the coefficients, γ_{US} and γ_{JP}, are insignificant for the Chinese market. These results demonstrate that there could be the volatility spillover effect from the US market to the Japanese market. However, the results do not support the evidence of the volatility spillover effects from the US and Japanese markets to the Chinese market.

Emerging Markets: Indonesia and Malaysia

We attempt to examine the international transmission from the three major markets to the two emerging markets through using the ARMA-GARCH models with the short-run fluctuations of the major markets estimated in the previous discussion. Formally, to find the impact of the international transmission, we estimate the following ARCH-GARCH model with the mean and variance equations:

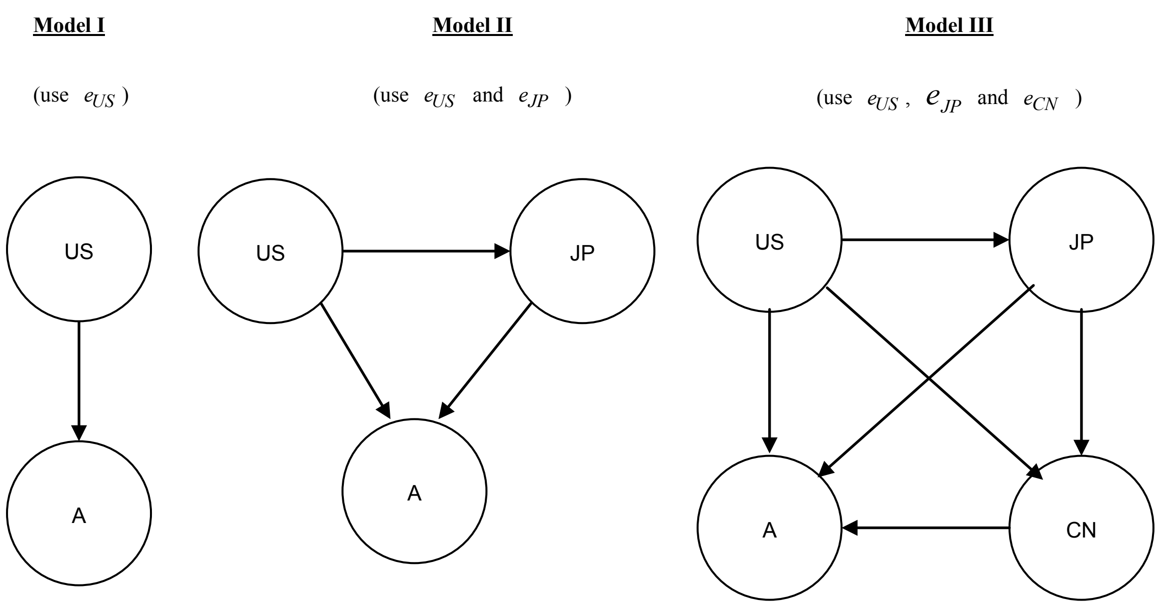
$$r_t = \varphi_0 + \varphi_1 r_{t-1} + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum_{j=1}^{4} d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \lambda_{JP} e_{JP,t} + \lambda_{CN} e_{CN,t} + \varepsilon_t, \quad (7)$$

$$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon^2_{t-1} + \gamma_{US} e^2_{US,t-1} + \gamma_{JP} e^2_{JP,t} + \gamma_{CN} e^2_{CN,t} \quad (8)$$

where $e_{US,t}$, $e_{JP,t}$, and $e_{CN,t}$ are respectively the residuals for the US, Japanese and Chinese markets estimated in equations (1) to (6). In particular, we focus on the coefficients, λ_{US}, λ_{JP}, and λ_{CN}, in the mean equations to examine the mean spillover effects and on the coefficients, γ_{US}, γ_{JP}, and γ_{CN}, in the variance equations to examine the volatility spillover effects.

We consider three models depending on the transmission patterns: the first is the case where the emerging markets (Indonesia and Malaysia) are influenced by only the US market (Model I); the second is the case where the emerging markets are influenced by the US and Japanese markets (Model II); and the third is the case where the emerging markets are influenced by the US, Japanese, and Chinese markets (Model III). The three specific models are depicted in Figure 4. Notice that Model I corresponds to the case where no international transmission from the Japan and China markets exists in terms of the mean and volatility ($\lambda_{JP} = \lambda_{CN} = \gamma_{JP} = \gamma_{CN} = 0$ in equations (7) and (8)); Model II to the case where no international transmission from the China market exists ($\lambda_{CN} = \gamma_{CN} = 0$); and Model III to the case where international transmission from all major markets could exist without any restrictions on λ s and γ s. The model specification of the mean equation is decided according the AIC.

Figure 4: Second Stage



Note: A represents each stock market of ASEAN countries

Table 3: ARMA-GARCH Model for the U.S., Japan, China Markets

	US	Japan		China	
φ_0	-0.0001	0.0008		0.0009	
	(0.0010)	(0.0012)		(0.0018)	
φ_2	2.4525	-2.5670		6.3419	
	(12.5349)	(8.7635)		(5.1902)	
φ_3	-0.0826	-0.0638		0.0033	
	(0.0503)	(0.0479)		(0.0480)	
d_1	0.0006	-0.0019		-0.0003	
	(0.0013)	(0.0013)		(0.0022)	
d_2	-0.0001	-0.0005		-0.0028	
	(0.0010)	(0.0014)		(0.0021)	
d_3	0.0008	-0.0011		-0.0005	
	(0.0010)	(0.0013)		(0.0018)	
d_4	-0.0004	0.0007		-0.0040	*
	(0.0010)	(0.0013)		(0.0019)	
λ_{US}		0.5548	*	0.2384	*
		(0.0603)		(0.0894)	
λ_{JP}				0.1422	*
				(0.0609)	

	US		Japan		China	
α_0	0.0000	*	0.0000		0.0000	*
	(0.0000)		(0.0000)		(0.0000)	
α_1	0.8964	*	0.9035	*	0.8972	*
	(0.0265)		(0.0334)		(0.0227)	
α_2	0.0664	*	0.0743	*	0.0858	*
	(0.0188)		(0.0292)		(0.0211)	
γ_{US}			0.0354	*	-0.0054	
			(0.0151)		(0.0387)	
γ_{JP}					-0.0352	
					(0.0183)	
Ljung Box Q-Statistics						
Standardized Residuals						
LB(12)	10.87		13.44		5.33	
LB(24)	22.87		23.87		21.86	
Squared Standardized Residuals						
LB(12)	15.96		11.98		5.85	
LB(24)	20.41		20.37		20.00	

The estimated coefficients are shown for the following models over the sample period from January 2005 to December 2007. The model for the US is: $r_t = \varphi_0 + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum d_j D_{j,t} + \varepsilon_t$

$$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 .$$

The model for Japan is: $r_t = \varphi_0 + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \varepsilon_t$,

$$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 + \gamma_{US} e_{US,t-1}^2 .$$

The model for China is: $r_t = \varphi_0 + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \lambda_{JP} e_{JP,t} + \varepsilon_t$

$$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 + \gamma_{US} e_{US,t-1}^2 + \gamma_{JP} e_{JP,t}^2 .$$

$D_{j,t}$ *is the dummy variable for Monday through Thursday.*

*LB(k) is the Ljung-Box Q statistic for k order serial correlation. Standard error is in parentheses. * indicates significance at the 5 percent level.*

RESULTS FOR EMERGING MARKETS

We estimate the modified ARMA-GARCH models to find the international transmission with the mean and volatility spillover effects. Tables 4 to 5 present our estimations of the three models, Model I, II, and III, for each of the two emerging markets, Indonesia and Malaysia. The main results of each emerging market are as follows.

Indonesia

Table 4 reports the results of the estimation for Indonesia. The LB Q-statistics confirms that the three models fit the data well since there is no serial correlation in the residual series. It is observed that since the coefficients, λ_{US}, λ_{JP}, and λ_{CN}, are positive and significant at the 5% level for all three models, there are significant mean spillover effects from the three major markets to Indonesia. Evaluating the magnitude of the mean spillover effect implies that the transmission from the US is the most influential. In terms of the volatility spillover, the coefficient γ_{US} is significant for all models, so that there are significant volatility spillover effects from the US market to Indonesia. In contrast, the coefficient γ_{JP} is insignificant for Models II and III, so that the Japanese market might not affect the Indonesian market in terms of the volatility spillover. Furthermore, since the coefficient γ_{CN} is significant for Model III, the Chinese market could induce the volatility spillover to the Indonesian market, although its magnitude is not so large compared to that of the US market. Our result of the spillover effect from the US is in contrast with the argument of Janakiramanan and Lamba (1998) in their VAR approach that the US market had been less influential over the sample period from 1988 to 1996. The disagreement might be not only due to the different method and data sample, but due to the recent trend of financial integration of the world capital markets.

Malaysia

Table 5 reports the results of the estimation for Malaysia, where the LB Q-statistics present that all models fit the data well. Similar to the results of the Indonesian market, it can be shown that there exist mean spillover effects from the three major markets to Malaysia, since the coefficients, λ_{US} , λ_{JP} , and λ_{CN} , are significant for all three models. In addition, the magnitude of the mean spillover effect from the US is the most evident, as in conventional arguments.

Our empirical analysis also presents that the volatility spillover from the US market to the Malaysian market is less clear, since the coefficient γ_{US} is significant for Model I but insignificant for Models II and III. These results are different from those for Indonesia in that all models are supportive of clear evidences of the volatility spillover from the US. In contrast, the analysis on the volatility spillover effect from Japan and China shows the similar results as in the case of Indonesia. The Japanese market would not affect the Malaysian market through the volatility spillover, since the coefficient γ_{JP} is not significant for Models II and III. However, the coefficient γ_{CN} is significant for Model III, which implies that the Chinese market could induce the volatility spillover to the Malaysian market.

Table 4: ARMA-GARCH Model for Indonesia

	Model I		Model II		Model III	
φ_0	0.0031	*	0.0027	*	0.0031	*
	(0.0015)		(0.0013)		(0.0012)	
φ_1	0.0376		0.9456	*	0.0223	
	(0.0514)		(0.0446)		(0.0520)	
φ_2	-2.5966		-2.6462		-1.6309	
	(7.5640)		(7.7399)		(8.1992)	
φ_3			-0.9582	*		
			(0.0397)			
d_1	-0.0030		-0.0031	*	-0.0035	*
	(0.0016)		(0.0014)		(0.0014)	
d_2	-0.0013		-0.0011		-0.0015	
	(0.0016)		(0.0014)		(0.0014)	
d_3	-0.0013		-0.0011		-0.0010	
	(0.0015)		(0.0014)		(0.0014)	
d_4	-0.0006		-0.0005		-0.0008	
	(0.0015)		(0.0014)		(0.0013)	
λ_{US}	0.5341	*	0.5337	*	0.5372	*
	(0.0742)		(0.0667)		(0.0640)	
λ_{JP}			0.4208	*	0.4193	*

Table 4: ARMA-GARCH Model for Indonesia (continued)

	Model I		Model II		Model III	
			(0.0488)		(0.0407)	
λ_{CN}					0.0826	*
					(0.0269)	
α_0	0.0000	*	0.0000	*	0.0000	*
	(0.0000)		(0.0000)		(0.0000)	
α_1	0.5662	*	0.5516	*	0.5859	*
	(0.0685)		(0.0999)		(0.0954)	
α_2	0.1949	*	0.2023	*	0.2004	*
	(0.0513)		(0.0667)		(0.0676)	
γ_{US}	0.2796	*	0.1556	*	0.1471	*
	(0.0811)		(0.0604)		(0.0642)	
γ_{JP}			0.0892		-0.0002	
			(0.0478)		(0.0005)	
γ_{CN}					0.0005	*
					(0.0002)	
Ljung Box Q-Statistics						
Standardized Residuals						
LB(12)	11.47		12.71		13.20	
LB(24)	26.52		23.28		26.19	
Squared Standardized Residuals						
LB(12)	14.70		14.43		12.80	
LB(24)	35.14		24.66		27.67	

The estimated coefficients are shown for the following three models over the sample period from January 2005 to December 2007.

Model I is: $r_t = \varphi_0 + \varphi_1 r_{t-1} + \varphi_2 v_t + \sum d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \varepsilon_t$

$$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 + \gamma_{US} e_{US,t-1}^2 .$$

Model II is: $r_t = \varphi_0 + \varphi_1 r_{t-1} + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \lambda_{JP} e_{JP,t} + \varepsilon_t$

$$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 + \gamma_{US} e_{US,t-1}^2 + \gamma_{JP} e_{JP,t}^2 .$$

Model III is: $r_t = \varphi_0 + \varphi_1 r_{t-1} + \varphi_2 v_t + \sum d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \lambda_{JP} e_{JP,t} + \lambda_{CN} e_{CN,t} + \varepsilon_t$

$$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 + \gamma_{US} e_{US,t-1}^2 + \gamma_{JP} e_{JP,t}^2 + \gamma_{CN} e_{CN,t}^2 .$$

$D_{j,t}$ *is the dummy variable for Monday through Thursday. LB(k) is the Ljung-Box Q statistic for k order serial correlation. Standard error is in parentheses. * indicates significance at the 5 percent level.*

Table 5: ARMA-GARCH Model for Malaysia

	Model I		**Model II**		**Model III**	
φ_0	0.0009		0.0008		0.0004	
	(0.0006)		(0.0006)		(0.0006)	
φ_1						
φ_2	2.9617		4.5622		10.4018	
	(10.7826)		(11.3789)		(11.9232)	
φ_3	0.1770	*	0.1821	*	0.1688	*
	Model I		**Model II**		**Model III**	
	(0.0506)		(0.0501)		(0.0486)	
d_1	-0.0016	*	-0.0015	*	-0.0012	
	(-0.0007)		(0.0007)		(0.0007)	
d_2	-0.0010		-0.0011		-0.0006	
	(0.0008)		(0.0007)		(0.0007)	
d_3	-0.0009		-0.0008		-0.0004	
	(0.0007)		(0.0006)		(0.0006)	
d_4	-0.0001		-0.0002		0.0000	
	(0.0006)		(0.0006)		(0.0006)	
λ_{US}	0.1907	*	0.2030	*	0.2145	*
	(0.0311)		(0.0300)		(0.0302)	
λ_{JP}			0.1282	*	0.1257	*
			(0.0192)		(0.0182)	
λ_{CN}					0.0610	*
					(0.0175)	
α_0	0.0000	*	0.0000	*	0.0000	*
	(0.0000)		(0.0000)		(0.0000)	
α_1	0.7690	*	0.7666	*	0.7533	*
	(0.0384)		(0.0437)		(0.0622)	
α_2	0.1771	*	0.1692	*	0.1155	*
	(0.0365)		(0.0389)		(0.0383)	
γ_{US}	0.0188	*	0.0170		0.0044	
	(0.0094)		(0.0089)		(0.0101)	
γ_{JP}			-0.0055		-0.0042	
			(0.0030)		(0.0029)	

Table 6: ARMA-GARCH Model for Malaysia (continued)

	Model I	Model II	Model III
γ_{CN}			0.0120 *
			(0.0037)
Ljung Box Q-Statistics			
Standardized Residuals			
LB(12)		6.37	4.84
LB(24)	21.62	18.82	18.95
Squared Standardized Residuals			
LB(12)		8.31	5.94
LB(24)	23.37	21.63	15.28

The estimated coefficients are shown for the following three models over the sample period from January 2005 to December 2007.

Model I is: $r_t = \varphi_0 + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \varepsilon_t$

$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 + \gamma_{US} e_{US,t-1}^2$.

Model II is: $r_t = \varphi_0 + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \lambda_{JP} e_{JP,t} + \varepsilon_t$

$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 + \gamma_{US} e_{US,t-1}^2 + \gamma_{JP} e_{JP,t}^2$.

Model III is: $r_t = \varphi_0 + \varphi_2 v_t + \varphi_3 \varepsilon_{t-1} + \sum d_j D_{j,t} + \lambda_{US} e_{US,t-1} + \lambda_{JP} e_{JP,t} + \lambda_{CN} e_{CN,t} + \varepsilon_t$

$v_t = \alpha_0 + \alpha_1 v_{t-1} + \alpha_2 \varepsilon_{t-1}^2 + \gamma_{US} e_{US,t-1}^2 + \gamma_{JP} e_{JP,t}^2 + \gamma_{CN} e_{CN,t}^2$.

$D_{j,t}$ *is the dummy variable for Monday through Thursday.*

*LB(k) is the Ljung-Box Q statistic for k order serial correlation. Standard error is in parentheses. * indicates significance at the 5 percent level.*

In summary, the three major markets (the US, Japan, and China) have significant mean spillover effects on the Indonesian and Malaysian stock markets. In particular, the US market is the most influential in terms of the mean spillover. On the other hand, the evidences of the volatility spillover effects are less clear. The US and Chinese markets have the international transmission in terms of the volatility spillover to Indonesia, while only the Chinese market has the international transmission in terms of the volatility spillover to Malaysia. More interestingly, our analysis shows clearly that the Chinese market has significant international transmissions in terms of both mean and volatility spillovers.

CONCLUSION

This paper has investigated the transmission of mean return and volatility from the US, Japan, and China to the Indonesian and Malaysian markets, using daily data from January 2005 to December 2007. These emerging countries have increased their economic integration in recent years, and their stock markets have achieved remarkable development. By adopting a GARCH model based on the concept of Liu and Pan (1997), we construct mean return and volatility spillover models to discuss whether regional (China and Japan) and global (the US) impacts are crucial for the determination of stock returns in Indonesia and Malaysia.

The findings of this paper show that, as expected, the US market influences the Indonesian and Malaysian markets. The results also support significant feedback relationships in mean return between Japan and Indonesia and between Japan and Malaysia. More importantly, the empirical results suggest significant levels of mean and volatility spillover effects between China and its neighbors, Indonesia and Malaysia. It coincides with the recent argument that the Chinese market has gradually played more important roles in the international stock market transmission.

In this paper, we consider a model specification with a one-way transmission from developed markets to emerging markets. However, recent trends of international capital integration, including the existence of multinational financial institutions, could intensify the other way from emerging markets to developed markets. Thus, careful examination on such mutual interdependence among capital markets must be needed in future research.

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THE SURVIVAL OF INITIAL PUBLIC OFFERINGS IN AUSTRALIA

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ABSTRACT

This paper examines the survival of Australian initial public offerings (IPOs). The Cox proportional hazards model is used to test the value of the information available at the time of listing and whether this information foreshadows the likelihood of survival or failure of an IPO. The number of risk factors listed in the prospectus and the size of the firm are found to be negatively related to survival of the firm. The size of the offering and the forecast dividend yield are found to be positively related to firm survival. The likelihood of survival is also found to vary with industry and firms in the finance and natural resources industries are more likely to survive than firms in other industries.

JEL: J23

KEYWORDS: Survival analysis, Cox proportional hazards model, IPO, Australia

INTRODUCTION

For owners and managers of an unlisted firm, the decision to take the firm public is not made without thorough consideration yet the failure rate among firms that debut on stock exchanges is still relatively high. Previous studies of American IPOs have shown that about 30% of IPOs delist within the first five years (Jain and Kini, 1999). Of the sample of Australian IPOs used in this paper, 20% fail within first five years and 29% fail within the first seven years. Despite these failure rates there is a distinct lack of analysis of the survival of IPOs in the Australian capital market. Owners of listing firms are eager to maximise the value of their financial stake in the company and are presumably concerned with the subsequent post-listing performance and ultimate survival. For company managers, ensuring survival is a dominant factor in protecting and enhancing their financial interests in the company. The firm's survival also has implications regarding the protection of managerial, reputational, capital, and career prospects. Survival is a simple measure but is also the ultimate assessment of long run performance because it offers a clear test of whether a firm has performed well enough to survive, given the competitive nature of the capital markets. From a business strategy perspective, it also indicates whether a firm has performed well enough to maintain its corporate identity.

In capital markets, investor expectations and investment decisions are based on all publicly available information. In the case of IPOs, the majority of available information is contained in the prospectus. IPO prospectuses provide information relating to both the firm (including financial and governance information) and the offering (including size and structure) and in case of Australian firms, forecasts regarding the future prospects of the firm. These prospectuses also act as legal documents that ensure all the material facts of the public offering issue are available to investors. Even though IPO prospectuses are meant to serve as reliable and important indicators of the future performance and survival of firms, there is a limited amount of published research examining the effectiveness of the information contained in these prospectuses to anticipate future survival. To our knowledge, this paper is the first to examine the long-term survivorship of Australian IPOs.

In this paper, we examine the relative survival of firms following their stock exchange listing using a Cox proportional hazards model, which utilises publicly available information available in IPO prospectuses.

We test a central hypothesis of whether the information available at the time of offering is related to the relative mortality of a firm. In further analysis, we examine specific characteristics in order to provide evidence about whether certain characteristics of an IPO are informative about a firm's chances of survival.

This paper makes several important contributions to the understanding of IPOs in Australia. Firstly, we document that there is a high rate of failure among Australian IPOs within the first five or seven years of their listing date. Secondly, we provide an Australian perspective of the survival of firms. By conducting such a study in the Australian context, it provides a robust check of empirical findings regarding survival of firms since the Australian capital market setting differs in some respects (tax, listing requirements, and industry concentration) from that of the U.S. Lastly, we provide an insight into the informational value of the data provided in IPO prospectuses. To the extent that investors can determine the significance of factors listed in IPO prospectuses in relation to the future performance and survivorship of firms, this paper provides an understanding of the relative importance of these factors.

The remainder of the paper is set out as follows. Section 2 provides a brief account of the prior literature related to survival analysis of IPOs and provides an understanding of characteristics of firm and the issue chosen in this paper. Section 3 discusses the data and the methodology of Cox proportional hazards model. Section 4 examines the empirical results and Section 5 concludes the paper.

LITERATURE REVIEW

There is a limited amount of published research into the survival of firms following their IPO. Many papers include survival as a side issue rather than the focus of the paper, others choose to focus on specific groups of IPOs, and this limits the application of the results. Differences in definitions as to what constitutes survival and non-survival and non-conformity in the length of the observation period are also apparent. It should also be noted that of the papers which analyse survival, only a few use the Cox proportional hazards model with most papers using regression models. The most relevant literature to this paper can be categorised as research into the survival of firms following IPOs, research into long run performance of IPOs (due to the intuitive relationship between survival and long run performance) and research into the characteristics of IPOs in Australia (since this paper is concerned with the informational value of the prospectus).

The research of Hensler, Rutherford and Springer (1997) into survival is significant. Using a Cox proportional hazards model for a sample of American IPOs listed between 1976 and 1984, they examine the relationship between certain firm characteristics and the probability of survival. Hensler, Rutherford and Springer (1997) find that age at listing, size of the offering, percentage of shares owned by insiders and the level of IPO activity in the overall market are all positively related to survival. Their results also indicate that the survival time following an IPO decreases with the number of risk factors listed in the prospectus and also with the general market level at the time of listing. Hensler, Rutherford and Springer (1997) also find that the industry in which the firm operates is also significant to their survival which complements the findings of a similar study of Portuguese firms. Mata and Portugal (1994) found that for a sample of Portuguese firms, survival varied positively with start up size, the number of plants operated, and the industry growth rate but was negatively related to the extent of entry into the industry.

Jain and Kini (1999) examine the life cycle of IPOs in the U.S. between 1977 and 1990. Classifying firms into three categories of survivor, non-survivor and acquired, Jain and Kini (1999) examine factors influencing the transition into one of these three categories following the IPO. Using multinomial logistic regression, they establish that size, pre-IPO operating performance and investment banker prestige are positively related while firm risk, industry barriers to entry and industry concentration are negatively related to future survival. Using a regression model Platt (1995) analyses the survival of American firms for the following three years after issue, concentrating on bankruptcy as the only reason for non-survival and focusing on the importance of capital structure to IPOs and their endeavours to avoid bankruptcy. Testing for a group of financial ratios Platt (1995) finds that some operating financial ratios (long-term debt, interest expense to cash, and inventory to cash flow) are positively related to the likelihood of failure.

The effect of the form of the offering on the survival of a firm is investigated by Shultz (1993). Relying on the agency cost argument that a bundled share and option provides opportunities for managers to avoid capital market scrutiny in subsequent capital offerings Shultz (1993) find that firms which conduct bundled offerings consisting of a share and option are less likely to survive than firms which issue shares alone. However, in a similar study of Australian IPOs, How and Howe (2001) found no significant difference between the survival of firms issuing ‘packaged’ offerings and straight share offerings. They attribute the difference in finding, among other factors, to ‘differences in opportunity set faced by Australian firms compared to U.S. companies’.

Bhabra and Pettway (2003) examine the value of information contained in prospectuses in their analysis of the financial and operating performance of IPOs. Their findings suggest that while prior profitability, firm size, relative offer size and the degree of underpricing are related to one-year abnormal returns, there is no evidence to suggest a relationship between prospectus information and long run performance. However, as a complement to their study between prospectus information and performance they examine survival. Using a logistic regression model which classifies a firm depending upon whether or not it fails or delists within five years, relative offer size, spending on research and development, the size of the firm and the number of risk factors in the prospectus are found to be significant.

Ritter (1991) investigated the long run under-performance of IPOs by analysing the three year buy and hold returns for companies which listed between 1975 and 1984 and found that the relative under-performance of IPOs, when compared to matched firms, was greatest for firms with small offer sizes. Ritter (1991) also found a strong positive monotonic relationship between the age of the firm going public and its corresponding aftermarket performance. Lee, Taylor and Walker (1996) document the long run under-performance of Australian industrial IPOs listed between 1976 and 1989. They find that there is some evidence to suggest that smaller issues and issues that are fully subscribed and listed relatively quickly are not associated with under-performance. An examination of Australian mining IPOs between 1979 and 1990 (How, 2000) finds that is no significant evidence of under-performance during the three year period after listing and when contrasted with the results of Lee, Taylor and Walker (1996) provides evidence that the relative performance of IPOs varies with industry.

Concentrating instead on the operating performance of firms after an IPO Jain and Kini (1994) found a positive relationship between managerial ownership retention and post-issue operating performance (consistent with both the agency theory hypothesis and signalling theory hypothesis). Balatbat, Taylor and Walter (2004) found during their investigations into the operating performance of Australian IPOs between 1976 and 1993 that operating performance is related to ownership structure and corporate governance characteristics.

An investigation into the board characteristics of Australian IPOs between 1994 and 1997 was conducted by Da Silva Rosa, Izan and Lin (2001) while Dimovski and Brooks (2003) examined financial and offer characteristics of Australian IPOs which listed between 1994 and 1999. Da Silva Rosa, Izan and Lin (2001) find that less than a third of the boards consist of a majority of independent directors and also find that only about half of the boards have an independent chairman, suggesting that there is a tendency for IPOs not to follow what is considered ASX best practice. Dimovski and Brooks (2003) examine the structure of the offerings and find that 22% had options attached, 82% were underwritten and 67% had an independent accountant that was one of the big-five accounting firms. They also examine issue price, issue size, forecast earning to offer price ratio and forecast dividend to offer price yield and find that for each of these factors the difference between the mean and the median is significant in size, whilst the range (difference between the maximum and minimum) is also relatively large. The significant differences in the types of firms, the non-conformance of the statistics to a tighter spread (as highlighted by Dimovski and Brooks (2003)), and the relatively high rate of failure of IPOs suggest that relationships exist between these characteristics and the likelihood of survival.

OFFER AND FIRM CHARACTERISTICS OF IPOs AND FUTURE SURVIVAL

The fundamental hypothesis of this paper is that the information contained in the prospectus foreshadows the likelihood of survival or failure for an IPO. Similar to studies cited earlier, we conjecture that the characteristics of an IPO at the time of listing have an influence on the future operational well being of the firm. In the case of IPOs, the majority of available information is contained in the prospectus. Later in this paper, we extract several firm characteristics from IPO prospectuses and provide comparisons of relative survival amongst firms with different characteristics. A brief explanation of the justification behind each characteristic used and its expected relationship with the probability of future survival (shown in parentheses) follows.

Age at Offering (+): It is expected that the age at offering of the IPO is positively related to its likelihood of survival. Established firms, as measured by age at the time of offering, are expected to be more stable and are more likely to survive, while younger firms are considered unproven in their business model. Further, it is likely that more information is available for older firms and, as a result, less uncertainty and risk is associated with older firms.

Offer Price (+): The offer price of the firm is expected to be positively related to survival. Low issue prices are associated with speculative stocks. On the Australian Stock Exchange the minimum issue price is $0.20.

Size of Offering (+): The size of the offering is expected to be positively related to the survival of the firm. Apart from the fact that larger offerings are associated with larger firms, larger offerings are also indicators of market confidence. Large offerings, ceteris paribus, are subject to more capital market scrutiny and are favoured by institutional investors (Hensler, Rutherford and Springer, 1997; Jain and Kini, 1999) and performance (Ritter, 1991).

Ownership Retained (+): It is expected that the percentage of equity retained by the original owners should be positively related to survival. The level of ownership acts as a signal about the quality of the issue and its future prospects. A larger share of ownership net of the offerings, reduces agency costs and provides incentive for the original owners to use in future the funds raised in the most value maximising way.

Attachment of Options to the Offer (-): It is expected that bundled IPOs (a common share bundled with a warrant) will be negatively related to the likelihood of survival. According to agency theory, bundled offerings provide an incentive for management to avoid capital market scrutiny for future investments and increase the likelihood of cash being squandered on unprofitable opportunities.

Underwriter Backing (+): It is expected that firms with underwriter backing are more likely to survive than firms without backing. The reliance of underwriters on their reputation to attract future clients means that it is in the underwriter's best interest to endorse firms with sound prospects. This coupled with the fact that most underwriters invest in the offers they underwrite, is a signal of positive future prospects.

Issue Costs as a Percentage of the Offer Proceeds (-): The percentage of issue costs to the offer size should be negatively related to the survival of the firm. This is based on the notion that issue costs, associated with marketing the issue and underwriting are incurred in order to ensure the issue is fully subscribed and that the maximum amount of capital is raised. It is reasonable to assume that, ceteris paribus, a firm with good prospects will be able to launch an IPO with lower issuing costs than otherwise.

Auditor in the Big-Five (+): The use of an auditor from one of the big-five accounting firms (PricewaterhouseCoopers, KPMG, Arthur Anderson, Deloitte Touche Tohmatsu and Ernst and Young) should add credibility to the information contained in the prospectus. While the well documented public demise of Arthur Anderson has detracted from this credibility, the large accounting firms are recognized for their name and reputation by the common investor and serve as a signalling mechanism. As a result, it is contended that the accounting information emanating from the big-five accounting firms is of better quality contributing to a better future for the firm.

Earnings to Price Ratio (-): The ratio of the forecast earnings per share to the offer price (E/P ratio) should be negatively related to survival. Since E/P ratio is a measure of the expected return of the company, speculative firms associated with increased risk and uncertainty and therefore higher E/P ratios, are less likely to survive than stable firms.

Forecast Dividend Yield (+): Dividends are typically associated with firms which have a stable income stream and therefore more confidence and certainty about their future prospects.

Number of Risk Factors in the Prospectus (-): With the requirement of disclosure of all material information, Australian firms are required to list and describe risk factors in the prospectus. The informational value of risk factors in the prospectus is considered significant (Hensler, Rutherford and Springer (1997) and Bhabra and Pettway (2003)).

Non-Executive Chairman (+): A non-executive chair is associated with good governance policy of a corporation. The expectation that a non-executive chair will increase the likelihood of survival is based on the argument that a board led by an independent leader will better represent the interests of the shareholders and more effectively monitor the managers of the company. A reduction in agency costs and an improvement in operating performance should translate to an improved probability of survival.

Number of Directors (+): The number of directors should be positively related to survival. Guidelines of good governance endorse larger board sizes based on the notion of greater accountability. Greater monitoring should reduce agency costs and discourage the misallocation of funds, ensuring that the decisions are value maximising.

Percentage of Independent Directors (+): The level of independence of the board of directors is also expected to be positively related to the survival of the IPO. A board that comprises of a majority of independent members should be a more effective monitor. Technically, there is a slight difference between a non-executive director and an independent director but for the purposes of ease of measurement, this paper assumes that all non-executive directors are independent.

Industry (?): Just as the level of relative performance varies with industry, the rate of survival should also vary with industry. It is expected that industries with small barriers to entry and more competitive industry environment, should be negatively related to survival. Therefore, we classify each firm according to industry and control over empirical analysis for this factor.

Leverage (-): The trade-off theory of capital structure postulates that the financing decisions made by a firm balance the benefits (tax shields) and costs (financial distress) of debt. As the level of debt increases, the likelihood of financial distress becomes greater. Thus it is expected that the survival of the firm is negatively related to its level of leverage.

Profitability (+): The profitability of the firm is a key survival factor. Firms, which are more profitable from the beginning of their public life, are likely to be so in future and thus profitability is positively associated with survival.

Size of the Firm (Total Assets) (+): Larger firms are better positioned than smaller firms to weather tough economic periods or recover from past mistakes in strategy and direction. Therefore, firms that have a larger asset base have a better ability to prolong survival than firms with a smaller asset base.

Liquidity of Assets (+): Liquidity of assets ensures that a firm's assets are flexible while liquidity is also a measure of efficiency. Firms, which have liquid assets, are better positioned to use their resources to maximum effect in order to avoid financial distress or bankruptcy. Hence liquid firms are more effectively able to prolong survival. The more liquid the firm's assets are, the greater the firm's likelihood of survival.

Total Asset Turnover (+): Total asset turnover is a measure of efficiency in utilisation of assets. The efficiency of a firm contributes to its competitiveness and ultimately its survival (Trimbath, Frydman and Frydman, 2001). As a result, it is expected that this ratio should be positively related to survival.

A list of above characteristics, as they were measured as well as their predicted relationship to survival probability is summarised in Table 1.

Table 1: Definitions of Firm Characteristics and Their Expected Relationship to Survival Probability

Firm Characteristic	**Definition and measurement**	**Expected relationship to survival**
Age at Offering	The difference between the year in which the prospectus was lodged and the year in which the company was founded.	+
Offer Price	The offer price listed in the prospectus, or the midpoint of the price range.	+
Size of the Offering	The size of the offering listed in the prospectus, or the minimum subscription amount.	+
Ownership Retained	The difference between the market capitalization of the company after listing and the size of the offering, divided by the market capitalization of the company after listing.	+
Attachment of Options to the Offer	A value of 1 was attributed to offerings which had options attached, and a value of 0 otherwise.	-
Underwriter Backing	IPOs which had an underwriter recorded a value of 1 and a value of 0 otherwise.	+
Issue Costs	The ratio of the issue costs of the offering to the size of the offering as a percentage of the offer proceeds	-
Auditor in the Big 5	IPOs which had an auditor belonging to one of the Big 5 Accounting firms recorded a value of 1, and a value of 0 otherwise.	+
Earnings to Price Ratio	The ratio of the forecast first full year earnings to the offer price.	-
Forecast Dividend Yield	The ratio of the forecast first full year dividends to the offer price.	+
Number of Risk Factors in the Prospectus	The number of risk factors listed in the prospectus.	-
Non-Executive Chairman	If the Chairman listed in the prospectus is a non-executive director then a value of 1 is recorded, and a value of 0 otherwise.	+
Number of Directors (Including Chairman)	The number of directors (including the Chairman) listed in the prospectus.	+
Percentage of Independent Directors	The ratio of the number of non-executive directors to the number of directors, as listed in the prospectus.	+
Industry	The industry of the IPO.	?
Leverage	The ratio of long term debt to total assets for the first available full year results after listing.	-
Profitability	The ratio of EBIT to Total Assets for the first available full year results after listing.	+
Size of the Firm	The total assets of the firm according to the first available full year results after listing.	+
Tangibility of Assets	The ratio of the value of Plant, Property and Equipment to Total Assets according to the first available full year results after listing.	+
Total Asset Turnover	The ratio of Total Revenue to Total Assets for the first available full year results after listing.	+

METHODOLOGY AND DATA

The Cox Proportional Hazards Model

This paper uses the Cox proportional hazards model to examine the survival of IPOs. In this section, we briefly explain the methodology and features of this model. The probability of survival from one time period to the next is taken as a function of the force of mortality or the hazard rate. The hazard rate is the rate at which a life, alive at time t, is dead at time t + h, where h is a very small time interval. Thus the hazard rate can be considered as the instantaneous rate of change from a state of survivor to the state of non-survivor. Therefore, the lower the force of mortality the more likely the entity under observation (in this case the IPO) will survive.

The model takes the form:

$$\lambda\ (t;\ z_i) = \lambda_0\ (t)\ \times \exp\ (\beta z_i^T) \qquad (1)$$

In the above equation $\lambda\ (t;\ z_i)$ is the hazard rate at time t of the entity i and $\lambda_0\ (t)$ is the baseline hazard function of t (the hazard rate at time t for an entity with z_i values equal to 0) and is independent of the variables. In the model β represents a $1\ \times p$ vector of regression parameters for the variables ($\beta_1, \beta_2, ..., \beta_p$), z_i is a $1\ \times p$ vector of covariates.

Thus the hazard rate at time t of an IPO is a function of an underlying baseline hazard function (describing the expected time to failure of the sample of IPOs) and a vector of factors which have been hypothesised as affecting the future survival. While some papers have assumed a distribution for the baseline hazard, for the purposes of this paper such an assumption is not necessary.

The proportional hazards model takes the form:

$$\lambda\ (t;\ z_i)\ /\ \lambda\ (t;\ z_j) = \exp\ (\beta z_i^T)\ /\ \exp\ (\beta z_j^T) \qquad (2)$$

The proportional hazards model allows for the relative mortality of two entities to be examined (in this case IPO_i and IPO_j). Note that in above formulation it removes the need for parametric assumptions about the distribution of the baseline hazard as the hazard rate is relative. Since the Cox proportional hazards model allows for β to be estimated without any assumption about the distribution of the baseline hazard, the model is semi-parametric. This formulation also effectively allows for censored and whole lifetime data to be used in the construction of the model and is another advantage of using this model. Censoring refers to IPOs which survive for the period of the observation, while whole lifetime data refers to those IPOs which fail during the set sample period.

The values for the regression parameters (β) are estimated using the maximum likelihood procedure:

$$L\ (\beta) = \prod \exp\ (\beta z_i^T)\ /\ \sum \exp\ (\beta z_j^T) \qquad (3)$$

The above likelihood equation is the product of the force of mortality of the IPO which dies at time t_j, divided by the total force of mortality for the IPOs which are at risk of dying at time t_j. Thus by taking logs and differentiating with respect to β the maximum likelihood estimate of each of the regression parameters is obtained.

The sign and magnitude of these regression parameters indicate the relationship of the variable to survival. As stated earlier, the lower the force of mortality the more likely it is that the entity will survive. Negative values of β_i indicate that the ith factor in the model is positively related to survival, while a positive value of β_i will increase the force of mortality and indicate a negative relationship to survival. A step log-likelihood model is used to determine whether variables should be included in the model or not.

Data

We obtain an initial sample of firms from the *Connect-4 Company Prospectuses* database. We collect a sample of firms that issued a prospectus in the years 1995, 1996 or 1997. For these firms we obtain listing information from the *Aspect Huntley Financial Analysis* database to ensure that the prospectus was for an IPO (since the *Connect 4* database does not differentiate between initial and seasoned public offerings prior to 1999). The date of listing was also obtained and IPOs in the sample, which did not list at least seven years prior to 31 December 2004, were excluded from the sample with seven years being chosen to represent a full business cycle. The industry classification of these firms was obtained from the *Aspect Huntley* database and firms classified as Listed Property Trusts (LPT) were removed from the sample as they are subject to different listing rules. This exclusion of LPTs from our sample is consistent with the practice of excluding REITs (Real Estate Investment Trusts) in other studies.

Our final sample consists of 154 IPOs that listed on the Australian stock exchange between 1995 and 1997 and for each of these 154 IPOs we collect from their prospectuses and the *Aspect Huntley* information for each of the factors listed in the previous section. The trading status, date of delisting and reason for delisting is cross-checked from information on the delisted website (delisted.com.au).

Similar to Bhabra and Pettway (2003), this paper defines a survivor as simply any firm which is not delisted at the end of seven years meaning that firms which are delisted, suspended, acquired or merged within seven years of their listing date are classified as non-survivors. This is based on the belief that as long as the stock continues to be listed, an upside potential for the stock price exists. The classification of acquired or merged firms as non-survivors is consistent with Welbourne and Andrews (1996) who found that seven out of eight merged firms experienced declining stock prices prior to the merger. Further, acquired and merged firms no longer possess the same corporate structure as non-survivors. The inclusion of suspended firms is based on the notion that suspension from trading merely foreshadows the company being delisted in the future.

The observation period of our sample is seven years after the date of issue or until the firm is delisted. Of our final sample of 154 IPOs 110 survive at least seven years. All results reported in this paper are based on this seven-year sample. We also repeat this procedure and all analysis for a five-year survival period to create another sub sample which has 123 IPOs surviving after five years. The results for the five-year observation period are similar to the seven-year observation period. In this paper, we report our findings of the seven-year period analysis.

RESULTS

Table 2 shows descriptive statistics of the characteristics of the firms in the sample. Variables which have indicator variables are shown as percentages of the sample. These indicator characteristics are: attachment of options to the offer, underwriter backing, use of an auditor in the big-five and the classification of the chairman as a non-executive. The median age of firms in the sample is 3.5 years and the median size of the offering is around $8 million indicating that the majority of IPOs in Australia are relatively young and small. It is also interesting to note that the mean and median percentage of equity ownership retention is around 50% and hence the original owners retain majority control of the company on average. There is a considerable variation on the type of offering amongst the sample of these 154 firms. In this sample, 22% have options attached to their shares to raise additional capital later, 76% use an underwriter and 56% have an auditor which is one of the big-five accounting firms. The cost of offering the issue appears to be relatively high as a percentage of offer proceeds (average 9.14%), while the average firm has a forecasted rate of return of around 5.5% (E/P ratio) and a forecast dividend yield of 2.7%.

Table 2: Firm and Offer Characteristics

	Mean	Median	Std. Deviation	Min	Max	25%	75%
Age at Offering (years)	15.010	3.500	27.660	0	157.00	1.000	14.000
Offer Price ($)	4.250	0.500	40.260	0.200	500.00	0.250	1.200
Log of Offering Size ($)	16.480	15.890	1.770	13.820	23.40	15.200	17.670
Ownership Retained (%)	49.570	50.780	26.260	0	99.52	35.180	67.760
Attachment of Options (%)	22.080	-	-	-	-	-	-
Underwriter Backing (%)	75.970	-	-	-	-	-	-
Issue Costs as % of Offer (%)	9.140	7.810	9.310	.000	73.02	4.390	10.580
Auditor in the Big 5	56.490	-	-	-	-	-	-
Earnings to Price Ratio	0.055	0.034	0.068	-0.120	0.234	0.000	0.109
Dividend Yield	0.027	0.000	0.038	0.000	0.140	0.000	0.055
Number of Risk Factors	11.377	11.000	5.444	0.000	30.000	7.000	14.000
Non-Executive Chairman (%)	66.880	-	-	-	-	-	-
Num of Dir including chair	5.110	5.000	1.686	3.000	12.000	4.000	6.000
Percentage of Independent Dir (%)	56.360	60.000	23.540	0.000	100.000	48.210	75.000
Leverage	0.076	0.007	0.137	0.000	0.648	0.000	0.079
Profitability	-0.017	0.000	0.184	-1.406	0.509	-0.050	0.060
Log of Total Assets ($)	17.330	17.000	2.010	12.740	24.220	15.780	18.670
Liquidity of Assets	0.234	0.114	0.273	0.000	0.971	0.016	0.353
Total Asset Turnover	0.501	0.120	1.020	0.000	3.164	0.015	0.477

All values are obtained from IPO prospectuses and annual reports. Description and measurements of variables are contained in the data section.

It is also interesting to note that not all IPOs follow the ASX recommendations for good governance principles. While it is not compulsory for firms to follow ASX recommendations it is required that the company address each of the breaches in their annual report. Consistent with Da Silva Rosa, Izan and Lin (2004) the majority of IPOs have less than the recommended number of six directors (the mean number of directors is 5.11) while only 25% of IPOs have more than the recommended six directors on the board. However, 67% have a non-executive as a chair and the majority of firms have a board that could be considered independent, on which the non-executive directors outnumber the executive directors on the board. One way to interpret these findings is that for many IPOs, the perceived benefits associated with corporate governance have been outweighed by the cost of compliance. Another noticeable aspect is that for many of the factors there is a distinct difference between the mean and the median. Such a pronounced difference suggests that the collected data is skewed in distribution. In order to address this issue, we employ non-parametric tests for both the difference in means and medians.

Table 3 shows the life-table of survival of the 154 firms in the sample, from year zero (time of issue) to year seven and a breakdown of terminations by year of age. The life table indicates that of the 154 firms in the sample 31 are classified as non-survivors by the end of year five while 44 are classified as non-survivors by the end of year seven. This corresponds to probabilities of 20% and 29% that a firm will effectively fail within five and seven years of listing, respectively. While the differences in characteristics for survivors and non-survivors are discussed in more detail later, the results are similar to that of Lee et al (1996) who found that 17% of Australian firms listed between 1976 and 1989 did not survive for more than three years. For American firms listed between 1977 and 1990 Jain and Kini (1999) found that 31% of IPOs did not survive more than five years.

Table 3: Life Table

Interval Start Time	Number Entering Interval	Number Terminating	Proportion Terminating	Proportion Surviving	Cum. Proportion Surviving at End of Interval	Std. Error of Cumulative Proportion Surviving at End of Interval	Probability Density	Std. Error of Probability Density	Hazard Rate	Std. Error of Hazard Rate
0	154	0	0.00	1.00	1.00	0.00	0.000	0.000	0.00	0.00
1	154	5	0.03	0.97	0.97	0.01	0.032	0.014	0.03	0.01
2	149	8	0.05	0.95	0.92	0.02	0.052	0.018	0.06	0.02
3	141	10	0.07	0.93	0.85	0.03	0.065	0.020	0.07	0.02
4	131	8	0.06	0.94	0.80	0.03	0.052	0.018	0.06	0.02
5	123	8	0.07	0.93	0.75	0.04	0.052	0.018	0.07	0.02
6	115	5	0.04	0.96	0.71	0.04	0.032	0.014	0.04	0.02

Life table is constructed using the proportional hazard model with the starting and ending number of observations determined by actual sample sizes.

In order to gain an insight into whether firm characteristics affect survival, the differences between the two samples are of interest. Before we apply the hazard model to estimate the probability of survival, we employ simple difference in means and medians to see if the characteristics of survivor firms are different from that of the non-survivors. As noted earlier, in order to address the skewness in distribution of characteristics, we employ non-parametric tests which do not rely on the assumption that characteristics are normally distributed. We employ the non-parametric Kruskal-Wallis test for difference in means and medians to detect differences in distribution location between the two sub-samples (Webster (1995)).

The comparison between survivors and non-survivors at time seven shows that there is a significant difference between the mean and median of the two groups for the number of risk factors, total assets (firm size) and the degree of leverage at the time of listing. The mean and median of non-survivors for these characteristics exceed the corresponding statistics for the survivor group. Consistent with the results of Hensler, Rutherford and Springer (1997) and Bhabra and Pettway (2003), our findings support the hypothesis that the number of risk factors listed in the prospectus should be negatively related to survival. Firms with greater levels of risk are more likely to suffer operational losses, which over time erode their asset base and financial resources. However, contrary to expectation, firm size (as measured by total assets) is found to be larger for the non-survivor group. This result contradicts the hypothesis that larger firms which have greater asset bases may better able to weather tougher economic periods or recover from mistakes in strategy or direction. As for leverage, the implied relationship between the level of long term debt and survival, is consistent with increased financial distress costs leading to failure.

Results contained in Table 4 provide evidence that the number of risk factors, the size of the firm (value of total assets), and the leverage of a firm provide a basis to identify firms likely to survive for more than seven years. It may come as surprise that of the chosen 19 characteristics only three are significantly different across the survivor and non-survivor groups. Possible reasons for lack of distinguishing characteristics would be due to lack of industry classification and precision in mortality rates. To the extent that survival characteristics vary across industry, these differences are not apparent in Table 4. To control for the industry variable, we include an industry variable in our analysis later allowing for more definitive conclusions regarding the factors affecting survival.

Table 4: Difference of Means and Medians

	Mean					Median				
	Survivors	Non-Survivors	Simple Difference	Kruskal-Wallis Chi-Square Difference	KW Asymptotic significance of diff.	Survivors	Non-Survivors	Simple Difference	Kruskal-Wallis Chi-Square Difference	KW Asymptotic significance of diff.
Age at offering (years)	15.03	14.98	-0.05	0.05	0.213	4	2	-2	2.04	0.154
Offer price ($)	5.35	1.49	-3.86	2.44	0.119	0.5	1	0.5	2.19	0.139
Size of Offering ($, in Log)	16.49	16.45	-0.04	0.02	0.893	15.89	16.12	0.23	0.84	0.359
Ownership retained (%)	47.38	55.02	7.64	2.42	0.12	50.22	56.77	6.55	1.15	0.285
Attachment of option (%)	24.55	15.91	-8.64	1.35	0.245	0	0	0	1.36	0.243
Underwriter backing (%)	73.64	81.82	8.18	1.15	0.285	100	100	0	-	-
Issue costs[a] (%)	8.95	9.61	0.66	0.5	0.479	8.08	6.78	-1.3	1.15	0.285
Auditor in big-5[a] (%)	56.36	56.82	0.46	0	0.959	100	100	0	-	-
E/P ratio (%)	5.36	5.72	0.36	0.37	0.545	0	4.98	4.98	3.19	0.44
Forecast div. yield (%)	2.8	2.61	-0.19	2.4	0.877	0	0	0	0.59	0.44
Number of risk factors	10.58	13.36	2.78	7.57***	0.006	10	12.5	2.5	13.61***	0.00
Non-exec chairman[a] (%)	67.27	65.91	-1.36	0.03	0.871	100	100	0	-	-
Number of directors	5.07	5.23	0.16	0.95	0.33	5	5	0	0.78	0.379
Independent directors (%)	58.13	51.95	-6.18	1.29	0.256	60	60	0	0.95	0.330
Leverage	0.0657	0.1057	0.04	4.19**	0.041	0	0.0268	0.0268	3.993**	0.046
Profitability	-0.0194	-0.0097	0.0097	0.62	0.804	0	0.0015	0.0015	0.003	0.956
Total assets ($, in Log.)	17.15	17.82	0.67	3.56*	0.059	16.73	17.44	0.71	2.59	0.108
Liquidity	0.237	0.2236	-0.0134	0.022	0.881	0.1044	0.1193	0.0149	0.003	0.959
Total asset turnover	0.4971	0.5102	0.0131	0.962	0.327	0.1098	0.2214	0.1116	1.488	0.223

[a] *All values are less than or equal to median. Median tests can not be performed.*

The results of the Cox proportional hazards model are presented in Table 5, which censors survivors at the end of year seven. We employ three models and an overall best-fit model. Model 1 represents the Cox proportional hazards model with 14 factors, which are available in the prospectus at the time of listing. Model 2 adds industry variables to Model 1 for firms belonging to the natural resource, finance, business services or manufacturing industries. Model 3 includes financial characteristics. Model 4 is the model of best fit overall and is determined by using a backward likelihood ratio technique to minimize the overall significance level of the model.

An examination of the overall significance of the models shows that the inclusion of industry factors and the financial characteristics improves the significance level of the estimation. When observing the survival of IPOs over a seven-year-time period the level of significance improves from 35% (Model 1) to about 0.7% (Model 3). The model of best fit (Model 4) is well below the 1% level of significance and produces seven factors that are significant at a significance level of 10%. These factors include the size of the offering, underwriter backing, forecast dividend yield, number of risk factors listed in the prospectus, size of the firm and whether or not the firm is in the finance or natural resources industries.

Table 5: Cox Proportional Hazards Model

Characteristics	Model 1 β	Model 1 Sig.	Model 1 Exp (β)	Model 2 β	Model 2 Sig.	Model 2 Exp (β)
Age at Offering	0.0033	0.7066	1.0033	-0.0008*	0.9303	0.9992
Offer Price	-0.0107	0.8162	0.9893	-0.0132	0.8596	0.9869
In (Size of Offering)	-0.0678	0.6746	0.9345	-0.1620	0.3816	0.8504
Ownership Retained	1.2085	0.1863	3.3483	0.5449	0.5585	1.7245
Attachment of Options=1	-0.6580	0.2176	0.5179	-0.5751	0.3112	0.5627
Underwriter Backing = 1	0.7872	0.1180	2.1972	0.9628**	0.0738	2.6189
Issue Costs	-0.1770*	0.9374	0.8378	-1.4477	0.5838	0.2351
Auditor in the Big 5 = 1	0.0719	0.8440	1.0746	0.0277	0.9421	1.0281
Earnings to Price Ratio	0.9921	0.7980	2.6970	-1.5341	0.6842	0.2157
Forecast Dividend Yield	1.5523	0.8213	0.2118	-6.4883	0.3618	0.0015
Number of Risk Factors	0.0734**	0.0327	1.0761	0.0675**	0.0596	1.0698
Non-Exec Chair = 1	0.2794	0.5258	1.3223	0.3425	0.4520	1.4085
Num. of Directors (incl. Chair)	0.0272	0.8558	1.0275	0.0208	0.8984	1.021
Percentage Independent Directors	-0.5361	0.5250	0.5850	-0.6880	0.4191	0.5026
Business Services				-0.7366	0.3065	0.4787
Finance				-0.8000	0.2617	0.4493
Manufacturing				-0.3671	0.5399	0.6927
Natural Resource				-1.6854***	0.0047	0.1854
Overall Score		**Model 1**			**Model 2**	
- 2 Log Likelihood		327.6303			318.18	
Chi Square		15.4047			25.781	
df.		14.0000			18.0000	
Sig		0.3511			0.1049	

Characteristics	Model 3 β	Model 3 Sig.	Model 3 Exp (β)	Model 4 β	Model 4 Sig.	Model 4 Exp (β)
Age at Offering	-0.0020	0.7830	0.9980			
Offer Price	-0.0140	0.8000	0.9860			
In (Size of Offering)	-0.9440	0.0060	0.3890	-0.4245*	0.0059	0.6541
Ownership Retained	-0.8560	0.4320	0.4250			
Attachment of Options=1	-0.7840	0.2010	0.4570			
Underwriter Backing = 1	0.9150	0.1060	2.4970	0.8428	0.0914	2.3229
Issue Costs	-5.3740	0.1010	0.0050			
Auditor in the Big 5 = 1	-0.4240	0.3570	0.6540			
Earnings to Price Ratio	-0.7070	0.8710	0.4930			
Forecast Dividend Yield	-10.9000	0.1690	0.0000	-9.4857*	0.0689	0.0001
Number of Risk Factors	0.0250	0.4960	1.0260	0.0534*	0.0722	1.0549
Non-Exec Chair = 1	0.4850	0.3120	1.6240			
Num of Directors (incl. Chair)	-0.0730	0.6820	0.9300			
Percentage Independent Directors	-0.6150	0.4950	0.5410			
Business Services	-0.2530	0.7450	0.7760			
Finance	-2.0450	0.0360	0.1290	-1.1742*	0.0821	0.3091
Manufacturing	-0.3080	0.6250	0.7350			
Natural Resource	-1.6010	0.0120	0.2020	-1.0966**	0.0257	0.3340
Leverage	0.6720	0.6920	1.9590			
Profitability	-1.3130	0.3430	0.2690			
In (Total Assets)	0.9220	0.0040	2.5140	0.4455**	0.0108	1.5613
Liquidity	-0.3600	0.6390	0.6970			
Total Asset Turnover	-0.2910	0.2160	0.7480			
Overall Score		**Model 3**			**Model 4**	
- 2 Log Likelihood		305.10**			317.51***	
Chi Square		42.7957			28.1847	
df.		23.0000			7.0000	
Sig		0.0073			0.0002	

Hazard rates, β, are coefficient estimates from Cox proportional model and exp (β) are relative hazard rates of non-survivors. A negative value of β reduces the hazard rate and indicates that the factor is positively related to survival, while a positive value of β indicates that the factor is negatively related to survival. The relative hazard rate value is represented by Exp (β). Exp(β) being less than 1 indicates that the factor is positively related to the likelihood of survival, while an Exp(β) which is greater than 1 indicates a negative relationship to survival.

As indicated by the negative value of the β coefficient and a relative hazard rate value of *exp (β)* being less than one the size of the offering is negatively related to the likelihood of failure. This relationship is consistent with the hypothesis that the size of the offering should be positively related to survival because larger offerings are a signal of market confidence. After all, it is harder to raise a large amount of capital for a company unless there is strong investor support. This is consistent with the findings of Hensler, Rutherford and Springer (1997).

It is also evident that firms classified as belonging to the natural resource or finance industries are more likely to survive than IPOs in other sectors. This result supports of the importance of the mining industry in the Australian economy and the relationship between survival and performance. The research of Lee, Taylor and Walter (1996) found evidence of the post-issue under-performance of Australian industrial IPOs, while Australian mining IPOs consistently outperform the market (How, 2000). Taken together with the evidence presented here, it implies that investors with investment horizons of less than seven years should choose firms in the finance or mining industries.

The significance of the number of risk factors listed in the prospectus was foreshadowed by the difference in means and medians presented in Table 3 and so it is not surprising that the number of risk factors is a significant factor in the proportional hazards model. Consistent with expectations, the number of risk factors is negatively related to survival and supports the notion that the number of risk factors is an appropriate proxy for the risk of a firm. Firms with a bigger list of risk factors are more likely to incur operational losses over time. The high informational value of the risk factor section in the prospectus is consistent with the findings for American IPOs of Hensler, Rutherford and Springer (1997) and Bhabra and Pettway (2003).

Dividend yield is strongly and positively related to survival. If a firm forecasts to pay a dividend in its first year this implies strong profitability from the beginning of its publicly traded life. However, it may also mean that because the firm is established and stable there is a limited amount of growth opportunities. In terms of minimizing risk, profitability and stability are favourable characteristics. Therefore, the evidence presented here strongly suggests that the forecast dividend yield of an IPO provides valuable information.

It is also worth noting that contrary to expectations, underwriter backing is negatively related to the survival of IPOs. The negative relationship between the use of an underwriter and survival should be treated carefully because it may be explained by the inability of the methodology employed here to differentiate between a reputable underwriter or otherwise. The results of the survival analysis indicate that some of the information available at the time of listing is valuable to investors concerned with the duration of their investment. However, the implications to the decisions of owners and management of factors which are not significant should also be considered. For example, such factors as the age of the firm at offering, the attachment of options, ownership retained and the board composition characteristics are found to have no significant effect on survival.

CONCLUSION

In this study, we examine the survival of Australian IPOs which lodged prospectuses in 1995, 1996, or 1997. We find that there is high failure rate among Australian IPOs with 20% and 29% of firms delisting within five and seven years of their listing date. The value of the public information available IPO prospectuses at the time of listing is tested using the Cox proportional hazards survival model and the results suggest that the size of the offering and the forecast dividend yield are positively related to survival, while the number of risk factors listed in the prospectus is negatively related to survival. Firms in the finance or natural resource industries are also more likely to survive than other firms. The implications of these results to investors are that they should invest in firms that have a low number of risk factors, a large offer size, a forecast dividend yield for the first full year after issue and which are either in the finance or natural resource industries. There is also some evidence to suggest that contrary to expectations, the size of the firm (as measured by total assets) and the use of an underwriter are negatively related to survival. Further research is needed to explain why firms with many assets are more likely to fail. Meanwhile, the distinction between underwriters based on reputation may also be helpful in explaining this result. However, some of the firm characteristics, offer characteristics, financial characteristics and corporate governance characteristics were found to have no significant impact on survival.

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FUNDAMENTAL ANALYSIS WITH ARTIFICIAL NEURAL NETWORK

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ABSTRACT

This study performs fundamental analysis and cross-sectional prediction of stock return with neural network technology. Eighteen financial ratios are used as the input vector and one-year ahead stock returns are used as the output vector. The fundamental analysis trading strategy generated by artificial neural networks yields an average annual abnormal return of 22.32% after controlling for market risk, book-to-market, size and momentum effects. Our results highlight neural network's ability to predict future returns in NYSE/AMEX/Nasdaq securities for the period 1990-2005. Artificial neural network technology stands out as a valuable tool for fundamental analysis and forecasting equity returns in the U.S. markets.

JEL: G11; M41; C45

KEYWORDS: Fundamental Analysis, Stock Market, Neural Network

INTRODUCTION

Fundamental analysis is an irreplaceable part of financial analysts', institutional and individual investors' toolbox (Carter and Van Auken 1990). Consistent with the high demand for fundamental analysis, prior literature documents evidence emphasizing fundamental analysis' predictive power of future returns (Ou and Penman, 1989; Lev and Thiagarajan, 1993; Abarbanell and Bushee, 1997, 1998; Greig, 1992; Houltsen and Larcker, 1992). Prior literature testing fundamental analysis's ability to generate future abnormal return assumes the relationship between financial ratios and returns to be linear. However, there is strong evidence indicating the relationship between key fundamental ratios and returns to be non-linear (Beaver, Clerke and Wright, 1979; Freeman and Tse, 1989; Abdel-khalik, 1990; Pahor and Mramor, 2001; Omran and Ragab, 2004). Nevertheless, prior studies rely on a linear estimation technique to measure fundamental analysis's predictive power of returns. Relying on a linear estimation method restrains the relationship to a linear one which limits the predictive power of fundamental analysis.

We examine whether a statistical method that does not assume a linear relationship generates significant returns adjusted for the beta and other previously documented anomalies such as the size, book-to-market and momentum anomalies. To test whether a non-linear assumption generates significant returns we propose the use of neural network technology.

The most powerful feature of artificial neural network technology is solving nonlinear problems that other classical techniques do not deal with. The artificial neural network (ANN) technology does not require any assumption about data distribution and missing, noisy and inconsistent data do not possess any problems. Another important aspect of the ANN is its ability to learn from the data. Artificial neural network technology is used in classification, clustering, predicting, forecasting, pattern recognition problems successfully. In most cases, ANN technology produces superior performance than other statistical techniques (Haykin, 1999; Hill, Marques, O'Connor and Remus, 1994; Cheng and Titterington, 1994; Zhang, Patuwo and Hu, 1998).

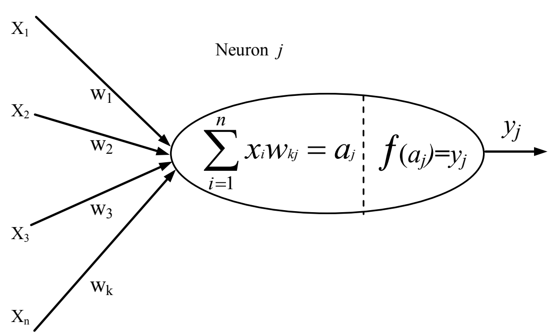
ANN technology has been commonly used in accounting and finance literatures specifically in bankruptcy prediction, bond rating, stock index forecasting, foreign exchange rate forecasting, credit evaluation, fraud detection (Wong, Bodnovich and Selvi, 1997; Wong and Selvi, 1998; Vellido, Lisboa and Vaughan, 1999; Krishnaswamy, Gilbert, and Pasley, 2000; Wong, Lai and Lam, 2000; Coakley and Brown, 2000). However, there is limited examination of the performance of ANN using U.S. equity data.

The remainder of the paper is organized as follows. The next section introduces the artificial neural network technology. The subsequent section describes the sample and performance measurement methodology. Section 4 presents our empirical results and section 5 concludes.

LITERATURE REVIEW

Artificial neural network is an information processing system, which simulates some human brain functionality like thinking and learning. The first commercial artificial neural network designer was Robert Hecht-Neilsen. He defined artificial neural network as a distributed information processing structure which consisted of simple and interconnected processing elements that produces dynamic outputs for each input (1990:2).

Figure 1: An Artificial Neuron



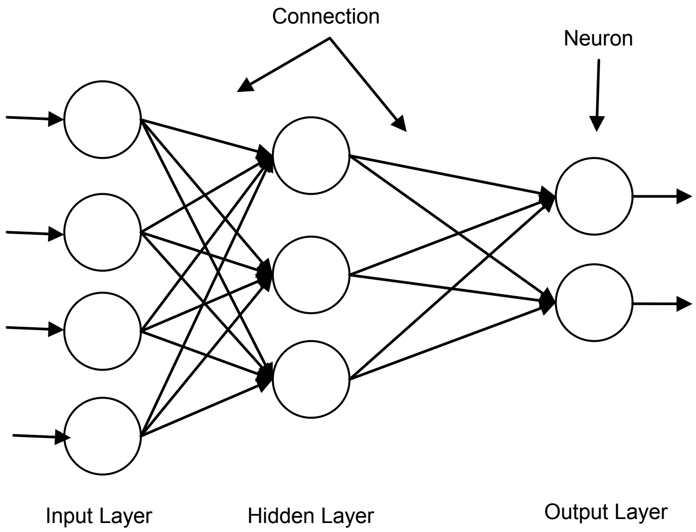
An artificial neuron sums all inputs and produces an output.

The major components of neural network are neurons, connections, and the learning algorithm. A neuron (j) is basic processing unit of a neural network. All neurons in the network receive a number of inputs (x_i) and generate an output (y_i). These outputs can be either an input to other neurons or output to outside of neural network (See Figure 1).

A neural network is built by interconnection of neurons (See Figure 2). The term "layer" is used to indicate the row of neurons in the artificial neural network. The first layer is identified as an input layer that receives data from outside of neural network. Output layer is the last layer in the neural network and sends calculated results to the outside. Layers between input and output are called hidden layers.

Data is transmitted among neurons through these connections. Any connection between neuron (k) and neuron (j) has a weight (wkj) and each input is multiplied by its respective weighting factor. This operation is especially important because every input is weighted.

Figure 2: An Artificial Neural Network



An artificial neural network consists of neurons and connections in a particular structure.

Connection types like feed-forward or feedback, number of layers and number of neurons at a layer are identified as architecture. In information processing, data enter input layer and flow on connections as well as neurons through network. In this information processing, data are processed at each neuron. Neurons contain two basic functions to process information: summation function and transfer function (See Figure 1). The summation function (1) gets the weighted sum of all inputs that reach neuron. This function determines stimulation level of neuron.

$$\sum_{i=1}^{n} x_i w_{kj} = a_j \tag{1}$$

The transfer function determines activation level of the neuron and relationship between stimulation level and output (*yi*). The crucial feature of transfer function is limitation of the output.

$$f(a_j)=y_j \tag{2}$$

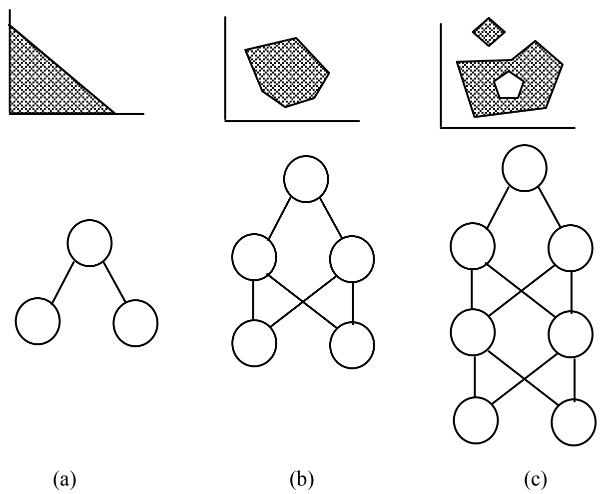
The most popular transfer function is sigmoid functions (3) that limit the output value to between 0 –1 for every input value.

$$y_j = \frac{1}{1+e^{-yi}} \tag{3}$$

Basically, a neural network learns from errors. The learning algorithm calculates errors from the difference between the network output and the desired output that is gathered from real world model. The learning algorithm uses the error term to adjust weights and repeats this procedure until the network produces desired outputs. When the neural network produces desired outputs for all input values it captures real world model that exists between inputs and outputs. Once this phase is completed the neural network is considered trained.

A neural network exhibits some statistical abilities depending on its architecture, especially, when faced with a classification problem whether an input should be classified class A or B. A neural network having threshold transfer function and one connection level can be used to separate the decision space in two categories with a line (See Figure 3.a). A neural network with two connection levels can separate the input space into open convex or close concave planes (See Figure 3.b). If neural network have tree connection levels, it has ability to separate the input space into a number of open or closed planes (See Figure 3.c) (Bishop, 1997:122-124).

Figure 3: Number of Hidden Layer in the Neural Networks and Their Statistical Abilities.



Neural networks can present some statistical capability according to their structures. (a) The neural network consists only input and output layer can separate input space into two linear pieces. (b) The neural network consist of a hidden layer can separate input space to closed concave and convex piece. (c) The neural network consist of more than one hidden layers can separate input space in to many open and closed pieces. Source- Bishop Christopher M., Neural Networks for Pattern Recognition, Clerendon Press, Oxford, 1997, p.123.

The artificial neural network method has many advantages compared to other techniques (Trippi and Turban, 1996; Schalkof, 1997; Goonatilake and Treleaven, 1995): i) Generalization: The most important advantage of neural network is learning. A trained neural network can reach satisfactory results with incomplete and faulty inputs. For instance, a neural network that is trained to recognize human faces can recognize individuals using photographs that were taken in various conditions (e.g. dark place, a different point of view and etc.). ii) Fault tolerance: Traditional computing systems are very sensitive to faults in systems. Any problem in these systems may cause the system to halt or create an important error in results. However, a neural network is not affected as much as a traditional computing system if some of neurons are damaged. iii) Adaptation: Neural networks can learn and adapt to different environments without requiring the completion of retraining. iv) Parallel distributed processing: All processing units in neural network run simultaneously, so the neural network is speedy. v) No assumption is needed: Artificial neural network makes no assumption about the used data. Any kind of data could be used as input for neural networks. This is the most important advantage of neural network technology.

The artificial neural network method also possesses disadvantages: i) Failure to achieve accurate results: This technology may produce unreasonable and irrelevant results. Sometimes neural networks cannot be trained. ii) Lack of explanation: While other statistical techniques generate understandable and interpretable parameters for problems, neural networks' weights cannot be interpretable. In other words the model used by neural networks remains as a black box. Neural network's features have attracted some interest from researchers and researchers have used neural network analysis to predict future returns and classify stocks to portfolios (Wong, Wong, Goh and Quek, 1992; Kryzanowski, Galler and Wright, 1993).

Nevertheless, prior studies are generally limited in nature: Quah and Srinivasan (1999) applied neural network analysis to Singapore Stock Exchange and Albanis and Batchelor (2007) applied this analysis to a sub-sample of firms listed in the London Stock Exchange.

DATA AND METHODOLOGY

Our sample includes all firms traded in the New York (NYSE), American (AMEX) and Nasdaq exchanges that have data available in both Center for Research in Security Prices (CRSP) and Compustat files. The sample spans over the fiscal years between 1962 and 2005. Companies with missing data are excluded. The final sample contains 136,924 firm-year observations**.** Eighteen financial ratios are calculated for each firm-year (see Table 1). For each firm year we compute the annual buy-hold return beginning four months after the fiscal-year-end and ending twelve months later. We then rank each firm-year into ten groups based on the annual buy-hold return.

Table 1: Financial Ratios

Panel A: Liquidity Ratios		
Current Ratio	Current Assets / Current Liabilities	data #4 / data #5
Quick Ratio	(Cash and Short-Term Investments Plus Receivables – Total) / Current Liabilities	(data #1 + data #2) / data #5
Short Term Debt to Equity	Current Liabilities / Stockholders' Equity	data #5 / data #216
Panel B: Solvency Ratios		
Debt to Equity	Total Liabilities / Stockholders' Equity	data #181 / data #216
Debt to Assets	Total Liabilities / Total Assets	data #181 / data #6
Interest Coverage	Income Before Interest and Tax Expense / Interest Expense	(data #15 + data #170) / data #15
Panel C: Profitability Ratios		
Liquid Asset Turnover	Net Sales / Liquid Assets	data #12 / (data #1 + data #2)
Current Asset Turnover	Net Sales / Current Assets	data #12 / data #4
Tangible Fixed Asset Turnover	Net Sales / Tangible Fixed Asset	data #12 / (data #6- data #4)
Equity Turnover	Net Sales / Stockholders' Equity	data #12 / data #216
Asset Turnover	Net Sales / Total Assets	data #12 / data #6
Gross Profit Margin	Gross Profit / Net Sales	(data #12 – data #41) / data #12
Operating Profit Margin	Operating Profit / Net Sales	data #13 / data #12
Net Profit Margin	Net Profit / Net Sales	data #172 / data #12
Return on Equity	Net Profit / Common Equity	data #172 / data #60
P/E	Price/Earnings	abs(prc)*shrout / data #172
B/M	Book/Market	data #60 / abs(prc)*shrout
P/S	Price/Sales	abs(prc)*shrout / data #12

This table lists the names of the financial ratios used in this study. For each ratio the table reports the formula and the data items that were used to compute the ratio. Variables listed in the form of data #x are from Compustat and prc and shrout variables are from CRSP.

We use financial ratios as the input vector and the twelve months return of the firm as the output vector for developing neural network model. There is no information about which financial ratio is important and we didn't utilize a statistical tool for dimension reduction. We divided our sample into three sub-samples: training, test and validation. Training and testing samples were used to develop the neural network model and assess its performance. For training data, 4,000 random observations were selected from the 1962-1989 sample period. For testing data, we used 70,252 observations from the sample period 1962- 1989. Finally for validation we relied on the sample between the years 1990 and 2005 (66,672 observations).

The most important aspect of the training process is the testing of the neural-network model. In the training process, we used the testing sub-sample to gauge whether there was serious over fitting. In cases where over fitting was a concern we repeated the training process. We finally arrived at a neural network model that is feed forward neural network and has three hidden layer. Each hidden layer consisted of 100, 35, 15 nodes consecutively (Main absolute error, sigmoid (-/+) transfer function and Jacob's Enhanced Back Propagation learning algorithm is used for training the ANN model).

After training the neural network model, we used the model's outputs as predictors of firms' future returns. Neural network model assigned each firm-year into ten portfolios: one (1) being the least favorable and ten (10) being the most favorable. To assess the performance of the artificial neural network, we measured the abnormal return that accrues to the ten portfolios and a hedge portfolio that goes long on the tenth portfolio and short on the first portfolio.

We use the calendar time regression approach (Jensen's alpha) to measure the abnormal performance of the ten portfolios. In the calendar time regression approach we first calculated mean monthly returns for all ten portfolios starting four months after fiscal year end for the duration of one year, we then rebalanced according to the new rankings artificial neural network assigned. This yielded a series of monthly raw returns for each portfolio from April, 1990 to March, 2004. We then computed excess monthly portfolio returns by subtracting the risk free rate. Finally, we regressed (using OLS) the mean excess monthly portfolios returns on the excess CRSP value weighted index, size (SMB), book to market (HML) and momentum factors (UMD), as follows:

$$R_{pt} - R_{ft} = \alpha + \beta_i\left(R_{mt} - R_{ft}\right) + s_i SMB_t + h_i HML_t + u_i UMD_t + \xi_{it}, \quad (4)$$

where R_{pt} is the monthly return for the constructed portfolio on month t, R_{ft} is the Ibbotson One Month Treasury Bill Rate. R_{mt} is the CRSP value weighted index return for month t. SMB_t is the average return on three small market capitalization portfolios minus the average return on three large market capitalization portfolios on month t. HML_t is the average return on two high book-to-market equity portfolios minus the average return on two low book-to-market equity portfolios for month t. UMD_t is the average of the returns on two (big sized and small sized) high prior return portfolios minus the average of the returns on two low prior return portfolios. In this regression, the intercept proxies for the average monthly abnormal return accumulated by holding the portfolio for the estimation period. In the tables we report annualized intercepts.

EMPRICAL RESULTS

We measure the annual abnormal returns that accrue to the ten portfolios formed according to rankings the artificial neural network model generates. Furthermore a hedge portfolio consisting of a long position in the most favorable stocks and a short position in the least favorable stocks is created and its performance is assessed.

In Table 2 we report the abnormal returns that accrue for each portfolio within the validation sample that spans between the years 1990 and 2005. The results suggest that the least favorable portfolio underperforms expected returns generated by the Carhart four-factor model by an average of 28.9% which is statistically significant at the one-percent level. This suggests that shorting least favorable stocks generates a positive abnormal return which is statistically and economically significant. On the other hand the portfolio consisting of the most favorable stocks fails to generate returns that are above the expected returns.

We also test whether a hedge portfolio that goes long on most favorable securities and short on the least favorable ones generates significant abnormal returns. Our results suggest that such a trading strategy generates annual abnormal returns in excess of 22 percent. The hedge portfolio result is consistent with artificial neural network having significant predictive power of future abnormal returns.

Our results, combined, suggest that the artificial neural network model applied in this study has predictive power of future returns. Moreover our results indicate that the predictive power of artificial neural network is not due to previously documented size, book-to-market and momentum anomalies. In other words abnormal returns generated by the neural network trading strategy are in excess of an investor that would follow a combined strategy of previously documented anomalies.

Table : 2 Long-Term Performance of an Analyst Consensus Based Trading Strategy

Portfolio	Annualized Abnormal Return	Intercept	Beta	SMB	HML	UMD	Obs.	R-square
Strong Sell	-28.9%	-0.024*** (-3.66)	1.203*** (6.72)	1.428*** (7.61)	-0.538** (-2.31)	-0.408*** (-3.06)	199	55.1%
2	-13.3%	-0.011 (-0.9)	1.372 (4.12) ***	0.124 (0.35)	-0.953*** (-2.19)	0.032 (0.13)	200	19.9%
3	7.7%	0.006* (1.76)	1.006*** (10.2)	0.555*** (5.38)	0.051 (0.39)	0.077 (1.04)	200	51.6%
4	-3.0%	-0.002 (-0.84)	1.279*** (15.95)	0.063 (0.75)	-0.516*** (-4.93)	-0.103 (-1.71)	200	74.1%
5	3.8%	0.003** (2.63)	0.979*** (29.62)	-0.048 (-1.38)	-0.386*** (-8.94)	-0.055** (-2.23)	200	90.3%
6	-0.3%	0.000 (-0.25)	0.955*** (34.12)	0.006 (0.19)	0.192*** (5.25)	-0.038* (-1.82)	200	88.3%
7	-2.0%	-0.002 (-1.54)	1.013*** (34.28)	0.055* (1.77)	0.459*** (11.89)	-0.032 (-1.44)	200	87.1%
8	-4.6%	-0.004 (-1.11)	1.082*** (11.56)	0.795*** (8.11)	-0.105 (-0.86)	-0.001 (-0.01)	200	64.7%
9	1.3%	0.001 (0.18)	1.109*** (6.65)	0.893*** (5.11)	-0.093 (-0.43)	0.003 (0.02)	200	38.9%
Strong Buy	-3.5%	-0.003 (-0.54)	1.293*** (8.74)	0.430 (2.78) **	0.214 (1.11)	-0.320** (-2.89)	200	41.0%
Hedge Portfolio	22.2%	0.019** (2.26)	-0.068 (-0.31)	-0.833 (-3.56) *	0.857 (2.96) **	0.017 (0.1)	199	19.4%

*This table reports the abnormal performance of portfolios constructed using ratings assigned by the neural network model. Each firm in the database is distributed to one of the ten portfolios (strong sell – strong buy) with respect to its rating. And the eleventh portfolio titled "Hedge" represents the returns to a trading strategy that goes long on the portfolio with the strong buy stocks and short on the strong sell stocks. Using the calendar time portfolio regression approach the Jensen's alpha of each portfolio is computed and reported, with its t-statistics, on the first row of both panels under the label "Intercept (Abnormal Return)". The following row titled beta shows the beta (with t-statistics), SMB, HML and UMD factor sensitivities of all eleven portfolios. Finally the last two rows in each panel report the r-square of the asset pricing model. The first figure in each cell is the regression coefficient. The second figure in each cell is the t-statistic. *, **, and *** indicate at the 10, 5, and 1 percent levels respectively.*

However, as in market efficiency studies, we would like to note that our results are subject to a joint hypothesis problem which restrains us from attributing these to market efficiency or mispricing as these results may be an artifact of an incomplete asset pricing model. Nevertheless, assuming the Carhart four-factor model to be a complete model we find evidence supporting the use of artificial neural network model as a successful tool for predicting future stock returns.

CONCLUSION

The purpose of this paper was to estimate the abnormal returns that can be earned through an investment strategy based on ratings assigned by an artificial neural network model. We find that over the 1990 to 2005 period, a portfolio of the stocks with the most (least) favorable neural network rating provides an average annual abnormal gross return of -3.5 (-28.9) percent, after controlling for market risk, size, book-to-market, and momentum effects. A hedge strategy of purchasing stocks that have the highest neural network ratings and selling short stocks with the lowest ratings generates an abnormal gross return of 1.9 percent a month. The fundamental analysis trading strategy generated by artificial neural networks yields an average annual abnormal return of 22.32%. Our results show neural network's ability to predict future returns in NYSE/AMEX/Nasdaq securities for the period 1990-2005.

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CAUSALITIES BETWEEN SENTIMENT INDICATORS AND STOCK MARKET RETURNS UNDER DIFFERENT MARKET SCENARIOS

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ABSTRACT

This paper investigates the causal relationships between sentiment and returns under different market scenarios. In contrast to previous studies that subjectively identify the bullish and bearish markets, we apply a threshold model to detect the extreme level of investors' sentiment econometrically. The empirical results show that most of the sentiment measures exhibit a feedback relationship with returns while ignoring different market states. However, sentiment could be a leading indicator if the higher or lower levels of sentiments were to be distinguished. Among them, the bullish/bearish indicator of ARMS, which is named after its creator, Richard Arms (1989), is a leading indicator if the market is more bearish (in the higher regime). Otherwise, the leading effect of the derivatives market sentiment indicators (the put-call trading volume and option volatility index) is discovered if the market is more bullish (in the lower regime). Our empirical findings further confirm the noise trader explanation that the causal direction would run from investors' sentiment to market behavior.

JEL: C32; G10

KEYWORDS: Investor sentiment, Stock market returns, Granger causality, threshold model

INTRODUCTION

The behavioral models of securities markets regard investors as being of two types: rational arbitrageurs who are sentiment-free and irrational traders who are prone to exogenous sentiment. In considering that investors may either overreact or under-react to extreme levels of sentiment indicators, we examine whether the sentiment indicators are classified according to multiple regimes by using the multivariate threshold model. Since previous studies have usually defined the extreme level subjectively, this paper analyzes the different states more objectively. The causality relationships between stock market returns and sentiment indicators are more significant when the different states are distinguished. The empirical results lead us to conclude that sentiment in both the stock and derivative markets gives rise to distinct lead-lag relationships with returns.

While there is an abundant literature on implied volatility indexes in developed markets, little research has been conducted in the context of emerging markets. Index options involving the Taiwan Stock Exchange Capitalization Weighted Stock Index (*TAIEX* index options, abbreviated as TXO) were first traded on December 24, 2001. The *TAIEX* covers all of the listed stocks on the Taiwan Stock Exchange (TWSE) excluding preferred stocks, full-delivery stocks and newly-listed stocks, which are listed for less than one calendar month. The statistical data published in the annual report of the Futures Industry Association (FIA) in 2003 show that the trading volume of the TXO grew significantly faster in 2003 than in 2002. The FIA is the only association that is representative of all organizations having an interest in the futures market. The FIA has more than 180 corporate members, and reaches thousands of industry participants. Further information may be found on the website http://www.futuresindustry.org/. The FIA annual report in 2006 further indicates that *TAIEX* options is ranked sixteenth in the world in terms of trading volume meaning that it is among the top 20 derivatives contracts. In addition, the trading volume of *TAIEX* options still exhibits a high growth rate. These motivate us to investigate the possible causalities between market sentiment and stock returns in Taiwan.

The analysis is conducted on a daily basis and the sentiment indicators used in this study include the TXO put-call trading volume ratio (TPCV), the TXO put-call open interest ratio (TPCO), the option market volatility index (TVIX) and the ARMS index. Our major focus of concern is on whether the causal relationship between sentiment and returns differs when investors' sentiment is at an extreme level identified optimistically by the threshold model. Our major findings suggest that there is nonlinearity in the sentiment indicators. The causality between sentiment and returns leads to different results when the sentiment index is at an extremely high or low level, or else reflects a typical regime. In the ordinary market scenario, there is low negative correlation as well as bi-directional causality. When the market overacts, the sentiment indicators Granger cause the returns. Among them, the ARMS index Granger causes the stock returns in the median and higher regimes, while the sentiment indicators in the derivatives market Granger cause the returns in the median and lower regimes. Our empirical findings further confirm the noise trader explanation that the causal direction runs from sentiment to market behavior.

The remainder of this paper is organized as follows. Section 2 briefly discusses the relevant literature. Section 3 outlines the measurement and summary statistics of the data. Section 4 summarizes the empirical design of the paper. Section 5 reports the empirical results, confirming that the nonlinear model better captures the dynamic causal relationship between the sentiment index and the stock market index. Section 6 concludes the paper.

LITERATURE REVIEW

Early papers (Friedman, 1953; Fama, 1965) argued that noise traders are unimportant in the financial price formation process because trades made by rational arbitrageurs drive prices close to their fundamental values. However, the market anomalies, for example, the under-reaction and overreaction of stock prices, challenge the efficient markets theory. De Long, Shleifer, Summers and Waldmann (DSSW (1990) hereafter) modeled the influence of noise trading on equilibrium prices and motivated empirical attempts to substantiate the proposition that 'noise traders' risks influence price formation'. Lee, Jiang and Indro (2002) tested the impact of noise trader risk on the formation of conditional volatility and expected returns. Their empirical results show that sentiment is a systematic risk that is priced. Baker and Wurgler (2006) also indicated that investor sentiment affects the cross-section of stock returns. They found that when beginning-of-period proxies for sentiment are low, subsequent returns are relatively high for small stocks, young stocks, high volatility stocks, unprofitable stocks, non-dividend-paying stocks, extreme growth stocks and distressed stocks. If sentiment indicators are risk factors in the time series of returns, they will have the ability to predict the future returns on portfolios, even after appropriately adjusting for other risk factors. These findings all support the need for research on the relationship between stock market returns and indicators of investor sentiment.

The causal relationships between sentiment indicators and stock market returns are mixed in previous studies. Clarke and Statman (1998) found that the sentiment of newsletter writers, whether bullish or bearish, does not forecast future returns, but that past returns and the volatility of those returns do affect sentiment. Causality would thus run from sentiment to market behavior if the noise trader explanation were to be accepted. However, Brown and Cliff (2004) and Solt and Statman (1988) documented that returns cause sentiment rather than the other way round. Brown and Cliff (2004) used a large number of sentiment indicators to investigate the relationship between sentiment and equity returns and found that returns cause sentiment rather than the opposite being the case. Brown (1999) supported the DSSW theory that irrational investors acting in concert and giving a noisy signal can influence asset prices and generate additional volatility. His tests used volatility instead of returns and his results indicated that deviations from the average level of sentiment are associated with increases in fund volatility only during trading hours. Wang, Keswani and Taylor (2006) further tested the relationships between sentiment, returns and volatility. They also found strong and consistent evidence that sentiment measures, both in levels and first differences, are Granger-caused by returns. Banerjee, Doran and Peterson (2007) found that future returns are significantly related to both volatility index (VIX) levels and innovations for most portfolios, where the VIX is treated as a proxy variable for sentiment. While the causality test results presented above do not provide evidence of a consistent relationship between noise traders' sentiments and subsequent price movements, it might be possible that a relationship exists, but only in some special market scenarios.

The frame dependence theory, proposed by Shefrin (2000) in behavioral finance, argues that investors' decisions are sensitive to different market scenarios. This motivates us to investigate whether there are dynamic causal relationships between sentiments and returns. Besides considering both positive and negative market scenarios, we infer that investors may exhibit dissimilar behaviors depending on the level of sentiment, and therefore different dynamic relationships may exist between stock market returns and sentiment indicators. Giot (2005) found that for very high (low) levels of the VIX, future returns are always positive (negative). His findings suggested that extremely high levels of the VIX might signal attractive buying opportunities. Banerjee et al. (2007) examined the relationship between returns and the VIX, the proxy variable for sentiment, for different levels of market performance and relatively high or low levels of volatility. Banerjee et al. (2007) defined those returns above and those below the sample median as constituting a 'bull market' and a 'bear market', respectively. Volatilities above the median level of the VIX are said to be in a 'high volatility' period and those below the median in a 'low volatility period'. They provided two analyses, one of the 'bull and bear market' and the other of 'high and low volatility'. Their findings suggested that the market states based on directional movements (positive and negative returns) or volatility levels (above or below the average) do not make a difference. On the contrary, we believe that the results will be misunderstood if the separation of the different market states is defined subjectively.

To sum up, we apply the threshold model to examine the threshold effect of the sentiment indicators. Higher and lower regimes of sentiment indicators will be detected objectively. Therefore, the causality relationship needs to be tested for different market scenarios.

DATA

The daily sentiment indicators used consist of the TXO put-call trading volume ratio (TPCV), the TXO put-call open interest ratio (TPCO), the TXO volatility index (TVIX) and the TAIEX ARMS index. To do this, we use data that are fully quoted on the Taiwan Futures Exchange (TAIFEX) and the Taiwan Stock Exchange (TSE). The study period extends from 2003 to 2006, encompassing 993 trading days.

Investor Fear Gauge – Option Volatility Index

Options market-based implied volatility can reflect the expectations with respect to price changes in the future, and it can be treated as an indicator of sentiment. Olsen (1998) indicated that the volatility index has been viewed as a 'sentiment indicator' in the recent behavioral finance literature and can be regarded as a market indicator of rises and falls in the underlying index. Whaley (2000) and research conducted by the Chicago Board Options Exchange (CBOE) have indicated that the greater the fear, the higher the VIX level is. Therefore, the volatility index is commonly referred to as the 'investor fear gauge'. Baker and Wurgler (2007) also treated option-implied volatility as one of the sentiment measures in investigating the investor sentiment approach. Therefore, we adopt the Taiwan stock market volatility index (TVIX) as one of the sentiment proxy variables in the Taiwan options market.

In 1993, the CBOE introduced the Volatility Index (VIX) based on the S&P 100 index options that can be defined as the magnitude of price variation for the following 30 days. The new version of the Volatility Index published in 2003 is based on S&P 500 index options prices. In March 2004, the CBOE futures exchange (CFE) introduced volatility futures, and volatility options were launched in February 2006. The underlying index is just the VIX published in 2003. The volatility index has become a tradable derivative. Since the CBOE published the new volatility index in 2003, we construct the TVIX by adjusting the last revision of the CBOE volatility index. The construction of the CBOE's new volatility index incorporates information from the skewness of volatility by using a wider range of strike prices including the out-of-the-money call and put option contracts rather than just the at-the-money series. The new volatility index is more precise and robust than the original version. However, the fundamental features of the volatility index between the old and new versions remain the same. For details of the index's construction, the interested reader may refer to the white book published by the CBOE in 2003, http://www.cboe.com/micro/vix/vixwhite.pdf. In the construction of the Taiwan stock market VIX, the interest rate has been adjusted accordingly. The risk-free rate is calculated from the monthly average one-year deposit rates at the Bank of Taiwan, Taiwan Cooperative Bank, First Bank, Hua Nan Bank and Chang Hwa Bank. The CBOE's volatility index (VIX) uses put and call options in the two nearest-term expiration months in order to bracket a 30-day calendar period. With 8 days left to expiration, CBOE's VIX 'rolls' to the second and third contract months in order to minimize pricing anomalies that might occur close to expiration. However, the nearest-term expiration contract usually has high trading volume and the next nearest-term contract usually has low trading volume in the Taiwan options market even if the nearest-term contract is traded on the last trading day. In considering the market structure of liquidity and trading volume for the second and third contract months, we have revised the rollover rule from 8 days to 1 day prior to expiration in constructing the volatility index in Taiwan.

Put-Call Trading Volume and Open Interest Ratios

The put-call trading volume ratio equals the total trading volume of puts divided by the total trading volume of calls (TPCV). Like the TVIX, market participants view the TPCV as a fear indicator, with higher levels reflecting bearish sentiment. When market participants are bearish, they buy put options to hedge their equity positions or to speculate bearishly. By contrast, a low level of TPCV is associated with a lower demand for puts, which reflects bullish sentiment.

The put-call open interest ratios can be calculated using the open interest of options instead of trading volume (TPCO). When the total option interest increases, most of it comes from higher investor demand for TXO puts. Thus the TPCO tends to be higher on days when the total open interest is high.

ARMS Index

The ARMS index is named after its creator, Richard Arms (1989), and is an indicator of bullish or bearish sentiment. The ARMS index on day t is equal to the number of advancing issues scaled by the trading volume (shares) of advancing issues divided by the number of declining issues scaled by the trading volume (shares) of declining issues. It is measured as:

$$\mathrm{ARMS}_t = \frac{\#\mathrm{Adv}_t / \mathrm{AdvVol}_t}{\#\mathrm{Dec}_t / \mathrm{DecVol}_t} = \frac{\mathrm{DecVol}_t / \#\mathrm{Dec}_t}{\mathrm{AdvVol}_t / \#\mathrm{Adv}_t} \tag{1}$$

where $\#\mathrm{Adv}_t$, $\#\mathrm{Dec}_t$, AdvVol_t, and DecVol_t, respectively, denote the number of advancing issues, the number of declining issues, the trading volume of advancing issues, and the trading volume of declining issues.

ARMS can be interpreted as the ratio of the number of advances to declines standardized by their respective volumes. If the index is greater than one, more trading is taking place in declining issues, while if it is less than one, the average volume of advancing stocks outpaces the average volume of declining stocks. Its creator, Richard Arms, argued that if the average volume of declining stocks far outweighs the average volume of rising stocks, then the market is oversold and this should be treated as a bullish sign. Likewise, he argued that if the average volume of rising stocks far outweighs the average volume of falling stocks, then the market is overbought and this should be treated as a bearish sign.

Summary Statistics of the Data

Table 1 contains summary statistics of all the variables discussed in the study. The returns display excess kurtosis, negative skewness and almost no serial correlation. The contemporaneous relationships among many measures of investor sentiment and market returns depicted in Table 2 are shown to be strong. Figure 1 shows the daily evolution of the TAIEX and returns from 2003 to 2006. Figure 2 is the daily evolution of the sentiment indices from 2003 to 2006.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Skewness	Kurtosis	Autocorrelation			
					ρ_1	ρ_2	ρ_3	ρ_4
TAIEX	6,030.7580	732.2869	-0.4379	3.2624	0.9850	0.9700	0.9550	0.9410
R	0.0006	0.0120	-0.3855	6.3835	0.0390	-0.0110	0.0250	-0.0420
TVIX	20.7318	5.4899	0.9942	3.9072	0.9710	0.9530	0.9390	0.9230
TPCV	0.7835	0.1669	0.8043	4.3116	0.4640	0.3470	0.2820	0.2280
TPCO	0.9307	0.2597	1.1246	5.2412	0.9410	0.8720	0.8010	0.7370
ARMS	0.7168	0.3820	9.0595	175.3529	0.1190	0.0690	0.0010	-0.0120
ΔTVIX	-0.0029	1.2995	1.2845	16.4393	-0.2030	-0.0490	0.0360	-0.0510
ΔTPCV	0.0004	0.1729	-0.0767	4.3869	-0.3920	-0.0550	-0.0050	-0.0220
ΔTPCO	0.0004	0.0885	-3.0162	35.3451	0.0870	0.0250	-0.0670	-0.0420
ΔARMS	-0.0010	0.5087	-0.9781	91.5070	-0.4700	0.0110	-0.0320	0.0110

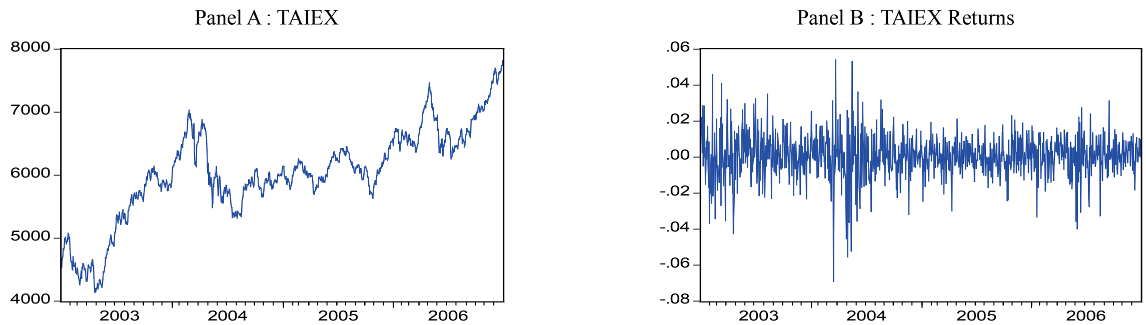
This table presents the summary statistics for the return on the Taiwan stock exchange capitalization weighted stock index (TAIEX) and various sentiment measures, namely, the Taiwan volatility index (TVIX), the put-call volume ratio (TPCV), the put-call open interest ratio (TPCO) and the ARMS ratio. The period covers 1/2/2003 to 12/29/2006.

Table 2: Contemporaneous Correlations

	R	TVIX	TPCV	TPCO	ARMS	ΔTVIX	ΔTPCV	ΔTPCO	ΔARMS
TAIEX	0.0442	-0.4035***	0.0559*	0.2024***	-0.0282	0.0016	0.0007	-0.006	0.0035
R		-0.0885***	-0.2773***	0.1509***	-0.3542***	-0.2537***	-0.2622***	0.3703***	-0.2635***
TVIX			-0.0759**	-0.1974***	0.1028***	0.1197***	-0.0006	-0.0406	-0.0117
TPCV				0.0345	0.1476***	0.0667**	0.5179***	-0.146***	0.021
TPCO					-0.162***	0.0395	-0.0036	0.1704***	0.0222
ARMS						0.0316	0.0404	-0.1609***	0.6638***
ΔTVIX							0.0674**	-0.0431	-0.0285
ΔTPCV								-0.1509***	0.0486
ΔTPCO									-0.0596*

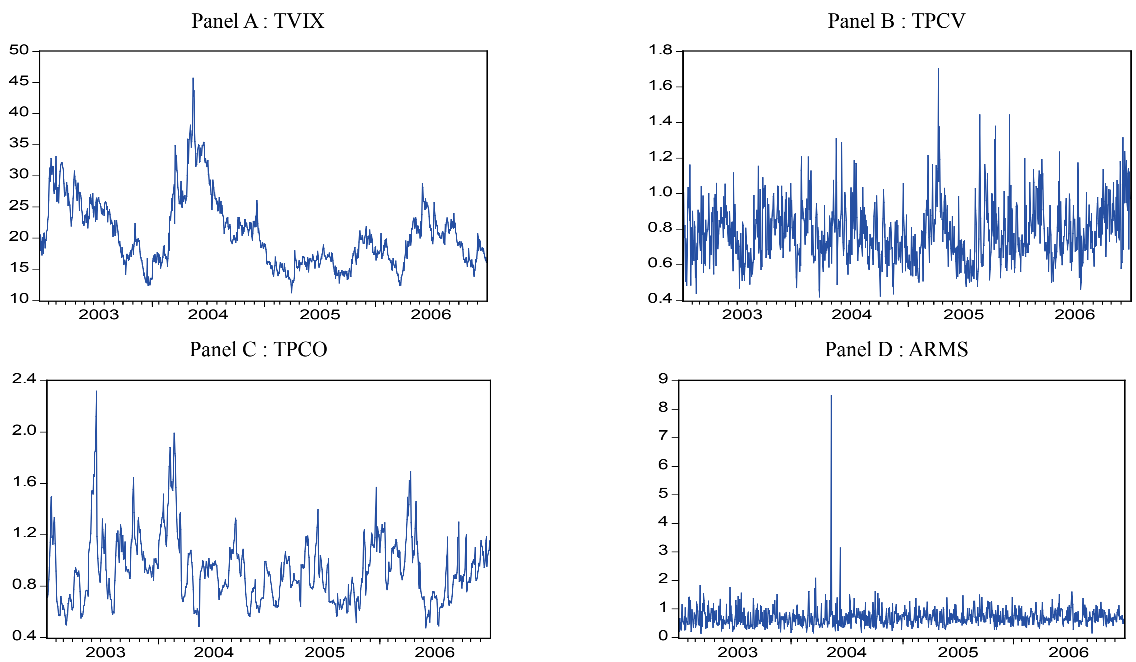
*The pairwise correlations are for selected variables used in the analysis. *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.*

Figure 1: Daily Evolution of the TAIEX and TAIEX Returns from 2003 to 2006



This figure shows the daily evolution of the TAIEX and TAIEX returns from 2003 to 2006. TAIEX represents the Taiwan stock exchange capitalization weighted stock index. TAIEX returns are calculated as the logarithmic difference in the daily TAIEX, i.e., R_t=lnS_t-lnS_{t-1}, where R_t represents the TAIEX market returns on day t, and S_t and S_{t-1} are the daily closing prices of the TAIEX on day t and t-1, respectively.

Figure 2: Daily Evolution of the Sentiment Indices from 2003 to 2006



This figure shows the daily investor sentiments during 2003 to 2006. The Taiwan volatility index (TVIX) is calculated using daily data quoted on the Taiwan Futures Exchange (TAIFEX) and the Taiwan Stock Exchange (TWSE). The method used to construct the TVIX refers to the essence of the last revision of the volatility index of the CBOE and the interest rate, and the rollover rule is revised accordingly. The ARMS, put-call trading volume ratio (TPCV) and put-call open interest ratio (TPCO) are calculated using daily data quoted on the TWSE and TAIFEX.

RESEARCH DESIGN

Causality Tests

We test for Granger causality between sentiment and returns by estimating bivariate VAR models (Granger, 1969, 1988). The Granger causality tests examine whether the lags of one variable enter the equation to determine the dependent variables, assuming that the two series (sentiment index and stock market return) are covariance stationary and the error items are i.i.d. white noise errors.

We estimate the models using both levels and changes in sentiment measures since it is not easy to determine which specification should reveal the primary effects of sentiment. For example, suppose investor sentiment decreases from very bullish to bullish. One might anticipate a positive return due to the still bullish sentiment, but on the other hand, since sentiment has decreased, it is also possible for someone to expect a reduction in the return. The general model we use here can be expressed as follows:

$$\begin{aligned} R_t &= C_1 + \sum_{p=1}^{L} \alpha_{1p} R_{t-p} + \sum_{p=1}^{L} \beta_{1p} Senti_{t-p} + \varepsilon_{1t} \ , \\ Senti_t &= C_2 + \sum_{p=1}^{L} \rho_{2p} R_{t-p} + \sum_{p=1}^{L} \beta_{2p} Senti_{t-p} + \varepsilon_{2t} \ , \end{aligned} \qquad (2)$$

where R_t denotes the stock market returns and $Senti_t$ represents the sentiment levels or the sentiment changes. The sentiment indices include TVIX, TPCV, TPCO and ARMS. In the bivariate Granger causality tests, the returns do not Granger cause the sentiment measures if the lagged values R_{t-p} do not enter the $Senti_t$ equation. Similarly, the returns do not Granger cause the sentiment measures if all the ρ_{2p} equal zero as a group based on a standard F-test. Meanwhile, the sentiment measures do not Granger cause the returns if all the β_{1p} equal zero.

Causality Relationship under Different Market Scenarios

We examine the causality relationship under the positive and negative market return scenario. The model may alternatively be written as:

$$\begin{cases} R_t = C_{11} + \sum_{p=1}^{L} \rho_{11p} R_{t-p} + \sum_{p=1}^{L} \beta_{11p} Senti_{t-p} + \varepsilon_{11t} \\ Senti_t = C_{12} + \sum_{p=1}^{L} \rho_{12p} R_{t-p} + \sum_{p=1}^{L} \beta_{12p} Senti_{t-p} + \varepsilon_{12t} \end{cases} , \text{ if } R_t \geq 0 \qquad (3\text{-}1)$$

$$\begin{cases} R_t = C_{21} + \sum_{p=1}^{L} \rho_{21p} R_{t-p} + \sum_{p=1}^{L} \beta_{21p} Senti_{t-p} + \varepsilon_{21t} \\ Senti_t = C_{22} + \sum_{p=1}^{L} \rho_{22p} R_{t-p} + \sum_{p=1}^{L} \beta_{22p} Senti_{t-p} + \varepsilon_{22t} \end{cases} , \text{ if } R_t < 0 \qquad (3\text{-}2)$$

where $R_t \geqq 0$ represents the positive return scenario and $R_t < 0$ is the negative return scenario. The threshold variable of the return is also substituted as a sentiment variable. There are three scenarios examined in the following study, the extremely high sentiment (top 20%), the extremely low sentiment (bottom 20%) and the typical sentiment group (median 60%).

The Oversold and Overbought Scenarios Identified by the Threshold Model

A two-regime version of the threshold autoregressive (TAR) model developed by Tong (1983) is expressed as follows:

$$y_t = I_t\left[\beta_{10} + \sum_{i=1}^{p}\beta_{1i}y_{t\text{-}i}\right] + \left(1\text{-}I_t\right)\left[\beta_{20} + \sum_{i=1}^{p}\beta_{2i}y_{t\text{-}i}\right] + \varepsilon_i,\ I_t = \begin{cases}1,\ if\ y_{t\text{-}1} \geq \gamma \\ 0,\ if\ y_{t\text{-}1} < \gamma\end{cases} \tag{4}$$

where y_t is the series of interest, β_{1i} and β_{2i} are the coefficients to be estimated, i=1…p, p is the order of the TAR model, γ is the value of the threshold, and I_t is the Heaviside indicator function. One problem with Tong (1983)'s model is that the threshold may not be known. When γ is unknown, Chan (1993) shows how to obtain a super-consistent estimate of the threshold parameter. The general form of Chan's model can be described as:

$$y_t = \begin{cases}\beta_{10} + \beta_{11}y_{t\text{-}1} + \cdots + \beta_{1p}y_{t\text{-}p} + c_1e_t,\ if\ y_{t\text{-}d} < \gamma \\ \beta_{20} + \beta_{21}y_{t\text{-}1} + \cdots + \beta_{2p}y_{t\text{-}p} + c_2e_t,\ if\ y_{t\text{-}d} \geq \gamma\end{cases} \tag{5}$$

For a TAR model, the procedure is to order the observations from the smallest to the largest such that $y_1 < y_2 < y_3 \ldots < y_T$. For each value of y_i, let $\gamma = y_i$, and let the Heaviside indicator be set according to this potential threshold in order to estimate a TAR model. The regression equation with the smallest residual sum of squares contains a consistent estimate of the threshold. Chan (1993) indicates that each data point within the band has the potential to be the threshold. However, it may be inefficient to examine the threshold effect of each value. Therefore, we adopt the grid search method whereby n sample points within the estimation period are selected to test the threshold effect and we set n equal to 100. In order to classify the oversold and overbought regimes, we apply the threshold test twice in the above and below average levels of each sentiment indicator. The highest and lowest 10 percent of the values are excluded from the search to ensure an adequate number of observations on each side of the threshold.

EMPIRICAL RESULTS AND ANALYSIS

Granger-Causality Tests under Different Market Scenarios

The lag lengths of the TAIEX returns and sentiment indices are determined before the causality test is performed. The numbers of lagged terms in the VAR models are decided parsimoniously by the Akaike information criterion (AIC) and the Schwarz criterion (SC). Table 3 presents the general causality tests. The results show that there is a feedback relationship between returns and sentiment, in both levels and first differences, and including TVIX and ARMS. As for the other two derivatives market sentiment indicators, TPCV and TPCO, these have no leading effect.

Table 3: General Causality Tests between Returns and Sentiment

Sentiment	Hypothesis			
	H_{01}	H_{02}	H_{03}	H_{04}
TVIX	2.7533 (0.0642)*	3.9627 (0.0193)**	4.3919 (0.0364)**	6.4175 (0.0115)**
TPCV	0.0196 (0.9806)	0.9918 (0.3713)	0.1901 (0.9031)	6.4853 (0.0002)***
TPCO	0.4045 (0.5249)	51.7436 (<0.0001)***	3.0538 (0.0809)*	30.2449 (<0.0001)***
ARMS	4.8131 (0.0083)***	19.369 (<0.0001)***	2.5839 (0.0173)**	9.0376 (<0.0001)***

*The numbers of lagged terms in the VAR models are decided parsimoniously by the Akaike information criterion (AIC) and the Schwarz criterion (SC). H_{01}: Granger-noncausality from sentiment to returns, i.e., sentiment does not cause returns. H_{02}: Granger-noncausality from returns to sentiment, i.e., returns do not cause sentiment. H_{03}: Granger-noncausality from changes in sentiment to returns, i.e., changes in sentiment do not cause returns. H_{04}: Granger-noncausality from returns to changes in sentiment, i.e., returns do not cause changes in sentiment. Values in the table and the parentheses are F test statistics and p-values, respectively. *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.*

The positive and negative market return scenarios indicate whether the market returns are greater than zero or not. The results of these Granger-causality tests are presented in Table 4. The TVIX Granger causes returns when the return is greater than zero. However, the sentiment indicators are Granger-caused by returns while the return is smaller than zero. In short, TVIX could be a leading indicator while the market returns are positive.

Table 4: Causality Tests between Returns and Sentiment – Considering the Positive and Negative Market Return Scenarios

Sentiment	Hypothesis			
	H_{01}	H_{02}	H_{03}	H_{04}
Panel A :Positive Return				
TVIX	33.5609 (<0.0001)***	0.4766 (0.6212)	3.8761 (0.0495)**	0.0607 (0.8056)
TPCV	0.4318 (0.6496)	2.1598 (0.1164)	1.0806 (0.3568)	5.9478 (0.0005)***
TPCO	4.9796 (0.0261)**	15.1619 (0.0001)***	0.782 (0.377)	7.5925 (0.0061)***
ARMS	13.4788 (<0.0001)***	9.4277 (0.0001)***	4.7919 (0.0001)***	5.8443 (<0.0001)***
Panel B Negative Return				
TVIX	23.7999 (<0.0001)***	4.9421 (0.0075)***	0.0029 (0.9569)	9.9774 (0.0017)***
TPCV	1.2442 (0.2891)	0.2446 (0.7831)	0.8122 (0.4876)	2.5514 (0.0551)*
TPCO	2.2443 (0.1348)	61.2698 (<0.0001)***	0.118 (0.7314)	42.7464 (<0.0001)***
ARMS	0.5613 (0.5708)	11.2781 (<0.0001)***	1.3231 (0.2451)	4.7347 (0.0001)***

*This table presents the causality tests between returns and sentiment considering the positive and negative market return scenarios. The numbers of lagged terms in the VAR models are decided parsimoniously by the Akaike information criterion (AIC) and the Schwarz criterion (SC). H_{01}: Granger-noncausality from sentiment to returns, i.e., sentiment does not cause returns. H_{02}: Granger-noncausality from returns to sentiment, i.e., returns do not cause sentiment. H_{03}: Granger-noncausality from changes in sentiment to returns, i.e., changes in sentiment do not cause returns. H_{04}: Granger-noncausality from returns to changes in sentiment, i.e., returns do not cause changes in sentiment. Values in the table and the parentheses are F test statistics and p-values, respectively. *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.*

The other situations with which we are concerned in this study are whether the sentiment is grouped in the top 20% or the bottom 20%. Most of the results, which are presented in Table 5, show that there is no distinct causal relationship between sentiment and returns although the TVIX and TPCV Granger cause returns while in the bottom 20%. Considering that the critical values of the overreaction scenarios are determined subjectively, the feedback relationship may be mixed.

Table 5 Causality Tests between Returns and Sentiment – Sentiments Grouped at the Top, Median and Bottom Levels

Sentiment	Hypothesis			
	H_{01}	H_{02}	H_{03}	H_{04}
Panel A: Top 20% of the Sentiment				
TVIX	3.8314 (0.0233)**	8.6299 (0.0003)***	0.0076 (0.9308)	56.8343 (<0.0001)***
TPCV	1.943 (0.1461)	0.8829 (0.4152)	1.4031 (0.2432)	1.9424 (0.1242)
TPCO	0.4743 (0.4918)	2.7216 (0.1006)	0.0001 (0.9938)	0.2948 (0.5877)
ARMS	1.4385 (0.2398)	3.3526 (0.037)**	1.1535 (0.3333)	2.6497 (0.0173)**
Panel B: Median of the Sentiment				
TVIX	2.686 (0.069)*	8.3332 (0.0003)***	0.0053 (0.9417)	4.2173 (0.0405)**
TPCV	1.4351 (0.2389)	1.0379 (0.3548)	1.5621 (0.1975)	1.7258 (0.1605)
TPCO	28.2164 (<0.0001)***	25.3552 (<0.0001)***	0.701 (0.4028)	27.3828 (<0.0001)***
ARMS	13.3482 (<0.0001)***	3.2147 (0.0409)**	7.4548 (<0.0001)***	0.6305 (0.7059)
Panel C: Bottom 20% of the sentiment				
TVIX	0.3011 (0.7404)	3.3127 (0.0385)**	3.6214 (0.0585)*	0.7986 (0.3726)
TPCV	10.5245 (<0.0001)***	1.7001 (0.1854)	4.4979 (0.0045)***	1.8991 (0.1312)
TPCO	20.0555 (<0.0001)***	16.3919 (0.0001)***	0.7241 (0.3959)	0.7776 (0.379)
ARMS	0.3037 (0.7384)	1.7525 (0.1761)	2.1734 (0.0474)**	5.4883 (<0.0001)***

*This table presents causality tests between returns and sentiment considering the sentiments grouped at the top, median and bottom levels. The numbers of lagged terms in the VAR models are decided parsimoniously by the Akaike information criterion (AIC) and the Schwarz criterion (SC). H_{01}: Granger-noncausality from sentiment to returns, i.e., sentiment does not cause returns. H_{02}: Granger-noncausality from returns to sentiment, i.e., returns do not cause sentiment. H_{03}: Granger-noncausality from changes in sentiment to returns, i.e., changes in sentiment do not cause returns. H_{04}: Granger-noncausality from returns to changes in sentiment, i.e., returns do not cause changes in sentiment. Values in the table and the parentheses are F test statistics and p-values, respectively. *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.*

Finally, there is the causality test between the returns and sentiment indicators in the extreme levels of investor sentiment that are determined by the threshold model. The threshold tests for each sentiment indicator are presented in Table 6 and the percentages for each regime classified by threshold model are shown in Table 7. The threshold tests show that the higher regime of TVIX and the lower regime of ARMS are not significant. Besides, the other sentiment indicators give rise to significant critical values of the higher and lower regimes that can represent the oversold and overbought situations.

Table 6 Threshold Test

	Upper regime			Lower regime		
Sentiment	Threshold Value	F test statistic	p-value	Threshold Value	F test statistic	p-value
TVIX	22.3673	0.3000	(0.5459)	17.9989	3.4807	(0.0293)**
TPCV	0.9612	8.3180	(0.0003)***	0.7377	6.3779	(0.0018)***
TPCO	1.1807	7.0289	(0.0009)***	0.7633	10.7162	(<0.0001)***
ARMS	1.0648	5.0219	(0.0038)***	0.5045	1.7117	(0.12)
ΔTVIX	0.9236	8.5034	(0.0002)***	-1.2803	10.3877	(<0.0001)***
ΔTPCV	0.1876	11.7296	(<0.0001)***	-0.1243	4.8070	(0.0084)***
ΔTPCO	0.0345	4.1566	(0.0159)**	-0.0223	7.7502	(0.0005)***
ΔARMS	0.3477	103.4980	(<0.0001)***	-0.0896	87.9864	(<0.0001)***

*This table presents the threshold tests. The upper regime is the regime above the average level of the sentiment indicators. The lower regime is the regime below the average level of the sentiment indicators. *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.*

Table 7 Percentage of Each Regime Classified by Threshold Model

	Higher Regime	Typical Regime	Lower Regime
TVIX			39%
TPCV	14%	42%	44%
TPCO	14%	57%	29%
ARMS	10%		
ΔTVIX	15%	74%	10%
ΔTPCV	13%	68%	19%
ΔTPCO	24%	50%	26%
ΔARMS	15%	46%	39%

This table presents the percentages of different regimes classified by the threshold model. The higher regime is the regime above the higher threshold which is above the average level of the sentiment indicators. The lower regime is the regime below the lower threshold which is below the average level of the sentiment indicators. The typical regime is the regime between the higher and lower thresholds of the sentiment indicators. The blank of the higher regime and typical regime of TVIX indicates that the threshold test is not significant in the upper regime of the TVIX level. The blank of the lower regime and typical regime of ARMS indicates that the threshold test is not significant in the lower regime of the ARMS level.

The results of the causality relationship in the oversold and overbought situations are shown in Table 8. We can find that the market sentiment indicator, ARMS, leads returns while in the upper regime. Both the equity market and derivatives market sentiment indicators, ARMS and TPCV, Granger cause returns in the median regime. In the lower regime, only the sentiment indicators in the derivatives market, TVIX and TPCV, Granger cause returns. From these findings, we can conclude that the equity or derivatives markets sentiment indicators perform differently in terms of the lead-lag relationship between returns while the sentiments are in the higher, median or lower regimes. Our study suggests that investors can adjust their portfolios by analyzing the sentiment indicators for different scenarios.

CONCLUSIONS

In this paper, we have examined the causal relationship between investors' sentiment and stock market returns. The difference between this paper and the previous literature is that we identify the extreme level of sentiment econometrically by using the threshold model. Our analysis is conducted in three steps by using equity market data. We first construct the sentiment indicators in the equity and derivatives markets including the ARMS index, option volatility index, put-call trading volume ratio and put-call open interest ratio. We then examine the threshold of the sentiment indicators to test whether the sentiment could be classified into oversold, overbought and ordinary regimes. Finally, we investigate the relationships and causal directions for the different market scenarios.

Table 8 Causality Tests between Returns and Sentiment - Application of the Multivariate Threshold Model

Sentiment	Hypothesis			
	H_{01}	H_{02}	H_{03}	H_{04}
Panel A: Upper regime (above the higher threshold)				
TVIX			0.2056 (0.6509)	43.7114 (<0.0001)***
TPCV	0.7388 (0.4796)	1.1357 (0.3243)	0.5386 (0.6567)	0.7615 (0.5178)
TPCO	0.0732 (0.7871)	0.5083 (0.4771)	0.0589 (0.8084)	0.0922 (0.7616)
ARMS	3.4356 (0.0364)**	0.8965 (0.4115)	1.5796 (0.1574)	3.0123 (0.0085)***
Panel B : Typical regime (between the two thresholds)				
TVIX			0.065 (0.7988)	12.5205 (0.0004)***
TPCV	5.7821 (0.0033)***	0.1239 (0.8835)	2.3032 (0.0759)*	3.1818 (0.0235)**
TPCO	29.5417 (<0.0001)***	39.5976 (<0.0001)***	1.4719 (0.2256)	16.3007 (0.0001)***
ARMS			5.2997 (<0.0001)***	0.5891 (0.7391)
Panel C : Lower regime (below the lower threshold)				
TVIX	4.4883 (0.0118)**	5.8011 (0.0033)***	3.8007 (0.0541)*	0.5805 (0.4479)
TPCV	7.0184 (0.001)***	1.3517 (0.2599)	4.4569 (0.0048)***	1.6189 (0.1865)
TPCO	10.7606 (0.0012)***	18.2885 (<0.0001)***	0.8613 (0.3542)	0.4873 (0.4858)
ARMS			3.2284 (0.0042)***	4.4251 (0.0002)***

This table presents the causality tests between returns and sentiment by applying the multivariate threshold model. The numbers of lagged terms in the VAR models are decided parsimoniously by the Akaike information criterion (AIC) and the Schwarz criterion (SC). H_{01}*: Granger-noncausality from sentiment to returns, i.e., sentiment does not cause returns.* H_{02}*: Granger-noncausality from returns to sentiment, i.e., returns do not cause sentiment.* H_{03}*: Granger-noncausality from changes in sentiment to returns, i.e., changes in sentiment do not cause returns.* H_{04}*: Granger-noncausality from returns to changes in sentiment, i.e., returns do not cause changes in sentiment. The blank spaces for the causality tests in the higher regime of the TVIX, the typical regime of TVIX and ARMS, and the lower regime of ARMS indicate that the threshold test is not significant in that scenario. Therefore, the causality tests are not examined in these scenarios. *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.*

The empirical results show that the causal relationships between the sentiment indicators and returns are mixed if the market scenario is not classified according to investors' sentiments. The TVIX Granger causes returns in the scenario that returns are greater than zero. Although previous studies (Simon and Wiggins, 2001; Giot, 2005) define the top 20% and bottom 20% as the extreme levels of sentiment, the causality information is still mixed. The linearity test of sentiment shows that the threshold effect is significant except in the higher regime of TVIX and the lower regime of ARMS in levels. When the threshold level is decided objectively, we find that ARMS Granger causes returns in the upper regimes. The sentiment indicators in the derivatives market including TPCV and TVIX Granger cause returns in the typical and lower levels. ARMS (TPCV and TVIX) could be the leading indicator if the market is more bearish (bullish). In conclusion, ARMS (sentiments in the derivatives market) will lose the leading effect in the overbought (oversold) scenario.

We find that the causality relationship is confused if the market scenarios are not taken into account. A leading characteristic of the sentiment indicators would be captured if the extreme scenarios were to be identified. Our empirical findings confirm the noise trader explanation that the causality would run from sentiment to market behavior. The results also support the view that accurate models of prices and expected returns need to assign a prominent role to investor sentiment.

This study is limited to the assumptions of the overreaction regime identified by the upper or lower thresholds of the sentiment indicators. Other econometric methodology, for example the smooth transition autoregressive (STAR) model that is viewed as a generalization of a nonlinear model, could be applied in further research to capture the transition process from bullish regimes to bearish regimes or vice versa. Besides, the information content of the investors' overreaction could be applied to the trading strategy or other portfolio management for further research.

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THE EFFECTS OF SHORT-TERM INTEREST RATES ON OUTPUT, PRICE AND EXCHANGE RATES: RECENT EVIDENCE FROM CHINA

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ABSTRACT

This paper utilizes VAR techniques to examine the relationship between a policy related variable and selected macro-variables in China. Johansen's cointegration tests fail to find a moving equilibrium among the related variables. Based on a VAR model in first differences, we find that an unexpected temporary one-off shock to the change in the seven-day money market interbank borrowing rate does not have significant influence on GDP changes but a significant influence on price level changes in a "wrong" direction. Empirical testing demonstrates that the seven-day Repo rate has an insignificant influence on both GDP changes and on the price level changes. Furthermore, the relationships between monetary aggregate (M2) and short-run money market interest rates suggest that the short-run interest rates do not have significant influence on the monetary aggregate. Therefore, we have determined that short-run money market interest rates are ineffective as a monetary policy-operating objective.

JEL: E4, E5, E6

KEYWORDS: monetary, money, macroeconomic policy

INTRODUCTION

Many studies have examined China's monetary policy mechanism, focusing on the effectiveness of intermediate targets, M1 and M2. For example, Xia and Liao (2001), Yu (2001), Xie (2004), and Geiger (2006, 2008) have argued that monetary aggregates (M1 and M2) are no longer suitable as intermediate targets, because the money multiplier is unstable and the monetary aggregates are not controllable by the nation's monetary authority. However, the optimal monetary policy target for China is debatable.

According Kasman (1992)，Morton and Wood (1993), Borio (1997, 2001), and Ho (2008), all central banks in the industrialised countries currently implement monetary policy through market-oriented instruments geared to influence closely short-term interest rates as operating targets. Ho's (2008) research on emerging Asian countries confirmed a number of broad themes across central banks with respect to the main features of policy implementation: focusing on short-term money market interest rates as operating objectives, favouring averaging reserve requirements, using interest rate corridors with penalty rates, and searching for alternative instruments. Therefore, the question of whether China's central bank should switch to short-term interest rate as its operating objective has attracted scholarly attention (see Xie and Luo, 2002; Yang, 2002; Xie and Yuan, 2003; Lu and Zhong, 2003; Wang and Zou, 2006; Wu, 2008). In regards to monetary theory, the precondition for adopting short-term interest rate as an operating instrument is that an effective an interest rate transmission mechanism established in a specific monetary framework and the operating objectives closely correlated to the final policy goal. However, whether short-run interest rates are highly correlated with China's monetary policy goals – price stability and economic growth – remains ambiguous.

This study uses Vector AutoRegressive (VAR) techniques to analyse the monetary transmission mechanism in China. Specifically, the study seeks to answer two questions:

1. How does a monetary policy shock, defined as a temporary and exogenous change in the short-term money market interest rate, affect real output, prices, and the nominal effective exchange rate?
2. How much do variations in short-run interest rates account for fluctuations in output, price level, and the nominal effective exchange rate?

The remainder of this paper is organized as follows. The next section describes the introduction of the study followed by background information on China's monetary framework and the literature review on monetary policy instruments. The data and research methodology present the empirical models and variables used in the study. The empirical results section discusses the relationship between the monetary policy variables and both output and prices in China using a VAR analysis. The last section concludes the paper.

BACKGROUND INFORMATION

The People's Bank of China (PBC) states that the aim of monetary policies is to maintain stability in the value of the currency and thereby promote economic growth. Therefore, the central bank is committed to two objectives: realizing price stability and promoting economic growth. The PBC claims to pursue currency stability as the sole target of its monetary policy, but it is impossible to ignore the goal of economic growth given its decision process is not independent of the state council's directives.

Since exchange rate unification in 1994, China has maintained a manageable floating exchange rate regime, a de facto peg of the renminbi (RMB) to the US dollar (USD), with different floating bandwidths during different periods. A crawling peg regime from 1994 to 1996 followed a de facto peg of the RMB against the USD with a trading band of 0.4 per cent (about RMB/USD 8.28). The trading band tightened to 0.01 per cent around the parity of RMB/USD 8.277. After an immediate appreciation of the RMB against the USD of around 2 per cent on July 21, 2005, China's exchange rate regime changed a peg against a basket of currencies, with a fluctuation bandwidth up to 0.3 per cent of the previous day's exchange rate (Anderson, 2005). On May 21, 2006, the daily floating band of the RMB against the USD trading price expanded to 0.5 percent (People's Bank of China, 2007). Based on this account, one can conclude that another objective of China's monetary policy is to maintain the stability of exchange rate vis-a-vis the USD.

Concerns on the risks of financial sector reform have led to a gradual interest rates liberalization that took place relatively late in the course of economic reform. The liberalization of the interest rates were announced in November 1993 at the Third Plenum of the Fourteenth Communist Party Central Committee (CPCC). The Party recognized that the central bank should promptly adjust the benchmark interest rates according to changes in market supply and demand. This allows the commercial banks to set their loans and deposits rates within a specific range. In 2002, the Sixteenth National Congress reiterated the need to advance interest rates reforms and optimize financial resource allocation. Furthermore, the Third Plenary Session of the Sixteenth Central Committee in 2003 argued the need to establish a robust mechanism for market-based interest rates and monetary policy actions consistent with the country's economic objectives (Bernard and Maino, 2007).

During the period 1986-1993, China's policies included targets on currency in circulation and bank's loans portfolios. In September 1994, the PBC defined and announced three levels of money supply indicators; M0, M1, and M2. In 1996, the PBC formally treated money supply as an intermediate target.

The elimination of credit ceilings in 1998 left M2 (money supply) as the single major intermediate target. The theoretical assumptions underlying China's monetary policy is that the objectives such as the GDP growth rate and the inflation rate correlate with the intermediate targets (money supply), that the intermediate targets are firmly connected to the monetary base. Equivalently, the money multiplier is assumed to be stable, and the central bank can influence intermediate targets by adjusting policy instruments.

LITERATURE REVIEW

Several scholars had devised classification schemes to describe the mechanism central banks have at their disposal for controlling financial activities.

Bernard (2004) has noted that monetary policy instruments fall into two broad categories: rules-based instruments and monetary market operations. The first category refers to the regulatory power of the central bank, which includes liquidity asset ratio, reserve requirements, and standing facility. The second category, market operations, is used at the discretion of the central bank. These bear an interest rate linked to money market conditions and aim to influence the underlying demand and supply conditions of the central bank. This includes open market–type operations, auction techniques, and fine–tuning operations (Bernard, 2004).

Xie (2004) classified the PBC's 13 monetary policy instruments into four categories relevant to 1983-2002: (1) instruments with ratios such as required reserve ratios; (2) interest rates, such rediscount rates, central bank interest rates on reserve requirements, central bank lending rates, deposits and lending interest rates of financial institutions; (3) quantity instruments, such as central bank lending, open market operations (on treasury bonds and foreign exchange), rediscounting; and (4) other instruments, such as central bank bills, central bank bonds, special deposits to the central bank, standing facilities, and moral suasion.

Geiger's (2006, 2008) classification of the PBC's monetary policy instruments is different from Xie's classification. He identifies two main categories of PBC's instruments, price-based and quantity-based. Price-based instruments are indirect and incorporate PBC lending and deposit rates, discount and rediscount rate, reserve requirements, and open market operations (OMOs). Quantity based instruments are direct and include window guidance, direct PBC lending, and capital control.

Bernard and Maino (2007) summarized China's main monetary policy instruments as standing facilities, OMOs, reserve requirements, interest rates control, window guidance, and other administrative measures. "The PBC has developed a set of monetary instruments which conform to best practices and which place the PBC in a relatively strong position to rely primarily on market-based instruments in the conduct of money policy. Open market operations in the form of issuance of PBC bills play an important role in the sterilization of excess liquidity and reserve requirements provide important support to OMOs" (Bernard and Maino, 2007, pp. 14).

Based on Bernard's (2004) theoretical framework, we can conclude that the current choice of China's monetary policy is a mix of rules-based instruments and money market operations. In 1993, the PBC introduced the OMO into its monetary policy toolbox. Following the abolishment of the credit rationing policy in 1998, the OMOs became the PBC's main monetary policy instrument. The PBC benchmark lending rates - rediscount rates, the interest rate on required reserves, and excess reserves constitute an upper and a lower limit in the money market interest rates. The central bank bill rates serves as a target rate in setting the money market interest rate, such as the federal fund rate in the U.S (Xie, 2004; Wu, 2008). Automatic collateralized lending and the excess reserves facility constitute China's standing tools for monetary control.

Xie (2004) investigated the relationship between the monetary aggregate (M1, M2) and the monetary base, from the first quarter of 1994 through the fourth quarter of 2002. The results of the quarterly cross-correlation coefficients and Granger-causality tests for the base money and monetary aggregates indicate that the impact of the monetary base on M1 is not strong, and the impact of the monetary base on M2 is even weaker. Among the four different liquidity injecting channels, namely, the PBC's lending to financial institutions, foreign exchange purchase by the monetary authority, OMOs on treasury bonds, and the rediscount window, only the central bank lending Granger causes M1, and none Granger causes M2. Therefore, monetary aggregates are endogenously determined and have strong correlations with monetary policy.

Xie (2004) also explored the dynamic relationships between monetary aggregates, economic growth, and inflation rates using data from the first quarter of 1992 to the third quarter of 2002. The author argues that the money supply affects output and money is not neutral in the short run. Nevertheless, the impacts of money supply on output last no more than eleven quarters. Money is neutral in long run and the impacts of money supply on output are not of a permanent nature. In both the short run and long run, money supply and inflation correlate, where changes in the money supply have permanent effects on the inflation rate and the price level. Geiger (2006, 2008) documents severe deviations of the targeted and the actual values from 1994-2004 and 1994-2006.

Table 1 compares the targeted with the actual values of China's monetary aggregates, M1 and M2 from 1994 to 2006. The targeted and the actual values fell only three times in the case of M1, and four times in the case of M2. Strong deviations of more than four percentage points occurred several times for both M1 and M2, and this raises the doubt on the controllability of the monetary aggregates.

Table 1: Targeted and Actual Values of PBC Monetary Aggregates (1994-2006)

Year	M1 growth (per cent)		M2 growth (per cent)	
	Target	Actual	Target	Actual
1994	21	26.2	24	34.5
1995	21-23	16.8	23-25	29.5
1996	18	18.9	25	25.3
1997	18	16.5	23	17.3
1998	17	11.9	16-18	15.3
1999	14	17.7	14-15	14.7
2000	15-17	16	14-15	14.7
2001	13-14	12.7	15-16	14.4
2002	13	16.8	13	16.8
2003	16	18.7	16	19.6
2004	17	13.6	17	14.6
2005	15	11.8	15	17.6
2006	14	17.5	14	16.9

This table shows the comparison of the targeted and the actual values of the China's monetary aggregates of the M1 and M2 from 1994 to 2006 (Geiger, 2008).

The systematic liberalization of the interest rates involved the lifting of the restrictions on wholesale transactions followed by liberalization of the retail transactions. Interest rates on foreign currencies deposits and lending were eliminated before those for local currency (Bernard and Maino, 2007). The reform on market interest rates progressed steadily from 1996. By the end of 1999, the interbank borrowing rates, discount rates for commercial paper, and repos and spot trading rates in the interbank bond market were fully liberalized. The purchasers' bids determined the interest rates on policy financial bonds and treasury bonds (Xie, 2004). The PBC also adjusted the refinancing rate to a reference rate for the money market.

Reform of the retail banking operations involved first allowing banks to price counterpart risks on customers within a floating margin before fully liberalizing the lending and deposit rates (Mehan, Quintyn, Nordman, and Laurens, 1996). The authorities reduced the number of administered interest rates, adjusted bank lending rates on industrial and commercial enterprises more frequently to reflect changes in the PBC benchmark rate, and allowed financial institutions to price their lending operations within a floating margin. The discretionary bands on lending rates expanded in 1998(Xie, 2004). In October 2004, the PBC removed ceilings on lending rates and floors on deposit rates. A floor for lending rates and a ceiling for deposit rates protect the banks' intermediation margins. The PBC reduced about 120 administered interest rates from 1996 to 2007 (Wu, 2008).

Both the depth and breadth of the money markets in China have improved significantly over the past decade. Currently, China's money market comprises of three sub-markets. The first sub-market is the interbank money market. Originating in the 1980s and modified in 1993, a reformed and unified national interbank market started operation in January 1996, where banks lent and borrowed funds among themselves for terms from overnight to four months. The amount of lending and borrowing are fixed in proportion to the balance of deposits. In contrast, non-bank financial institutions lend and borrow funds among themselves for a maximum of seven-days and the trading volumes depend on the capital level. The seven-day loan rate is the China's inter bank offered rate (CHIBOR) (Xie, 2002).

By the end of 2007, the number of market participants reached 717, fourteen times greater than when markets began operation. As of November 28, the trading volume reached RMB13,700 billion. The interbank markets rules and regulations were enforced in August 2007. Stephen (2007a, 2007b) argues that the introduction of a more market driven reference rates such as the Shanghai interbank offered rate (SHIBOR) for the onshore money market is a critical step in terms in improving China's money market.

The second sub-market is the interbank bond market, which functions as a liquidity market. The China inter-bank bond market began operation in June 1997. By the end of 2007, the number of participants was 7095 (The People's Bank of China Annual Report, 2007). Both the turnover and the liquidity of the interbank bond market have expanded significantly, with a total turnover exceeding RMB100,000 billion in 2008. The tradable stocks increased from RMB72.3 billion in 1997 to RMB9,024 billion by June 2008 (China Monetary Policy Report, 2008). It is currently the biggest bond market in China.

China's interbank bond market currently has three characteristics added since its initial development. First, the trading participants in the interbank bond market is diversified by allowing non-banking financial institutions (such as funds companies, securities companies, and insurance companies) and other enterprises to trade in this market. Second, with Treasury bonds and PBC bills as the main trading products, the debts issued by policy banks and commercial banks, and commercial papers issued by the financial companies and other big corporations have increased significantly. Issuers of bonds in this market have included the Ministry of Finance, the central bank, policy banks, commercial banks, nonbanking financial institutions, and corporations. The central bank uses the term structure of bond yields and long-term interbank rates as reference rates to predict inflation trends. This also serves as an important basis for pricing other financial products through the market.

Finally, the bond repo market, the third sub-market of the money market, is used for short-term borrowing. Turnover reached RMB51,580 billion by the end of November 2008. Since 1997, the repo rate has been set by the market, with the most active contracts between one and seven days. The seven-day repo in effect became the bond benchmark rate and it became the official reference indicator for the money market from October 12, 2004. Because commercial banks, securities companies, and other financial institutions trade in this market, frequent changes in the repo rate reflect changes in the stock and money loans markets (ChinaNet). This market is less volatile and liquid than the CHIBOR and its successor SHIBOR. Compared with interbank markets, repo markets are more active and the interest rates are more stable (Xie, 2002; Loretan and Wooldridge, 2008).

The segmentation in the money markets is the result of regulations, because the initial operations of the money markets led to disorder in the financial industry in the early 1990s. Instead of using it as a means to manage reserves by commercial banks, it is abused by both financial and other nonfinancial institutions to obtain short-term funds to invest in securities and real estate (Xie, 2002; Bernard and Maino, 2007). In order to prevent bank funds being used to participate in the stock market, the PBC ruled that commercial banks would withdraw from repo trading on the stock exchange. Beginning in 1997, commercial banks were only allowed to carry out repo trading on the interbank market, with the goal of building a firewall between the money and capital markets (Xie, 2002; Bernard and Maino, 2007). Short-term borrowing by securities companies in the interbank market led to contagion, as changing conditions in the capital market had a direct impact on the interbank markets. From 2000, securities companies, funds management companies, and other non-banking financial institutions were permitted to trade into the inter-bank markets under certain conditions. However, the coexistence of the interbank bond market and the stock exchange bond market, and the limits on RMB interbank market activity for commercial banks funded in foreign currencies remain the source of market segmentation (Wu, 2005; Bernard and Maino, 2007).

In 1994, China adopted a managed floating exchange rate regime against the USD, coupled with a move to partial convertibility on the current account (Zhang, 2001). Further, in December 1996, China adopted current account convertibility, but maintained administrative controls on the capital account (Xie, 2004). Following the 1997 Asian financial crisis, China implemented a fixed foreign exchange regime. This was in place until July 2005, when they announced a switch to a new exchange rate regime. The exchange rate would be set with reference to a basket of other currencies, with numerical weights unannounced. This allowed movement within any given day towards increased flexibility (Frankle, 2009). However, some researchers argued that China's current foreign exchange policy was still "fixed" instead of "floating" (see McKinnon and Schnabl, 2006; Frankle and Wei, 2007; Prasad, 2007).

Previous studies argue that for one country unfettered movement of international capital, independent monetary policy and a fixed exchange rate policy cannot coexist. In theory, capital controls can prevent large inflows (outflows) when domestic interest rates are higher (lower) than foreign rates. This allows the PBC to operate an independent monetary policy. In practice it is difficult to maintain effective capital controls over time, particularly in an economy like China's, that is not only open to trade but trades extensively (Goldstein and Lardy, 2007; Wu, 2006). With a large current account surpluses, the PBC faces the challenge of sterilizing the increase in the domestic money supply resulting from the large purchase of foreign exchange (i.e. sale of domestic currency).

China's balance of payments has remained strong since 1996, and its global current account surplus has expanded substantially over recent years. The current account surplus was $72.4 billion in 1996, rising to $68.7 billion (3.6 percent of GDP) in 2004, $160.8 billion (7.2 precent of GDP) in 2005, and $371.8 billion in 2007 (11.3 precent of GDP) (National Bureau of Statistics, 2008; IMF Statistic Database, 2007; State Administration of Foreign Exchange). Since then, China's account surplus (in absolute terms) is the largest of any country.

The build-up of official holding of foreign exchange reserves has accelerated since 2005. In the 12 months from June 2005 to June 2006, the foreign exchange reserves rose by $240 billion and $230 billion, respectively (Goldstein and Lardy, 2007). However, in the 12 months through June 2007, foreign exchange reserves rose by $391 million, about three-fifths more than in the previous two 12 month periods, In the 12 months through June 2008, the foreign exchange reserves rose by an astonishing $467 billion. At the end of September 2008, total foreign exchange reserves reached $1,905.5 billion (People's Bank of China, 2008).

Since the unification of China's exchange rate in 1994, the RMB has been under pressure to appreciate, except during the 1997 Asian financial crisis year. To maintain stability in the RMB, the PBC adopted several comprehensive measures. These have included improving the foreign exchange purchase-and-sale system via foreign exchange designed banks, changing interest rate policy and shifting to OMOs (Xie, 2004). Following 2000, the appreciation pressure was fueled by expanding capital inflows and foreign trade surpluses. Thus, the PBC has more pressure to intervene in the market.

Anderson (2004, 2005) and Stephen (2007a, 2007b) suggest that China can run an independent monetary policy under any foreign exchange regime and have little difficulty in retaining control of the growth of its domestic money supply. They argue that this can be absorbed with relatively effective capital control and successful stabilization via the sale of central bank bills and an increase in the required reserve ratio for banks. In contrast, Goldstein and Lardy (2006), Lardy (2006), and Prasad, Rumbaugh, Wang (2005) argue that China's (quasi) fixed exchange rate has weakened the effectiveness of its monetary policy. They believe that the resulting policy mix has left China with an interest rate structure that is far from optimum. Since a low real interest rate contributes to an underlying excess demand for credit and rapid growth of lending from banks, low deposit interest rates have been a major contributing factor to the boom in the property market.

DATA AND METHODOLOGY

This section examines the relationship between the monetary policy variables and both output and prices in China using VAR analysis. Since Sims's seminal paper in 1980, the VAR framework has been widely used in macroeconomics research as it allows the direct estimation of the joint stochastic process describing the variables under consideration. If one is unclear on which variable is endogenous and which is exogenous, the VAR method allows the researcher to treat all variables as jointly endogenous. Researchers using VAR to identify transmission of monetary policy in advanced economies include Christiano, Eichenbaum, and Evans (2000) for the United States, Kim and Nouriel, (2000) for the G-7 economies, and Peersman and Smets (2003) for the Euro area. Armenia by Era and Holger (2007) and Kenya by Cheng (2006) use the VAR framework to study the monetary policy transmission mechanism in developing countries. In this study, we use quarterly data from 1996:Q1 to 2008:Q1 to examine the macroeconomic dynamics of the unified interbank market operation in China. We first test all time series for unit roots using the augmented Dickey-Fuller method, and then estimate a reduced form VAR, indentifying money policy shocks through the assumptions about variable ordering.

Data and Variable Description

First, we consider the effects of short-term interest rates on GDP, general price level, monetary aggregate, and exchange rates. We assume the 7-day interbank money market rate (INTm), and the CHIBOR market's benchmark, as the PBC's policy stance (i.e., a 7-day repo rate (INTr), which is another benchmark short-term interest rates used in the interbank bond market). Another policy-related variable in our study is the domestic monetary aggregate M2 (M), which is the intermediate target of the PBC. We use the nominal effective exchange rate (NEER) to examine effects on output and prices. The output measure is real GDP with the consumer price index (CPI) as the general price level. All data are expressed in natural logs and are seasonally adjusted using ARIMAX12, with the exception of short-term interest rates. Table 2 display the unit root tests for the time series. The unit root tests show that INTm and INTr are trend stationary variables.

Table 2: Unit Root Tests for Time Series

Variable	(C,T,K)	ADF-Statistic	1% critical value	5% Critical Value	P-Value
GDP	(C,0,1)	0.590	-3,563	-2.921	0.98
CPI	(C.0.0)	2.581	-3.5654	-2.919	1.00
M	(C,0,0)	-0.712	-3.565	-2.919	0.83
INTm	(C,0.0)	-3.962	-3.563***	-2.919	0.00
INTm	(C,T,0)	-1.709	-4.148	-3.500	0.73
INTr	(C,0.3)	-3.024	-3.605	-2.936**	0.04
INTr	(C,T,3)	-2.908	-4.205	-3.526	0.17
NEER	(C,0,1)	-0.474	-3.568	-2.921	0.88

*This table reports the unit root tests results. (C,T,K) indicates constant, trend, and lag-length included in the unit root test. The unit root tests show that INTm and INTr are trend stationary variables. *** and ** stand for the significance at 1 and 5 percent respectively.*

The variables in the model should be stationary in displaying the relationships among the output, prices, and policy-related variables in a VAR. However, the unit root tests show the instability of the time series used in our study. Sims (1980) and Sims, Stock and Watson (1990) recommend against differencing when the related variables are cointegrated, even if the variables contain a unit root. They argue that the goal of a VAR analysis is to determine the interrelationships among the variables, not to determine the parameter estimates. Conducting the analysis in levels allow for implicit cointegration relationship in the data. However, if the related $I(1)$ variables are not cointegrated, it is preferable to use the first difference. There are three consequences if the $I(1)$ variables are not cointegrated and one estimates the VAR in level. The first consequence is the test loses its power because we estimate n^2 with more than one parameter. The second is the test for Granger causality on the $I(1)$ variables, which do not have a standard F distribution for a VAR in levels. The last is when the VAR has $I(1)$ variables, the impulse responses at long forecast horizons are inconsistent estimates of the true response.

Enders (2004) notes that the lag length test can be performed regardless of the variables in question are stationary or integrated. Eviews 6 selects the lag length of the VAR model using the VAR lag order selection criteria. All the information criteria select a lag order of one. The residual test suggests that we can reject autocorrelation and heteroskedasticity at the conventional 5% significance level. Based on the selected lag length, we perform two cointegration tests: one for the same five variables in the level VAR, and exclude the short-term interest rates in the second test. The results show that when short-term interest rates are included into the VAR, we fail to reject the null hypothesis of no cointegration (see table 3).

Table 3: Johansen Cointegration Test Results

Variables: GDP, CPI, M, INTm, NERR (p=1)				
H_0	Trace	5% Critical Value	Max-Eigen	5% Critical Value
$r = 0$	76.72	88.03	27.07	38.33
Variable: GDP, CPI, M, NEER (p=1)				
H_0	Trace	5% Critical Value	Max-Eigen	5% Critical Value
$r = o$	67.50	54.07	35.99	28.58

This table reports two Johansen Cointegration test results, one for the five variables in the level VAR, excluding the short-term interest rate variable.

In this study, we use the first order difference of the related variables to construct a VAR model. The basic concepts underlying the VAR modelling process can be summarised as follows.

Let Y_t be a $n \times 1$ vector of variables, ε_t a $n \times 1$ vector of mean zero structural innovations and $B(L) = B_0 - B_1 L - B_2 L^2 - \ldots B_p L^p$ a $n \times n$ matrix polynomial in the lag operator. The *pth* order structural VAR model is written as:

$$B(L) = \varepsilon_t \,;\; E\varepsilon_t \varepsilon_t^{'} = \Lambda \,;\; E\varepsilon_t \varepsilon_{t+s}^{'} = 0 \,,\quad \forall \neq 0 \qquad (1)$$

where Λ is a diagonal matrix. B_0 is a non-singular normalized matrix with ones on the diagonal. This matrix summarizes the contemporaneous relationships between the variables of the model. Since the coefficients are the unknown and the variables have contemporaneous effects, we therefore transform equation (1) into a reduced form VAR:

$$Y_t = A(L)Y_t + \mu_t \,;\; E\mu_t \mu_t^{'} = \Sigma \,;\; E\mu_t \mu_{t+s}^{'} = 0 \,, \forall \neq 0 \qquad (2)$$

where $A(L) = B_0^{-1} B(L) = I - AL - A_2 L^2 - \ldots A_p L^p$ and $\mu_t = B_0^{-1} \varepsilon_t$.

The error terms μ_t are composites of the underlying shocks ε_t. The model must be exactly or over-identified in order to estimate the structural model. In order to recover the structural parameters from the reduced form model, there must be the same number of parameters in B_0 and Λ as there are in Σ, the covariance matrix of the reduced form. Hamilton (1994) called this the order condition.

Combining equation 1 and 2, the variance-covariance matrix, Σ can be expressed as follows:

$$\Sigma = (B_0^{-1})\Lambda(B_0^{-1})^{'} \qquad (3)$$

Consistent estimates of F ($F = B_0$) and Λ can be obtained through the sample estimation of Σ, which can be obtained by maximum likelihood estimation. The right hand side of equation (3) contains $n \times (n+1)$ parameters to be estimated, while the left-hand side contains only $n \times (n+1)/2$ parameters; we need $n \times (n+1)/2$ restrictions to achieve identification. If the n diagonal elements of Λ are set to one, all that is required is a further $n \times (n+1)/2$ restrictions on B. There are only a few methods to recover the parameters of the structural form from the parameters in the reduced form. The most widely used approach in recursive VAR models is the Cholesky decomposition (Don and O'Reilly, 2004; Cheng, 2006).

The vector of endogenous variables in our benchmark model, equation (4), consists of real GDP (GDP), the consumer price index (CPI), monetary aggregate (M), interbank market borrowing rate (INTm), and nominal effective foreign exchange rate (NEER). We replaced interbank market bond repurchase rate (INTr) with INTm in equation (5) to test the robustness of our results.

$$Y_t = [GDP, CPI, M, INTm, NEER] \qquad (4)$$

$$Y_t = [GDP, CPI, M, INTr, NEER] \qquad (5)$$

Equation (4) shows the ordering of the variables. Intuitively, we assumed that prices (CPI) have no immediate effects on output (GDP), money stock (M) has no immediate effect on prices, monetary policy shock (INTm) has no immediate effect on the money stock, and the nominal effective exchange rate (NEER) has no immediate effect on the money policy. Technically, this amounts to first estimating the reduced form of the benchmark model equation (4), then computing the Cholesky factorization of the reduced form VAR covariance matrix. In other words, the relations between the reduced form errors and the structural disturbances are given as follows:

$$\begin{bmatrix} \varepsilon_t^{GDP} \\ \varepsilon_t^{CPI} \\ \varepsilon_t^{M} \\ \varepsilon_t^{INTm} \\ \varepsilon_t^{NEER} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ f_{21} & 1 & 0 & 0 & 0 \\ f_{31} & f_{32} & 1 & 0 & 0 \\ f_{41} & f_{42} & f_{43} & 1 & 0 \\ f_{51} & f_{52} & f_{53} & f_{54} & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{GDP} \\ \mu_t^{CPI} \\ \mu_t^{M} \\ \mu_t^{INTm} \\ \mu_t^{NEER} \end{bmatrix} \quad (6)$$

The standard practice in VAR analysis is to report results from Granger-causality tests, impulse responses, and forecast error variance decompositions (Stock and Watson, 2001). Because of the complicated dynamics in the VAR, these statistics are more informative than are the estimated VAR regression coefficients or R^2 statistics, which typically go unreported (Stock and Watson, 2001). Granger-causality statistics examine whether the lagged values of one variable help to predict another variable. Table 4 summarizes the Granger-Causality results for the five-variable VAR and shows the P-values associated with the F-statistics for testing whether the relevant sets of coefficients are zero.

Table 4: VAR Granger-Causality/Block Exogeneity Wald Tests

	Dependent Variable in Regression				
Regressor	ΔGDP	ΔCPI	ΔM2	ΔINTm	ΔNEER
ΔGDP		0.56	0.74	0.20	0.86
ΔCPI	0.45		0.51	0.29	0.37
ΔM	0.21	0.95		0.07*	0.55
ΔINTm	0.61	0.06*	0.90		0.49
ΔNEER	0.84	0.01**	0.86	0.71	

*This table summarizes the Granger-Causality results for the five-variable VAR. * and ** indicates significance level of 10 and 1 percent levels respectively.*

The result shows increases in the growth rate of INTm and NEER were significant to predict the CPI growth rate at 10% and 1% significance levels respectively, but did not Granger-cause GDP. An increase in the growth rate of the monetary aggregate Granger-causes the growth rate of INTm at the 10% significance level, but not vice versa.

RESULTS

Impulse responses trace out the response of current and future values for each of the variables to a one-unit increase in the current value of one of the VAR errors. This assumes that errors return to zero in subsequent periods and that all other errors are equal to zero (Stock and Watson, 2001). In other words, the interpretation of the impulse response requires that the innovations be contemporaneously uncorrelated across equations. However, the innovations in a VAR are correlated and may be viewed as having a common component, which cannot be associated with a specific variable (Eviews 6). Thus, we use the inverse of the Cholesky factor of the residual covariance matrix to orthogonalize the impulses.

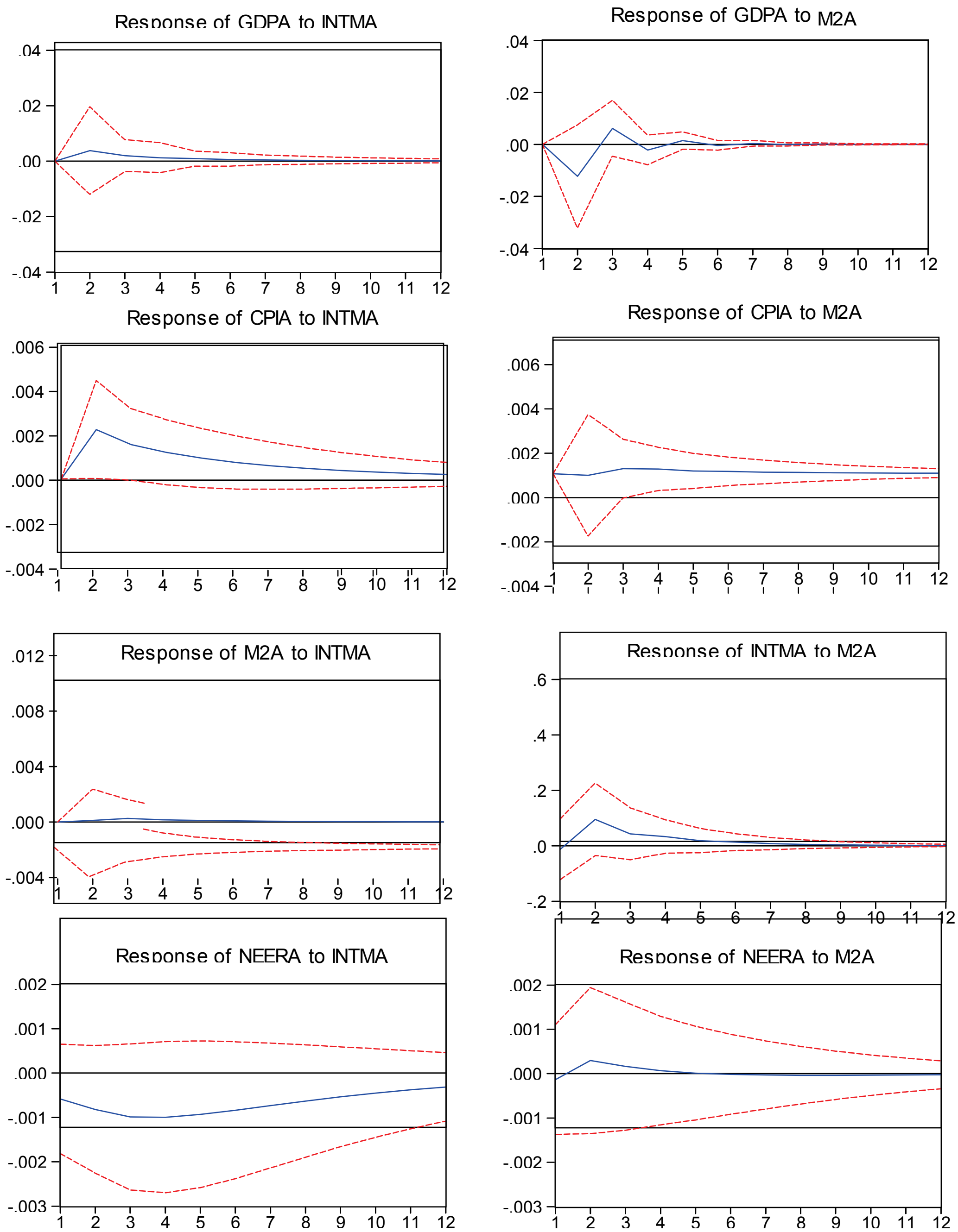
Figure 1 presents the impulse response functions, showing the impact of a one-off rise in the INTm growth rate on output, prices, monetary aggregate and exchange rate. The dotted lines represent the 95% confidence levels and the impact of a unit rise in the growth rate of monetary aggregate on other variables. Output growth rate changes by about 0.4%, peaking at the second quarter and vanishing completely at the seventh quarter following the monetary contraction. The CPI growth rate changes by about 0.2%, peaking at the second quarter and decreasing to below 0.1% at the fifth quarter after contraction. The response of the monetary aggregate growth rate to the interest rate growth shock appears to be insignificant. However, an inspection of these impulse response functions shows that the response functions of GDP growth rate and CPI growth rate are inconsistent with what we expected to be the effects of a contraction in monetary policy. Only the impulse response function of the nominal effective exchange rate appeared to be consistent with the theoretical prediction that an increase in the interest rate growth rate leads to an appreciation of the nominal exchange rate, but is statistically insignificant.

Furthermore, we examine the impacts of the shocks of monetary aggregate growth rate on the other variables. A rise in a one-unit monetary aggregate growth rate results in a 1% decline in GDP growth rate, reaching the trough at the second quarter and reverting to 0.5% at the peak of third quarter. An increase in monetary aggregate leads to a decline in real GDP within two quarters, and then promotes economic growth with four to six quarters' lag. There is an insignificant impact on both the CPI and NEER growth rates. However, the impact on the short-term interest rate is significant at the 10% level after one quarter.

The forecast error decomposition is the percentage of the variance of the error made in forecasting a variable due to a specific shock at a given horizon (Stock and Watson, 2001). The relative importance of monetary policy fluctuations in the other variables can be measured through variance decomposition. Table 5 reports the variance decomposition of the five VAR, variables covering 1 to 12 quarters. The second column in each sub-table shows the forecast errors of the variable for each forecast horizon. The remaining columns present the percentage of the variance due to the shock of the variable appearing as the column heading, with each row adding up to 100. The results show that innovations in INTm growth rate account for about 0.34 percent of the forecast error variance in the output growth rate and about 9 percent in the price level growth rate in a year. Innovations in the monetary aggregate growth rate explain about 3.24 percent of the output growth rate forecast error, and only about 0.1 percent in the price level growth rate. The innovations of money supply growth rate and interest growth rate explain each other, at about 4.7 and 0.1 precent respectively. Our results confirm the insignificant influence of changes in short-run interbank bank borrowing interest rate on GDP growth rate, and the statistically significantly influence on price level growth rate, but in the "wrong" direction. This further confirms that monetary aggregate growth rates have no influence on both the GDP and price level fluctuations. Another interesting result is that shocks to the monetary aggregate growth rate, which significantly influence the INTm change rate rather than the reverse.

Figure 2 displays the impulse responses to monetary policy shocks defined as temporary, unexpected and exogenous rises in Repo growth rate, with the variance decomposition of the forecast errors shown in Table 6. The results support our conclusion. For a one-unit rise in Repo growth rate, the GDP growth rate rises by about 0.4% at the second quarter peak and decreased to 0.08% in the fourth quarter; the CPI growth rate rose at the peak by 0.2% in the second quarter. The directions of the changes are similar to those in the benchmark VAR. Within one year, the innovations in the Repo growth rate explained about 0.35 percent of the GDP growth rate forecast error and about 7.7 percent for the price level growth rate forecast error. However, the impact of the Repo and monetary aggregate on GDP is statistically insignificant

Figure 1: Impulse Response in Recursive VAR



This figure shows the impulse response functions showing the impact of a one-off rise in INTm growth rate on output, prices, monetary aggregate and exchange rate, with the dotted lines representing 95% confidence level and the impact of a unit rise in the growth rate of monetary aggregate on other variables.

Table 5: Variance Decomposition (Percent of Total Variance)

Variance Decomposition of GDPA						
Period	**S.E.**	**GDPA**	**CPIA**	**M2A**	**INTMA**	**NEERA**
1	0.067191	100.0000	0.000000	0.000000	0.000000	0.000000
4	0.077274	95.61735	0.747174	3.247708	0.337880	0.049888
8	0.077403	95.55325	0.755237	3.277852	0.359609	0.054049
12	0.077405	95.55067	0.755621	3.277949	0.361010	0.054747
Variance Decomposition of CPIA						
Period	**S.E.**	**GDPA**	**CPIA**	**M2A**	**INTMA**	**NEERA**
1	0.008903	1.015293	98.98471	0.000000	0.000000	0.000000
4	0.009952	1.899751	81.56250	0.100684	8.907859	7.529210
8	0.010235	1.914807	78.09226	0.128086	10.33863	9.526215
12	0.010288	1.917015	77.46623	0.130873	10.55684	9.929040
Variance Decomposition of M2A						
Period	**S.E.**	**GDPA**	**CPIA**	**M2A**	**INTMA**	**NEERA**
1	0.009551	0.308828	1.161612	98.52956	0.000000	0.000000
4	0.009617	0.678184	1.982264	97.19940	0.107697	0.032459
8	0.009620	0.685572	1.988073	97.15250	0.133768	0.040086
12	0.009620	0.685725	1.988910	97.14739	0.136041	0.041934
Variance Decomposition of INTMA						
Period	S.E.	GDPA	CPIA	M2A	INTMA	NEERA
1	0.389118	0.700276	0.140861	0.108984	99.04988	0.000000
4	0.505393	3.529952	3.985635	4.734654	87.66348	0.086276
8	0.512978	3.528730	4.259895	4.819651	87.29407	0.097652
12	0.513331	3.529012	4.276629	4.819884	87.26525	0.109224
Variance Decomposition of NEERA						
Period	**S.E.**	**GDPA**	**CPIA**	**M2A**	**INTMA**	**NEERA**
1	0.004518	0.283709	5.497382	0.090923	1.655793	92.47219
4	0.007174	0.545544	10.47459	0.265867	5.794468	82.91954
8	0.007993	0.731029	11.54858	0.218461	8.591484	78.91045
12	0.008165	0.777887	11.77393	0.215670	9.328558	77.90395

This table shows the variance decomposition of the five variables VAR covering 1 to 12 quarters. The second column in each sub-table shows the forecast errors of the variable for each forecast horizon. The remaining columns present the percentage of the variance due to each shock, with each row adding up to 100.

Table 6: Variance Decomposition of VAR (Repo)

Variance Decomposition of GDPA:						
Period	**S.E.**	**GDPA**	**CPIA**	**M2A**	**INTRA**	**NEERA**
1	0.071468	100.0000	0.000000	0.000000	0.000000	0.000000
4	0.082012	94.62480	1.382626	3.424394	0.355899	0.212286
8	0.082096	94.59207	1.390798	3.435846	0.359099	0.222188
12	0.082097	94.58933	1.391206	3.435795	0.359456	0.224209
Variance Decomposition of CPIA:						
Period	**S.E.**	**GDPA**	**CPIA**	**M2A**	**INTRA**	**NEERA**
1	0.009595	1.302966	98.69703	0.000000	0.000000	0.000000
4	0.010676	1.775495	81.55952	1.970865	7.730516	6.963607
8	0.010884	1.730996	79.14847	1.915285	8.505136	8.700115
12	0.010921	1.723015	78.72026	1.905542	8.610425	9.040754
Variance Decomposition of M2A:						
Period	**S.E.**	**GDPA**	**CPIA**	**M2A**	**INTRA**	**NEERA**
1	0.008841	0.701716	0.345849	98.95243	0.000000	0.000000
4	0.008876	0.762420	0.413269	98.41496	0.037637	0.371711
8	0.008882	0.762074	0.425920	98.30062	0.048837	0.462552
12	0.008883	0.761997	0.429913	98.27425	0.054278	0.479562
Variance Decomposition of INTRA:						
Period	**S.E.**	**GDPA**	**CPIA**	**M2A**	**INTRA**	**NEERA**
1	0.352308	0.308717	0.466141	1.921718	97.30342	0.000000
4	0.413797	2.023479	5.832656	1.886932	89.95875	0.298180
8	0.415126	2.024507	5.909361	1.876778	89.88886	0.300489
12	0.415136	2.024533	5.909992	1.876696	89.88830	0.300480
Variance Decomposition of NEERA:						
Period	**S.E.**	**GDPA**	**CPIA**	**M2A**	**INTRA**	**NEERA**
1	0.004997	0.453490	6.613098	0.393814	17.40211	75.13749
4	0.007863	0.405743	11.70457	0.392003	17.68611	69.81157
8	0.008662	0.421778	12.40114	0.407970	18.38188	68.38723
12	0.008814	0.425498	12.52219	0.410484	18.52898	68.11285

This table 6 shows the variance decomposition of the forecast error in the VAR. The results shows a one-unit rise in Repo growth rate, the GDP growth rate rises by about 0.4% at the peak at the second quarter and decreases to 0.08% in the fourth quarter; the CPI growth rate rises at the peak by 0.2% in the second quarter.

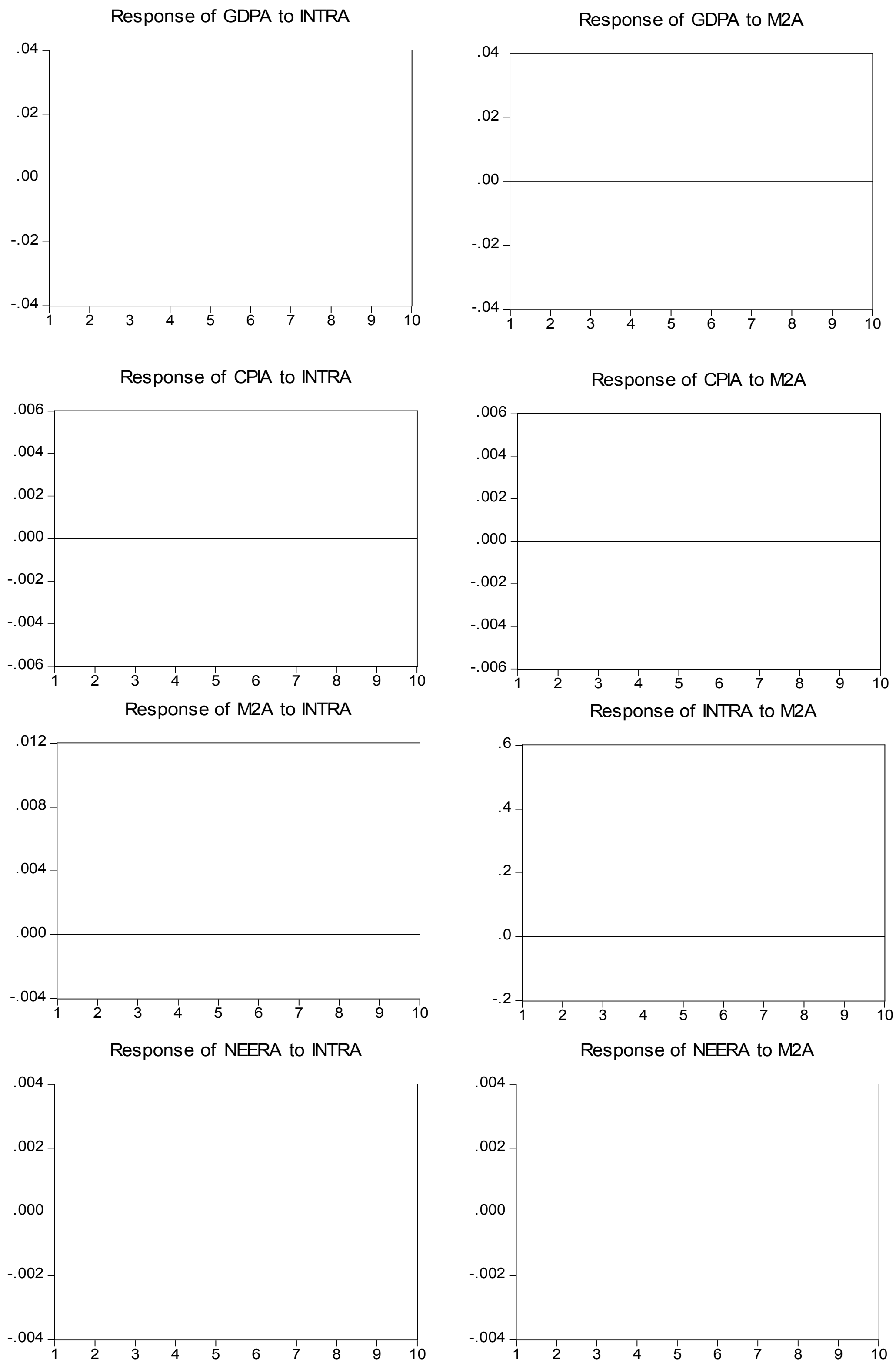
CONCLUDING COMMENTS

This study examines the transmission mechanisms of monetary policy in China, based on a VAR framework. Our findings suggest that level moving equilibrium did not exist among short-term money market interest rates, monetary aggregate, nominal effective exchange rates, and macro-economy variables (GDP and price level). However, in a differenced VAR, an exogenous, unexpected and temporary rise in the growth rate of money market short-term interest rates shows insignificant effect on the change rates of the real GDP and the price level. The impulse response functions and variance decompositions show that short-term money market interest change move along with money aggregate change rate, not the reverse. These findings show that under the current monetary aggregate targeting regime in China, a move in the short-term money market interest rate has not been able to reflect the changes in macro-economy variables. In other words, the response of the central bank's benchmark interest rate to macro-economy fluctuations fails to transfer effectively to the money market. The weak link between the short-term interest rate and the macro-economy variable implies that China cannot use the short-term money market interest rate as it operation target. An institutional reason for this failure is the existence of two cut-off separate interest rate systems: the central bank interest rate system and the commercial bank loan and deposit interest rates system.

After 2003, the PBC has adopted a contractionary monetary policy, namely, increasing the central bank bills to reduce the money supply. Therefore, the PBC could not influence the money market short-run interest rate. In this situation, the interest rate on the central bank bills rather than the money market interest rate, acts as the central bank target interest rate (Wu, 2008). To switch to an official interest rate as a policy instrument and to adopt a short-term money market rate as operation target, China needed first to establish an effective interest rate transmission channel, so that the PBC can effectively influence the short-term money market rate through OMOs.

It should be noted that the sample size in the study is not particularly large, which may limit the robustness of the tests and estimates presented here. The small sample has also prevented a reliable structural break analysis when it comes to cointegration testing. Therefore, future research that addresses similar issues should conduct with a sufficiently large sample so that one can investigate if structural breaks have taken place, and, if they have, what are their impacts on the long-run relationships between the variables.

Figure 2: Response Impulse in the Recursive VAR (Repo)



This figure shows impulse responses to a monetary policy shocks defined as a temporary, unexpected and exogenous rises in Repo growth rate

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