國立交通大學

經營管理研究所

碩士論文

股票訂價折現模型−以台灣股票市場為例

Taiwan Stock Valuation with Time-Varying Discount Factor

研　究　生：曹家銘

指導教授：周雨田　教授

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研 究 生:曹家銘　　Student: Chia-Ming Tsao

指導教授:周雨田 教授　　Advisor: Ray Yeutien Chou

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研究生:曹家銘　　　　　　　　　　　　　　　　　指導教授:周雨田 教授

國立交通大學經營管理研究所碩士班

中文摘要

有別於 Chow [2] 在假定折現因子為常數的情況下，考慮了現金股利和現金股利成長率所建立的傳統股票訂價模型，在適應預期的基本假設下，本文嘗試將此非線性模型，推廣至一個更一般化的股票評價模型。本篇論文包含了四組模型，藉由將折現因子納入模型中，以及透過不同類型股票的時間序列資料，我們欲探討，現金股利、現金股利成長率、名目無風險利率以及市場風險溢酬是否對於台灣地區指數型基金和傳產類股之成份股的股票價格產生影響。本文除了使用指數型基金的成份股為樣本資料外，更首次將類股資料導入非線性的股利折現模型中。研究結果顯示：(1) 在我們選擇的三種指數型和八種傳產類股中，只有台灣高股利指數、食品類、機電類以及金融類股資料在我們使用的一般化股利折現模型中，符合適應預期的基本假設；(2) 由部分樣本資料不符合適應預期的研究結果，我們可以推測其個別投資人較不受過去財務訊息所影響；(3) 在我們所討論的成份股中，我們普遍發現其個別投資人對於股利成長率與股價的的關係存在著悲觀觀點，而這樣的觀點恰與 Chow [29] 以香港恆生指數為樣本之研究結果不謀而合；(4) 針對傳統的八大類股而言，由於相似的股利政策和市場風險溢酬，使得僅有機電和建築類股的股票價格能被模型所解釋；(5) 我們進一步發現，在傳統的股利折現模型中，水泥窯業、食品以及機電類股之非限制方程式的係數具有相似的現象，儘管這些類股分屬不同產業，但這樣的結果隱含著這些類股的股價受到相似的因素所影響; (6) 透過統計檢定方法，我們發現名目無風險利率的期望值以及市場風險溢酬的期望值對於台灣股票價格具有顯著的影響，同時也說明了考量折現因子後的一般化股票評價模型更能捕捉台灣地區的股票價格。

關鍵字:　適應預期、非線性折現模型、股票訂價模型、折現因子、市場風險溢酬

Taiwan Stock Valuation with Time-Varying Discount Factor

Student: Chia-Ming Tsao **Advisor: Ray Yeutien Chou**

Institute of Business and Management

National Chiao Tung University

Abstract

In contrast with the model of Chow [2], which implied that the logarithm stock price is a linear function of expected log dividends and the expected rate of growth of dividends under the assumption of the adaptive expectation, we have attempted to provide a general approach to estimation of models with stock price in this paper. This research includes four models designed to investigate how dividends, growth rate of dividends, nominal risk-free rates and risk premiums affect individual stock prices by using the different kinds of data for stocks. Following the theoretical framework of Chow [2], our researches use the individual stock of the stock market index as well as the individual stock of the eight major sectors as data in four models. The preliminary findings are: (1) Only the individual stock of TWSE Taiwan Dividends+ Index, Cement & Ceramics, Foods, Electric & Machinery, Construction and Finance sectors are consistent with the assumption of adaptive expectation. (2) The data which are not fit the adaptive expectations may suggest that the investors of these data do not take the historical information into consideration. (3) Furthermore, we discover that the coefficients α for $E_t d_t$ are practically zero in the data, which are consistent with the adaptive expectations. Similar to the results of Chow [29], which used the Hang Seng Index, the empirical phenomena suggest that the overall pessimistic view of investors in these data. (4) For individual stock of the eight major sectors, merely the individual stock of the Electric & Machinery and Construction are consistent with the adaptive expectation hypothesis and can be explained by the expected level of log dividends. (5) We further discover that the unrestricted β coefficients are similar in the Cement & Ceramics, Foods, and Electric & Machinery sectors in model 1. This result indicates that behaviors in these sectors are identical. (6) According to the statistical test, we have strong evidence that the expected nominal free-risk rates and expected risk premiums have significant effect to contribute the current pricing. Besides, we find statistical evidence supporting the general model of stock price formation.

Keywords: Adaptive Expectations; Nonlinear Present-Value Model; Stock Valuation Model; Discount Factors; Risk Premiums

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時光飛逝，很開心順利完成這個人生的階段性任務。人生總是充滿著意外，但又不得不佩服上天的安排；2009 年的一場運動傷害、一場失敗的告白，不知道是逃避還是不服輸的個性使然，我把三萬塊的保險理賠金都給了補習班，只有七個月的時間，我考上交大。進入交大，能認識這麼多優秀的同學、能得到國內最頂尖教授的指導，甚至是順利的拿到碩士學位，對我來說就好像做了一場夢。首先，我要感謝我的論文指導教授-周雨田老師，在論文的撰寫上對我的指導和幫助；記得老師常說，做研究要站在巨人的肩膀才能看得遠，能成為老師的指導學生以及能與老師在學術議題上有這麼多的討論，都使得學生不論在學術的討論甚至是思維邏輯上有了很大的成長。同時，也感謝初稿審查委員丁承老師、胡均立老師的寶貴意見，以及口試委員周恆志教授、楊奕農教授的指教，因為這些老師的幫助，才使得學生的論文更趨於完整。此外，我要特別感謝經管所的所長-胡均立教授，對於胡所長的敬業精神以及對學術上的堅持，學生都感到十分的佩服，希望老師能保重身體，為經管所開創更美好的將來。

感謝這兩年來，給我不斷鼓勵和幫助的夥伴們；謝謝研究室的夥伴，嘉文、煒婷、小馬、祈妤、Mick、阿拉，能與這麼多優秀的同學共事，是我在經管所感到最光榮的。另外，我要特別感謝大學時期的學長-紀建文先生，謝謝他在過去我幾度徬徨、蹉跎的時刻，給我適時的鼓勵和幫助，他是我的偶像，如果沒有他，就沒有讀交大的我。同時，也祝福他能趕緊與洪茜欣學姐早日結婚，生下美貌智慧兼具的小寶寶。我還要感謝我的父母，總是支持我的任何決定，或許我的父母沒有很高的學歷，或許他們時常被瞧不起，但他們對我的百分之百支持，成就了今天的我，我想，我沒讓你們失望。回首兩年的時光，只能以忙碌來形容，經管所繁重的課程、撰寫論文的壓力、再加上在外兼課的疲勞，常常讓自己喘不過氣；幸虧我的身邊還有個溫柔體貼、善解人意的女孩兒-黃怡芬小姐，感謝她這兩年來

容忍我無數次的發脾氣和不貼心，也因為有她精神上的支持和鼓勵，才讓我有動力不斷的接受挑戰以及順利完成論文。我常覺得，交女朋友就像在買福袋，你永遠不知道你抽到的是衛生紙還是豪華房車，但我想說，對於我來說，妳就是上天給我最好的禮物，因此我希望把這篇論文的榮耀獻給妳。我愛妳。

曹家銘 謹誌於

國立交通大學經營管理研究所

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1. Introduction

What are the reasons that cause stock price fluctuation? What factors determine the individual stock price? The relationship between stock prices and the fundamental factors has long been the subject of both theoretical and empirical research in financial economics. Studies by Cutler, Poterba, and Summers [1], have claimed that the variation in aggregate stock price can be attributed to various types of economic news. A standard approach to examine stock price is the present-value model; this fundamental valuation formula implies the stock price is the expected present discount value of future dividend streams.

The present-value model was first used in the stock price determination by Chow [2]. It was based on the model that stated the price of a stock at the beginning of time t was the sum of the expected discounted values of all of its future dividends. In other words, the model of Chow [2] assumed that the logarithm of the price of a stock is a linear function of the expected current log dividend and the expected rate of growth of dividends. Since future dividends were uncertain, Chow proposed to summarize by the expected level dividends and expected growth rate under adaptive expectations. The fundamental valuation formula became nonlinear function of the four parameters.

Furthermore, the empirical research of the nonlinear present-value model was widely used in financial economics since 1958. Michael [3] first used nonlinear present-value model in labor migration and urban unemployment. Michael assumed that the percentage change in the urban labor force was governed by the differential between the discounted streams of expected urban and expected rural real income. Michael and Eduardo [4] used the model for the evaluation natural resource investment projects. The model suggested that the cash flow stream was then equal to the current value of the replicating portfolio. Hamilton and Flavin [5] used the nonlinear present-value model in

Government Deficits. The research investigated whether the historical data provided a basis for expecting a violation of the present-value borrowing constraint. The results provided the proposition that in order to be able to issue interest-bearing debt, the government must promise to balance its budget in expected present-value terms. Lloyd [6] used the nonlinear present-value model to discuss the land price. This paper presented the relationship between land prices and cash rents derived from an encompassing present value framework.

Patricia [7] focused on the estimation of future profitability as the fundamental determinant of firm value. The model indicated that book value and earnings have distinct roles. The price earnings ratio (P/E) was a function of expected changes in future profitability, and the price book ratio (P/B) was a function of the expected level of future profitability. The model predicted that P/B should correlate positively with future return on book value, and that P/E should correlate positively with growth in earnings. Liu [8] used a nonlinear present-value model that allows for a time-varying expected discount rate in conjunction with a VAR process to decompose real-estate risk. The study indicated that cash-flow risk was found to result in a weaker mean reversion process for real estate relative to stocks. Geltner [9] provided an improved present-value model, taking account of the predictability of property returns, was described and found to track or the traditional present-value model with constant expected returns. Analysis in this paper suggested that most of the changes in commercial property market values have been due to changes in expected returns, rather than changes in expected future operating cash flows.

For stock price volatility, Yuhn [10] aimed to an alternative approach based on a cointegrating regression model for the present value relation. Different from the Campbell and Shiller [11], which demonstrated a linear cointegration between stock prices and dividends, this study lied in its distinction between linear and nonlinear cointegration. The results indicated that a linear cointegration was not appropriate for investigating stock price volatility and a non-linear representation of cointegration was developed. Duffie and Singleton [12] developed a multi-factor econometric model of the term structure of interest-rate swap yields. The model showed that the fixed payment rate of a swap, assuming that the floating rate was London Interbank Offering Rate (LIBOR), can be expressed in terms of present values of net cash flows of the swap contract discounted by a default and liquidity-adjusted instantaneous short rate. In other words, there was an adjusted short rate process that allowed us to develop a term structure model for the swap market in the same way that models have been developed for government yield curves. Kallberg and Liu [13] applied the West and Campbell–Shiller tests of the dividend pricing relation to an index of real estate investment trusts (REITs). Similar to previous research, this research suggested that, for the REIT population, dividend pricing models cannot be rejected. The present-value model was poor predictors of true prices when tested on market indexes.

Talan [14] used the nonlinear present-value model on the current account of durables consumption. Different from the previous studies, assuming that all goods were traded and that aggregate consumption decisions can be closely approximated by a random walk process, Talan extended these models by explicitly introducing durables and nontrade goods into an intertemporal model of the current account. Since forecasts derived from standard intertemporal current account (ICA) models generally failed to match the volatility of actual current accounts, Gruber [15] offered a solution to the ‘‘excess volatility’’ problem of standard ICA models by incorporating consumption habits into the standard model. The model showed that significant habit formation implies increased current account volatility, as sluggishness was introduced into the consumption adjustment process that followed income shocks. According to Hall [16], which pointed out that because stock price predicted the future state of the economy, it predicted consumption. Yoshihiro [17] used the present-value model on the current account and stock returns. The model assumed that consumption depended on permanent income, and the empirical finding indicated that a representative agent smoothes consumption based on stock market information.

Recent stock price movements had led to a re-examination of the present-value model. Several studies of asset pricing have challenged the views that stock price were attributed to future dividend streams. Bansal and Lundblad [18] and Bansal and Yaron [19] argued that dividends may be potentially poor instruments because dividends were often manipulated or smoothed. Shiller [20] had shown evidence that stock returns were fluctuating too much to be explained by shocks to future cash flows or plausible variations in future discount rates, argued for other sources of movement in asset prices. Shiller [21] also claimed a change in the volatility of either future cash flows or discount rates caused a change in the volatility of stock returns in present-value models. In addition, Shiller showed the evidence that stock market volatility cannot be explained by movements in the rational expectation of future dividends and interest rates. Hence, we believe that more than one factor drives the dynamics of cash flows. Grossman and Shiller [22] argued the variability of stock prices can be attributed to information regarding discount factors (i.e., real interest rates), which were in turn related to current and future levels of economic activity. The capital asset pricing model (CAPM) of Sharp [23] implied that the expected return on a risky asset was estimated as the risk free rate plus an expected risk premium. The CAPM implied that the risk of the market portfolio was measured by the variance of its returns, so that the risk premium for the market portfolio increased with the variance of its returns. Further, Merton [24] gave an intertemporal CAPM model which implied a linear relationship between the equity premium and the market return variance.

The empirical validity of the hypothesis of rational expectations and adaptive expectations have been studied since the 1980s. According to Muth [25], under the rational expectations, we equate the subjective expectations in the minds of the economic agents with the mathematical expectations generated by the econometric model used by the econometrician. Based on Hicks [26], under the adaptive expectations, we interpret the subjective expectation in the minds of economic agents and not as a mathematical expectation given the information used by the econometrician. Even though Lovell [27] has shown further evidence that the validity of the rational expectation hypothesis by applying it to the present-value model. Many studies have attempted to test the present-value model under the rational expectation hypothesis and have different results from Lovell [27]. The studies of Campbell and Shiller [11], Fama and French [28], Poterba and Summers [29] and West [30] have found that the rational expectation hypothesis may have some restrictions on the present-value model. These restrictions for the rational expectation hypothesis may suggest that the data was inconsistent with the models. In spite of the skepticism of empirical validity for the rational expectations, the hypothesis of rational expectation still have much interested in financial economics in 1980s.

According to results by Chow and Kwan [31], who used the rational expectations hypothesis and the adaptive expectations hypothesis to discuss the Hong Kong stock prices, the present-value model can explain panel data of prices of individual stock and aggregate time series data on Hong Kong stock price index under the adaptive expectations hypothesis. The result indicated that an argument supporting the rational expectations hypothesis for econometric models was followed from (1) the correctness of the model, and (2) the economic agents having at least as much information as the econometrician building the model. In addition, both Campbell and Shiller [11] and Chow [32] have shown strong statistical evidence that the model is not significant under rational expectations. The problems arisen from applying the rational expectation hypothesis may be due to the fact that the general investors have no better model to estimate the expected variables. Based on Chow [32], which has provided the strong statistical evidence to support the present-value model under adaptive expectations, we assume the variables of this model, dividends, growth rate of dividends, nominal risk-free rates and risk premiums, following the adaptive expectations hypothesis.

In contrast to the models of Chow [2], we try to build a general model which includes the variables of dividends, growth rate of dividends, nominal risk-free rates, and risk premiums. We still assume the expected dividends grow at a constant rate g, but the restriction of a constant discount rate is removed. Our model implies that the logarithm stock price is a linear function of expected log dividends, expected log rate of growth, expected log nominal risk-free rates, and expected log risk premiums under the assumption of adaptive expectation. According to Merton [24] and [33], we consider a linear relationship between risk premiums and market return variances. To examine if the present-value model is suitable for different kinds of stocks with a new approach, we will be using the individual stock of market index as well as different kinds of industry data to construct the model in our researches. Data in our models is divided into two parts. First, we use individual stock of the stock market index in Taiwan, which including TWSE Taiwan 50 Index, TWSE Taiwan Mid-Cap 100 Index, and TWSE Taiwan Dividend+ Index. Secondly, we also use individual stock of the eight major sectors in Taiwan, which including Cement & Ceramics, Foods, Plastics & Chemicals, Textiles, Electric & Machinery, Construction, Finance and Paper sectors.

The aforementioned analyses focus on two purposes: First, we try to build a general nonlinear present-value model, which consider expected level of dividends, expected rate of growth and expected discount factors. Secondly, by using different kinds of stock data, we would like to know if the present-value model built under the assumption of adaptive expectation can explain different industries' stock price. The remainder of the article is organized as follows. Section 2 presents the theoretical framework of individual stock prices given by Chow [2]. We present the data and the estimation result in section 3. In section 4, we compare and discuss the estimation result from four models, which one is the best model to explain the stock prices. The last section provides the conclusion for this paper.

2. Stock Prices, Dividends, Interest Rates and Risk Premiums

Our model of stock price determination can be derived from the present-value model as follows. The present value model is

$$S_t = E_t \sum_{i=0}^{\infty} \frac{D_{t+i}}{\prod_{s=0}^{i} (1 + r_{f,t+s} + m_{t+s})} \tag{1}$$

Where S_t is the price of a stock at the beginning of period t, D_{t+1} is the forthcoming dividend during the period t+1. $r_{f,t+s}$ and m_{t+s} are respectively the nominal risk-free rate and the risk premium at period $t+s$. Eq. (1) is the familiar fundamental valuation formula which including nominal risk-free rates and risk premiums.

If the expected dividend is assumed to grow constant rate g so that $E_tD_{t+s}=(E_tD_t)(1+g)^s$, Eq. (1) can therefore be simplified to:

$$S_t = E_t \sum_{i=0}^{\infty} \frac{D_{t+i}}{\prod_{s=0}^{i} (1 + r_{f,t+s} + m_{t+s})} = \frac{E_t D_t}{r_{t+s} + m_{t+s} - g} \tag{2}$$

Taking logarithms, gives $s_t = \ln S_t = \ln(E_tD_t) - \ln(r_{t+s}+m_{t+s} - g) \fallingdotseq \ln(E_tD_t) - 1 - r_{t+s} - m_{t+s} + g$. Where the value of $r_{t+s} + m_{t+s} - g$ have to smaller than one and all $\ln(E_tD_t)$, r_{t+s}, m_{t+s}, and g have to be estimated.

To extend the model to a general model, we simultaneously consider dividends, rate of growth of dividends, nominal risk-free rates and risk premiums into our model. In model 4, we assume that $\ln(E_tD_t)$ is a linear function of the adaptive expectation of $lnD_t = d_t$ for the forthcoming period and that the permanent expected growth rate g is a linear function of the adaptive expectation of $g_t = d_t - d_{t-1}$ for the forthcoming period. The adaptive expectations for the forthcoming period are formed by

$$E_td_t = E_{t-1}d_{t-1} + c(d_{t-1} - E_{t-1}d_{t-1}) = c[1-(1-c)L]^{-1}d_{t-1}$$

$$E_tg_t = E_{t-1}g_{t-1} + b(g_{t-1} - E_{t-1}g_{t-1}) = b[1-(1-b)L]^{-1}g_{t-1}$$

$$E_tr_t = E_{t-1}r_{t-1} + e(r_{t-1} - E_{t-1}r_{t-1}) = e[1-(1-e)L]^{-1}r_{t-1}$$

$$E_tm_t = E_{t-1}m_{t-1} + h(m_{t-1} - E_{t-1}m_{t-1}) = h[1-(1-h)L]^{-1}m_{t-1} \quad (3)$$

Where L denotes the lag operators, $Ld_t = d_{t-1}$, $Lr_t = r_{t-1}$, $Lm_t = m_{t-1}$. Under the assumption of adaptive expectation, the adjustment coefficients c, b, e, and h in the adaptive formation of expected level of log dividends, expected log rate of growth, expected log nominal risk-free rates and expected level of log risk premiums, respectively, must between zero and one. The reason for adjustment coefficient is due to the expected variable become negative, when adjustment coefficient is over than one. As one extreme case, if adjustment coefficient = 0, the model reduces to a naive prediction of no change; alternatively, if adjustment coefficient =1 we continue with the same static forecast as before without revision for current error.

Under our assumption, the present-value model for the logarithm s_t of stock price at the beginning of period t becomes

$$s_t = \delta \cdot E_td_t + \alpha \cdot E_tg_t - \tau \cdot E_tr_t - \omega \cdot E_tm_t + \gamma \quad (4)$$

Where the coefficient δ, α, τ, ω, γ are respectively represent expected dividends, expected growth rate, expected nominal risk-free rates, expected risk premiums and constant term. Multiplying Eq.(4) by$[1-(1-c)L][1-(1-b)L][1-(1-e)L][1-(1-h)L]$ and substituting for $E_t d_t$, $E_t g_t$, $E_t r_t$, and $E_t m_t$ from Eq.(3), one obtains the following model for s_t.

$$s_t = \beta_1 s_{t-1} + \beta_2 s_{t-2} + \beta_3 s_{t-3} + \beta_4 s_{t-4} + \beta_5 d_{t-1} + \beta_6 d_{t-2} + \beta_7 d_{t-3} + \beta_8 d_{t-4} + \beta_9 d_{t-5} + \beta_{10} r_{t-1} + \beta_{11} r_{t-2} + \beta_{12} r_{t-3} + \beta_{13} r_{t-4} + \beta_{14} m_{t-1} + \beta_{15} m_{t-2} + \beta_{16} m_{t-3} + \beta_{17} m_{t-4} + \gamma^* \quad (5)$$

The coefficients from the Eq. (5) are reported in the Appendix A. There are seventeen coefficients($\beta_1,\beta_2,...,\beta_{17}$) in Eq. (5) which derived from eight structural parameters, δ, α, τ, ω, c, b, e and h. Eq. (5) is a linear functions of the ten coefficients ($\beta_1,\beta_2,...,\beta_{17}$) but a nonlinear function of the eight parameters (δ, α, τ, ω, c, b, e, h). It will be estimated by the method of nonlinear least squares, which minimizes the sum of squared residuals with respect to the eight parameters. The nonlinear restriction will also be tested.

Based on Chow [2], we only consider the logarithm stock price is a linear function of expected of log dividends and the expected rate of growth of dividends in model 1.
Under our assumption, the present-value model for the logarithm s_t of stock price at the beginning of period t becomes

$$s_t = \delta \cdot E_t d_t + \alpha \cdot E_t g_t + \gamma \quad (5)$$

Where the coefficient δ, α, γ are respectively represent expected dividends, expected growth rates and constant term. Multiplying Eq. (4) by$[1-(1-c)L][1-(1-b)L]$ and substituting for $E_t d_t$ and $E_t g_t$ from Eq. (3), one obtains the following model for s_t.

$$s_t = \beta_1 s_{t-1} + \beta_2 s_{t-2} + \beta_3 d_{t-1} + \beta_4 d_{t-2} + \beta_5 d_{t-3} + \gamma^* \quad (6)$$

Where $\gamma^{*}= \gamma \cdot cb$; the coefficients of s_t : $\beta_1 = (2 - c - b)$, $\beta_2= -(1- c)(1- b)$; the coefficients of $E_t d_t$: $\beta_3 = \delta c + \alpha b$, $\beta_4 = -\delta c(1-b) - \alpha b(2- c)$, $\beta_5 = \alpha b (1- c)$. Since the five coefficients($\beta_1,\beta_2,...,\beta_5$) in Eq. (6) are derived from four structural parameters, δ, α, c and b, there is one nonlinear restriction on the coefficients ($\beta_1,\beta_2,...,\beta_5$). Eq. (6) is a linear functions of the five coefficients ($\beta_1,\beta_2,...,\beta_5$) but a nonlinear function of the four parameters (δ, α, c, b). It will be estimated by the method of nonlinear least squares, which minimizes the sum of squared residuals with respect to the four parameters.

Different from the general model, we respectively consider risk premiums and nominal risk-free rates to our model. In model 2, on the basis of the CAPM model, it implies a linear relationship between risk premiums and market return variances. The CAPM postulates a linear relationship between an asset's beta (a measure of systematic) and expected return. We will assume that a linear relationship with the market return variance by Merton [8],[17].i.e.

$$m_t = \sigma_{i,m} = \beta_i \times \sigma_m^2 \tag{7}$$

$$\beta_i = \frac{\sigma_{i,m}}{\sigma_m^2} = \frac{\rho_{i,m} \cdot \sigma_i}{\sigma_m} \tag{8}$$

From Eq. (7) and Eq. (8), it will be clear that the higher beta stocks yield may cause higher risk premiums and a higher expected rate of return. Further, we directly calculate the value of β_i and σ_m^2 by using financial data. The risk premiums, m_t , are attributed to the value of β_i and σ_m^2, where we consider that m_t is the sector's beta times the variance of market return from different kinds of stock in model 2. Especially, since the beta of the Weighted Price Index of the Taiwan Stock Exchange is used to measure the total market risk in the Stock Exchange, the beta value is a constant figure of one. When we use individual stock of the market index to exam the present-value model, the value of m_t will be the variance of market return.

Under our assumption, the present-value model for the logarithm s_t of stock price at the beginning of period t becomes

$$s_t = \delta \cdot E_t d_t + \alpha \cdot E_t g_t - \omega \cdot E_t m_t + \gamma \quad (9)$$

Where the coefficient ω is represent expected risk premiums. Multiplying Eq.(9) by $[1-(1-c)L][1-(1-b)L][1-(1-h)L]$ and substituting for $E_t d_t$, $E_t g_t$ and $E_t m_t$ from Eq.(3), one obtains the following model for s_t.

$$s_t = \beta_1 s_{t-1} + \beta_2 s_{t-2} + \beta_3 s_{t-3} + \beta_4 d_{t-1} + \beta_5 d_{t-2} + \beta_6 d_{t-3} + \beta_7 d_{t-4} + \beta_8 m_{t-1} + \beta_9 m_{t-2} + \beta_{10} m_{t-3} + \gamma^* \quad (10)$$

The coefficients from the Eq. (10) are reported in the Appendix B. There are ten coefficients ($\beta_1, \beta_2, \ldots, \beta_{10}$) in Eq. (10) which derived from six structural parameters δ, α, ω, c, b and h.

We directly use the one-year deposit rates to represent nominal risk-free rates in model 3. Under our assumption, the present-value model for the logarithm s_t of stock price at the beginning of period t becomes

$$s_t = \delta \cdot E_t d_t + \alpha \cdot E_t g_t - \tau \cdot E_t r_t + \gamma \quad (11)$$

Where the coefficient τ is represent expected nominal risk-free rates. Multiplying Eq.(12) by$[1-(1-c)L][1-(1-b)L][1-(1-e)L]$ and substituting for $E_t d_t$, $E_t g_t$ and $E_t r_t$ from Eq. (3), one obtains the following model for s_t.

$$s_t = \beta_1 s_{t-1} + \beta_2 s_{t-2} + \beta_3 s_{t-3} + \beta_4 d_{t-1} + \beta_5 d_{t-2} + \beta_6 d_{t-3} + \beta_7 d_{t-4} + \beta_8 r_{t-1} + \beta_9 r_{t-2} + \beta_{10} r_{t-3} + \gamma^* \quad (12)$$

The coefficients from the Eq. (12) are reported in the Appendix C. There are ten coefficients ($\beta_1, \beta_2, \ldots, \beta_{10}$) in Eq. (12) which derived from six structural parameters δ, α, τ, c, b and e.

3. Data and Estimation Results

Different from the data of Chow [29], who respectively used individual stocks of the Hang Seng Index, we try to build a general model by different kinds of industrial data for the first time. The data in our models can be divided by two parts. First, similar to the previous models, we focus on individual stock of the stock market index, which included TWSE Taiwan 50 Index, TWSE Taiwan Mid-Cap 100 Index, and TWSE Taiwan Dividend+ Index. Secondly, we try to consider the data of the eight major sectors, which included Cement & Ceramics, Foods, Plastics & Chemicals, Textiles, Electric & Machinery, Construction, Finance, and Paper sectors, into nonlinear model.

Table 1. The individual stock of the TWSE Taiwan 50 Index

	Companies		Companies
1	Taiwan Cement Corporation	26	Quanta Computer Inc.
2	Asia Cement	27	AU Optronics Corporation
3	Uni-President Enterprises Corporation	28	Chunghwa Telecom Co., Ltd
4	Formosa Plastics Corporation	29	MediaTek Inc.
5	Nan Ya Plastics Corporation	30	Catcher Technology Co., Ltd.
6	Formosa Chemicals & Fibre Corporation	31	HTC Corporation
7	Far Eastern New Century	32	Chang Hwa Commerciai Bank,LTD
8	Taiwan Fertilizer Co.,Ltd.	33	Hua Nan Financial Holding Co.,Ltd.
9	Taiwan Glass Ind. Corp.	34	Fubon Financial Holding Co., Ltd.
10	Yulon Motor Co., Ltd	35	Cathay Financial Holding Co.,
11	China Stell Corporation	36	China Development Financial Holding Corporation
12	Hotai Motor Co., Ltd	37	Yuanta Financial Holdings
13	Cheng Shin Rubber Ind., Co., Ltd.	38	Mega Financial Holding Co.,
14	LITE-ON Technology Corporation	39	Sinopac Financial Holding Company Limited
15	United Microelectronics Corporation	40	Chinatrust Financial Holding Company Ltd.
16	Delta Electronics, INC	41	First Financial Holding Co. Ltd.
17	Advanced Semiconductor Engineering Inc	42	President Chain Store Corporation
18	Hon Hai Precision Ind. Co., Ltd.	43	Largan Precision Co., Ltd
19	Compal Electronics, Inc.	44	Taiwan Mobile CO., LTD.
20	Siliconware Precision Industries Co.,Ltd	45	Wistron Corporation
21	Taiwan Semiconductor Manufacturing Co., Ltd.	46	CHIMEI Innolux Corporation
22	Synnex Technology International Corporation	47	TPK Holding Co., Ltd.
23	ACER Incorporated	48	Far EasTone Telecommunications Co., Ltd.
24	Foxconn Technology Co., Ltd	49	Taiwan Cooperative Bank
25	Asustek Computer Inc.	50	Formosa Petrochemical Corporation

According to TWSE Taiwan 50 Index, similar to the Dow Jones Index for industrial stocks of the New York Stock Exchange, which consists of the fifty blue-chip stocks in the Taiwan Stock Exchange. There are fifty representative stocks of TWSE Taiwan 50

Index listed in Table 1. The market value of TWSE Taiwan 50 Index accounted for 70% of the market.

Table 2. The individual stock of the TWSE Taiwan Mid-Cap 100 Index

	Companies		Companies
1	Standard Foods Corporation	51	Yang Ming Marine Transport Corp.
2	USI Corporation	52	China Airlines Ltd.
3	China Petrochemical Development Corporation	53	Wan Hai Lines Ltd.
4	Tong Yang Industry Co., Ltd	54	EVA Airways Corporation
5	Formosa Taffeta Co., Ltd	55	Formosa International Hotels Corporation
6	Tainan Spinning Co., Ltd	56	Gourmet Master Co. Ltd.
7	TECO Electric & Machinery Co., Ltd	57	King's Town Bank
8	Yungtay Engineering Co., Ltd	58	Taichung Commerical Bank Co., Ltd
9	Airtac Internatinnal Group	59	China Life Insurance Company, Ltd.
10	Walsin Lihwa Corporation	60	Taiwan Business Bank
11	LCY Chemical Corp.	61	Far Eastern International Bank
12	Oriental Union Chemical Corp.	62	President Securities Corp.
13	Eternal Chemical Co., Ltd	63	E. Sun Financial Holding Company ,Ltd.
14	China Steel Chemical Co.	64	Taishin Financial Holding Co., Ltd.
15	ScinoPharm Taiwan, Ltd.	65	Shin Kong Financial Holding Co.,Ltd.
16	Yuen Foong Yu Paper Mfg. Co., Ltd	66	Waterland Financial Holdings
17	Tung Ho Steel Enterprise Corp.	67	Far Eastern Department Stores Ltd.
18	Feng Hsin Iron & Steel Co., Ltd	68	Mercuries & Associates, Ltd.
19	Hiwin Technologies Corp.	69	Ruentex Industries Limited
20	NanKang Rubber Tire Corp., Ltd	70	Novatek Microelectronics Corp.
21	Tsrc Corporation	71	Unimicron Technology Corp.
22	Kenda Rubber Industrial Co., Ltd	72	Tripod Technology Corporation
23	China Motor Corporation	73	Kinsus Interconnect Technology Corp.
24	Yageo Corporation	74	Genius Electronic Optical Co., Ltd.
25	Macronix International Co., Ltd	75	Inotera Memories, Inc.
26	Winbond Electronics Corp.	76	MStar Semiconductor, Inc.
27	Inventec Corporation	77	WPG Holdings Limited
28	Chroma Ate Inc.	78	Taiwan Prosperity Chemical Corporation
29	Clevo Co.	79	Pegatron Corporation
30	Tatung Co.	80	Zhen Ding Technology Holding Limited
31	Realtek Semiconductor Corp	81	Farglory Land Development Co., Ltd
32	Wintek Corporation	82	Chailease Holding Company Limited
33	Chicony Electronics Co., Ltd	83	Capital Securities Corp.
34	VIA Technologies, Inc.	84	Radiant Opto-Electronics Corp.
35	Cheng Uei Precision Industry Co., Ltd	85	Powertech Technology Inc.
36	Everlight Electronics Co., Ltd.	86	Flexium Interconnect Inc
37	Advantech Co., Ltd.	87	Wistron NeWeb Corporation
38	EPISTAR corporation	88	Richtek Technology Corp.
39	Senao International Co.,Ltd.	89	Lite-On IT Corporation
40	Transcend Information, Inc.	90	Nan Ya Printed Circuit Board Corporation
41	Cathay Real Estate Development Co., Ltd	91	Compal Communications Inc.
42	Golddsun Development & Construction Co., Ltd	92	Cleanaway Company Limited
43	Prince Housing & Development Corp.	93	Pou Chen Corporation
44	Highwealth Construction Corp.	94	Ton Yi Industrial Corp.
45	Huang Hsiang Construction Corporation	95	Merida Industry Co., Ltd.
46	Radium Life Tech. Co., Ltd	96	Taiwan Secom Co., Ltd.
47	Huaku Development Co., Ltd	97	Giant Manufacturing Co., Ltd.
48	Evergreen Marine Corp. (Taiwan) Ltd	98	CTCI Corporation
49	U-Ming Marine Transport Corp.	99	Sinyi Realty Inc.
50	Evergreen International Storage & Transport	100	Ruentex Development Co., Ltd.

Simultaneously, we also use individual stock of the other stock market index. There are one hundred representative stocks of TWSE Taiwan Mid-Cap 100 Index listed in Table 2. TWSE Taiwan Mid-Cap 100 Index is made up of the 100 large, publicly owned companies in Taiwan, which except for individual stock of the TWSE Taiwan 50 Index. In other words, the individual stock of TWSE Taiwan Mid-Cap 100 Index are ranked from 51^{th} to 150^{th} in the Taiwan Stock Exchange. In comparison with the market value of TWSE Taiwan 50 Index, TWSE Taiwan Mid-Cap 100 Index accounted for 20% of the market. The individual stock of TWSE Taiwan Dividend+ Index are listed in Table 3. TWSE Taiwan Dividend+ Index is composed of the 30 listed companies in individual stock of the TWSE Taiwan 50 Index and the TWSE Taiwan Mid-Cap 100 Index, which predicts the cash dividend yield will be higher in the next year. In other words, the individual stock in the TWSE Taiwan Dividend+ Index are selected from 150 large, outstanding stocks which ranked in the Taiwan Stock Exchange.

Table 3. The individual stock of the TWSE Taiwan Dividend+ Index

	Companies		Companies
1	Taiwan Cement Corporation	16	Quanta Computer Inc.
2	Formosa Plastics Corporation	17	Chicony Electronics Co., Ltd
3	Nan Ya Plastics Corporation	18	Chunghwa Telecom Co., Ltd
4	Formosa Chemicals & Fibre Corporation	19	Transcend Information, Inc.
5	Oriental Union Chemical Corp.	20	MediaTek Inc.
6	Eternal Chemical Co., Ltd	21	Highwealth Construction Corp.
7	Tung Ho Steel Enterprise Corp.	22	Huaku Development Co., Ltd
8	Tsrc Corporation	23	U-Ming Marine Transport Corp.
9	LITE-ON Technology Corporation	24	Mega Financial Holding Co.,
10	United Microelectronics Corporation	25	Novatek Microelectronics Corp.
11	Compal Electronics, Inc.	26	Taiwan Mobile CO., LTD.
12	Siliconware Precision Industries Co.,Ltd	27	Wistron Corporation
13	Yageo Corporation	28	Far EasTone Telecommunications Co., Ltd.
14	Macronix International Co., Ltd	29	Farglory Land Development Co., Ltd
15	Realtek Semiconductor Corp	30	Lite-On IT Corporation

Furthermore, the individual stock of the eight major sectors are reported in the Appendix D. Since different companies have different time to be a listed company and did not issue dividends in cash every year, the total information of the data is listed in Table 4. To fulfill the purpose of researches, which investigate how dividends, growth rate of dividends, nominal risk-free rates and risk premiums affect individual stock prices, we build the unbalanced panel data. For the stock market index, the date covers a period from 1991 to 2010 and total number of observations respectively are 496, 817 and 326. In the second section, we consider individual stock of the eight major sectors in Taiwan. The eight major sectors we selected in Taiwan Stock Exchange are respectively Cement & Ceramics sector, Foods sector , Plastics & Chemicals sector, Textiles sector, Electric & Machinery sector, Construction sector, Finance sector, and Paper sector. We discover that the samples of individual stock in Paper sector has minimum amount in eight sectors and different sample period.

Table 4. Data Information

Stock Market Index	Period	firms	observations
TWSE Taiwan 50 Index	1991~2010	48	496
TWSE Taiwan Mid-Cap 100 Index	1991~2010	93	817
TWSE Taiwan Dividend+ Index	1991~2010	29	326
Eight Major Sectors	period	firms	observations
Cement & Ceramics	1991~2010	11	133
Foods	1991~2010	18	160
Plastics & Chemicals	1991~2010	52	473
Textiles	1991~2010	32	199
Electric & Machinery	1991~2010	35	295
Construction	1991~2010	35	189
Finance	1991~2010	31	221
Paper	1994~2010	5	35

In this research we will use four models, built upon the assumption of adaptive expectation, to explain the prices of stocks in Taiwan. Following the model of Chow [2], our model only implies that the logarithm stock price is a linear function of expected log dividends, expected log rate of growth in model 1. In regards to data for stock prices, the price of stock was reflected by the market value of the listed company; when a listed company issues cash dividends, the market value of the stock prices will reduce.

For market value of post-dividend stocks, we use the ex-dividend stock prices to build the unbalanced panel data. Consequently, since the data ranges across a time span of 20 years, we will also take the effect of inflation into account. To solve the issue with inflation, we use the GDP deflator (2006 = 100), which is a measurement of the level of prices of all new, domestically produced, final goods and services in an economy, to process the data. To calculate the real stock prices, we will divide the ex-dividend stock prices by the GDP deflator. For dividends data, the GDP deflator is also used to process the data. After the calculations, we build the data called real cash dividends.

Besides, different from Chow [2], we add two discount factors, nominal risk-free rates and risk premiums into our model. The beta for TWSE Taiwan 50 Index is shown in Table 5. We discover that the average beta for individual stocks of the TWSE Taiwan 50 Index is higher in the Global Financial Crisis in 2009. Furthermore, we also note that the average of individual betas is highest than each years, when Asian Financial crisis happened in 1997.

Table 5. The beta for TWSE Taiwan 50 Index, 1991-2010

Year	Mean	Std. Dev.	Year	Mean	Std. Dev.
1991	0.9391	0.0742	2001	1.0139	0.3039
1992	0.8525	0.2606	2002	0.9499	0.3679
1993	0.8660	0.1467	2003	0.9818	0.2975
1994	0.9523	0.2190	2004	0.9865	0.2707
1995	0.8996	0.1980	2005	0.9825	0.4186
1996	0.9203	0.2055	2006	1.0099	0.3851
1997	1.1597	0.3523	2007	1.0223	0.2591
1998	1.1302	0.3008	2008	1.0454	0.2593
1999	0.9915	0.1899	2009	1.0699	0.2979
2000	0.9425	0.2040	2010	1.0067	0.2837

Table 6 shows descriptive statistics of beta for individual stock of the eight major sectors. The mean beta of Electric & Machinery sector is at the summit in 20 years, which suggests that the individual stock may have higher systematic risk. We also discover that Construction sector have the highest standard deviation in eight major sectors. This result indicates that the beta of Construction sector may have higher volatility than others.

Table 6. The beta for eight major sectors, 1991-2010

Sector	Mean	Median	Maximum	Minimum	Std. Dev.
Cement & Ceramics	0.8380	0.8124	2.6195	– 0.665	0.3139
Foods	0.8461	0.8466	2.1119	– 0.2327	0.2802
Plastics & Chemicals	0.8888	0.9045	1.7285	0.1787	0.2294
Textiles	0.9812	0.9981	1.8853	0.1025	0.2489
Electric & Machinery	1.0597	1.0437	1.9658	0.2737	0.1904
Construction	0.9471	0.9325	2.7373	– 0.2665	0.3366
Finance	1.0488	1.0363	1.9239	0.2477	0.2419
Paper	0.9278	0.9471	2.7135	– 0.2605	0.3209

Figure 1 gives plots of the variance of market return from 1991 to 2010 in Taiwan. Similar to the average beta in TWSE Taiwan 50 Index, the variance of market return is higher in the Global Financial Crisis in 2009. Based on the results of Robert Merton [8], we consider that risk premium is the sector's beta times the variance of market return in our models. Hence, the higher variance of market return may cause higher risk premiums in this year.

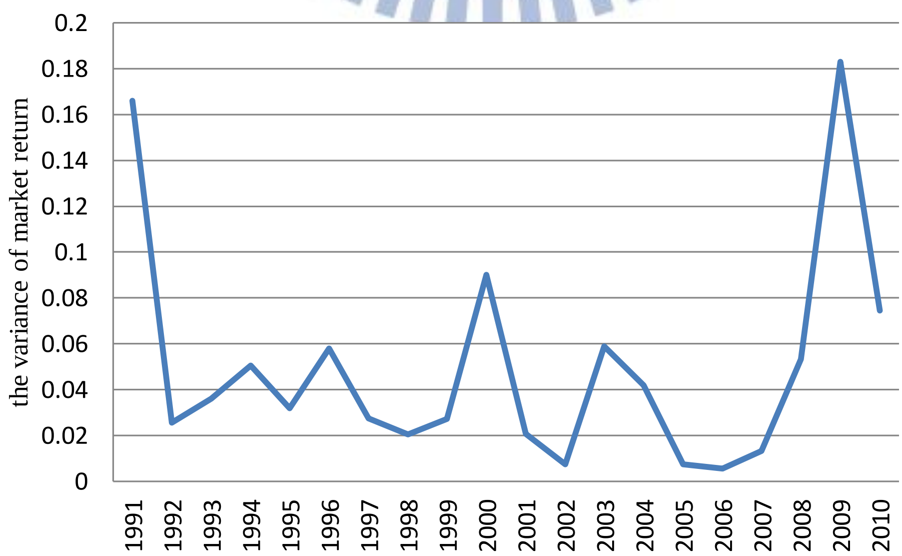

Figure 1. The variance of market return in Taiwan, 1991-2010

We directly use the one-year deposit rates to represent nominal risk-free rates. Figure 2 gives plots of the one-year deposit rates series from 1991 to 2010 in Taiwan.

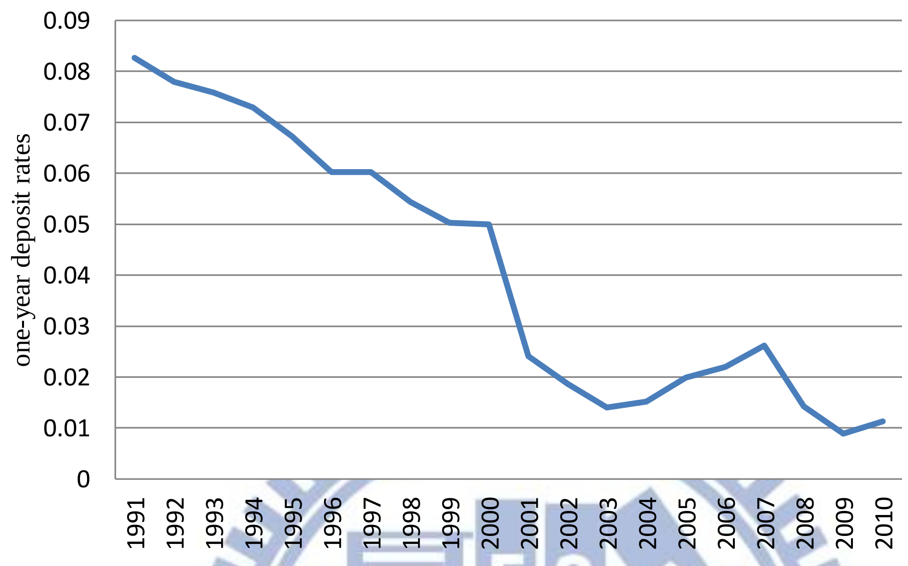

Figure 2. One-year deposit rates series in Taiwan, 1991-2010

Sources: Central Bank of Republic of China (Taiwan)

We can discover that the trend of one-year deposit rates are gradually reduced from 1991 to 2010. Since the Internet bubble and the September 11th event were in early 2000's, America's economy suffered the recession. Governments in other countries adopt the easy money policy which has the great effect of reducing deposits rates to encourage their domestic economies. From 2000 to 2001, Government in Taiwan rapidly cut down the one-year deposit rates from 5% to 2.41%, which means a 51.8% reduction. We note that one-year deposit rates are maintained around 2% after the year of 2001. Furthermore, when Financial crisis happened in 2009, the one-year deposit rates was reduced under 1%.

Table 7 contains the results of applying unit root tests to log stock price series. We discover that the unit root hypothesis are rejected in log stock price series of TWSE Taiwan Mid-Cap 100 Index and Electric & Machinery sector. The result indicates that the log stock price series of TWSE Taiwan Mid-Cap 100 Index and Electric & Machinery sector are stationary series. And we note that the stock price series of TWSE Taiwan 50 Index and TWSE Taiwan Dividend+ Index are stationary when the log stock price series are first differenced. Furthermore, the log stock prices series in Cement & Ceramics, Foods, Plastics & Chemicals, Textiles, Construction, Finance and Paper sector are stationary when the series are first differenced.

Table 7. Unit root tests in stock price series

Stock Market Index	ADF – Intercept	
	s	△s
TWSE Taiwan 50 Index	76.0678 (0.2895)	*240.330 (0.0000)
TWSE Taiwan Mid-Cap 100 Index	*119.299 (0.0914)	
TWSE Taiwan Dividend+ Index	55.9100 (0.2021)	*176.464 (0.0000)
Eight Major Sector	**ADF - Intercept**	
	s	△s
Cement & Ceramics	25.2871 (0.1907)	*65.3129 (0.0000)
Foods	10.2091 (0.9936)	*43.1105 (0.0020)
Plastics & Chemicals	70.6650 (0.4553)	*164.124 (0.0000)
Textiles	35.7078 (0.3881)	*97.5862 (0.0000)
Electric & Machinery	*71.9905 (0.0225)	
Construction	42.3539 (0.2158)	*61.3339 (0.0001)
Finance	44.0598 (0.4691)	*79.4822 (0.0002)
Paper	8.6578 (0.3720)	*17.2769 (0.0083)

NOTE. The null hypothesis is that the series in question contains a unit root in its univariate autoregressive representation. ADF is the regression t-ratio for the autoregressive coefficients to sum to unity-the augmented Dickey-Fuller statistic; * $p < 0.1$. ; (·): p-value; s: log stock prices; △s: difference of log stock prices

Table 8 contains the results of applying unit root tests to log dividends series. Our conjecture that the log dividends series are stationary in the TWSE Taiwan 50 Index, TWSE Taiwan Mid-Cap 100 Index, Foods, Plastics & Chemicals, Textiles, Electric &

Machinery, Construction, and Finance sector. Furthermore, the log dividends series in TWSE Taiwan Dividend+ Index, Cement & Ceramics Sector and Paper Sector are stationary when the series are first differenced.

Table 8. Unit root tests in dividends series

Stock Market Index	ADF – Intercept	
	dvd	△dvd
TWSE Taiwan 50 Index	*113.086 (0.0009)	
TWSE Taiwan Mid-Cap 100 Index	*123.570 (0.0551)	
TWSE Taiwan Dividend+ Index	49.6398 (0.4077)	*134.740 (0.0000)
Eight Major Sector	**ADF - Intercept**	
	dvd	△dvd
Cement & Ceramics	22.9366 (0.2919)	*92.9127 (0.0000)
Foods	*45.1695 (0.0056)	
Plastics & Chemicals	*101.574 (0.0081)	
Textiles	*56.9047 (0.0082)	
Electric & Machinery	*87.2239 (0.0009)	
Construction	*58.4730 (0.0103)	
Finance	*82.2114 (0.0004)	
Paper	9.6697 (0.2890)	*14.9048 (0.0210)

NOTE. The null hypothesis is that the series in question contains a unit root in its univariate autoregressive representation. ADF is the regression t-ratio for the autoregressive coefficients to sum to unity-the augmented Dickey-Fuller statistic; * $p < 0.1$. ; (·): p-value; dvd: log dividends; △dvd: difference of log dividends

Table 9 lists the results of tests for unit roots in risk premiums and nominal risk-free rates series. Since the beta value, which measured the total market risk, is a constant figure of one in stock market index, the value of risk premiums will be the variance of market return. Hence, the risk premiums series are equal in TWSE Taiwan 50 Index, TWSE Taiwan Mid-Cap 100 Index and TWSE Taiwan Dividend+ Index. We discover that the unit root hypothesis are rejected at the 10% level in log risk premiums series of the Stock Market Index. The result suggests that the log risk premiums series in stock market index are stationary.

Table 9. Unit root tests in risk premiums and nominal risk-free rates series

Stock Market Index	ADF – Intercept	
	m	△m
TWSE Taiwan 50 Index	*104.592 (0.0000)	
TWSE Taiwan Mid-Cap 100 Index	*104.592 (0.0000)	
TWSE Taiwan Dividend+ Index	*104.592 (0.0000)	
Eight Major Sector	**ADF – Intercept**	
	m	△m
Cement & Ceramics	*68.8747(0.0000)	
Foods	*71.5986 (0.0000)	
Plastics & Chemicals	*114.199 (0.0000)	
Textiles	*58.6233 (0.0054)	
Electric & Machinery	*102.103 (0.0000)	
Construction	37.8575 (0.3845)	*66.2617 (0.0000)
Finance	*71.2613 (0.0058)	
Stock Market Index & Eight Major Sector	**ADF – Intercept**	
	r	△r
	*39.1716 (0.0027)	

NOTE. The null hypothesis is that the series in question contains a unit root in its univariate autoregressive representation. ADF is the regression t-ratio for the autoregressive coefficients to sum to unity-the augmented Dickey-Fuller statistic; * $p < 0.1$. ; (·): p-value; m: log risk premiums; △m: difference of log risk premiums; r: log nominal risk-free rates; △r: difference of log nominal risk-free rates

In the eight major sectors, we discover that the log risk premiums series of Cement & Ceramics, Foods, Plastics & Chemical, Textiles, Electric & Machinery and Finance sectors are stationary. And the unit root hypothesis of log risk premiums series in Construction sector can be rejected at the 10% level when the series are first differenced. Table 9 also presents the result of unit root test in the log nominal risk-free rates series. The result shows that the unit root hypothesis can be rejected at the 10% level. In other words, the log nominal risk-free rates series are stationary in all data.

Table 10 summarizes the results from individual stock of the TWSE Taiwan 50 Index, in which assumes all parameters follows the adaptive expectation hypothesis.

Table 10. Results in the TWSE Taiwan 50 Index

TWSE Taiwan 50 Index 1991-2010 (firms: 48; observations: 496)				
	Model 1	Model 2	Model 3	Model 4
c	0.0547 (.01845)*	0.9753 (.0607)*	0.0844 (.0777)	1.4224 (.0684)*
b	1.1722 (.0433)*	0.0849 (.0313)*	0.9753 (.1767)*	0.7305 (.1082)*
h	-	1.2476 (.0616)*	-	1.0745 (.1345)*
e	–	-	1.2480 (.1162)*	0.0634 (.0251)*
δ	– 0.0156 (.1632)	0.6927 (.3137)*	0.7123 (.5862)	0.1824 (.0555)*
α	0.3227 (3.4706)	– 7.5551 (6.1987)	– 0.0217 (.0230)	0.2928 (.0739)*
ω	-	0.0158 (.0524)	-	0.0395 (.2424)
τ	-	-	0.1168 (.1206)	1.1620 (.9702)
β_1	0.7732	0.6921	0.6922	0.7092
β_2	0.1628	0.2101	0.2106	0.3155
β_3	– 0.0006	– 0.0056	– 0.0056	– 0.0875
β_4	0.0385	0.0341	0.6929	– 0.0079
β_5	– 0.0172	0.0476	– 0.4624	0.0455
β_6	-	– 0.0062	– 0.1573	0.0144
β_7	-	– 0.0198	– 0.0001	0.0490
β_8	-	0.0186	– 0.1458	– 0.01193
β_9	-	– 0.0005	0.1371	– 0.0063
β_{10}	-	– 0.0005	– 0.0033	– 0.0425
β_{11}	-	-	-	0.0333
β_{12}	-	-	-	0.0109
β_{13}	-	-	-	–0.00453
β_{14}	-	-	-	– 0.0736
β_{15}	-	-	-	– 0.0168
β_{16}	-	-	-	0.0075
β_{17}	-	-	-	0.0006
R^2	0.9169	0.9358	0.9360	0.9361
s	.2782	.2504	.2500	.2518

NOTE. * $p<.05$. ; (·) the standard errors of the parameter estimates

Under the assumption of adaptive expectation, the adjustment coefficients *c*, *b*, e, and *h* in the adaptive formation of expected level of log dividends, expected log rate of growth, expected log risk-free rates and expected level of log risk premiums, respectively, must between zero and one. If the adjustment coefficients are over than one, which means the assumption of the adaptive expectation would be violated. The standard errors of the parameter estimates are given in parentheses. The point estimates of the β_i coefficients are unconstrained least squares estimates provided for reference.

From the first column of Table 10, the adjustment coefficients *c* and *b* in the formation of expected dividends and expected rate of growth are respectively 0.0547 and 1.1722. Different from the previous models of Chow, the adjustment coefficients *b* for the formation of expected rate of growth would violate the assumption of adaptive expectation. Column 2 of Table 10 shows the results of model 2, we also find that the adjustment coefficients *h* for the formation of expected level of log risk premiums is over than one. In model 3, the adjustment coefficients *c* in the adaptive formation of expected level of dividends is not significant. Similar to the previous models, the adjustment coefficients *c* for the formation of expected level of log dividends is 1.4224 in model 4, which means the data is inconsistent with the adaptive expectation hypothesis. In spite of the adjustment coefficients *c* is inconsistent with the adaptive expectations in model 4, the coefficients δ, α for $E_t d_t$ and $E_t g_t$ in the equation for log stock price are 0.1824 and 0.2928. The positive results suggest that expected level of log dividends and expected level rate of growth may contribute to the current pricing in individual stock of the TWSE Taiwan 50 Index.

Table 11 shows the result from individual stock of the TWSE Taiwan Mid-Cap 100 Index. Similar to the results of TWSE Taiwan 50 Index, we also discover that the adjustment coefficients *b* for the formation of expected rate of growth are inconsistent with the adaptive expectations in model 1 and 3. Besides, the adjustment coefficients *c* in model 2 and the adjustment coefficients *h* in model 4 are both inconsistent with the adaptive expectations. However, we still discover that the coefficients *δ*, *ω* for $E_t d_t$ and $E_t m_t$ in the equation for log stock price are significant in model 4.

Table 11. Results in the TWSE Taiwan Mid-Cap 100 Index

TWSE Taiwan Mid-Cap 100 Index 1991-2010 (firms: 93; observations: 817)				
	Model 1	Model 2	Model 3	Model 4
c	0.1375 (.0214)*	1.2894 (.0646)*	0.9405 (.1224)*	0.1927 (.0522)*
b	1.2582 (.0396)*	0.9022 (.1091)*	1.2985 (.0744)*	0.9499(.1093)*
h	-	0.1948 (.0714)*	-	1.5309 (.0630)*
e	–	-	0.1704 (.0744)*	0.7597 (.0936)*
δ	0.0524 (.0818)	0.0903 (.0502)	0.0752 (.0485)	0.3819 (.1712)*
α	– 0.5091 (.7030)	– 0.0795 (.0598)	– 0.0636 (.0550)	– 0.0142 (.0185)
ω	-	0.5336 (.2738)	-	0.1977 (.0627)*
τ	-	-	– 0.3554 (.6770)	0.0144 (.0860)
β_1	0.6044	0.6136	0.5906	0.5667
β_2	0.2227	0.1826	0.2160	0.3363
β_3	– 0.0041	– 0.0228	– 0.0147	– 0.1211
β_4	– 0.1408	0.0447	0.0378	0.0052
β_5	0.0568	0.0036	0.0048	0.1851
β_6	-	–0.01111	– 0.0122	– 0.2855
β_7	-	– 0.0167	– 0.0148	0.0294
β_8	-	– 0.1038	0.0606	0.1477
β_9	-	– 0.0199	0.0145	– 0.0193
β_{10}	-	0.0029	– 0.0011	– 0.0221
β_{11}	-	-	-	0.0242
β_{12}	-	-	-	– 0.0054
β_{13}	-	-	-	0.0002
β_{14}	-	-	-	– 0.0110
β_{15}	-	-	-	0.0036
β_{16}	-	-	-	0.0045
β_{17}	-	-	-	– 0.0002
R^2	0.8486	0.8570	0.8553	0.8616
s	.3484	.3393	.3414	.3335

NOTE. * p<.05. ; (·) the standard errors of the parameter estimates

Table 12 summarizes the result from individual stock of the TWSE Taiwan Dividend+ Index. The results are similar to those achieved by Chow [35]; the adjustment coefficients *c* and *b* are respectively 0.2079 and 1.0977 in model 1. The relative weights of expected level of dividends and expected rate of growth in the determination of log stock price are as given by δ and α. The coefficients δ、α for $E_t d_t$ and $E_t g_t$ in the equation for log stock price are 0.3182 and –0.0587. The result of significantly positive expected level of log dividends indicates that more cash dividends issued may cause the stock price upswing. Column 2 of Table 12 shows the results of model 2, we find that the adjustment coefficients *b* for the formation of expected rate of growth is 1.2202, which violates the assumption of adaptive expectation. In model 3, the adjustment coefficient *c* for the formation of expected level of dividends is inconsistent with the adaptive expectation hypothesis.

From the Column 4 of Table 12, the adjustment coefficients *c*, *b*, e, and *h* are respectively 0.9858, 0.2095, 0.9844 and 1.1289, which suggests the data is consistent with the adaptive expectation hypothesis in model 4. The coefficients δ、α for $E_t d_t$ and $E_t g_t$ in the equation for log stock price are 0.4696 and –1.9384. The result of significantly negative expected level of growth rate indicates that investors in individual stocks of the TWSE Taiwan Dividends+ Index who does not believe that recent growth of dividend rate can let stock price upswing. In spite of the adjustment coefficients *e* and *h* are consistent with the adaptive expectation hypothesis, the coefficients γ and ω for $E_t r_t$ and $E_t m_t$ in the equation for log stock price are both not significant. The results suggest that expected log free-risk rates and expected level of log risk premiums may not contribute to the current pricing in individual stocks of the TWSE Taiwan Dividends+ Index. To summarize the results from individual stock of the stock market index, we discover that only the data of TWSE Taiwan Dividend+ Index are consistent with the assumption of adaptive expectation in model 1 and 4.

Table 12. Results in the TWSE Taiwan Dividend+ Index

TWSE Taiwan Dividend+ Index 1991-2010 (firms: 29; observations: 326)				
	Model 1	Model 2	Model 3	Model 4
c	0.2079 (.0453)*	0.2615 (.1666)	1.2661 (.1012)*	0.9858 (.1136)*
b	1.0977 (.0686)*	1.2202 (.1093)*	0.2895 (.1631)	0.2095 (.0630)*
h	-	0.7828 (.2572)*	-	1.1289 (.2168)*
e	-	-	0.7715 (.2344)*	0.9844 (.3005)*
δ	0.3182 (.1237)*	0.2166 (.1591)	0.2746 (.1733)	0.4696 (.1500)*
α	– 0.0587 (.0259)*	– 0.0290 (.0225)	– 0.0381 (.0214)	– 1.9384 (.7425)*
ω	-	0.1789 (.1140)	-	0.0632 (.2122)
τ	-	-	0.4745 (.2974)	0.1176 (.1076)
β_1	0.6944	0.7355	0.6729	0.6914
β_2	0.0774	0.0500	0.0875	0.0820
β_3	0.3371	– 0.0035	– 0.0432	– 0.0029
β_4	– 0.6272	0.0213	0.0312	0.0002
β_5	0.2767	0.0693	0.0966	0.0569
β_6	-	– 0.0422	– 0.0580	0.0523
β_7	-	0.0057	0.0078	– 0.0007
β_8	-	– 0.1400	– 0.3661	– 0.0016
β_9	-	0.0726	0.1627	0.0001
β_{10}	-	0.0228	0.0692	– 0.0714
β_{11}	-	-	-	0.0586
β_{12}	-	-	-	– 0.0017
β_{13}	-	-	-	0.0001
β_{14}	-	-	-	– 0.1158
β_{15}	-	-	-	0.0783
β_{16}	-	-	-	0.0107
β_{17}	-	-	-	– 0.0002
R^2	0.8903	0.8961	0.8957	0.9102
s	.2944	.2916	.2922	.3928

NOTE. * p<.05. ; (·) the standard errors of the parameter estimates

The result of models from individual stock of the Cement and Ceramics sector is listed in Table 13.

Table 13. Results in the Cement and Ceramics sector

Cement and Ceramics sector 1991-2010 (firms: 11; observations: 133)				
	Model 1	Model 2	Model 3	Model 4
c	0.3245 (.1276)*	1.0480 (.5365)	0.2467(.2960)	0.7044 (.5057)
b	0.9205 (.1858)*	0.2420 (.1399)	1.0191 (.8379)	0.2321 (.1857)
h	-	0.9686 (.6265)	-	1.3570 (.3245)*
e	-	-	1.0128 (1.1205)	0.9213 (.3543)*
δ	0.0385 (.1583)	– 0.0405 (.2642)	– 0.065029 (.3544)	0.2343 (.2170)
α	– 0.0373 (.4137)	0.3888 (1.1744)	0.4133 (2.0994)	– 0.3714 (1.1836)
ω	-	0.1176 (0.1079)	-	– 0.0449 (.1417)
τ	-	-	– 0.0358 (.2367)	0.2035 (.1070)
β_1	0.7550	0.7413	0.7214	0.7852
β_2	– 0.0537	0.0141	0.0238	0.0971
β_3	0.0233	– 0.0011	0.0002	– 0.0940
β_4	– 0.0584	0.0516	0.0357	0.0064
β_5	0.0239	– 0.0590	– 0.0497	0.0789
β_6	-	– 0.0027	– 0.0026	0.0687
β_7	-	0.0001	– 0.0002	– 0.0319
β_8	-	– 0.1139	0.0363	– 0.0111
β_9	-	0.0808	– 0.0267	0.0007
β_{10}	-	0.0042	– 0.0005	– 0.0609
β_{11}	-	-	-	0.0696
β_{12}	-	-	-	– 0.0189
β_{13}	-	-	-	0.0011
β_{14}	-	-	-	– 0.1875
β_{15}	-	-	-	0.1325
β_{16}	-	-	-	0.0286
β_{17}	-	-	-	– 0.0152
R^2	0.8055	0.8064	0.7955	0.8462
s	.2720	.2808	.2886	.2626

NOTE. * p<.05. ; (·) the standard errors of the parameter estimates

From the first column of Table 13, we discover that the adjustment coefficients *c* and *b* are respectively 0.3245 and 0.9205 in model 1. However, the coefficients δ, α for $E_t d_t$ and $E_t g_t$ in the equation for log stock price are not significant. This result suggests that expected level of log dividends and expected rate of growth as projected by adaptive expectations does not contribute to the current pricing of Cement & Ceramics sector. Furthermore, the data of Cement and Ceramics sector are inconsistent with the adaptive expectation hypothesis in model 2, 3 and 4.

Table 14 summarizes the result from individual stock of the Foods sector. In spite of the adjustment coefficients *c* and *b* in the adaptive formation of expected level of log dividends, expected rate of growth are respectively 0.4210, and 0.7208, the coefficients δ, α for $E_t d_t$ and $E_t g_t$ in the equation for log stock price are not significant in model 1. These results suggest that the expected level of log dividends and expected rate of growth as projected by adaptive expectations does not contribute to the current pricing of Food sector. In model 2, the adjustment coefficients *b* and *h* in the adaptive formation of expected rate of growth and expected risk premiums are not significant. Hence, the model under the adaptive expectation is rejected as before. We also discover that the data are inconsistent with the adaptive expectation hypothesis in model 3. In model 4, we note that all of the adjustment coefficients follow the assumption of adaptive expectation. But, the coefficients δ, α, τ, ω for $E_t d_t$, $E_t g_t$, $E_t r_t$, $E_t m_t$ in the equation for log stock price are not significant in model 4. These results suggest that these variables as projected by adaptive expectations may not explain to the current pricing of Foods sector.

Table 14. Results in the Foods sector

Foods sector 1991-2010 (firms: 18; observations: 160)				
	Model 1	Model 2	Model 3	Model 4
c	0.4210 (.1886)*	0.9655 (.5224)*	0.8187 (.5297)	1.2928 (.1675)*
b	0.7208 (.2176)*	0.8589 (.7156)	0.9949 (.3139)*	0.6478 (.1880)*
h	-	0.2991 (.2139)	-	0.8193 (.3282)*
e	-	-	0.3090 (.2330)	0.2265 (.0948)*
δ	0.1761 (.1044)	0.1357 (.1209)	0.1367 (.1220)	0.1438 (.3513)
α	– 0.1810 (.2159)	– 0.0704 (.2288)	– 0.0867(.2060)	– 0.4871 (1.0299)
ω	-	0.0969 (.2786)	-	– 0.0614 (.1836)
τ	-	-	0.2124 (.5173)	0.2511 (.5478)
β_1	0.8582	0.8765	0.8774	0.9135
β_2	– 0.1617	– 0.1280	– 0.1297	0.0374
β_3	0.0794	0.0034	0.0006	– 0.1377
β_4	– 0.2245	0.0706	0.0651	0.0193
β_5	0.0901	– 0.0054	0.0017	– 0.1152
β_6	-	– 0.0330	– 0.0326	0.2309
β_7	-	0.0015	0.0003	– 0.0076
β_8	-	– 0.0290	– 0.0299	0.0386
β_9	-	0.0051	0.0056	0.0173
β_{10}	-	– 0.0001	– 0.0002	0.0503
β_{11}	-	-	-	– 0.0369
β_{12}	-	-	-	– 0.0085
β_{13}	-	-	-	0.0054
β_{14}	-	-	-	– 0.0569
β_{15}	-	-	-	0.0080
β_{16}	-	-	-	0.0083
β_{17}	-	-	-	– 0.0014
R^2	0.9060	0.9113	0.9113	0.8858
s	.2147	.2132	.2132	.2499

NOTE. * $p<.05$. ; (·) the standard errors of the parameter estimates

The result of models from individual stock of the Plastics and Chemicals sector is listed in Table 15. It is worth to be mentioned that the data for Plastics and Chemicals sector are inconsistent with the adaptive expectation hypothesis in four models.

Table 15. Results in the Plastics and Chemicals sector

Plastics and Chemicals sector 1991-2010 (firms: 52; observations: 473)				
	Model 1	Model 2	Model 3	Model 4
c	1.2391 (.0473)*	0.7409 (.1841)*	0.1929 (.1504)	1.3123 (.2025)*
b	0.0235 (.0104)*	0.1754 (.1455)	0.7165 (.1852)*	0.6798 (.1650)*
h	-	1.4019 (.0635)*	-	0.0146 (.0118)
e	-	-	1.4028 (.0604)*	1.3343 (.0948)*
δ	– 0.3351 (.8806)	– 0.0414 (.1108)	– 0.0377 (.1029)	– 0.0782 (.0999)
α	– 0.0167 (.0171)	0.0281 (.4688)	0.2098 (.4456)	0.1537 (.1809)
ω	-	– 0.0073 (.0186)	-	6.6981 (6.1017)
τ	-	-	0.2932 (.0877)*	– 0.0181 (.0173)
β_1	0.7375	0.6817	0.6878	0.6590
β_2	0.2335	0.2220	0.2105	0.4243
β_3	– 0.0286	– 0.0859	– 0.0921	– 0.0677
β_4	0.0262	– 0.0257	0.0135	– 0.0330
β_5	0.0019	0.0087	– 0.0247	0.0019
β_6	-	0.0090	– 0.0007	– 0.0402
β_7	-	0.0005	0.0046	– 0.0079
β_8	-	0.0103	– 0.4113	0.0794
β_9	-	– 0.0112	0.4486	0.0108
β_{10}	-	0.0022	– 0.0941	– 0.0976
β_{11}	-	-	-	–0.0319
β_{12}	-	-	-	0.0100
β_{13}	-	-	-	0.0033
β_{14}	-	-	-	0.2413
β_{15}	-	-	-	– 0.0240
β_{16}	-	-	-	– 0.0022
β_{17}	-	-	-	0.0024
R^2	0.9574	0.9620	0.9638	0.9664
s	.3353	.3301	.3221	.3223

NOTE. * p<.05. ; (·) the standard errors of the parameter estimates

Table 16 summarizes the result from individual stock of the Textile sector. There are not sufficient observations to estimate Eq. (12) in the Textile sector. The data is inconsistent with the adaptive expectation hypothesis in models. These results suggest that the models may not a good model to explain the price of the Textile sector.

Table 16. Results in the Textile sector

Textiles sector 1991-2010 (firms: 32; observations: 199)			
	Model 1	Model 2	Model 4
c	0.1005 (.0340) *	1.3270 (.0851) *	1.4237 (.1725) *
b	1.3401 (.0739) *	0.0815 (.1352)	1.0227 (.2776) *
h	-	0.9620 (.1585)	0.2132 (.1046) *
e	-	-	0.6600 (.2863) *
δ	– 0.0046 (.1215)	– 0.0339 (.0973)	0.1288 (.1581)
α	0.6802 (1.6668)	– 0.0241 (7.6668)	– 0.1408 (.1919)
ω	-	– 0.0507 (.1246)	– 3.7458 (3.0940)
τ	-	-	– 0.1537 (.2151)
β_1	0.5595	0.6269	0.6803
β_2	0.3059	0.2778	0.2259
β_3	0.0622	– 0.0114	– 0.1086
β_4	0.0349	– 0.0469	– 0.0026
β_5	– 0.0055	0.0444	0.0394
β_6	-	– 0.0010	0.0428
β_7	-	– 0.0002	– 0.0267
β_8	-	0.0488	0.0138
β_9	-	– 0.0289	0.0163
β_{10}	-	– 0.0147	0.7986
β_{11}	-	-	0.0850
β_{12}	-	-	– 0.1135
β_{13}	-	-	– 0.0026
β_{14}	-	-	0.1015
β_{15}	-	-	– 0.0345
β_{16}	-	-	– 0.0347
β_{17}	-	-	– 0.0008
R^2	0.8954	0.8902	0.9138
s	.2575	.2713	.2433

NOTE. * p<.05. ; (‧) the standard errors of the parameter estimates

The result of models from individual stock of the Electric and Machinery sector is listed in Table 17.

Table 17. Results in the Electric and Machinery sector

	Electric and Machinery 1991-2010 (firms: 35; observations: 295)			
	Model 1	Model 2	Model 3	Model 4
c	0.3901 (.0915) *	0.7211 (.2674)	0.5241 (.7654)	1.1490 (.2675) *
b	0.9763 (.1099) *	1.2513 (.1195) *	0.6754 (.6288)	0.4534 (.1079) *
h	-	0.4468 (.3543)	-	0.8362 (.2423) *
e	-	-	1.2278 (.1666) *	0.9608 (.2867) *
δ	0.1932 (.0935) *	0.1338 (.0978)	0.1147 (.1228)	0.1542 (.1446)
α	– 0.2691 (.2207)	0.0142 (.0265)	0.0519 (.0739)	– 0.1739 (.5160)
ω	-	– 0.1374 (.1513)	-	– 0.9051 (.6540)
τ	-	-	– 0.1867 (.3815)	– 0.1271 (.1832)
β_1	0.6336	0.5808	0.5727	0.6007
β_2	– 0.0144	0.0548	0.0279	– 0.0057
β_3	0.0836	– 0.0388	– 0.0352	– 0.0140
β_4	– 0.3012	0.1143	0.1046	0.0005
β_5	0.1150	– 0.0617	– 0.0490	0.9832
β_6	-	0.0041	– 0.0078	– 0.0497
β_7	-	– 0.0274	0.0020	0.0184
β_8	-	0.0614	0.2293	– 0.0016
β_9	-	– 0.0017	– 0.1835	0.0008
β_{10}	-	– 0.0043	0.0354	0.7668
β_{11}	-	-	-	– 0.3306
β_{12}	-	-	-	– 0.0498
β_{13}	-	-	-	0.0024
β_{14}	-	-	-	0.1221
β_{15}	-	-	-	– 0.0685
β_{16}	-	-	-	– 0.0020
β_{17}	-	-	-	0.0016
R^2	0.7240	0.7001	0.7043	0.7167
s	.3497	.3506	.3482	.3424

NOTE. * $p<.05$. ; (·) the standard errors of the parameter estimates

The data of Electric and Machinery sector is consistent with the adaptive expectation hypothesis in model 1. The result indicates that the coefficient δ is positive, which may suggest that investors in the Electric and Machinery sector believes that recent dividend will lead to the stock price upswing. From the second column of Table 14, we note that the adjustment coefficients *b* violate the assumption of adaptive expectation in model 2. We also discover that the data are inconsistent with the adaptive expectation hypothesis in model 3. In spite of all adjustment coefficients *c*, *b*, *e*, *h* follows the assumption of adaptive expectation, the coefficients δ, α, τ, ω for $E_t d_t$, $E_t g_t$, $E_t r_t$, $E_t m_t$ in the equation for log stock price are not significant in model 4. Similar to the result of Foods sector, this result suggests that $E_t d_t$, $E_t g_t$, $E_t r_t$, and $E_t m_t$ do not contribute to the current pricing of Electric and Machinery sector.

Table 18 shows the results of using individual stock of the Construction sector to explain the stock price. Similar to the Electric and Machinery sector, we discover that the data is consistent with the adaptive expectation hypothesis in model 1 and can be explained by the expected level of log dividends. We further discover that adjustment coefficients *b*, which measured the adaptive formation of expected log rate of growth, are inconsistent in model 2 and 4. The adjustment coefficient *b* for the formation of expected rate of growth is 1.3336 in model 3, which means the data is inconsistent with the adaptive expectation hypothesis. However, the coefficient δ for $E_t d_t$ in the equation for log stock price is 0.1896. The positive results suggest that expected level of log dividends may contribute to the current pricing in Construction sector.

Table 18. Results in the Construction sector

	Construction sector 1991-2010 (firms: 35; observations: 189)			
	Model 1	Model 2	Model 3	Model 4
c	0.4299 (.0834) *	0.2290 (.4093)	0.7021 (.1914) *	0.9404 (.2227) *
b	1.1577 (.0988) *	1.4122 (.0801) *	1.3336 (.0845) *	0.0518 (.0909)
h	-	0.8595 (.4111)	-	1.6117 (.2684) *
e	-	-	0.3967 (.1799) *	1.0003 (.4158) *
δ	0.3524 (.0915) *	0.2101 (.1083)	0.1896 (.1026) **	1.0008 (1.1229)
α	– 0.6345 (.3541)	– 0.0291 (.0326)	– 0.3406 (.2149)	–17.5696 (42.7540)
ω	-	0.1379 (.1893)	-	0.2787 (.2370)
τ	-	-	– 1.1601 (.9004)	0.0189 (.0958)
β_1	0.4124	0.4994	0.5677	0.3958
β_2	0.0899	0.2673	0.1209	0.5601
β_3	0.1352	– 0.0447	– 0.0600	– 0.0344
β_4	– 0.6835	0.0069	0.0137	– 0.0001
β_5	0.2326	0.0917	0.0757	0.0317
β_6	-	– 0.0448	0.0291	0.0907
β_7	-	0.0045	– 0.0481	– 0.0106
β_8	-	– 0.1185	0.4601	– 0.0330
β_9	-	0.0425	0.0164	– 0.0001
β_{10}	-	0.0377	– 0.0457	0.4492
β_{11}	-	-	-	– 0.4526
β_{12}	-	-	-	0.0253
β_{13}	-	-	-	0.0008
β_{14}	-	-	-	– 0.0189
β_{15}	-	-	-	0.0075
β_{16}	-	-	-	0.0106
β_{17}	-	-	-	– 0.0007
R^2	0.7830	0.8276	0.8376	0.8574
s	.3562	.3369	.3269	.3236

NOTE. * p<.05. ** p< .1 ; (·) the standard errors of the parameter estimates

Table 19 summarizes the result of models in individual stock of the Finance sector. We discover that the data of Finance sector is inconsistent with the adaptive expectation hypothesis in model 1 and 2.

Table 19. Results in the Finance sector

	Finance sector 1991-2010 (firms: 31; observations: 221)			
	Model 1	Model 2	Model 3	Model 4
c	0.0606 (.0279) *	0.2086 (.2419)	0.8180 (.3102) *	0.1778 (.0733) *
b	1.3627 (.0678) *	0.8345 (.3225) *	0.2194 (.2358)	1.2136 (.4383) *
h	-	1.4296 (.1371) *	-	1.4145 (.4256) *
e	-	-	1.4266 (.1360) *	0.6441 (.2798) *
δ	– 0.0664 (.0675)	0.2468 (.2583)	0.2361 (.2344)	0.4324 (.1709) *
α	2.3161 (1.7644)	0.0344 (.0339)	0.0353 (.0350)	0.0013 (.0212)
ω	-	0.0193 (.0895)	-	– 0.2525 (.6763)
τ	-	-	0.0860 (.3746)	0.3174 (.2717)
β_1	0.5766	0.5273	0.5360	0.5500
β_2	0.3407	0.2801	0.2685	0.3588
β_3	0.0531	– 0.0563	– 0.0606	– 0.0795
β_4	0.2202	0.0798	0.0807	– 0.2591
β_5	– 0.0820	– 0.0256	– 0.0265	0.0785
β_6	-	– 0.0030	– 0.0034	0.0181
β_7	-	0.0098	0.0096	– 0.0095
β_8	-	– 0.0276	– 0.1226	– 0.0012
β_9	-	0.0264	0.1180	– 0.0002
β_{10}	-	– 0.0036	– 0.0174	0.3572
β_{11}	-	-	-	– 0.3445
β_{12}	-	-	-	0.0146
β_{13}	-	-	-	0.0223
β_{14}	-	-	-	– 0.2045
β_{15}	-	-	-	0.0397
β_{16}	-	-	-	0.0875
β_{17}	-	-	-	0.0149
R^2	0.8874	0.8976	0.8977	0.8977
s	.1979	.1945	.1945	.1971

NOTE. * p<.05. ; (·) the standard errors of the parameter estimates

We further discover that the data is inconsistent with the adaptive expectation hypothesis in model 3. Column 4 of Table 19 shows the result that implies that the logarithm stock price is a linear function of expected log dividends, expected log rate of growth, expected log risk-free rates, and expected level of log risk premiums. Despite of the data of Finance sector is consistent with the adaptive expectation hypothesis, but not all of the coefficients are significant in model 4. Only the coefficients δ for $E_t d_t$ is significant; this result suggests that only expected level of log dividends as projected by adaptive expectations contribute to the current pricing of Finance sector.

In the sample of Paper sector, there are simply not sufficient observations to estimate Eq. (5), Eq. (10) and Eq. (12) by statistical analysis software. Table 20 shows the results of model 1 in individual stock of the Paper sector, which suggests that the data is inconsistent with the adaptive expectation hypothesis.

Table 20. Results in the Paper sector

	Paper sector 1994-2010 (firms: 5; observations: 35)
	Model 1
c	0.0972(.1153)
b	1.3905 (.1572) *
δ	4.5898(5.9740)
α	− 0.2966(.2288)
β_1	0.5123
β_2	0.3525
β_3	0.0336
β_4	0.1005
β_5	− 0.1742
R^2	0.9532
s	.1259

NOTE. * p<.05. ; (·) the standard errors of the parameter estimates

To summarize the results from the eight major sectors, we note that the data of Cement & Ceramics, Foods, Electric & Machinery and Construction sectors are consistent with the assumption of adaptive expectation in model 1 ,and the data of Electric & Machinery and Finance sectors are consistent with the adaptive expectations in model 4. Furthermore, we discover that the data of Electric & Machinery sectors are consistent with the adaptive expectation hypothesis in model 1 and 4. Similar to the results of using stock market index, all of the data in eight major sectors are inconsistent with the adaptive expectation hypothesis in model 2 and 3.

4. Comparison with findings for Taiwan Stocks

In comparison with the model of Chow [2], a general present-value model, which consider the discount factors, cause the lag length of the expected variables to be large. Since the model is built under the adaptive expectation hypothesis, all adjustment coefficients c, b, e, and h in the adaptive formation of expected level of log dividends, expected log rate of growth, expected log risk-free rates and expected level of log risk premiums, respectively, must be between zero and one. Similar to the previous researches, not all of the data that we selected will fit the adaptive expectation hypothesis. The data which consisted with the adaptive expectations are listed in Table 21. In the stock market index, the data of TWSE Taiwan Dividends+ are consistent with the assumption of adaptive expectations in model 1 and 4. In the eight major sectors, some of the data can be accepted by the adaptive expectation, but the other are not. In model 1, which using nonlinear regression equation (6) to explain the stock price, only the results of Cement & Ceramics, Foods, Electric & Machinery, and Construction sectors follow the assumption of adaptive expectation. In model 4, the individual stock of Foods, Electric & Machinery and Finance sectors are consistent with the adaptive expectation hypothesis. It is worth be mentioned that only the individual stock of TWSE Taiwan Dividends+ Index, Foods and Electric & Machinery sectors are both consistent with the adaptive expectations in model 1 and 4.

Table 21. The data are consistent with the adaptive expectations

Stock Market Index	Model 1	Model 2	Model 3	Model 4
TWSE Taiwan 50 Index	×	×	×	×
TWSE Taiwan Mid-Cap 100 Index	×	×	×	×
TWSE Taiwan Dividend+ Index	✓	×	×	✓
Eight Major Sectors	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Cement & Ceramics	✓	×	×	×
Foods	✓	×	×	✓
Plastics & Chemicals	×	×	×	×
Textiles	×	×	×	×
Electric & Machinery	✓	×	×	✓
Construction	✓	×	×	×
Finance	×	×	×	✓
Paper	×	×	×	-

Different from the results of Chow and Kwan [31], which provided the strong statistical evidence to support the assumption of adaptive expectation, we discover that the data are not conformed to the adaptive expectations in some models. In general present-value model, which using nonlinear regression equation (5), we note that only TWSE Taiwan Dividends+ Index, Foods, Electric & Machinery and Finance sectors are consistent with the assumption of adaptive expectation. As discussed above, there are some debates between the empirical validity of the hypothesis of the rational expectations and the adaptive expectations. The result stimulates an another method to follow-up research that under the assumption of rational expectation, we can use the nonlinear present-value model to explain the stock price in Taiwan. Simultaneously, the data which are inconsistent with the adaptive expectations, may suggest that the investors of these data may not take the historical information into consideration.

To illustrate the reason why the data cannot be explained by the nonlinear present-value model in some models, we make the following discussions. George [34] claimed that the present-value model was a kind of valuation tool which was limited under the restrictive assumptions that according to the dividend payout policy. Since the increasing of dividend has a positive influence to the listed companies, management of the listed companies may have downward rigidity for dividends. Even though the listed companies do not perform very well on profit, the authorities may not decrease the dividends due to the downward rigidity. The dividends policy made by authorities depend on the dividend behavior, which have been used to make inferences about information asymmetry and agency conflicts and to determine whether dividends play an important role in signaling information about profitability. The researches of Miller and Rock [35], John and Williams [36] suggest that dividend changes are employed by firms to convey information about firm profitability. Dividend Signaling plays a central role in corporate finance theory, which implies the stock price may reduce when dividends are reduced. Therefore, the dividend policy may not be a discretional action for management. Downward rigidity for dividends may suggest that expected level dividends and expected rate of growth cannot explain expected stock prices well in our empirical researches.

Using four models by various data, we find that expected log nominal risk-free rates and expected level of log risk premiums do not have significant effect on the current pricing in some cases. In the eight major sectors, the one reason of making risk premiums not significant is due to traditional-industry sectors have comparatively low beta and risk premiums. Thus, making risk premiums have low ability of explanation in present-value model. Furthermore, we would like to know which discount factors, nominal risk-free rates and risk premiums can affect the stock price by testing that the set of nonlinear restrictions on the coefficients of regression function (5).

Hypothesis 1: nominal risk-free rates and risk premiums have no effect on the current pricing.

Table 22. The sum of squared residuals of the unrestricted linear regression (5) and the restricted linear regression (6)

Stock Market Index	SSE1(UR)	df1(UR)	SSE2(R)	df2(R)
TWSE Taiwan 50 Index	15.0854	243	25.6943	347
TWSE Taiwan Mid-Cap 100 Index	41.0498	374	63.9713	542
TWSE Taiwan Dividend+ Index	11.0060	163	18.9006	233
Eight Major Sectors	SSE1(UR)	df1(UR)	SSE2(R)	df2(R)
Cement & Ceramics	3.7940	60	5.8463	94
Foods	3.8107	64	4.1031	104
Plastics & Chemicals	21.5048	212	33.5110	313
Textiles	2.8412	53	5.9020	104
Electric & Machinery	12.6604	113	20.7912	185
Construction	4.3983	43	10.6593	96
Finance	2.1372	57	4.3089	123

Note. The sum of squared residuals and the degrees of freedom of the unrestricted linear regression (5) with $\beta_1,\beta_2,\ldots,\beta_{17}$ as coefficients, respectively denoted SSE1(UR) and df1(UR). Besides, the sum of squared residuals and the degrees of freedom of the restricted linear regression (6) with $\beta_1,\beta_2,\ldots,\beta_5$ as coefficients, respectively denoted SSE2(R) and df2(R).

Table 23 shows the relational information of the unrestricted linear regression (5) and the restricted linear regression (6) in all data. In the first place, we test the hypothesis 1, which assumed that nominal risk-free rates and risk premiums have no significant effect on the current pricing.

Table 24 summarizes the results of F-test by testing the unrestricted linear regression (5). Assuming normally distributed residuals, the statistic [SSE2(R) - SSE1(UR)]÷12/SSE1(UR) ÷ df1(UR), which denoted F_1, is distributed as F(12, df1(UR)). The critical value for rejecting the null hypothesis at an 5% level is $F(12,\infty) = 1.75$. We discover that only the observed value of Cement & Ceramics sector and Foods sector are smaller than the critical value for rejecting the null hypothesis at an 5% level.

This result indicates that we have not enough statistical evidence supporting nominal risk-free rates and risk premiums can affect current pricing in individual stock of Cement & Ceramics and Foods sector.

Table 23. The results of F-test by testing the unrestricted linear regression (5).

Stock Market Index	F_1	Critical value
TWSE Taiwan 50 Index	14.2409	1.75
TWSE Taiwan Mid-Cap 100 Index	17.4029	1.75
TWSE Taiwan Dividend+ Index	9.7433	1.75
Stock Market Index	F_1	Critical value
Cement & Ceramics	1.3868	1.75
Foods	0.4092	1.75
Plastics & Chemicals	9.8635	1.75
Textiles	4.7583	1.75
Electric & Machinery	6.0476	1.75
Construction	5.1010	1.75
Finance	4.8267	1.75

Note. The statistic of $F_1 = [SSE2(R) - SSE1(UR)] \div 12 / SSE1(UR) \div df1(UR)$; $F_1 \sim F(12, df1(UR))$; The critical value at an 5% level is $F(12,\infty) = 1.75$.

Hypothesis 2: risk premiums have no effect on the current pricing.

Hypothesis 3: nominal risk-free rates have no effect on the current pricing.

According to the result of hypothesis 1, we further examine the risk premiums by testing the unrestricted linear regression (10) and the nominal risk-free rates by testing the unrestricted linear regression (12). Table 23 presents the relational information of the unrestricted linear regression (10) and (12) in all data. Since the individual stock of Cement & Ceramics and Foods sectors are rejected by hypothesis 1 at an 5% level, we further consider the data except from the individual stock of Cement & Ceramics and Foods sectors for testing hypothesis 2 and 3.

Table 24. The sum of squared residuals of the unrestricted linear regression (10) and (12)

Stock Market Index	SSE3(UR)	df3(UR)	SSE4(UR)	df4(UR)
TWSE Taiwan 50 Index	17.8669	296	17.81230	296
TWSE Taiwan Mid-Cap 100 Index	51.1086	455	51.7476	455
TWSE Taiwan Dividend+ Index	15.9868	199	16.0543	199

Eight Major Sectors	SSE3(UR)	df3(UR)	SSE4(UR)	df4(UR)
Plastics & Chemicals	27.3511	262	26.0389	262
Textiles	4.8586	77	-	-
Electric & Machinery	16.8399	148	16.6090	148
Construction	6.9226	69	6.5204	69
Finance	3.1017	91	3.1012	91

Note. The sum of squared residuals and the degrees of freedom of the unrestricted linear regression (10) are SSE3(UR) and df3(UR); and the sum of squared residuals and the degrees of freedom of the unrestricted linear regression (12) are SSE4(UR) and df4(UR).

Table 25 summarizes the results of F-test by testing the unrestricted linear regression (10) and (12). Assuming normally distributed residuals, the statistic [SSE2(R) – SSE3(UR)]÷5/SSE3(UR) ÷ df3(UR), which denoted F_2, is distributed as F(5, df3(UR)). For testing the hypothesis 3, the statistic [SSE2(R) – SSE4(UR)]÷5/SSE4(UR) ÷ df4(UR), which denoted F_3, is distributed as F(5, df4(UR)). The critical value for rejecting the null hypothesis at an 5% level is $F(5,\infty) = 2.21$. We discover that all of the observed value are bigger than the critical value. In other words, the result suggests that we have enough statistical evidence supporting nominal risk-free rates and risk premiums can affect current pricing in individual stock of stock market index, Plastics & Chemicals, Textiles, Electric & Machinery, Construction and Finance sectors. To summarize the results by testing the unrestricted linear regression, we discover that discount factors have significant effect to the current pricing. In spite of the discount factors have no significant on the current pricing in our empirical researches, we still find strongly statistical evidence supporting the general model of stock price formation.

Table 25. The results of F-test by testing the unrestricted linear regression (10) and (12)

Stock Market Index	F_2	F_3	Critical value
TWSE Taiwan 50 Index	25.9353	26.1930	2.21
TWSE Taiwan Mid-Cap 100 Index	22.9024	21.4958	2.21
TWSE Taiwan Dividend+ Index	7.2541	7.0563	2.21
Stock Market Index	F_2	F_3	Critical value
Plastics & Chemicals	11.8013	15.0368	2.21
Textiles	3.3073	-	2.21
Electric & Machinery	6.9454	7.4537	2.21
Construction	7.4492	8.7597	2.21
Finance	7.0834	7.0876	2.21

Note. The statistic of F_2 =[SSE2(R) – SSE3(UR)]÷5/SSE3(UR) ÷ df3(UR) ; F_2~ F(5, df3(UR)); The statistic of F_3 =[SSE2(R) – SSE4(UR)]÷5/SSE4(UR) ÷ df4(UR) ; F_3~ F(5, df4(UR)); The critical value at an 5% level is $F(5,\infty) = 2.21$.

Table 26 summarizes the results from estimating the nonlinear regression equation (6) using individual stock of the TWSE Taiwan Dividend+ Index. It also presents the results of Chow and Kwan [29] from estimating the same regression equation, which using individual stock of the Hang Seng Stock Price index. We also show the results of Chow [34] and Lin [35], which respectively using the Shanghai Index and Dow Jones Industrial Index as data in Table 18. In comparison with the results of these models, we discover that expected level of dividends have positive effect on log stock price in these stock markets. It is worth to be mentioned that the adjustment coefficient b , which measures the importance of the recent growth rate, are higher than the adjustment coefficient c, which measures the importance of the past level of dividends in all cases. The relative weights of expected level of log dividends and expected log rate of growth in the determination of log stock price are as given by δ and α. The coefficient δ for TWSE Taiwan Dividends+ is the smallest in all four cases. The smaller coefficient δ means that the smaller influence on the expected level of log dividends for individual stock of the TWSE Taiwan Dividends+ Index.

Table 26. Results in the market stock index

Estimates of Parameters of Eq.(6) Explaining Log Stock Price in the market stock index				
	Taiwan Dividend+ 1991~2010 (firms: 29; obs: 326)	Shanghai 1996-1998[a] (firms: 47; obs: 72)	Hong Kong 1982-1993[b] (firms: 17; obs: 204)	United State 1996-1998[c] (firms: 30; obs: 1380)
c	0.2079 (.0453)	0.2993 (.0845)	0.5708 (.1081)	0.1520 (.0352)
b	1.0977 (.0686)	0.9321 (.1221)	0.8695 (.1281)	0.8690 (.0352)
δ	0.3182 (.1237)	0.5722 (.1687)	0.5668 (.0696)	0.7323 (.0675)
α	– 0.0587 (.0259)	0.0569(.0495)	– 0.0115 (.0532)	0.1809 (.0367)
β_1	0.6944	0.7636	0.5597	0.9332
β_2	0.0774	– 0.0731	– 0.0560	– 0.0723
β_3	0.3371	0.1847	0.3135	0.3192
β_4	– 0.6272	– 0.0731	– 0.0279	– 0.2957
β_5	0.2767	0.0977	– 0.0043	0.0696
R^2	0.8903	0.7848	0.7011	0.9112
s	.2944	.2635	.2177	

[a]Chow, Fan, and Hu(1999, Table 2)
[b]Chow and Kwan(1997, Tables 1 and 2)
[c]Lin(1998,Tables 3-3 and 3-4)

Similar to the results of Chow [31], the coefficient α for $E_t d_t$ is practically zero. The same empirical phenomena in the TWSE Taiwan Dividends+ Index and the Hang Seng Index with the coefficients α are practically zero, which suggest that the overall pessimistic view of investors in two data. This result indicates that investors in individual stock of the TWSE Taiwan Dividends+ Index and the Hang Seng Index who does not believe that recent growth of dividend rate can let stock price upswing. It is likely that the results of model 1, which using the stock market index, barely the data of the Cement & Ceramics, Foods, Electric & Machinery, and Construction sectors can be accepted by the assumption of adaptive expectation.

Table 27. Four of eight sectors consist with the adaptive expectations in model 1

Estimates of Parameters of Eq.(6) Explaining Log Stock Price in the eight sectors				
	Cement and Ceramics 1991~2010 (firms: 11; obs: 133)	Foods 1991-2010 (firms: 18; obs: 160)	Electric and Machinery 1991-2010 (firms: 35; obs: 295)	Construction 1991-2010 (firms: 35; obs: 189)
c	0.3245 (.1276)*	0.4210 (.1886)*	0.3900 (.0915)*	0.4299 (.0834)*
b	0.9205 (.1858)*	0.7208 (.2176)*	0.9763 (.1099)*	1.1577(.0988)*
δ	0.0385 (.1583)	0.1761 (.1044)	0.1931 (.0935)*	0.3524 (.0915)*
α	– 0.0373(.4137)	– 0.1810 (.2159)	– 0.2691 (.2207)	– 0.6345 (.3541)
β_1	0.7550	0.8582	0.6336	0.4124
β_2	– 0.0537	– 0.1617	– 0.0144	0.0899
β_3	0.0233	0.0794	0.0836	0.1352
β_4	– 0.0584	– 0.2245	– 0.3012	– 0.6835
β_5	0.0239	0.0901	0.1150	0.2326
R^2	0.8055	0.9060	0.7240	0.7830
s	.2720	.2147	.3497	.3562

NOTE. * p<.05. (·) the standard errors of the parameter estimates

Table 27 presents the results which supported by the adaptive expectations from estimating the nonlinear regression equation (6). We find that expected level of log dividends have significant effect on individual stocks of the Electric & Machinery and Construction sectors. Similar to the previous results, the the coefficients α for $E_t d_t$ are practically zero, which suggests the overall pessimistic view of investors in the Electric & Machinery and Construction sectors. It is worth be mentioned that estimates of the unrestricted β coefficients are similar in Cement & Ceramics, Foods and Electric & Machinery sectors. This result suggests that the behaviors of these sectors are similar in spite of their industrial differences.

Table 28. Three of eight sectors consist with the adaptive expectations in model 4

Estimates of Parameters of Eq.(5) Explaining Log Stock Price in the eight sector			
	Foods 1991-2010 (firms: 18; obs: 160)	Electric and Machinery 1991-2010 (firms: 35; obs: 295)	Finance 1991-2010 (firms: 31; obs: 221)
c	1.2928 (.1675)*	1.1490 (.2675) *	0.1778 (.0733) *
b	0.6478 (.1880)*	0.4534 (.1079) *	1.2136 (.4383) *
h	0.8193 (.3282)*	0.8362 (.2423) *	1.4145 (.4256) *
e	0.2265 (.0948)*	0.9608 (.2867) *	0.6441 (.2798) *
δ	0.1438 (.3513)	0.1542 (.1446)	0.4324 (.1709) *
α	– 0.4871 (1.0299)	– 0.1739 (.5160)	0.0013 (.0212)
ω	– 0.0614 (.1836)	– 0.9051 (.6540)	– 0.2525 (.6763)
τ	0.2511 (.5478)	– 0.1271 (.1832)	0.3174 (.2717)
β_1	0.9135	0.6007	0.5500
β_2	0.0374	– 0.0057	0.3588
β_3	– 0.1377	– 0.0140	– 0.0795
β_4	0.0193	0.0005	– 0.2591
β_5	– 0.1152	0.9832	0.0785
β_6	0.2309	– 0.0497	0.0181
β_7	– 0.0076	0.0184	– 0.0095
β_8	0.0386	– 0.0016	– 0.0012
β_9	0.0173	0.0008	– 0.0002
β_{10}	0.0503	0.7668	0.3572
β_{11}	– 0.0369	– 0.3306	– 0.3445
β_{12}	– 0.0085	– 0.0498	0.0146
β_{13}	0.0054	0.0024	0.0223
β_{14}	– 0.0569	0.1221	– 0.2045
β_{15}	0.0080	– 0.0685	0.0397
β_{16}	0.0083	– 0.0020	0.0875
β_{17}	– 0.0014	0.0016	0.0149
R^2	0.8858	0.7167	0.8977
s	.2499	.3424	.1971

NOTE. * p<.05. (·) the standard errors of the parameter estimates

In the eight major sectors, we note merely Foods, Electric & Machinery and Finance sectors can be accepted by the assumption of adaptive expectation in model 4. Table 28 summarizes the result from Foods, Electric & Machinery and Finance sectors from estimating the nonlinear regression equation (5). Compared to the result of Foods and Electric & Machinery sector in model 4, we discover that the coefficients δ for $E_t d_t$ in individual stock of the finance sector is significant. This result suggests significantly positive level of log dividends, as theory predicts. We further find that the coefficients α for $E_t d_t$ are practically zero in Foods, Electric & Machinery and Finance sectors. To summarize the results from the stock market index and the eight major sectors, we observe that investors are with the overall pessimistic viewpoint in individual stock of the TWSE Taiwan Dividends+ Index, Cement & Ceramics, Foods, Electric & Machinery, Construction and Finance sectors.

5. Conclusion

Different from the Chow [2], which assumed the discount factors are constant, we additional consider the discount factors, nominal risk-free rates and risk premiums, into the nonlinear present-value model. The aims to this article are to build a general model, which consider expected dividends, expected rate of growth, expected nominal risk-free rates, and expected risk premiums by using different kinds of data, and to provide the explanation of stock prices traded on the Taiwan Stock Exchange. Compared to the previous researches, which used the individual stock of the stock market index under the assumption of adaptive expectation, we use the different kinds of industrial data to build the nonlinear present-value model for the first time.

Similar to the results of other empirical researches, not all of the data that we selected are fit the adaptive expectation hypothesis. Compared to the results of Chow [2], which using nonlinear regression equation (6), only the individual stock of TWSE Taiwan Dividends+ Index, Foods, Electric & Machinery and Finance sectors are consistent with the assumption of adaptive expectation in general present-value model. Some data, which are inconsistent with the adaptive expectations, indicate that the investors of these individual stocks are forgetful of the historical information.

Despite of the some data are consistent with the hypothesis, we discover that only the individual stock of the Electric & Machinery and Construction sectors can be explained by the expected level of log dividends in model 1. For the coefficient α, which measures the relative weights of expected growth in the determination of log stock price, we note that the coefficients α for $E_t d_t$ are practically zero in the TWSE Taiwan Dividends+ Index, Cement & Ceramics, Foods, Electric & Machinery, Construction and Finance sectors. These results support that the overall pessimistic viewpoint in these investors. Furthermore, we note that the unrestricted β coefficients have the same value in the Cement & Ceramics, Foods, and Electric & Machinery sectors from estimating the nonlinear regression equation (6). This result suggests that the behaviors of these sectors are similar in spite of their different industries.

In spite of the discount factors, the expected nominal free-risk rates and the expected risk premiums are both not significant in our empirical models, we still have a strongly statistical evidence showing the expected nominal free-risk rates and the expected risk premiums can contribute the current pricing by testing the set of nonlinear restrictions on the coefficients of regression function (5). From the results of F-test, we further conclude that a general present-value model, which we built from estimating the nonlinear regression equation (5), have significant explanatory power on the current pricing.

References

[1] Cutler, David M., James M. Poterba, and Lawrence H. Summers. "What Moves Stock Prices?", Journal of Portfolio Management, 15, pp. 4-12, 1989.

[2] Chow, Gregory C. "The Formation of Stock Prices." Econometrica, 26(4), pp. 604-605, 1958.

[3] Todaro, M. P." A Model of Labor Migration and Urban Unemployment in Less Developed Countries", American Economic Review, Vol. 59, No. 1, pp. 138-148, 1969.

[4] Brennan, M. J. and Eduardo S. Schwartz. "Evaluating Natural Resource Investments", Journal of Business, Vol. 58, No. 2, pp. 135-157, 1985.

[5] Hamilton, James D., and Marjorie A. Flavin." On the Limitations of Government Borrowing : A Framework f or Empirical Testing", American Economic Review, Vol. 76, No. 4, pp. 808-819, 1986.

[6] T.A. Lloyd, A.J. Rayner and CD. Orme. "Present-value models of land prices in England and Wales", The European Review of Agricultural Economics , Vol.18, pp. 141-166, 1991.

[7] Fairfield, P. M. "P/E, P/B and the Present Value of Future Dividends", Financial Analysts Journal, Vol. 50, No. 4, pp. 23-31, 1994.

[8] Liu, C. H. and Jlan-ping Mei, "An Analysis of Real-Estate Risk Using the Present Value Model", Journal of Real Estate Finance and Economics, Vol. 8, pp. 5-20, 1994.

[9] Geltner, D. and Jlan-ping Mei, "The present value model with time-varying discount rates: Implications for Commercial Property Valuation and Investment Decisions", Journal of Real Estate Finance and Economics, Vol. 11, pp. 119-135, 1995.

[10] Ky-Hyang Yuhn. “Stock price volatility: tests for linear and non-linear cointegration in the present value model of stock prices.”, Applied Financial Economics, Vol. 6, pp. 487- 494, 1996.

[11] Campbell, John Y., and Robert J. Shiller. “Cointegration and Tests of Present Value Models”, Journal of Political Economy, Vol. 95, No.5, pp. 1062-1088, 1987.

[12] Duffie, D. and Kenneth J. Singleton. “An Econometric Model of the Term Structure of Interest-Rate Swap Yields”, The Journal of Finance, Vol. 52, No. 4, pp. 1287-1321, 1997.

[13] Kallberg, J. G., Crocker H. Liu and Anand Srinivasan. “Dividend Pricing Models and REITs”, Real Estate Economics, Vol. 31, No. 3, pp. 435- 450, 2003.

[14] I˙s¸can, T. B. “Present value tests of the current account with durables consumption”, Journal of International Money and Finance, Vol. 21, pp. 385-412, 2002.

[15] Gruber, J. W. “A present value test of habits and the current account”, Journal of Monetary Economics, Vol. 51, pp. 1495-1507, 2004.

[16] Hall, R.E. “Stochastic implication of the life cycle-permanent income hypothesis: theory and evidence”, Journal of Political Economy, Vol. 86, No. 6, pp. 971-987, 1978.

[17] Kitamura, Yoshihiro “The current account and stock returns”, Research in International Business and Finance, Vol. 23, pp. 302-321, 2009.

[18] Bansal, R., and C. Lundblad. "Market Efficiency, Fundamental Values and Asset Returns in Global Equity Markets," Journal of Econometrics, 109, pp. 195-237, 2002.

[19] Bansal, R., and A. Yaron. "Risks for the Long Run: A Potential Resolution of Asset Pricing Puzzles," Journal of Finance, 59(4), pp. 1481-1509, 2004.

[20] Shiller, R. J. "Do stock prices move too much to be justified by subsequent changes in dividends", American Economic Review, 75, pp. 421-436, 1981.

[21] Shiller, R. J. "The use of volatility measures in assessing market efficiency", Journal of Finance, 36, pp. 291-304, 1981.

[22] Grossman, Sandford J. and Shiller, R. J. "The Determinants of the Variability of Stock Market Prices", American Economic Review, 71(2), pp. 222 - 27, 1981.

[23] Sharpe, W. F. "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk", Journal of Finance, 19, No. 3, pp. 425-442, 1964.

[24] Merton, R.C. " On estimating the expected return on the market", Journal of Financial Economics, Vol. 8, pp. 323-361, 1980.

[25] Muth, John F., "Rational Expectations and the Theory of Price Movements", Econometrica, 29, pp. 315-335, 1961.

[26] Hicks, J. R., Value and Capital, Oxford University Press, 1939.

[27] Lovell, M. C. "Tests of the Rational Expectations Hypothesis", American Economic Review, Vol. 76, pp. 110-124, 1986.

[28] Fama, Eugene F., and Kenneth R. French. "Permanent and Temporary Components of Stock Prices", Journal of Political Economy, 96(2), pp. 246-273, 1988.

[29] Poterba, James M., and Lawrence H. Summers. "Mean Reversion in Stock Prices: Evidence and Implications", Journal of Financial Economics, Vol. 22, pp. 27-59, 1988.

[30] West, Kenneth D. "Dividend Innovations and Stock Price Volatility", Econometrica, 56(1), pp. 37-62, 1988.

[31] Chow, Gregory C., and Kwan, Yum K. "Rational Expectations Is Not Generally Valid for Econometric Models: Evidence from Stock Market Data", Pacific Economic Review, 2(3), pp. 149-163, 1997.

[32] Chow, Gregory C. "Rational Versus Adaptive Expectations in Present Value Models", The Review of Economics and Statistics, 71(3), pp. 376 –384, 1989.

[33] Merton, R.C., "An intertemporal capital asset pricing model", Econometrica, 41, pp. 867-887, 1973.

[34] Staubus, G. J. "The association of financial accounting variables with common stock values", The Accounting Review, Vol. 40, No. 1, pp. 119-134, 1965.

[35] Miller, M., Rock, K., "Dividend policy under asymmetric information", Journal of Finance, 40, pp. 1031-1051, 1985.

[36] Kose John and Joseph Williams, "Dividends, dilution, and taxes: a signaling equilibrium", Journal of Finance, 40, pp. 1053-1070, 1985.

[37] Chow, Gregory C., Zhao-zhi, Fan, and Jin-yan, Hu. "Shanghai Stock Prices as Determined by the Present-Value Model", Journal of Comparative Economics, 27 , pp. 553-561, 1999.

[38] Lin, J. "The Present Value Model of Stock Prices Under Rational and Adaptive Expectations: Evidence from the U.S. Stock Market", Princeton, NJ: A.B. thesis, Department of Economics, Princeton University, 1998.

Appendix A

Under the assumption of adaptive expectation, the coefficients ($\beta_1,\beta_2,\ldots,\beta_{17}$) in Eq. (5) which derived from eight structural parameters δ, α, τ, ω, c, b, e and h.

$$s_t = \beta_1 s_{t-1} + \beta_2 s_{t-2} + \beta_3 s_{t-3} + \beta_4 s_{t-4} + \beta_5 d_{t-1} + \beta_6 d_{t-2} + \beta_7 d_{t-3} + \beta_8 d_{t-4} + \beta_9 d_{t-5} + \beta_{10} r_{t-1} + \beta_{11} r_{t-2} + \beta_{12} r_{t-3} + \beta_{13} r_{t-4} + \beta_{14} m_{t-1} + \beta_{15} m_{t-2} + \beta_{16} m_{t-3} + \beta_{17} m_{t-4} + \gamma^* \quad (5)$$

Where $\gamma^* = \gamma \cdot cbeh$;

the coefficients of s_t,

$\beta_1 = (4-c-b-e-h)$,

$\beta_2 = -[(1-e)(1-h)+(1-b)(1-h)+(1-b)(1-e)+(1-c)(1-h)+(1-c)(1-e)+(1-c)(1-b)]$,

$\beta_3 = [(1-b)(1-e)(1-h) + (1-c)(1-e)(1-h) + (1-c)(1-b)(1-h) + (1-c)(1-b)(1-e)]$,

$\beta_4 = -(1-c)(1-b)(1-e)(1-h)$;

the coefficients of $E_t d_t$,

$\beta_5 = \delta c + \alpha b$,

$\beta_6 = -\delta c[(1-e)+(1-b)+(1-h)] - \alpha b[4-e-c-h]$,

$\beta_7 = \delta c[(1-b)(1-e)+(1-h)(1-e)+(1-h)(1-b)] + \alpha b[(1-c)(1-e)+(1-h)(1-e)+(1-h)(1-c)] + \alpha b[(1-e)+(1-c)+(1-h)]$,

$\beta_8 = -\delta c[(1-h)(1-b)(1-e)] - \alpha b[(1-h)(1-c)(1-e)] - \alpha b[(1-c)(1-e)+(1-h)(1-e)+(1-h)(1-c)]$,

$\beta_9 = \alpha b[(1-h)+(1-c)+(1-e)]$;

the coefficients of $E_t r_t$,

$\beta_{10} = -\tau e$,

$\beta_{11} = \tau e(3-b-c-h)$,

$\beta_{12} = -\tau e[(1-c)(1-b)+(1-h)(1-b)+(1-h)(1-c)]$,

$\beta_{13} = -\tau e[(1-h)+(1-c)+(1-b)]$;

the coefficients of $E_t m_t$,

$\beta_{14} = -wh$,

$\beta_{15} = wh(3-b-c-e)$,

$\beta_{16} = -wh[(1-c)(1-b)+(1-e)(1-b)+(1-e)(1-c)]$,

$\beta_{17} = wh[(1-e)+(1-c)+(1-b)]$;

Because the structural parameters are the nonlinear restriction on the coefficients ($\beta_1,\beta_2,\ldots,\beta_{17}$), so Eq. (5) is a linear functions of the seventeen coefficients ($\beta_1,\beta_2,\ldots,\beta_{17}$) but a nonlinear function of the eight parameters (δ, α, τ, ω, c, b, e, h).

Appendix B

Since we hypothesize that the assumptions are kept constant except for the risk premium will consider into our model, there are ten coefficients ($\beta_1, \beta_2, ..., \beta_{10}$) in Eq. (10) which derived from six structural parameters δ, α, ω, *c*, *b* and *h*.

$$s_t = \beta_1 s_{t-1} + \beta_2 s_{t-2} + \beta_3 s_{t-3} + \beta_4 d_{t-1} + \beta_5 d_{t-2} + \beta_6 d_{t-3} + \beta_7 d_{t-4} + \beta_8 m_{t-1} + \beta_9 m_{t-2} + \beta_{10} m_{t-3} + \gamma^* \quad (10)$$

Where, $\gamma^* = \gamma \cdot cbh$;

the coefficients of s_t,
$\beta_1 = (3 - c - b - h)$,
$\beta_2 = -[(1-b)(1-h) + (1-c)(1-h) + (1-c)(1-b)]$,
$\beta_3 = (1-c)(1-b)(1-h)$;

the coefficients of $E_t d_t$,
$\beta_4 = \delta c + \alpha b$,
$\beta_5 = -\delta c(2-b-h) - \alpha b(3-c-h)$,
$\beta_6 = \delta c(1-h)(1-b) + \alpha b(3-2c-2h+h*c)$,
$\beta_7 = -\alpha b(1-c)(1-h)$;

the coefficients of $E_t m_t$,
$\beta_8 = -wh$,
$\beta_9 = wh(2-b-c)$,
$\beta_{10} = -wh(1-c)(1-b)$;

Because the structural parameters are the nonlinear restriction on the coefficients ($\beta_1, \beta_2, ..., \beta_{10}$), so Eq.(10) is a linear functions of the ten coefficients ($\beta_1, \beta_2, ..., \beta_{10}$)but a nonlinear function of the six parameters (δ, α, ω, *c*, *b*, *h*).

Appendix C

Since we hypothesize that the assumptions are kept constant except for the nominal risk-free rate will consider into our model, there are ten coefficients ($\beta_1, \beta_2, \ldots, \beta_{10}$) in Eq. (12) which derived from six structural parameters δ, α, τ, *c*, *b* and *e*.

$$s_t = \beta_1 s_{t-1} + \beta_2 s_{t-2} + \beta_3 s_{t-3} + \beta_4 d_{t-1} + \beta_5 d_{t-2} + \beta_6 d_{t-3} + \beta_7 d_{t-4} + \beta_8 r_{t-1} + \beta_9 r_{t-2} + \beta_{10} r_{t-3} + \gamma^* \quad (12)$$

Where, $\gamma^* = \gamma \cdot cbe$;

the coefficients of s_t,
$\beta_1 = (3 - c - b - e)$,
$\beta_2 = -[(1-b)(1-e) + (1-c)(1-e) + (1-c)(1-e)]$,
$\beta_3 = (1-c)(1-b)(1-e)$;

the coefficients of $E_t\, d_t$,
$\beta_4 = \delta c + \alpha b$,
$\beta_5 = -\delta c(2-b-e) - \alpha b(3-c-e)$,
$\beta_6 = \delta c(1-e)(1-b) + \alpha b(3-2c-2e+e*c)$,
$\beta_7 = -\alpha b(1-c)(1-e)$;

the coefficients of $E_t r_t$,
$\beta_8 = -\tau e$,
$\beta_9 = \tau e(2-b-c)$,
$\beta_{10} = -\tau e(1-c)(1-b)$;

Because the structural parameters are the nonlinear restriction on the coefficients ($\beta_1, \beta_2, \ldots, \beta_{10}$), so Eq. (12) is a linear functions of the ten coefficients ($\beta_1, \beta_2, \ldots, \beta_{10}$) but a nonlinear function of the six parameters (δ, α, *τ*, *c*, *b*, *e*).

Appendix D

Cement & Ceramics Sector	
Companies	Companies
1 Taiwan Cement Corporation	7 Southeast Cement Co.,Ltd.
2 Asia Cement	8 Taiwan Glass Ind. Corp.
3 Chia Hsin Cement Corporation	9 Champion Building Materials Co.,Ltd
4 Universal Cement Corporation	10 China Glaze Co.,Ltd
5 Lucky Cement Co.	11 Hocheng Corporation
6 Hsing Ta Cement Co.,Ltd	

Foods Sector	
Companies	Companies
1 Wei Chuan Foods Corp.	10 Formosa Oilseed Processing Co,Ltd
2 Ve Wong Corporation	11 Standard Foods Corporation
3 Greatwall Ent	12 Lien Hwa Industrial Corporation
4 Charoen Pokphand Enterprise(Taiwan) Co., Ltd.	13 Lian Hwa Foods Corporation
5 Uni-President Enterprises Corporation	14 Ttet Union Corporation
6 Agv Products Corp.	15 Ten Ren Tea Co., Ltd.
7 Taisun Enterprise Co.,Ltd.	16 Hey-Song Corporation
8 Fwusow Industry Co.,Ltd	17 Shin Tai Industry Co.,Ltd.
9 Tairoun Products Co.,Ltd	18 Hunya Foods Co; Ltd.

Textiles Sector	
Companies	Companies
1 Far Eastern New Century Corporation	17 Zig Sheng Ind. Co., Ltd
2 Shinkong Synthetic Fiber Corporation	18 Lan Fa Textile Co.,Ltd.
3 Nan Yang Dyeing & Finishing Co.,Ltd	19 Everest Texttile Co.,Ltd
4 Tong-Hwa Synthetic Fiber Company Limited.	20 Chyang Sheng Dyeing & Finishing Co.,Ltd
5 Shinkong Textile Co.,Ltd	21 De Licacy Industrial Co., Ltd
6 Reward Wool Industry Corporation	22 Wisher Industrial Co., Ltd.
7 Formosa Taffeta Co.,Ltd	23 Tex-Ray Industrial Co.,Ltd.
8 Chuwa Wool Industry Co,(Taiwan) Ltd	24 Chang Ho Fibre Corporation
9 Tainan Spinning Co.,Ltd.	25 Lilontex Corporation
10 Tah Tong Textile Co.,Ltd	26 Tri Ocean Textile Co., Ltd.
11 Lealea Enterprise Co.,Ltd	27 Tainan Enterprises Co.,Ltd
12 Universal Textile Co., Ltd.	28 Honmyue Enterprise Co., Ltd.
13 Hong Ho Precision Textile Co.,Ltd.	29 Eclat Textile Co., Ltd.
14 Nien Hsing Textile Co., Ltd	30 Makalot Industrial Co., Ltd.
15 Hong Yi Fiber Industry Co.,Ltd	31 Roo Hsing Co., Ltd
16 Taiwan Taffeta Fabric Co., Ltd	32 Li Cheng Enterprise Co.,Ltd.

Electric & Machinery Sector			
	Companies		Companies
1	Shihlin Electric & Engineering Corp.	19	Kaulin Manufacturing Co. Ltd.
2	Teco Electric & Machinery Co., Ltd.	20	Mobiletron Electronics Co.,Ltd.
3	Right Way Industrial Co.,Ltd	21	China Ecotek Corp.
4	Yungtay Engineering Co., Ltd.	22	Hota Industrial Mfg. Co., Ltd.
5	Jui Li Enterprise Co.,Ltd.	23	Kung Long Batteries Industrial Co.,Ltd
6	Chung-Hsin Electric & Machinery Mfg. Corp.	24	Jenn Feng New Energy Co.,Ltd.
7	Allis Electric Co.,Ltd.	25	Chiu Ting Machinery Co.,Ltd.
8	Rexon Industrial Corp.,Ltd	26	Roundtop Machinery Industries Co., Ltd
9	Falcon Power Co., Ltd.	27	Chang Type Industrial Co.,Ltd.
10	Lee Chi Enterprises Co., Ltd.	28	Kinik Company
11	Fortune Electric Co.,Ltd	29	Goodway Machine Corp.
12	Ta Yih Industrial Co.,Ltd	30	Hiwin Technologies Corp.
13	Tyc Brother Industrial Co, Ltd.	31	Cub Elecparts Inc.
14	Gordon Auto Body Parts Co., Ltd	32	Tong-Tai Machine Tool Co., Ltd
15	Basso Industry Corp.	33	Rechi Precision Co.,Ltd.
16	Anderson Industrial Corp.	34	Depo Auto Parts Industrial Co., Ltd.
17	Luxe Electric Co.,Ltd.	35	Ace Pillar Co., Ltd
18	Awea Mechantronic Co.,Ltd		

Construction Sector			
	Compaies		Companies
1	Fui Industrial Co.,Ltd.	19	Hung Poo Real Estate Development Co.,Ltd.
2	Advancetek Enterprise Co.,Ltd.	20	We & Win Development Co., Ltd
3	Kpt Industries Ltd.	21	Kee Tai Properties Co.,Ltd
4	Run Long Construction Co., Ltd.	22	Sakura Development Co.,Ltd
5	Cathay Real Estate Development Co.,Ltd.	23	Highwealth Construction Corp.
6	Goldsun Development&Construction Co.,Ltd.	24	Hwang Chang General Contractor Co.,Ltd
7	Kuo Yang Construction Co.,Ltd	25	Huang Hsiang Construction Corporation
8	Pacific Construction Co., Ltd.	26	Kedge Construction Co., Ltd.
9	Chainqui Construction Development Co.,Ltd	27	Radium Life Tech. Co.,Ltd
10	Prince Housing & Development Corp.	28	Huaku Development Co., Ltd.
11	Bes Engineering Co	29	Ruentex Engineering & Const.Co
12	Kindom Construction Corp.	30	Chien Kuo Construction Co., Ltd
13	King'S Town Construction Co., Ltd.	31	Farglory Land Development Co., Ltd
14	Hung Ching Development & Construction Co. Ltd	32	Sweeten Real Estate Development Co.,Ltd.
15	Crowell Development Corp.	33	Shining Building Business Co.,Ltd.
16	Delpha Construction Co.,Ltd.	34	Founding Construction Development Co., Ltd.
17	Hung Sheng Construction Ltd.	35	Chong Hong Construction Co., Ltd.
18	Da-Cin Construction Co.,Ltd.		

Finance Sector			
Companies		Companies	
1	King'S Town Bank	17	President Securities Corp.
2	Taichung Commercial Bank Co., Ltd.	18	Masterlink Securities Corporation
3	China Bills Finance Corporation	19	E.Sun Financial Holding Company,Ltd.
4	China Life Insurance Company, Ltd.	20	Taishin Financial Holding Co., Ltd.
5	Taiwan Fire & Marine Insurance Co., Ltd.	21	Waterland Financial Holdings
6	Taiwan Life Insurance Co., Ltd	22	Capital Securities Corp.
7	Taiwan Business Bank	23	Chang Hwa Commerciai Bank,Ltd
8	Bank Of Kaohsiung,Ltd.	24	Hua Nan Financial Holding Co.,Ltd.
9	Cosmos Bank, Taiwan	25	Fubon Financial Holding Co., Ltd.
10	Union Bank Of Taiwan	26	Cathay Financial Holding Co.,
11	Far Eastern International Bank	27	China Development Financial Holding Corporation
12	Ta Chong Bank Ltd.	28	Yuanta Financial Holdings
13	Entie Commercial Bank	29	Mega Financial Holding Co.,
14	Shinkong Insurance Co., Ltd.	30	Sinopac Financial Holding Company Limited
15	Central Reinsurance Corporation	31	Hua Nan Financial Holding Co.,Ltd.
16	The First Insurance Co., Ltd.		

Paper Sector			
Companies		Companies	
1	Taiwan Pulp & Paper Corporation	4	Yuen Foong Yu Paper Mfg.Co., Ltd.
2	Cheng Loong Corp.	5	Long Chen Paper Co.,Ltd.
3	Chung Hwa Pulp Corp.		