# Reliability of Listed Companies' Value Estimates and Target Prices: Evidence from Industry-Based Combined Valuation Models

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Abstract

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The low reliability of listed companies' target prices is a major issue globally. As the foundation of the target price, the value estimate is important in the determination of target price reliability. The value estimate is the estimated intrinsic value of a company produced by the company valuation model. However, there is no individual valuation model capable of fully disclosing the intrinsic value, and the use of more than one valuation model simultaneously is a common practice. In addition, it is important for the valuation model to be consistent with the characteristics of the company. However, the existing literature offers little guidance on this valuation issue, especially on how to appropriately construct a combined valuation model based on the characteristics of the company.

This study investigates the underlying reasons for the low reliability of listed companies' value estimates and target prices, and attempts to improve their reliability via the enhanced company valuation method. In particular, the study focuses on the industry based combined valuation models and their application to the valuations of listed companies from different industries. The study begins with the estimation of discount rate for each selected firm, and then applies the industry based individual and combined models to generate value estimates for each firm, followed by the target price setting process to determine the most reasonable target price. The improved reliability test techniques will be used to measure the performance of value estimates, target prices and the financial analysts' target prices, so that the best individual and combined valuation models for different industries can be identified.

This study has produced several important findings. The results show that the reliability of the target price is determined by the value estimate and the target price setting process. The reliability of the value estimate is influenced by the data and valuation method. The results also show that absolute valuation models have significant advantages in emerging industries such as biotechnology. The relative valuation models exhibit good performance in the traditional industries such as technology hardware. The forward valuation models are suitable for stable industries such as insurance with accurate forecasts. The trailing valuation models have apparent advantages in unstable industries such as securities with great uncertainty. The results also show that the combined valuation models have significant advantages over the individual valuation models. The mixed combined valuation models are preferred in practice.

**Keywords:** industry characteristics, company valuation model, reliability

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# List of Abbreviations

| | |
|---|---|
| BYPRP | Bond Yield plus Risk Premium Model |
| CAPM | Capital Asset Pricing Model |
| DCF | Discounted Cash Flow Model |
| DD | Discounted Dividend Model |
| EBITDA | Earnings before Interest, Tax, Depreciation and Amortization |
| EVBV | Enterprise Value to Book Value Model |
| EVE | Enterprise Value to EBITDA Model |
| EVS | Enterprise Value to Sales Model |
| FDY | Forward Dividend Yield Model |
| FFM | Fama-French Model |
| FPEG | Forward Price Earnings to Growth Model |
| FPE | Forward Price to Earnings Model |
| GGM | Gordon Growth Method |
| MDCF | Modified Discounted Cash Flow Model |
| MPTTD | Market Prices Three Trading Days Prior to the Announcement or Valuation Dates |
| PBV | Price to Book Value Model |
| PFCF | Price to Free Cash Flow Model |
| PLSR | Partial Least Square Regression |
| PPE | Property, Plant, and Equipment |
| PS | Price to Sales Model |
| PSM | Pastor-Stambaugh Model |
| RI | Residual Income Model |
| TDY | Trailing Dividend Yield Model |
| TPE | Trailing Price to Earnings Model |
| TPEG | Trailing Price Earnings to Growth Model |
| TVW | Time Varying Weighting Scheme |
| WACC | Weighted Average Cost of Capital |
| YTM | Yield to Maturity |

# Chapter 1

# Introduction

## 1.1 Introduction

In general, listed companies' target prices are supposed to assist stock market investors to judge the best time to exit their existing positions in order to realize the maximum profit potential. However, the target prices do not always produce the appropriate trading signals and most of them tend to be over-bullish. A number of studies show that the target prices often significantly deviate from the market prices. Brav and Lehavy (2003) and Asquith et al. (2005) showed that, for the period 1997 to 1999, the average return implied by target prices was 32.9%. Bradshaw et al. (2013) found the target prices between the years 2000 and 2009 implied a return of 24.0%. In fact, there was only an actual market return of 8.1% from the years 1997 to 2009 (Bradshaw et al., 2014). Recently, there have been increasingly doubts about the target prices because of their low reliability, especially the assigned target prices for the technology stocks which are often too high to be achieved. Bonini et al. (2010) discovered that the target price reliabilities are very limited, their prediction errors are consistent, auto-correlated, non-mean reverting and large. In fact, the low reliability of target prices is a wide spread issue worldwide. Asquith et al. (2005) found that about 54.3% of target prices in the US reach their targets within 12 months. Kerl (2011) revealed that approximately 56.5% of target prices are achieved in Germany, and Bonini et al. (2010) found that only 33.1% of target prices are achieved in Italy.

The low reliability of listed companies' target prices is indeed a serious issue. This chapter provides a general discussion of the value estimates and target prices of listed companies to enable us to understand the improvement of value estimate and target price reliability. The rest of the chapter is organized as follows: Section 1.2 describes the basic concepts of some company valuation related terms. Section 1.3 presents the research problem statement. The research objectives are illustrated in Section 1.4. Section 1.5 discusses the research significance, followed by the thesis structure outline in the last section.

## 1.2 Definitions of Terms

### 1.2.1 Company Valuation

Company valuation is a widely used financial technique and process to estimate the economic value of a company. Depending on the status of the company (whether it continues to operate or is bankrupt), the premises of valuation can be under going-concern or liquidation, respectively. According to the different objectives in performing valuations, Pinto et al. (2010) classified company valuation into three categories: transaction-related, compliance-related and litigation-related valuation. Specifically, the transaction-related valuations contain the private equity financing, IPO, acquisition, etc. The compliance-related valuations include the compliance encompassing actions required by laws such as financial and tax reporting. The litigation-related valuations consist of the legal proceedings including those related to lost profits, shareholder disputes, etc.

### 1.2.2 Value Estimate

The economic value of a company can be defined as the intrinsic value, fair value or investment value, etc. With regard to the intrinsic value, Dong (2008) revealed that the intrinsic value is frequently used in the transaction-related valuation and it is the actual value of a company. However, what a company is actually worth is difficult to quantify. The company valuation technique attempts to estimate the intrinsic value based on the underlying perception, which includes all aspects of the company, both tangible and intangible factors. Therefore, many studies conclude that the company valuation is actually an art rather than an exact science (e.g. Frankel, 2005, King, 2012). In addition, the estimated intrinsic value produced by company valuation is known as the value estimate. The value estimate reflects the financial analyst's estimation of how much the company is worth at the valuation date. Depending on the different objectives in performing valuations, the "semi-finished product" value estimate needs to be adjusted according to a series of non-quantitative factors. Kerl (2011) concluded that the financial analysts do not take the outcome of valuation at face value, but adjust the results qualitatively to satisfy the specific valuation needs. By doing so, the value estimate can turn into several "final products" such as IPO price, the acquisition price paid to purchase a company or the target price of a listed company's stock.

### 1.2.3 Target Price

The listed company's target price is often a specific number used in the stock market investment. As a direct indicator of the future intrinsic value per share of a company, the target price reflects the financial analyst's expectation of the future price level that a listed company's stock is most likely to reach within a certain time horizon (Huang et al., 2009). The time horizon is usually half or one year following the initial target price announcement date. In general, the target price, together with the investment recommendation and earnings forecast are the three most important quantitative outputs of a financial analyst's report (Feldman et al., 2012). Brav and Lehavy (2003) suggested that the target prices are the financial analyst's most informative statement of the listed companies' future intrinsic values. The stock market often reacts significantly and immediately to the initial and revision announcements of target price.

### 1.2.4 Relationship between the Value Estimate and the Target Price

In general, the value estimate is the foundation of the target price. The target price is often based on the estimated future intrinsic value, where the future intrinsic value is predicted by using the value estimate. The value estimate is the estimated intrinsic value of a company at the current valuation date. Since the intrinsic value of a company is subject to change for all time, the value estimate cannot adequately reflect the future intrinsic value of a company. Therefore, the financial analysts predict the future intrinsic value based on the value estimate. In addition, the financial analysts prefer to subjectively set the target prices around rather than equal to the estimated future intrinsic values. The distance between the target price and the estimated future intrinsic value is known as the "safety margin". It is often used as an allowance for factors such as valuation error or the financial analysts' confidence towards their estimated future intrinsic values. Hence, it is often said that the value estimate is the product of objective valuation, and the target price is the product of subjective pricing. Brav and Lehavy (2003) revealed that the value estimate is basically the estimated intrinsic value of a company at the current valuation date. The value estimate needs to be adjusted to allow the intrinsic value to change over time, and better reflect the expected future price level.

### 1.2.5 Influential Factors of Target Prices

The low reliability of listed companies' target prices is becoming a wide spread issue. There are increasing researches investigating the underlying reasons and a number of influential factors have been identified. Bradshaw et al. (2013) found evidence that the target price accuracy is largely related to the overall market condition, where the target price forecasts are more accurate in the up rather than the down market. This is usually true as the financial analysts tend to issue "bullish" target prices, which are easier to achieve in a bull market. Asquith et al. (2005)

suggested that the high target prices actually are the products of the financial analyst's optimism. Bradshaw et al. (2013) discovered that the target prices issued by the financial analysts employed by pure brokers are more optimistic due to the incentives to generate trading. Financial analysts who are employed by the brokers with business ties with the target firms tend to provide more optimistic recommendations (Michaely and Womack, 1999; Krigman, et al. 2001). Bradshaw et al. (2013) further concluded that the financial analyst's optimism is exacerbated by the conflicts of interest and investment banking pressures. Cowen et al. (2006) revealed that the sales and trading activities used to fund research create strong incentives for the financial analyst's optimism. The authors also found evidence that the financial analysts who work in prestigious investment banks are prone to produce more optimistic reports to attract new clients and increase brokerage services income. In fact, the financial analyst's optimism is harmful to the reliability of the target price, and often causes the target price to become too high to achieve. Bonini and Kerl (2012) found that target price performance decreases with the financial analyst's optimism.

In addition, other studies have identified a series of other factors that have influence on the performance of listed companies' target prices. For example, Bonini and Kerl (2012) found that financial analysts' access to privately available information affected their ability to produce reliable valuation implications. The authors also revealed that the increased accuracy can be attributed to the additional information that financial analysts use to adjust the target prices. Gleason et al. (2013) discovered that the financial analysts who demonstrated superior concurrent earnings forecasting accuracy usually set target prices more accurately over the ensuing 12 months. Kerl (2011) highlighted that the size, reputation and research intensity of the investment bank had positive influence on the target price accuracy. Bradshaw et al. (2013) discovered that the target price performance is worse when the target company's stock price volatility is high, and the target price is more likely to be achieved during the company-specific positive price momentum. Bradshaw et al. (2013) and Bilinski et al. (2013) concluded that country-specialized financial analysts with better past target price forecast records, higher forecasting experience, and employed by a large broker often issued more accurate target prices. Bilinski et al. (2013) emphasized that country-specific institutional and regulatory factors such as accounting disclosure quality, cultural traits and financial reporting standards explained the difference in target price reliability across borders. Ali and Hwang (2000), Ball et al. (2000) and Imam et al. (2013) also discovered that the value relevance of accounting numbers varied significantly between countries due to the different legal systems, and the level of alignment of financial and tax accounting.

#### 1.2.6 Influential Factors of the Value Estimate

In addition to the above factors which have indirect influences on the listed company's target price reliability, the target price is directly affected by the quality of the value estimate. Financial analysts determine the target price on the basis of estimated future intrinsic value, where the future intrinsic value is often predicted based on the value estimate. Recent studies have shown that the quality of historical accounting data, the accuracy of company performance forecast data, the discount rate estimation method and the valuation model have significant effects on the quality of value estimates. For example, Gleason et al. (2013) found evidence that the accuracy of a value estimate is strongly associated with the accuracy of the earnings forecast. Cassia and Vismara (2009) suggested that the equity reports that adopt the steady state earnings growth rate to determine the terminal value always produce more reliable value estimates. Gleason et al. (2013) underscored the importance of both forecasting ability and the valuation model. The authors further revealed that the potential benefits of superior earnings forecasts can be lost if those forecasts are used as inputs in a flawed valuation model. Demirakos et al. (2010) showed that the valuation model affects value estimate accuracy. In the valuation of small, unstable and high-risk companies with volatile earnings and a limited number of comparable companies, the discount cash flow models often outperform the price multiples. For the companies with negative future cash flows, Pinto et al. (2010) emphasized that the residual income model is the most appropriate valuation model. Liu et al. (2002) found that the forward price to earnings multiples tend to produce the most accurate value estimates for high growth or profitable companies. The market condition also influences the valuation model choice. Demirakos et al. (2010) suggested that the value estimate quality is more likely to improve when the financial analyst applies the price to earnings model in a bull market and the discount cash flow model in a bear market.

### 1.2.7 Valuation Methods

The reliability of the value estimate is not only directly influenced by data, but also by the valuation method. The target price is further affected by the target price setting method. Sections 1.2.7.1 to 1.2.7.3 discuss the valuation methods such as the discount rate estimation method, company valuation model and target price setting method. The commonly used techniques to test the reliability of both value estimate and target price are presented in Section 1.2.7.4.

#### 1.2.7.1 Discount Rate Estimation Methods

As the first step in company valuation, the estimation of an accurate discount rate is essential. The discount rate has been widely used in company valuation to estimate the intrinsic value of a company. It has direct and significant influence on the reliability of both value estimate and target price. Pratt (2002) revealed that the cost of capital for a company has often been used as a discount rate that equates the expected economic income to the present value. Although the capital structure and source vary significantly across different companies, the equity and debt are two major sources of financing. Therefore, the cost of capital may refer to the required return on a company's equity capital or debt capital, or both (the weighted average cost of capital-WACC). However, the estimation of an accurate discount rate is one of the most challenging parts of valuation practice. The discount rate should fully reflect both the time value of money and the uncertainty of future cash flows (Pratt, 2002).

#### 1.2.7.1.1 Cost of Equity

The cost of equity, also known as the required return on equity is an important component of the WACC. The WACC is determined by the cost of equity, after-tax cost of debt and capital structure. The cost of equity can be estimated by using the following methods.

The build-up model is a traditional but widely used model to estimate the cost of equity for small-cap listed companies. Pratt (2002) revealed that the build-up method estimates the cost of equity as the sum of the risk free rate and a series of risk premiums, which include the equity market, size and company-specific risk premiums. The country-specific premium should be considered but it is not often required for the developed markets. In addition, there is a simple and convenient form of a build-up model known as the bond yield plus risk premium model (BYPRP). Pinto et al. (2010) recommend the BYPRP for the companies with publicly traded debts, which estimates the cost of equity as the sum of the yield to maturity on the company's long term debt and a risk premium.

The capital asset pricing model (CAPM) is also a popular model to estimate the cost of equity for medium and large-cap listed companies. The CAPM was developed 30 years ago by Sharpe (1964) and Lintner (1965) with a strong theoretical foundation and ease of application. In the earlier survey conducted by Graham and Harvey (2001), three out of four chief finance officers said that they use the CAPM to calculate the cost of equity. Based on the recent survey conducted by the Association for Financial Professionals (AFP) with more than 300 top financial practitioners, Jacobs and Shivdasani (2012) concluded that about 90% of respondents preferred the CAPM in their estimations of cost of equity. Koller et al. (2010) revealed that the CAPM estimates the cost of equity by using three factors: risk free rate, market wide risk premium, and risk adjustment (beta) that reflects each company's riskiness relative to the market. However, there are increasing doubts about the effectiveness of CAPM, as many studies argue that the beta does not describe the risk adequately. Pinto et al. (2010) showed that the coefficients of determination for stocks' beta regression range from 2 percent to 40 percent, with many under 10 percent. This implies that the CAPM cannot fully capture the risk faced by the company.

Because of the drawbacks of the CAPM, the empirical evidence based models such as the multiple-factor Fama-French model (FFM) and the Pastor-Stambaugh model (PSM) have been developed. The FFM model was introduced by Fama and French (1992) and (1993), which defines the risk as a stock's sensitivity to three portfolios: market, size and value. The PSM adds to a liquidity factor to represent the excess returns to a portfolio that invests the proceeds from shorting high-liquidity stocks in a portfolio of low-liquidity stocks (Pinto et al., 2010).

There is also a simple and direct cost of equity estimation method known as the Gordon growth method (GGM). There are two types of GGM: single-stage and multiple-stage (Pinto et al., 2010). Specifically, the single-stage GGM estimates the cost of equity as the sum of forward dividend yield and consensus long-term earnings growth rate. The multiple-stage GGM estimates the cost of equity that equates the sum of present values of the expected cash flows from several future stages to the current market price.

#### 1.2.7.1.2 Cost of Debt

The cost of debt, or the required return on debt (after marginal or effective tax) is another component of the WACC. The yield to maturity (YTM) on a company's long term public debt (option-free and non-convertible) has often been selected as a proxy of cost of debt. A company's publicly traded debts often contain certain degrees of default risk, especially for the companies below investment grade. Hence, the YTM has three major components: real interest rate, expected inflation premium and default risk premium. Pinto et al. (2010) revealed the default risk premium reflects a series of factors such as leverage, profitability and sensitivity of profitability to systemic risk.

In terms of YTM estimation, Koller et al. (2010) suggested that for the companies with public traded long term debts calculate the YTM directly from the bond's price and promised cash flows. Alternatively, the YTM on publicly traded debts is also available from many financial databases. For the companies with short-term public debts, public debt trades infrequently or even no publicly traded corporate bonds, the company's long term credit rating can be used to estimate the YTM indirectly. For the companies without credit ratings, the estimation of long term credit rating is required. The financial ratio comparison approach is the most commonly used method to determine the credit rating.

Jacobs and Shivdasani (2012) found that only 34% of the respondents in the survey of the Association for Financial Professionals selected the forecasted YTM rate on the new debt issuance. In addition, 37% of the respondents adopted the current average rate on outstanding debt to estimate the YTM. In order to produce an appropriate discount rate for the future cash flow, the authors argued that the YTM should be based on the forecasted rate on the newly issued bonds rather than "old" bonds.

#### 1.2.7.2 Company Valuation Models

Following the discount rate estimation, the valuation model selection and application is the second step in company valuation. In today's valuation practice of listed companies, there is a range of absolute and relative valuation models available. Specifically, the absolute valuation models estimate the intrinsic value based on the present value of all the future cash flows generated by a company. On the other hand, the relative valuation models apply the law of one price to disclose the intrinsic value of a company.

In order to produce a reliable value estimate and target price, the valuation model needs to be consistent with the characteristics of the company. Rees (1999) discovered that the valuation model's performance is very sensitive to the company's characteristics. A group of companies, classified as either an industry or a sector often share many similar features and they can be valued by certain types of valuation models. Demirakos et al. (2004) conducted a content analysis on the equity reports from three industries and discovered that the relative models are frequently used in the valuations of stable and traditional industries, where accrual accounting can better reflect the intrinsic value of the companies. The authors also revealed that the absolute models such as discounted free cash flow model is more suitable for those companies in fast growing industries with higher risk. Imam et al. (2008) conducted interviews with 42 sell-side financial analysts, and concluded that the absolute model of discounted free cash flow is the first choice to value the fast growing technology and media companies. The authors also ranked the relative model of price to book value as the primary model for financial companies, since financial companies mainly consist of highly liquid assets and their book values approximate their market prices. For a cyclical industry which is heavily subject to the business cycle effect, Imam et al. (2008) recommended the relative model of enterprise value to earnings before interest, tax, depreciation and amortization (EBITDA) as a reliable model to deal with the volatile earnings. For those cyclical companies whose earnings are often negative during the down part of a business cycle, Geddes (2003) discovered that dividing the enterprise value of a company by its sales is an effective way of comparing companies in cyclical industries.

In recent valuation practice, the time value of money based absolute models such as the discounted cash flow model (DCF) becomes the financial analyst's dominant valuation model (Giamouridis and Montagu, 2014, Lundholm and O'Keefe, 2001). Glaum and Friedrich (2006) discovered that the financial analysts started to rely more on the fundamental based absolute models after the 2001 dot.com bubble. The financial analysts became more risk averse after the crisis, and changed their focus from single period-oriented measures towards an assessment of profitability and cash flow generation. However, the absolute models are often over-sensitive to the changes in their key inputs, and they also face greater uncertainty in the company's performance forecasting and difficulty in estimating the discount rate. Pinto et al. (2010) argued that absolute models react significantly to the changes in the estimated inputs and this may potentially reduce their reliability. Goedhart et al. (2005) revealed that absolute models heavily rely on the estimation of a number of key components and if they turn out to be wrong this can lead to big mistakes. Francis et al. (2000) tested the performance of a series of absolute models by measuring the accuracy and explanatory power of the value estimates derived from these models. The authors found that in terms of explanatory power, the value estimates produced by the absolute models only explained a maximum of 51% variation in the current price. Their accuracy test also showed an average percentage valuation error as high as 69.1%. Francis et al. (2000) concluded that the major reason for the underperformance of absolute models is the over-reliance on the estimated terminal values. Steiger (2008) revealed that the terminal value accounts for a large portion of the company's total estimated intrinsic value and for the high growing companies, the terminal value often accounts for 80-90% of the estimated intrinsic value (Gode and Ohlson, 2006).

On the other hand, the law of one price based relative models are easy to apply and provide a fast estimation of the intrinsic value of a company. The relative models are often easy to understand and simple to present to clients and customers (DeAngelo, 1990), they are particularly useful when a company's intrinsic value cannot be directly observed (LeClair, 1990). The relative models were very popular in valuation practice, especially before the 2001 dot.com crisis. Earlier studies before the dot.com crisis such as Block (1999) who indicated that half of the financial analysts in his survey did not use the absolute models, they considered the relative models such as price to earnings as the basis for the valuation. The survey conducted by Carter and Auken (1990) also indicated that using the price to earnings model is the most valuable technique for the valuation practice conducted by investment managers. However, the relative models have one big problem and that is whether the chosen benchmark is fairly priced (Pinto et al., 2010). In fact, the effectiveness of the chosen benchmark is difficult to justify. Companies with similar operating and financial characteristics are the most common choice of benchmark (Palepu et al., 2000). Bhojraj and Lee (2002) found that the peer group benchmark based relative models often produced more reliable valuation results than the industry and market benchmark. Perhaps the most cost efficient way to identify the comparable companies for the peer group is to start by examining the target company's competitors or industry (Koller et al., 2005). Alford (1992) recommended the combination of risk (beta) and earnings growth rate as an effective criterion for selecting comparable companies. Although the 'best' benchmark is similar, it is not exactly the same as the company being valued. The valuation results would be misleading when the benchmarks are difficult to identify, especially for a company that operates in several industries (Palepu et al., 2000).

#### 1.2.7.3 Target Price Setting Methods

Following the company valuation, the third step is that financial analysts need to set a reasonable target price on the basis of the estimated future intrinsic value. The future intrinsic value is often predicted by using the value estimate. In general, the target price should fully reflect the financial analyst's expectation of the price level a listed company's stock is likely to reach within the next 12 months.

In practice, there is no standard way to set the target price for a listed company. For the technical investors, they rely mostly on the technical trading rules such as support and resistance, moving averages and Fibonacci extensions to predict what the price level is likely to be in the future. On the other hand, value investors tend to focus on the fundamentals of a company, and apply several valuation models and financial ratios to estimate the intrinsic value and then set the target price. Imam et al. (2008) presented the value investors' three major approaches in setting target price. The commonly used approach sets the target price based on a combination of valuation models after adjusting for the financial analyst's subjective judgments. The second approach relies on the comparable transaction or company, which applies the relative valuation models to arrive at the target price. The third approach uses the subjectively determined premium or discount on the current market price to set the target price. Apparently, the three pricing methods involve the financial analyst's subjective assessments of a company. Bonini and Kerl (2012) highlighted the importance of a setting process, whereby the increased reliability of the target price can be attributed to the additional information that financial analysts used to adjust the value estimate.

An immediate question is: how to combine several value estimates when more than one valuation model is used at the same time? Imam et al. (2008) found that the financial analysts tended to use qualitative judgments to directly combine various value estimates into one. However, this over-subjective process may introduce additional pricing error and result in an unreliable target price. Unfortunately, the extant literatures offer little guidance on this issue. Patena (2011) provided a comprehensive overview of the relevant literatures, and discovered that the weighted average methods are the dominant methods to combine several value estimates. Specifically, the Delaware Block method is the most prominent weighted average method. It is the industry standard approach in the financial legal proceedings and IRS tax-related valuation disputes (Beatty et al., 1999). In general, the weighted average method assigns weights manually to the value estimates produced by the different valuation models, according to their importance and relevance to the company being valued. The weighted average methods are based on the rule of thumb and the estimated weights often vary greatly between different financial analysts and thus are subject to serious criticisms. Yee (2008) argued that although the current research on the techniques to combine value estimates is not adequate, there are many studies exploring how to combine different forecasts as a result of applying differing forecasting models. Yee (2004) revealed that after appropriate adjustments, these methods can be adapted to determine the weights for various value estimates.

#### 1.2.7.4 Reliability Testing Techniques of Value Estimate and Target Price

Following the target price setting, financial analysts may wish to test the reliability of the target price. Since the target price is based on the value estimate, the test of value estimate is also important. Until recently, there were a range of reliability testing techniques for listed company's value estimate being developed. In general, the value estimate is the estimated intrinsic value of a company at the valuation date. The reliability of a value estimate depends on how well it discloses the intrinsic value of a company (accuracy), and whether it exhibits a similar trend to the fluctuation of intrinsic value over time (explanatory power). Kaplan and Ruback (1995) revealed it is possible that one value estimate could successfully estimate the intrinsic value on average, but perform poorly in explaining the variation in intrinsic value, and the converse is also possible. Francis et al. (2000) focused on accuracy and explanatory power, and used market price as a proxy for intrinsic value per share. The authors tested the accuracy of value estimate by calculating the price scaled difference between value estimate and market price, and measured the explanatory power by regressing between market prices and value estimates.

Instead of testing the "semi-finished product" of value estimate, investors prefer to focus directly on the "final product" of target price. In recent years, a variety of advanced techniques have been developed to test the reliability of the target price. Apparently, the easiest way to measure the reliability is to judge whether the predetermined target has been achieved by the market price within the time period identified by the financial analyst. Demirakos et al. (2010) presented three straightforward reliability metrics to test whether the target has been achieved during, on the last day or beyond the 12-month horizon. In contrast, the four metrics suggested by Bradshaw et al. (2013) are more technical. The first criterion is the ranked correlation between the realized and forecasted returns implicit in the financial analyst's target prices. The second criterion is the target price forecast error computed as the actual 12-month-ahead closing stock price minus the target price scaled by the beginning market price. The third criterion is a dummy variable equal to one if the actual 12-month-ahead closing price is at or above the target price. The last criterion is a dummy variable coded as one if the target price is met at any time during the 12-month horizon. In addition, it has been found that the financial analyst's over-optimistic target price setting also has strong influence on the reliability. Therefore, Bonini and Kerl (2012) consider the financial analyst-specific ‘boldness’ as an indirect reliability measurement. It is computed as the absolute difference between the target price and the market price, scaled by the latter. However, very few studies take into account the direction of target prices (targets set above, below or equal to the current market prices). Asquith et al. (2005) adopted a measurement ratio which is the maximum price achieved within 12 months divided by the target price if it is set above the current price. If the price target is below the current price, the measurement ratio is the target price divided by the minimum price achieved within 12 months. Imam et al. (2013) further distinguished the target prices according to three types of investment recommendation (buy, sell and hold), and then tested their reliability separately by different metrics.

## 1.3 Research Problem Statement

The low reliability of listed companies’ target prices is indeed a wide spread issue, Bonini et al. (2010) found that the target price reliability is worse in the emerging markets with lower levels of market efficiency. In general, the target price performance is directly affected by the quality of the value estimate and the target price setting method. Specifically, the value estimate is largely influenced by a range of factors including the accounting report quality, earnings forecast reasonableness, discount rate accuracy, and especially the valuation model suitability. The valuation model is the core element of company valuation, how to appropriately select and apply the valuation model is one of the key points to produce a reliable value estimate.

However, there is no valuation model capable of fully estimating the intrinsic value of a company. The multi-period absolute model such as discounted cash flow becomes the financial analysts’ dominant valuation model. This is especially true when the information on historical accounting items such as actual earnings is insufficient to assess the value of companies, and the demand for forecasted data based absolute models increases (DeFond and Hung, 2003). However, the absolute models often face great uncertainty in terms of specific forecast and difficulty in estimating the discount rate. Call et al. (2009) suggested that performance forecasting is highly sophisticated as it involves the use of various financial statement numbers. Block (1999) argued that the difficulty in creating multi-period forecasts in an uncertain corporate environment and estimating the appropriate discount rate, makes the multi-period absolute models unattractive to financial analysts. In contrast, the single period relative models such as the price to earnings model has been widely used in valuation practice. It provides a straightforward estimation of intrinsic value, and takes less time and requires fewer assumptions and less information than the application of a fully-fledged fundamental analysis with the absolute valuation models (Damodaran, 2009). However, its biggest problem is whether the chosen benchmark is fairly priced. Thus, every valuation model has its own limitations. Yee (2004) revealed that every value estimate is just an incremental piece of information and relying on only one value estimate or valuation model may ignore valuable information.

In fact, the use of more than one individual valuation model at the same time is already a common practice. According to the Institutional Factor Survey by Merrill Lynch in 2006, institutional investors use an average of nine individual valuation models and financial ratios together in company valuation. Vardavaki and Mylonakis (2007) argued that the combined valuation models outperform the individual valuation models in general. Jenkins (2006) concluded that the strength of the combined models is derived from their abilities to simultaneously capture the multiple dimensions of the valuation information contained. Courteau et al. (2006) revealed that the potential valuation benefits can be gained from combining several valuation models in practice, and there is the possibility of using one model as a check on others.

The current study highlights the importance of the combined valuation model. The performance of combined valuation model can be further improved by including the complementary absolute and relative valuation models. By doing so, the drawbacks of absolute and relative models can be minimized while their advantages can be maximized, the synergy can be fully generated. Jenkins (2006) revealed that an effective combination of absolute and relative models is able to focus both on the long-term forecasts as well as short-term forecasts. Imam et al. (2013) discovered that the use of an accrual based relative model alongside a cash flow based absolute model reduces valuation error, as accruals add value relevant information to cash flows (Burgstahler, 1998). The cash flows are also useful in validating the information in accruals, since cash flows have incremental value relevance to accruals (Akbar et al. 2011).

In addition, it is also important for the combined valuation model to be consistent with the characteristics of the company to better estimate the intrinsic value. The "apples to apples" comparison offers a more defensible way to reflect how much a company is worth. Tasker (1998) discovered that the systematic use of an industry-based valuation model is more appropriate in different industries. The current study emphasizes that it is important to concentrate on the general features of the companies in an industry, and use different combined valuation models in differing industries (industry-based combined valuation model).

The current study aims to improve the reliability of listed companies' value estimates and target prices. The current study highlights the importance of the valuation method and introduces a valuation concept of industry-based combined valuation model. The industry-based combined model benefits from the combination of both absolute and relative valuation models, which further improves the valuation performance by considering the industry-specific characteristics. However, there may be more than one suitable combined valuation model for a particular industry. The current study develops an improved suitability test method to identify the best industry-based combined valuation models. In order to further improve the value estimate and target price reliability, the current study also attempts to improve the cost of capital estimation technique and the target price setting method.

## 1.4 Research Objectives

1. Identify the factors which influence the reliability of listed companies' target prices and value estimates.
2. Improve the discount rate estimation method for listed companies, which includes cost of equity, after-tax cost of debt and capital structure estimation technique.
3. Identify the best industry-based individual and combined valuation models for the financial, information technology and health care industries.
4. Improve the target price setting method to produce reliable listed companies' target prices.
5. Improve the reliability test method for listed companies' value estimates and target prices.

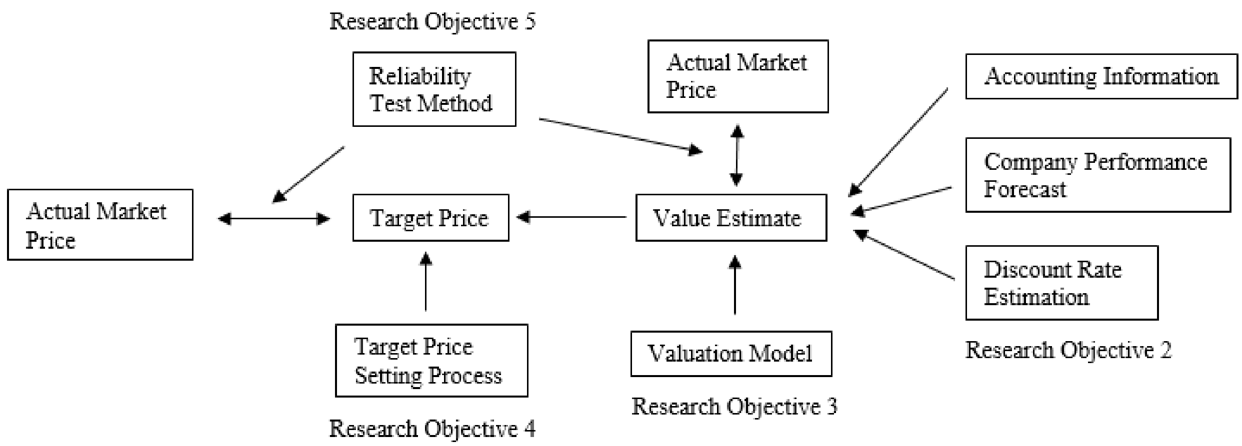
## 1.5 Significance of the Research

This is the first study to introduce an important concept of industry-based combined valuation model to improve the performance of company valuation. The current study contributes significantly to the literature on company valuation methods. The industry-based combined valuation model takes advantage of both combined model and industry-based model. The industry-based combined valuation model has excellent practical relevance in company valuation. It provides an effective guidance for the construction of combined valuation models, and significantly improves the reliability of valuation results. Second, this is also the first study to introduce the important valuation concepts of multi-valuation periods and multi-value indictors. The two valuation concepts provide effective practical guidance in the construction of combined valuation models. The superior performance of an industry-based combined valuation model is only guaranteed when it fully complies with the multi-valuation periods and multi-value indictors. A good industry-based combined valuation model should not only cover all the important life stages of a company, but also fully disclose the intrinsic value generated in each important life stage. Third, the current study also contributes to the discount rate estimation literature by improving the cost of equity, cost of debt and capital structure estimation techniques. More accurate discount rates can be estimated and applied to company valuation practice. Fourth, the current study provides great insight into the widely-used methods to set target price, and presents an enhanced target price setting approach to assist financial analysts to produce more reasonable target prices. Lastly, the reliability test method introduced in the current study is capable of measuring the performances of both value estimates and target prices. The reliability test method can be used to judge the quality of company valuation results.

## 1.6 Thesis Outline

The rest of thesis is structured as follows: Chapter 2 reviews the relevant literature on industry characteristics and industry-based valuation models. Chapter 3 presents the research design, research method and data. Chapters 4, 5 and 6 discuss the empirical research results. Chapter 7 applies the out-of-sample test to verify the robustness of the research results. Chapter 8 presents the conclusions, implications, limitations and recommendations for future research. In addition, Figure 1.1 presents the conceptual framework of the thesis. The conceptual framework clearly explains how different research objectives of the thesis are connected with each other, and what are relationship between the different terms (e.g. target price, value estimate and actual market price) mentioned in the thesis.

**Figure 1.1 Thesis Conceptual Framework**




Source: Examiners' comments

# Chapter 2

# Literature Review

## 2.1 Introduction

This chapter reviews the relevant literature on the industry characteristics and the industry-based valuation models. The rest of the chapter is organized as follows: Section 2.2 reviews the related studies on the characteristics of financial, information technology and health care industries, followed by the discussion of industry-based valuation models. Section 2.3 concludes the chapter.

## 2.2 Industry Characteristics and Industry-based Valuation Models

In company valuation practice, the selected valuation model needs to be consistent with the features of the company, so that the intrinsic value can be better estimated. Rees (1999) discovered that the performance of a valuation model is very sensitive to the characteristics of the target company. In addition, a group of companies in the same industry or sector share many similar features and thus can be valued by the same type of valuation model. Recently, financial analysts have tended to concentrate on the general features of the companies from an industry, and use different valuation models in differing industries to improve the quality of valuation results. Barker (1999) confirmed that the financial analysts prefer different valuation models in different industries, the preferences for valuation models vary systematically according to industry. Tasker (1998) discovered that the systematic use of industry-based valuation model is more appropriate in different industries. However, many practical problems still remain unsolved in company valuation. For example: how to select suitable valuation model based on the observed industry characteristics? How can one verify whether the selected valuation model is suitable for a specific industry? How can the degree of suitability for the selected valuation model in a specific industry be accurately measured? In fact, the financial analysts use their own standards to judge and select industry-based valuation models. This often caused that for the same industry, the financial analysts have different valuation model preferences and choices. Apparently, the different industry-based valuation model selection standards will cause different and even inconsistent valuation results, which will reduce the reliability of value estimates.

In the existing literature, there are many studies comparing the different valuation models' suitability at the company level without considering the industry characteristics, and they even contain strong arguments on the valuation model suitability. For example, Asquith et al. (2005) contrasted the performance of a series of valuation models at the company level, which included sales, earnings, cash flow and book value based valuation models. The authors concluded that the sales based valuation model outperforms other models in general. Sales may be the major value driver because the growth of future payoffs depends on sales growth if profit margin and asset turnover are stable (Nissim and Penman, 2001). However, the accounting item of sales may not be a reliable value indicator, especially as the sales figure can fluctuate erratically for the cyclical companies. Other accounting items may be able to better estimate the intrinsic value. Kim and Ritter (1999) argued that the price to book value model is better than the price to sales and price to earning models. The authors revealed that the accounting figures of sales and earnings are often volatile and subject to management manipulation. Although the book value is indeed an ideal value indicator under certain circumstances, the valuation method should pay more attention to the value creation rather than anything else. In fact, only few financial analysts view book value as a starting point in valuation, and the majority tend to focus on earnings and earnings growth (Ohlson, 2002). Cheng and McNamara (2000) emphasized that earnings is the most important driver of intrinsic value, other models such as the price to book value model cannot be used as the primary valuation model. Bernard (1995) further revealed that earnings is a more accurate value indicator than others such as dividend, where the price to earnings model outperforms the dividend yield model in general. In fact, the dividend based valuation models can generate accurate valuation results, especially when the company being valued is a mature company with a stable dividend payout policy. However, financial analysts often encounter companies without dividends or dividend payout ratios that are not consistent with their profitability. Gleason et al. (2013) discovered that in the valuation of companies without dividend or positive cash flow, the residual income model have significant valuation advantage over other valuation models.

In recent years, the application of different valuation models in different industries has gradually become a common practice in company valuation. More and more literatures has begun to simultaneously study the overall characteristics of an industry and the suitability of valuation models at the industry level. However, most studies are based on qualitative analysis, they judge the suitability of a valuation model in a specific industry from a purely theoretical point of view. For example, Imam et al. (2008) revealed that as the discounted cash flow model concentrates on the future, it is able to better reflect the risk and growth opportunities faced by the high-technology industries in the future. In addition, the authors found that the financial industry mostly consists of marketable assets with high degree of liquidity, the book value of the marketable assets are approximately the same as their market prices. Thus the authors regard the price to book value model as the primary valuation model for the financial industry. Pinto et al. (2010) discovered that for the manufacturing industry with large amounts of fixed assets and depreciation, EBITDA is able to effectively overcome the influence of depreciation on the valuation result. The authors concluded that the enterprise value to EBITDA model is an important valuation model for the manufacturing industry. Demirakos et al. (2004) found that for the traditional industries such as restaurant, food and beverage, they often have slow future earnings growth but their accounting data tend to be stable. The authors concluded that the historical or current accounting data based relative valuation models are able to better estimate the intrinsic values for such traditional industries. Banerjee (2003) revealed that the value creation process of the biotechnology industry is similar to the real options. Since most of the intrinsic values for the biotechnology industry are embedded in the R&Ds which are still in progress, these intrinsic values are expected to be released in the marketing stage after the lengthy R&D process. Thus the real options model has significant valuation advantage for the biotechnology industry.

In addition, some studies also attempt to judge the suitability of a valuation model in a specific industry via the observation of the financial analysts. In general, the valuation reports and interviews with the financial analysts are the major research data resources. For example, Imam et al. (2008) interviewed a list of financial analysts, and completed an equity report based content analysis. They concluded that the financial analysts often have different valuation model preferences for the same industry. A similar equity report based content analysis has been carried out by Demirakos et al. (2004) across three different industries. The authors found that the earnings and sales based valuation model has been frequently used in the equity reports of the beverage, electronic and pharmaceutical industries. In addition, based on the observed financial analysts' preferences in different industries, Imam et al. (2008) and Demirakos et al. (2004) further ranked the suitability of a series of valuation models in different industries. Imam et al. (2013) updated their ranking method and ranked the valuation models based on the target prices generated by the valuation models. Specifically, their study focused on the valuation models and the target prices in the equity report, and then ranked the suitability of valuation models in different industries based on the performance of their target prices.

In the existing literature, there are very few studies that have accurately measured the degree of suitability of a valuation model in a specific industry via quantitative analysis. Kaplan & Ruback (1995) produced a good representation of the quantitative analysis, which provided a strong theoretical foundation for the quantitative test on the suitability of valuation model. The authors emphasized that the test on a valuation model should be based on the value estimate generated by the valuation model. The authors also highlighted that the suitability of a valuation model/value estimate depends on two equally important features, which are accuracy and explanatory power. It is possible that one value estimate could successfully estimate the intrinsic value on average (accuracy), yet perform poorly in explaining the variation in intrinsic value (explanatory power) and the converse is also possible. Francis et al. (2000) highlighted the equal importance of accuracy and explanatory power, and then provided detailed definitions of both terms. Specifically, the authors defined accuracy as the price scaled difference between value estimate and market price, and explanatory power as the adjusted $R^2$ of the regression between market prices and value estimates. The authors assumed the market is efficient, where the market price is used as a proxy for the intrinsic value per share. The latter studies provide a series of improvements on the quantitative suitability test for valuation models.

The existing literature lacks relevant studies on the industry-based valuation models, especially the quantitative test on the suitability of industry-based valuation models. The current study concentrates on the industry-based valuation models from both qualitative and quantitative sides. The next section explores in detail why the valuation model is suitable for the specific industry from the theoretical point of view. The current study chooses the financial, information technology and health care industries as the sample industries. The three selected industries have apparent distinguishing features, which play important roles in a country's economic development. Section 2.2.1 to Section 2.2.3 review the relevant literature on the characteristics of the three sample industries, and then discuss the suitability of the industry-based valuation models based on qualitative analysis.

### 2.2.1 Financial Industry

#### 2.2.1.1 Commercial Bank Sector

The commercial bank is one of the major players in the financial industry. As an important financial intermediary in the economy, the commercial bank takes in deposits, offers loans and investment products to both personal and institutional customers. Dong (2008) revealed that the major source of profit for commercial banks is the spread between the interest it pays and the interest it charges. In addition, monopolization is one of the most significant characteristics of a commercial bank. The barrier to entry is high and commercial banks are often under strict government control in many countries. Compared to the companies in other industries such as the manufacturing industry, the fixed assets of commercial banks only account for a significantly low percentage of their total assets. In addition, the small capital base (low equity and high debt level in its capital structure) often causes the commercial bank to be highly sensitive to negative earnings. Although the commercial bank uses the loan loss reserves to absorb the expected losses on loans, the unexpected losses must be charged against the equity capital (Zhang et al., 2010). Therefore, the adequacy of equity is important and has been regarded as the last protection for depositors in an extreme situation. Commercial banks are often required by the regulators to maintain reasonable capital ratio.

As the unique role of debt in the commercial bank's capital structure, it is not appropriate to consider the total asset or enterprise value in valuation. Damodaran (2013) argues that the debt should be viewed as the raw material for a commercial bank to generate income. Therefore, the enterprise value based valuation models, such as the enterprise value to earnings before interest, tax, depreciation and amortization model, and the enterprise value to book value model have been ranked as the most unsuitable valuation models for commercial banks by Imam et al. (2008) and Demirakos et al. (2004).

The book value based valuation models focus directly on the important equity capital of commercial banks. Fink (2012) regards the book value of equity as a reliable value indictor, and recommends the price to book value model as the primary valuation model. For the companies in the non-financial industry, the book value often reflects the original invested cost. However, the book values of most of the commercial banks' assets may approximate their current market values (except certain fixed assets such as properties). Wild et al. (2001) disclosed that, as a measure of net asset value per share, the book value per share is appropriate for valuing a commercial bank, which is composed chiefly of marketable financial assets. Damodaran (2013) revealed that the accounting rules of commercial banks have historically been very different from the accounting rules for companies in other industries. Commercial banks have the "mark-to-market" accounting standard and the book value is often a surprisingly reliable value indicator of intrinsic value (Fink, 2012). In addition, the stable book value is more meaningful when the revenue is abnormally high or low, especially for the commercial bank without adequate business diversification and sensitive to changes in macroeconomic conditions.

Imam et al. (2008) ranked the price to earnings model as the second valuation model choice for commercial banks. However, as the performance of commercial banks is often over-sensitive to interest rate changes, other studies argue that the price to earnings is not a suitable valuation model for commercial banks. For example, Dong (2008) found significant earnings fluctuation in commercial banks. The author argued that volatile earnings is not a reliable indicator for the performance of a commercial bank, and this may reduce the effectiveness of the price to earnings model. In addition, the loan loss reserve is an important protection measure for commercial banks against expected loan losses. The loss reserve has been recognized as an expense in the commercial bank's income statement, and thus the amount of the reserve is negatively related to the earnings of the commercial bank. Different commercial banks have different attitudes toward credit risk. The more conservative the commercial bank, the higher the level of reserves, and the lower the earnings (Zhang et al., 2010). Therefore, the earnings is sensitive to the level of loan loss reserve, which cannot truly reflect the performance of the commercial bank. The price to earnings cannot be used as the primary valuation model for the commercial bank.

#### 2.2.1.2 Insurance Sector

Insurance has been widely defined in many studies as the equitable transfer of the risk of loss, from one entity to another in exchange for payment. As a special type of institution in the financial industry, insurance companies provide economic protection against identified risks occurring or discovered within a specified period. In general, insurance companies offer either life or nonlife insurance and their income is generated by the insurance policy underwriting and investment. Nissim (2013) revealed the major source of profit for insurance companies as the spread between the return on invested assets and the claims paid to the policy holders.

Nissim (2013) revealed that the valuation model such as discounted cash flow and price to free cash flow focus on the operating activities of insurance companies (insurance policy underwriting). Thus, they omit a part of value creation (investment activities). In addition, the free cash flows from insurance operations are often subject to great uncertainty and are difficult to predict. Therefore, the free cash flow based models cannot be the primary valuation models for insurance companies. The discounted cash flow model has been ranked as the 4$^{th}$ valuation model choice for insurance companies by Imam et al. (2008) and Demirakos et al. (2004).

The dividend based models such as discounted dividend and dividend yield have significant advantages in the valuation of insurance companies. Dividend is often easier to estimate than free cash flow, especially for the insurance company with a long term dividend policy that bears an understandable and consistent relationship to the company's profitability (Pinto et al., 2010). In addition to the cash dividend, the share buybacks are also a common way for the mature insurance company to return profit to its shareholders. Damodaran (2013) argued that the share buyback should be treated as dividend, the author recommended adding the share buyback each year to the cash dividends paid, and then computing the composite dividend.

In the valuation of mature insurance companies, Dong (2008) found that financial analysts often focus directly on the equity value. Similarly to a commercial bank, the book values are solid measures of most items on the insurance company's balance sheet. In addition, insurance companies are often required by the regulators to maintain minimum equity capital, which is at the level commensurate with the scope and riskiness of their activities (Nissim, 2013). These regulations affect the intrinsic value of insurance companies, and make the book value of equity a useful measure of the scale of operations. Nissim (2013) examined the accuracy of a series of relative models in the valuation of the U.S insurance companies. The author concluded that the book value based models perform significantly better than earnings based models. In contrast with the price to book value model, the price to tangible book value model is a better measure of the intrinsic value for the insurance company. The price to tangible book value model strips out goodwill and other intangible assets, and gives the investors a more accurate gauge of the net assets left over when the company goes bankrupt (Zhang et al. 2010).

Unlike other companies in the financial industry, the earnings of insurance companies tend to be stable and less subject to the business cycle effect. Therefore, the earnings based model is also a popular valuation model choice, especially the forecasted earnings based model. Imam et al. (2008) and Demirakos et al. (2004) ranked the price to earnings as the second valuation model choice for insurance company.

The traditional valuation models often underestimate the intrinsic value of the insurance company with excellent growth prospects. In the recent valuation practice of emerging insurance companies, an actuarial science based appraisal value model gains in popularity. The appraisal value model measures the intrinsic value as the sum of embedded value and the present value of future new business, where the embedded value equals the adjusted net worth plus the value of in-force business (Dong, 2008). Although the appraisal value model is complicated and has not been widely used in practice, it is ideal for the strongly growing insurance company. The appraisal value model is able to simultaneously consider the values from the net assets, existing business and possible new business in the future.

#### 2.2.1.3 Securities Sector

Securities companies, also known as investment banks or brokerage houses not only offer securities brokerage, investment banking and asset management services, but also actively participate in proprietary stock trading. Unlike commercial banks and insurance companies, Liu and Zheng (2011) concluded that securities companies have large positive beta, where their performance is closely correlated to the movement of the stock market. Securities companies often conduct valuation assignments on the target companies in events such as equity analysis, initial public offering, merger and acquisition. Most literature concentrate on how securities companies value other companies, not on how to value themselves. This section provides a better understanding of the specific valuation models for securities companies.

First, for those securities companies lack adequate business diversification and concentrate on risky businesses such as proprietary stock trading to generate revenues, their risks are significantly higher. Their earnings are extremely sensitive to investment decisions and the stock market condition. Their volatile and uncertain earnings are not good value indicators, thus the earnings based valuation model is not suitable for such securities companies. Similarly to commercial banks and insurance companies, securities companies are required by the regulators to maintain minimum loss reserves in proprietary trading. This is particularly true for the securities companies that lack diversification and earnings protection measures, which often have higher levels of loss reserves (Liu and Zheng, 2011). Thus, different securities companies are subject to different business structures and specific regulatory requirements, and the loss reserves are not the same for every company. This causes the earnings to be not comparable to others and makes the earnings based valuation model unsuitable, since the loss reserve is recognized as an expense in the income statement. In the valuation of securities companies which rely heavily on proprietary stock trading, the price to book value model is preferred to the price to earnings model. Because of the uncertainty of the stock market movement, the future performances of securities companies are difficult to forecast. Thus, the future performance based valuation models such as discounted cash flow and discounted dividend models are also not suitable.

Second, for those securities companies that focus on low risk brokerage, investment banking and asset management services, and their profits tend to be stable and less subject to the movement of the stock market. Therefore, their earning power is the major driver of intrinsic value. Zhang et al. (2010) revealed that the price to earnings is the primary valuation model for the mature securities companies that operate in stable businesses.

Third, the recent consolidation and diversification trend has caused many securities companies to gradually abandon the single business structure, and operate in multiple businesses (Liu and Zheng, 2011). In order to enhance earning quality and gain higher valuation premiums, Liu and Zheng (2011) discovered that many securities companies have begun to focus on defensive investment banking and securities asset management business. For securities companies that operate in a variety of businesses, the sum of parts is an ideal valuation method. The sum of parts model estimates the intrinsic values of different business units separately, and then adds them together to arrive at the overall intrinsic value of a company. For example, the price to book value model is ideal for the valuation of proprietary stock trading business, and the price to earnings model can be used to estimate the intrinsic value of the security underwriting business.

In the valuation of securities companies with strong growth prospects, the value estimates generated by the traditional valuation models such as price to earnings model tend to be volatile. In addition, the historical earnings cannot adequately reflect the potential risk and investment gain that a company may have in the future. Therefore, the true intrinsic value of a growing securities company may be severely underestimated by the traditional valuation models. Imam et al. (2008) emphasized the importance of the earnings growth rate in the valuation of a growing company. The authors recommended the price/earnings to growth as an alternative valuation model for growing securities companies. This model is able to simultaneously take into account the current earnings and future earnings growth rate in the next 3 to 5 years.

### 2.2.2 Information Technology Industry

#### 2.2.2.1 Software and Computer Services Sector

The software and computer services sector is a class of companies related to research, development and distribution of information technology-based products and services. The software and computer services sector contains a large number of non-listed companies with short operating history and limited accounting data. Thornton and Cairns (2011) revealed that the software and computer services companies are intangibles-rich, where many companies derive most of their value from intangible assets such as technology. The revenue of a software and computer services company is generated not only by directly exploiting the technology and gaining a competitive advantage through increased sales or premium prices, but also by licensing or selling the technology to a third party (Thornton and Cairns, 2011). Therefore, the core technology of a software and computer services company plays an important role in its business model, the "technology value" generated from the core technology often accounts for a large percentage of the company's total intrinsic value.

The software and computer services companies often specialize in the development of one particular group of related products and services, and their core technologies are usually unique and cannot be compared to other technologies. Therefore, the relative valuation models which compare the company with its peer do not have significant advantage over the absolute valuation models (Thornton and Cairns, 2011). Pinto et al. (2010) also discovered that in the valuation of a fast growing industry with great uncertainty, financial analysts devote little space to the accounting and financial analysis. The authors further argue that the accrual based relative valuation models are only appropriate for stable industries, where conventional accounting is able to better capture the intrinsic value of the company. Demirakos (2004) argued that the accounting measures of performance are less relevant for the intangibles-rich companies, or for those companies with large portfolios of growth opportunities. Lev (2001) discovered that accounting is relatively strong in valuing tangible assets and relatively weak in valuing intangible assets.

In fact, the valuation model should be more forward-looking, and be able to consider both high earnings growth and great uncertainty in the future. Cash flow is often more stable than earnings, and it is often less subject to the management manipulation. For the software and computer services company, the future cash flow based absolute valuation model has been regarded as one of the most appropriate choices (Demirakos et al., 2010 and Imam et al. 2008).

In general, the characteristics of a software and computer services company are not the same in each life stage. Accordingly, the valuation model choice also varies greatly across the different life stages. Section 2.2.2.1.1 to Section 2.2.2.1.3 discuss the characteristics of the software and computer services companies in each life stage, and their corresponding valuation models.

#### 2.2.2.1.1 Start-up Stage

In the software and computer services sector, the start-up companies account for a large percentage of the total companies. For those start-up companies, Thornton and Cairns (2011) found that most of them were in the technology R&D stage with little revenue or even ongoing loss. Their future earnings and growth rates are difficult to estimate due to the absence of adequate accounting records. In addition, Damodaran (2009) argued that the mis-categorization of the R&D investment as an operating expense results in underestimated earnings. Therefore, the historical earnings based-valuation model such as the trailing market capitalization to earnings (trailing P/E), and the future earnings-based model such as the forward market capitalization to earnings (forward P/E) can both be meaningless.

Since most start-up companies do not have profit, dividend payout is often impossible for them. The dividend-based valuation models such as discounted dividend and dividend yield models are both not suitable for such companies.

In general, the software and computer services companies have great uncertainty in their early stages of development. Zhang et al. (2010) recommended the modified discounted cash flow model (MDCF), which weighs up a number of uncertain elements to arrive at the end valuation. Thornton and Cairns (2011) revealed that information technology is a complex series of possibilities, the outcomes of each possibility need to be assessed, in order to ascertain the value of the technology. Unlike the traditional discounted cash flow model where a single (most-likely) scenario is used, the MDCF model is a type of risk-adjusted net present value model. It takes into account several possible scenarios for the start-up company, and then assesses the probability of each scenario separately (Zhang et al., 2010).

##### 2.2.2.1.2 Growth Stage

As the R&D process continues and the company moves into the growth stage, the certainty of success and of receiving the anticipated cash flows increases substantially, resulting in an increase in the company's intrinsic value (Robin and Malak, 2009). At this stage, the earnings of many companies become positive and less volatile. Therefore, the earnings gradually becomes a chief and reliable value indicator.

In the valuation of the growing software and computer services companies, Zhang et al. (2010) highlighted the importance of both current earnings and future earnings growth rate. The authors recommended the price/earnings to growth model as a superior alternative model over the price to earnings model. The traditional price to earnings model is unable to consider a company's growth prospects in the future, and the price/earnings to growth model provides an effective solution to overcome this deficiency.

The growing software and computer services companies often require a continuing capital injection to advance their R&D progress. They adopt a variety of ways to finance their growth, and this causes their capital structures to vary significantly. Pinto et al. (2010) recommended the enterprise value to EBITDA model. It is more suitable than the price to earnings model for comparing the companies with different financial leverages, since the EBITDA is the pre-interest earnings. In addition, the enterprise value takes into account the total value of equity and debt, and disregards the capital structure differences.

2.2.2.1.3 Mature Stage

After the companies complete the R&D process of their core technology and products, the technology uncertainty and the overall business risk are reduced sharply. Therefore, there is no point in considering many possible scenarios in the mature stage, especially for the mature software and computer services companies with little uncertainty. Hence, the single scenario based traditional valuation models such as discounted cash flow model gains in popularity. For the mature software and computer services companies with stable and sustainable cash flow, Demirakos et al. (2004) and Imam et al. (2008) ranked the discounted cash flow model as their number one valuation model choice.

For the mature software and computer services companies, most of their technology investments can generate only a return on invested capital that exceeds their cost of capital (Pinto et al., 2010).

Their earnings tend to be stable and easy to predict. Thus, the earnings based model such as price to earnings is a popular valuation model for the mature companies without profitable reinvestment projects.

For those mature companies with enormous amounts of retained earnings, but few reinvestment opportunities tend to distribute their earnings through cash dividend and share buyback. Pinto et al. (2010) recommended the dividend based models such as discounted dividend and dividend yield models for mature companies. They are appropriate for the dividend-paying companies, which have dividend payout policies compatible with their profitability. Damodaran (2009) showed that the dividend based models are appropriate for the mature software and computer services companies with sustainable dividend policies.

#### 2.2.2.2 Technology Hardware Sector

The technology hardware sector is a "traditional" but important part of the information technology industry, the software and computer services companies rely heavily on the technology hardware. In general, the technology hardware sector includes the companies which develop, manufacture and distribute a variety of electrical hardware. In addition, the technology hardware companies are spread widely along the industry chain, the products vary greatly for the companies located at upstream and downstream. The upstream technology hardware companies often specialize in business to business products such as electrical parts, integrated circuits, computer chips and accessories. The downstream companies manufacture a range of final electrical products directly for the consumers.

The product difference causes the characteristics of these companies to vary greatly. The technology hardware companies can be classified into two categories. The first category contains the capital-intensive companies, which include those without considerable R&D capability, such as electrical parts and accessories manufacturers. In the second category are the capital and technology-intensive companies which focus on capital and technology innovation to create high earnings growth, such as integrated circuits and computer chip manufacturers. Section 2.2.2.2.1 and Section 2.2.2.2.2 discuss the characteristics of the two categories of technology hardware companies, and their corresponding valuation models.

#### 2.2.2.2.1 Capital-Intensive Companies

The capital-intensive technology hardware companies such as manufacturers of electrical parts and accessories often face high threat of new entrants. Their low barrier to entry significantly increases the competition and reduces their overall profitability. Although these companies require relatively large initial investment in the manufacturing facilities, there is little need for higher levels of proprietary technology and patents. Therefore, this results in low entry barrier for such companies. In addition, in order to be compatible with the downstream electrical products, the electrical parts and accessories are often under strict industry standards and regulations. The industry standards cause little difference in products, while the threat of substitutes is high since there are many similar products in the market. Dong (2008) found that the low switching cost of electrical parts and accessories significantly increases the customers' bargaining power, and further decreases the profitability of capital-intensive companies.

In terms of suitable valuation models for capital-intensive technology hardware companies, Zhang et al. (2010) recommended the price to book value as an appropriate valuation model (after adjusting book value to fair value). This is particular true for the manufacturing companies with the following features, such as large amounts of fixed assets, relatively stable book value, low return on assets, and intensive competition with peers. Pinto et al. (2010) emphasized that the book value is appropriate for mature companies with slow growth rate and less uncertainty in the future. Frykman and Toleryd (2003) revealed that the price to book value model is best used for those companies in capital-intensive industries, where tangible assets are the source of value generation. Since the book value records the historical invested cost of the fixed asset, the book value often deviates from the current market price. The fair value of fixed assets has been frequently used in the price to book value model to replace book value, especially in the M&A valuation under the accounting rule of purchase method.

The revenues of the technology hardware manufacturing companies are often subject to less uncertainty, distortion and are easy to predict. The sales based models such as price to sales and enterprise value to sales are also suitable valuation models. The enterprise value to sales model is capable of distinguishing between undervalued companies and debt-burdened companies, since the enterprise value disregards the capital structure difference (Pinto et al., 2010).

The enterprise value to EBITDA model is frequently used in the valuation of manufacturing companies with little goodwill, negative net income but positive gross profit. Most manufacturing companies have substantial depreciation and amortization expenses, these expenses cause enormous pressure on their net incomes. Pinto et al. (2010) suggest the use of EBITDA to control for the differences in depreciation and amortization among companies.

##### 2.2.2.2.2 Capital and Technology-Intensive Companies

The capital and technology-intensive technology hardware companies exhibit significantly different features, where most of their products are highly complex and based on a large amount of intelligence and funds. In general, the capital and technology-intensive companies such as integrated circuits and computer chip manufacturers are high technology companies with exceptionally high barriers to entry to preserve their profitability. Such companies often have considerable fixed assets and R&D costs in the early stages. But they have low production-related variable expenses in the production stage as a result of economies of scale. In addition, the integrated circuits and computer chip manufacturers often have high possibility of failure, where their R&D is often subject to countless technology risks.

In valuation practice, the cash flow based valuation models such as discounted cash flow and price to cash flow are the major valuation models for the fast growing companies with volatile earnings and large risk. The cash flow is often more stable than earnings and less subject to management manipulation. The cash flow is a reliable value indictor for the capital and technology-intensive companies.

For the capital and technology-intensive companies such as integrated circuits and computer chip manufacturers, their products often have considerably high switching costs. Therefore, most downstream hardware companies tend to stay with their existing upstream suppliers of integrated circuits and computer chips. The downstream companies are less willing to pay the high switching costs, unless there is a large technology improvement (Wang et al., 2007). The high switching cost enhances the stability of demand, the sales of the integrated circuits and computer chip manufacturers tend to be less volatile. Thus, the sales based valuation models of price to sales and enterprise value to sales are appropriate for the companies with stable revenues.

In addition to the huge amount of tangible assets such as PPE, the capital and technology-intensive hardware companies also have large amounts of intangible assets such as goodwill and intelligence properties. Zhang et al. (2010) argued that the price to book value model is not a good valuation model for companies with a large proportion of intangible assets, since the book value often is unable to fully disclose the true value of intangible assets. The price to book value model also cannot take into account the large amount of value generated from the future stages of fast growing companies.

When the capital and technology-intensive companies complete their R&D process and move into the production stage, their profits increase sharply until the mature stage when the earnings tend to be relatively more stable. Dong (2008) recommends the earnings based model of price to earnings as the major valuation model choice for those companies with mature stable earnings. Since there are no longer many profitable reinvestment opportunities in the mature stage and the companies start to distribute their earnings, the suitability of the dividend yield and discounted dividend model becomes more apparent.

### 2.2.3 Health Care Industry

#### 2.2.3.1 Pharmaceutical Sector

The pharmaceutical sector is the biggest player in the health care industry in terms of market capitalization and revenue. It consists of a large number of capital intensive companies with huge amounts of tangible and intangible assets. In the developed economies, Trottier (2010) discovered that the pharmaceutical sector is often highly monopolized by a small number of R&D oriented large pharmaceutical companies. However, the 2011 Good Manufacturing Practice (GMP) significantly increased the initial capital investment and operating expenses of pharmaceutical companies. The degree of industry concentration is expected to increase as a result of the GMP (Wang et al., 2007). In addition, the products among the pharmaceutical companies often vary greatly. The pharmaceutical companies can be classified into two categories based on their major products: chemical raw medicines and chemical pharmaceuticals.

Section 2.2.3.1.1 and Section 2.2.3.1.2 discuss the two categories of pharmaceutical companies and their appropriate valuation models.

#### 2.2.3.1.1 Chemical Raw Medicine Manufacturers

As the major raw material used in the production of chemical pharmaceuticals, the chemical raw medicines are located at the upstream of the industry chain. Trottier (2010) suggested that chemical raw medicine manufacturers are capital and labor intensive companies with more tangible assets than intangible assets. In addition, Zhang et al. (2010) revealed that the chemical raw medicine manufacturers often require relatively large initial investment in the chemical manufacturing facilities, but there is little need for a higher level of proprietary technology. Therefore, the chemical raw medicines manufacturers often suffer high threat of new entrants, which significantly increases the competition and reduces their overall profitability. Further, the chemical raw medicine is highly regulated by industry standards and the difference in products is not huge. The threat of substitutes is high, since there are many similar chemical raw medicines available for the downstream chemical pharmaceutical companies. The low switching cost significantly increases the customer's bargaining power, and further decreases the profitability of chemical raw medicine manufacturers.

In the valuation of chemical raw medicine manufacturers, Zhang et al. (2010) recommended the price to book value model as an appropriate valuation model. The price to book value model is particular useful for the chemical raw medicine manufacturers with the following features: large amounts of fixed assets, relatively stable book value, low return on assets and poor growth prospects in the future.

In addition, the revenues of chemical raw medicine manufacturers are often subject to less uncertainty, distortion and are easy to predict. Pinto et al. (2010) highlighted that the sales based models such as price to sales and enterprise value to sales are appropriate valuation models for the chemical raw medicine manufacturers.

The chemical raw medicine manufacturers generally have substantial amounts of depreciation and amortization expenses. Pinto et al. (2010) argued that the EBITDA controls for the differences in depreciation and amortization among the different companies by adding depreciation and amortization back into earnings. The enterprise value to EBITDA model is frequently used in the valuation of chemical raw medicine manufacturers, which have a large amount of depreciation and amortization, negative net income but positive gross profit.

2.2.3.1.2 Chemical Pharmaceutical Companies

The chemical pharmaceutical companies specialize in the development, manufacturing and marketing of prescription and over-the counter chemical pharmaceuticals. In recent years, there has been an increase in competitions from the bio-pharmaceuticals and natural medicines. However, the chemical pharmaceuticals are still the dominant medicines in clinical treatment, and account for a large percentage of the total market share. Trottier (2010) concluded that the chemical pharmaceutical companies are capital-intensive companies, which focus on the R&D of chemical drugs and have relatively high levels of pharmaceutical technology. The author further revealed three major value-driving investments of the chemical pharmaceutical companies: investments in R&D, PPE and advertising. Specifically, the chemical pharmaceutical companies have considerable fixed costs for drug production facilities during the start-up stage, high R&D expenses in the early drug development phases, and huge costs in the clinical trial phases. In the marketing phases, the chemical pharmaceutical companies often encounter high sales expenses such as advertising and salesperson commissions, but low drug production-related variable expenses as a result of economies of scale (Trottier, 2010). In fact, the investments in R&D, PPE and advertising are important for the value creation of pharmaceutical companies. Hirschey (1982) and Chauvin and Hirschey (1993) regressed between the market values of pharmaceutical companies, R&D and advertising investments, and found significant positive coefficients on both types of investments. Sougiannis (1994) found that a one dollar increase in R&D investment often produced a five-dollar increase in market value.

After a long period of development, traditional chemical pharmaceutical technology becomes mature. There is little technical uncertainty and less demand for further technology development. For the mature chemical pharmaceutical companies that lack innovative new products or technology, their sales and earnings are often stable and easier to predict. In the valuation of such companies, Demirakos et al. (2004) ranked the price to earnings and price to sales as the first and second valuation model preferences. These models are particularly useful when the companies rely on low margin generic drugs to generate revenues. Pinto et al. (2010) found that sales are generally less subject to distortion or manipulation than other accounting data such as earnings. The price to sales model is more meaningful than the price to earnings model when the earnings are abnormally high or low.

The chemical pharmaceutical companies often have large amounts of drug production facilities, and substantial depreciation and amortization expenses. Pinto et al. (2010) recommended the enterprise value to EBITDA model as a good valuation model to control for the differences in depreciation and amortization among companies.

#### 2.2.3.2 Biotechnology Sector

According to the 2008 UN Convention on Biological Diversity, biotechnology is any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use. In today's world, the fast growing biotechnology sector is attracting great amounts of investors' attention and the emerging biotechnology has been widely adopted into many fields. Modern biotechnology consists of three branches: medical biotechnology, industrial/environmental biotechnology and plant biotechnology. Ranade (2008) reported that the medical biotechnology has been by far the most influential, beneficial, and controversial field in biotechnology and has generated many superlative discoveries to improve the lifespan and quality of human life.

In general, the medical biotechnology companies are intangibles-rich, where many companies derive most of their value from intangible assets such as technology, patents and licenses. The medical biotechnology companies typically rely on patents to protect their discoveries and revenues. In addition, the research intensive medical biotechnology companies have fewer tangible assets, but rich intangible assets such as patents and licenses. The intangibles-rich companies often have more R&D expenditures. Zhang et al. (2010) found that on average, the biotechnology R&D expenses accounted for as high as 60% of the overall cost of the bio-pharmaceuticals. Trottier (2010) highlighted the importance of R&D investment in the value creation of medical biotechnology companies. The intangible assets developed by the internal R&D are often used by the medical biotechnology companies to secure cash flows.

The book value based valuation models often have worse performances in the valuation of biotechnology companies. First, the current accounting standards have limitations such as non-recognition of self-generated intangibles assets, where all R&D investments have to be expensed in the period where they occur. Damodaran (2009) criticized the current accounting standards for mistreating the R&D investment and causing the book value of the biotechnology company to be understated. In fact, the investment in R&D should be capitalized and recorded as an asset rather than an expense. Bublitz and Ettredge (1989) examined whether R&D is valued as a long-term asset via regression analysis. The authors discovered a positive coefficient on R&D, and suggested that R&D investment has future benefits, hence meeting the definition of an asset. Second, the biotechnology companies are intangibles-rich, but the value of intangible assets is often difficult to fully measure by the book value, and this reduces the effectiveness of book value as a reliable value indicator. Third, the book value focuses on the current balance sheet, it does not account for the future growth prospect of the R&D oriented medical biotechnology companies. Therefore, the book value based valuation models such as price to book value and enterprise value to book value models are not appropriate for the biotechnology companies.

In the valuation of fast growing medical biotechnology companies which specialize in the R&D of profitable brand name bio-pharmaceuticals, Demirakos (2004) found that the financial analysts devoted little space to accounting and financial analysis. The reason is that the accounting measures of performance are less relevant for the intangibles-rich companies or for the companies with large portfolios of growth opportunities. Zhang et al. (2010) recommended the price/earnings to growth model for the biotechnology companies, which is a superior valuation model that takes into account the growth prospects.

The future cash flows such as the revenues of medical biotechnology companies are often difficult to forecast, especially the inability to predict the shifts in the factors influencing a new drug’s ability to gain market share (Bird, 2009). Banerjee (2003) argued that the traditional discounted cash flow method fails to capture the future value of biotechnology R&D, since most of their values are embedded in the unexercised real options with uncertain future values. Bird (2009) recommended the risk-adjusted net present value, real option, Monte Carlo Simulation and decision-tree valuation approaches. The four approaches can effectively address the impact of economic uncertainty in the drug development, regulatory approval and marketing. Specifically, the risk-adjusted net present value model, also known as the modified discounted cash flow model is one of the most commonly used valuation models for the medical biotechnology companies with great uncertainties. The risk-adjusted net present value model considers the probabilities of several possible scenarios for the unpredictable economic developments. It adjusts each cash flow by the corresponding success rates. In addition, Banerjee (2003) and Boer (2000) also recommend the concept of real options be applied to capture the value of biotechnology R&D.

Ranade (2008) emphasized that one of the principal determinants of a medical biotechnology company's success is the ability to maintain a reasonable capital ratio and raise funds at a reasonable cost. In general, the medical biotechnology companies have relatively low debt ratios and prefer equity financing sources, such as funds from venture capital, private equity, joint ventures and IPO (Ranade, 2008). As the importance of capital to support the costly ongoing R&D process, the medical biotechnology companies tend to retain their earnings rather than distribute them. Therefore, the dividend based models such as dividend yield and discounted dividend are both inappropriate valuation models for the biotechnology companies.

## 2.3 Chapter Summary

This chapter reviewed the relevant literatures on the industry characteristics and the industry-based valuation models. Specifically, the chapter divided the companies in each of the sample industries into several sectors based on their characteristics, and then discussed their corresponding valuation models according to previous studies. Table 2.1 summarizes the key findings of relevant literatures, which focus on the suitability of valuation models at the firm or industry level.

### Table 2.1 Literature Summary – Suitability of Valuation Models

| Author | Valuation Model Examined | Firm/Industry Level | Industry Examined | Key Findings |
|---|---|---|---|---|
| *North Amercia* | | | | |
| Asquith et al. (2004) | Price to Earnings Model - Trailing<br>Price to EBITDA Model<br>Price to Sales Model<br>Discounted Cash Flow Model<br>Enterprise Value Added Model<br>Price to Book Value Model | Firm Level | - | The sales based valuation model outperforms the earnings, cash flow and book value based valuation models. |
| Bernard (1995) | Dividend Yield Model - Forward<br>Price to Earnings Model - Forward | Firm Level | - | The forecasted earnings is more important than the forecasted dividend, the forward price to earnings model is better than the forward dividend yield model. |
| Cheng and McNamara (2000) | Price to Earnings Model<br>Price to Book Value Model | Firm Level | - | Earnings is the major driver of intrinsic value, the price to book value model can not be used as a primary valuation model. |
| Francis et al. (2000) | Discounted Dividend Model<br>Discounted Cash Flow Model<br>Discounted Abnormal Earnings Model | Firm Level | - | The value estimates generated by the discounted abnormal earnings model have higher level of accuracy and explanatory power. |
| Gleason et al. (2008) | Residual Income Model<br>Price/Earnings to Growth Model | Firm Level | - | The residual income model significantly outperforms other valuation models when the business being valued do not have dividend or positive cash flow. |
| Kim and Ritter (2000) | Price to Earnings Model<br>Price to Book Value Model<br>Price to Sales Model | Firm Level | - | Price to book model outperforms price to sales and price to earnings models. |
| Lie and Lie (2002) | Price to Earnings Model - Trailing Model<br>Price to Earnings Model - Forward<br>Enterprise Value to Sales Model<br>Enterprise Value to Book Value Model<br>Enterprise Value to EBITDA Model<br>Enterprise Value to EBIT Model | Firm Level | - | Enterprise value models dominate market price models in terms of valuation performance. |
| Liu et al. (2002) | Price to Book Value Model<br>Price to Cash Flow from Operations Model<br>Price to Earnings Model - Trailing<br>Price to EBITDA Model<br>Price to Sales Model<br>Price to Earnings Model - Forward<br>Enterprise Value to EBITDA Model<br>Enterprise Value to Sales Model | Industry Level | Basic Industries<br>Capital Goods<br>Consumer<br>Energy<br>Finance<br>Health Care<br>Public Utilities<br>Technology<br>Transportation | In all selected industries, the forecasted earnings based models are better than the current earnings based models. The enterprise value models do not have apparent advantage over the market price models in many industries. |

**Table 2.1 (continued)**

| Author | Valuation Model Examined | Firm/Industry Level | Industry Examined | Key Findings |
|---|---|---|---|---|
| *Western Europe* | | | | |
| Demirakos et al. (2009) | Price to Earnings Model<br>Discounted Cash Flow Model | Firm Level | - | The price to earnings model outperforms the discounted cash flow model in many cases. |
| Demirakos et al. (2004) | Earnings-based Models<br>Sales-based Models<br>Price to Book Value Model<br>Price to Asset Value Model<br>Price to Cash Flow Model<br>Dividend Yield Model<br>Enterprise Value to R&D Model<br>Economic Value Added Model<br>Real Options Model<br>Discounted Cash Flow Model<br>Residual Income Model | Industry Level | Beverage<br>Electronic<br>Pharmaceutical | The earnings and sales play more important role than other accounting items in the intrinsic value estimation of beverage, electronic and pharmaceutical firms. |
| Imam et al. (2013) | Price to Earnings Model<br>Price to Sales Model<br>Price/Earnings to Growth Model<br>Price to Book Value Model<br>Enterprise Value-based Models<br>ROEg/COEg Model<br>Return on Embedded Value Model<br>Warranted Equity Model<br>Discounted Cash Flow Model<br>Discounted Dividend Model | Industry Level | Automobiles & Parts<br>Financial Services<br>Health Care<br>Industrial Goods & Services<br>Oil & Gas<br>Personal & Household Goods<br>Retail<br>Media & Technology<br>Telecommunications<br>Utilities | Cash flow based models are more suitable for fast growing industries with unstable revenues. Book value based models are ideal for traditional industries with massive fixed assets. Eanrings based models can be applied into many industries. |
| Imam et al. (2008) | Price to Earnings Model<br>Discounted Cash Flow Model<br>Enterprise Value to EBITDA Model<br>Price to Cash Flow Model<br>Enterprise Value to Sales Model<br>Price to Book Value Model<br>Dividend Yield Model<br>Economic Value Added Model<br>Price/Earnings to Growth Model<br>Price to Sales Model<br>Discounted Dividend Model<br>Enterprise Value to Book Value Model | Industry Level | Financial<br>Industrial<br>Media<br>Retail<br>Technology | The price to earnings model is top one valuation model in terms of equity analyst useage and preference. The price to book value model often emerges in the equity report of financial firms. The EBITDA based models are ideal for capital intensive industrial firms with huge amount of depreciation. The discount cash flow model has often been used in the equity report of high-technology firms. |

Note: "Firm Level" stands for the study discusses the suitability of the valuation model without considering the industry characteristics; "Industry Level" means that the study simultaneously takes into account the valuation model suitability and industry characteristics.
Source: Author's summary

# Chapter 3

# Data and Methods

## 3.1 Introduction

This chapter discusses the data and research methods used in the current study. In general, the study focuses on the innovation of company valuation concepts and methods, and attempts to improve the reliability of listed companies' value estimates and target prices. The rest of the chapter is organized as follows: Section 3.2 describes the study sample companies and the data sources. Section 3.3 presents the details of research methods such as the discount rate estimation method, valuation model, target price setting method, reliability testing method and out-of-sample test. Section 3.4 concludes the chapter.

## 3.2 Sample and Data

The current study is based on 35 listed companies from the New York Stock Exchange and NASDAQ Stock Market (see Table 3.1). According to the 2010 Industry Classification Benchmark, the current study sample consists of 15 companies from the financial industry, 10 companies from the information technology industry, and 10 companies from the health care industry. Research objective three of the current study is to identify the most suitable individual and combined valuation models for the sample industries, and this requires the sample companies to be capable of fully reflecting the general characteristics of their industries. The current study selects a range of ratios to present and measure the characteristics of the study sample companies and sample industries (see Appendix A). According to Appendix A, the ratios of sample companies are generally in line with their industry average levels, which means the sample companies are good representatives to reflect the characteristics of their industries.

Timeliness is one of the most significant characteristics of individual and combined valuation models. In general, the suitability of an individual or combined valuation model tends to change over time, especially during the different stages of the business cycle. For example, the earnings-based valuation models have significant valuation advantages during the economic expansion stage, but their suitability declines sharply during a recession. According to the National Bureau of Economic Research (NBER), the most recent business cycle starts from June 2009 and is still in its expansion stage. The current study takes into account the timeliness of individual and combined valuation models, and limits the sample period (years 2010-2012) to within the expansion stage of the current business cycle. This means that the current study results are most suitable for the company valuation practice conducted within the economic expansion stage. In terms of data frequency, the quarterly accounting data is the most common type of data in many financial databases. Thus, quarterly data of the sample company is used in the current study. Table 3.2 describes the details of data used in the current study.

The relevant data and information of the sample companies are obtained from different databases. These include the company historical accounting information which is available from Datastream and EDGAR. The historical market prices are from the CRSP database. The quarterly financial analysts' consensus target prices and company performance forecast data are obtained from Zacks Investment Research. In addition, the data required to estimate the weighted average cost of capital (WACC) are obtained from Moody's, TRACE and the SBBI Yearbook.

Thomson Reuters Datastream is a comprehensive database of company, financial and economic data from around the world, which integrates economic research and strategy development with asset analysis and has been widely used by many professionals and academics. The Electronic Data Gathering, Analysis, and Retrieval system (EDGAR) is operated by the U.S. Securities and

Exchange Commission. The EDGAR collects electronic documents, especially SEC filings to help investors with information about listed companies. The Center for Research in Security Prices (CRSP) at the University of Chicago Graduate School of Business is a provider of historical time series data on securities. Many professionals and academics rely on CRSP, since it maintains some of the largest and most comprehensive proprietary historical databases in stock market research. Zacks Investment Research is a well-known institutional research and financial data provider, which provides institutional and individual investors with analytical tools and financial information. As one of the major providers of company data in the US, it is best known for providing an extensive array of consensus forecasts for listed companies, such as target price, earnings and sales forecast. Zacks Investment Research has been widely used by many professionals and academics in their researches into American listed companies. Moody's Investors Service provides ratings on the bonds issued by commercial and government entities, and is one of the Big Three credit rating agencies in the world. Moody's open-access database offers free company credit rating information to the public. The Trade Reporting and Compliance Engine (TRACE) is developed by the National Association of Securities Dealers, a vehicle that facilitates the mandatory reporting of over the counter secondary market transactions in fixed income securities. TRACE offers free information on yield-to-maturity rates on corporate bonds to the public. The Stocks, Bonds, Bills and Inflation Yearbook (SBBI) is published by Morningstar Ibbotson, which provides data on the long-term returns of the principal asset classes in the U.S economy.

## 3.3 Research Method

The general steps of the current study are presented as follows. First, the current study estimates the discount rates for the sample companies. Second, the current study applies the sample

**Table 3.1 Sample Industries, Sectors and Listed Companies**

| Sample Industry | Sample Sector | Sample Listed Company Code | | | | |
|---|---|---|---|---|---|---|
| Financial | Commercial Bank | USB | RF | MTB | CMA | PNC |
| | Insurance | TRV | WRB | ALL | ACE | CB |
| | Securities | GS | ETFC | LAZ | GHL | MS |
| Information Technology | S&C Services | IBM | IT | CSC | GIB | SYNT |
| | Technology Hardware | BMI | CGNX | CW | ESE | ALOG |
| Health Care | Pharmaceutical | MRK | LLY | AZN | ECTE | BMY |
| | Biotechnology | AMGN | BIIB | GILD | UTHR | CELG |

Source: Thomson Reuters Datastream

**Table 3.2 Characteristics of Data**

| Data | Type | Release Date | Forecast Period | Data Frequency | Major Data Source | Details |
|---|---|---|---|---|---|---|
| Past accounting data | Historical | Jan 2010 - Dec 2012 | - | Quarterly | Datastream, EDGAR | Items of income statement, balance sheet and cash flow statement,etc. |
| Market price | Historical | Jan 2010 - Dec 2012 | - | Quarterly | CRSP | Market prices of sample companies |
| Parameters of cost of equity | Historical | Jan 2010 - Dec 2012 | - | Various | Zacks Investment Research, SBBI | T.Note constant maturity rate, raw beta, beta-adjusted size pemium, etc. |
| Parameters of cost of debt | Historical | Jan 2010 - Dec 2012 | - | Various | TRACE, Moody's | Yield to maturity on bond, Moody's rating, etc. |
| Future accounting data | Forecasted | Jan 2010 - Dec 2012 | Next 1 to 5 years | Quarterly | Zacks Investment Research | Financial analysts' consensus forecasts of future revenue, earnings and earnings growth rate, etc. |
| Target price | Forecasted | Jan 2010 - Dec 2012 | Next 12 months | Quarterly | Zacks Investment Research | Financial analysts' consensus target prices of sample companies |

Source: Author's Conclusion

individual valuation models to estimate the intrinsic values of the sample companies. Third, the current study ranks the sample individual valuation models in the sample industries. Fourth, the current study constructs sample combined valuation models, combines individual value estimates, and ranks the sample combined valuation models in the sample industries. Fifth, the current study applies the best industry-based individual and combined valuation models to determine the target prices for the sample companies. Sixth, the current study tests the target prices produced by the best industry-based individual and combined valuation models, and compares them with the financial analysts' target prices. Last, the current study applies the out-of-sample test to verify the robustness of the research results.

### 3.3.1 Discount Rate Estimation

The first step is to estimate the appropriate discount rates (WACC or cost of equity) for the sample companies. In general, the cost of equity is an important component of WACC, and is often more difficult to estimate than the cost of debt. The study focuses on the cost of equity, and estimates it by using the expanded capital asset pricing model (Expanded CAPM). The expanded CAPM is based on the framework of Pratt (2002) and Pinto et al. (2010), which aims to provide a more accurate estimation of the cost of equity. The expanded CAPM follows the top-down approach, which estimates the cost of equity through three levels. The three levels are specific industry, a specific peer group within the industry and a specific company within the peer group. The model is given as follows:

Cost of Equity = Risk-free rate + Industry-adjusted beta *Market premium + BSP + CRP (1)

Where:

- BSP = Beta-adjusted size premium
- CRP = Company-specific risk premium

Pratt (2002) revealed that the traditional CAPM is based on the assumption that the unsystematic risk can be diversified away in a well-diversified portfolio, thus the traditional CAPM only considers the systemic risk of a company. In fact, the unsystematic risk cannot be fully diversified away. Pratt (2002), Banz (1981) and Keim (1983) discovered that the total realized returns on small companies have been substantially greater than the traditional CAPM would have predicted. Thus, the current study introduces the multifactor expanded CAPM model to simultaneously consider the systematic and unsystematic risks. The main features of the expanded CAPM are discussed below.

First, Pinto et al. (2010) revealed that the sum of the risk-free rate and the industry risk premium is the average required return on equity for all the companies in a particular industry. The industry risk premium reflects the unsystematic risk at the industry level, which is calculated as an industry-adjusted beta multiplied by market premium. The detailed estimation method for the industry-adjusted beta is presented at the end of this section.

Second, equation (1) further adds a beta-adjusted size premium to reflect the average required equity return for a specific peer group within the industry. The beta-adjusted size premium is used to capture the unsystematic risk at the peer level. Based on market capitalization, the Morningstar Ibbotson calculates the beta-adjusted size premium by dividing NYSE listed companies into 10 size groups (with 1 as the largest to 10 as the smallest). Each group has its own average beta, the realized return in excess of what traditional CAPM estimates is the beta-adjusted size premium.

Third, the company-specific risk premium is added into equation (1) to derive the cost of equity for a particular company within the peer group. The company-specific risk premium can be positive or negative (more or less risky than the peer average level), which captures the unsystematic risk at the company level. The estimation of company-specific risk premium often depends on subjective judgment, which ranges from -2% to +2% for the listed companies in America (Pinto et al., 2010).

The industry-adjusted beta has been widely used in practice to replace the raw beta, which can be used to measure the systematic and unsystematic risks for a specific industry. In estimating the industry-adjusted beta, the first step is to identify a series of companies within the same industry of the company being valued. The selected companies should be able to fully reflect the major characteristics of the industry. The second step involves estimating each company's raw beta by using the ordinary least squared regression. Since the raw beta reflects the capital structure and leverage of a company, the third step removes the effect of leverage from each company to obtain the unlevered beta (equation 2). Step three is important, especially for the company with a debt level that is significantly different from its peer average or its own historical mean value (Pratt, 2002). The fourth step determines the median value of unlevered beta for the selected companies. The last step re-levers the median unlevered beta with the industry-average capital structure to obtain the industry-adjusted beta.

$$B_u = \frac{B_L}{1+(1-t)D/E} \qquad (2)$$

Where:

- $B_u$ is the unlevered beta
- $B_L$ is the levered or raw beta
- t is the average effective tax rate of the company during the beta measurement period
- D is the average market value of the company's long term debt (includes the current portion of long-term debt) during the beta measurement period
- E is the average market value of the company's equity during the beta measurement period

### 3.3.2 Company Valuation by Sample Individual Valuation Models

Following the estimation of the discount rates, the next step begins with the quarterly valuation of the sample companies by using the sample individual valuation models. The valuation models of listed companies can be classified into two categories. The first category is the time value of money theory based absolute valuation model, and the second is the law of one price based relative valuation model. Pinto et al. (2010) introduced 12 types of the most commonly used absolute and relative valuation models in practice, and the current study chooses them as the sample valuation models. The details of the sample valuation models and their corresponding value indictors are presented in Table 3.3. Specifically, the value indictor is the core element and "engine" of a valuation model, where the valuation model relies on its own value indictor to estimate the intrinsic value of a company.

**Table 3.3 Sample Individual Valuation Models and Corresponding Value Indictors**

| Relative Valuation Models | Abbreviation | Major Value Indictor Contained |
|---|---|---|
| Price to Earnings Model (Trailing/Forward) | TPE/FPE | Last 1 year earnings/Future 1 year estimated earnings |
| Price Earnings to Growth Model (Trailing/Forward) | TPEG/FPEG | Last 1 year earnings and last 5 year average earnings growth rate/Future 1 year estimated earnings and future 5 year average estimated earnings growth rate |
| Price to Free Cash Flow Model | PFCF | Last 1 year free cash flow |
| Price to Book Value Model | PBV | Current book value |
| Price to Sales Model | PS | Current sales |
| Dividend Yield Model (Trailing/Forward) | TDY/FDY | Last 1 year dividend/Future 1 year estimated dividend |
| Enterprise Value to EBITDA Model | EVE | Current EBITDA |
| Enterprise Value to Book Value Model | EVBV | Current book value |
| Enterprise Value to Sales Model | EVS | Current sales |
| **Absolute Valuation Models** | | |
| Discounted Cash Flow Model | DCF | Future 1 year to future infinite year estimated free cash flow |
| Discounted Dividend Model | DD | Future 1 year to future infinite year estimated dividend |
| Residual Income Model | RI | Last 1 year book value and future 1 year to future infinite year estimated residual income |

Source: Pinto et al. (2010)

### 3.3.3 Sample Individual Valuation Model Ranking

Following the application of the sample individual valuation models and a range of value estimates produced, the next step begins with the suitability ranking of the sample individual valuation models in the sample industries. The ranking is based on the suitability test results, where the details of the suitability test method are shown below.

Based on the approaches suggested by Kaplan and Ruback (1995), Francis et al. (2000), Cheng and McNamara (2000) and Liu et al. (2007), the current study constructs an improved suitability test as follows. This suitability test method can be used to measure the degree of suitability of an individual or combined valuation model in a specific industry. This suitability test method first applies the individual or combined valuation model being examined to estimate the intrinsic value of a company at the current valuation date. The test method then compares the current market price with the value estimate produced by the individual or combined valuation model. Then the test can clearly reveal the capability of the individual or combined valuation model to estimate the intrinsic value of a company at the current valuation date.

In general, the suitability test method contains three key points. First, the method emphasizes that the test of the individual or combined valuation model should be based on its value estimate. Second, this method highlights that the reliability of a value estimate depends on two equally important factors, namely, accuracy and explanatory power. Specifically, the accuracy reflects how well the value estimate can disclose the intrinsic value, and the explanatory power indicates how well the value estimate can explain the variation of intrinsic value. Kaplan and Ruback (1995) revealed that it is possible that a value estimate could successfully estimate the intrinsic value on average, yet perform poorly in explaining the variation in intrinsic value and the converse is also possible (see Figure 3.1). Therefore, it is common to see a possible contradiction between accuracy and explanatory power. In general, the accuracy and explanatory power are equally important: a good individual or combined valuation model is expected to have both high degrees of accuracy and explanatory power at the same time. Third, the test is based on the assumption that the market price is efficient, where the current market price is used as a proxy of the intrinsic value per share of the company at the current valuation date.

The first part of the suitability test is to measure the accuracy of the value estimate. The accuracy emphasizes the valuation error, which is the deviation between intrinsic value and value estimate. The accuracy test consists of the following metrics (Francis et al., 2000):

- **Valuation error:** the signed and absolute deviation between the value estimate and the market price of a company at valuation date
- **Adjusted valuation error:** the average value of (1), (2), (3) and (4)
  (1) Valuation error scaled by the market price of a company at valuation date
  (2) Valuation error scaled by the value estimate of a company at valuation date
  (3) Valuation error scaled by the sum of market price and valuation error
  (4) Valuation error scaled by the sum of value estimate and valuation error
- **Statistics distribution of the above metrics:** include mean, median, average percentage difference between value estimate and market price, standard deviation, coefficient of variation and central tendency

Specifically, the absolute valuation error reflects the size of the error, and the sign (negative or positive) of the valuation error indicates underpricing or overpricing of the market price. The valuation error is scaled by the sum of the market price and the valuation error, or by the sum of the value estimate and valuation error, which can be used to regulate the error between 0 and 1. Since an extremely large market price or value estimate may cause its distribution to be right-skewed, the square root is required to solve the skewness issue. In addition, the coefficient of variation is calculated as the standard deviation divided by the mean value. The central tendency is the percentage of the value estimates within ±15% of market prices at valuation dates.

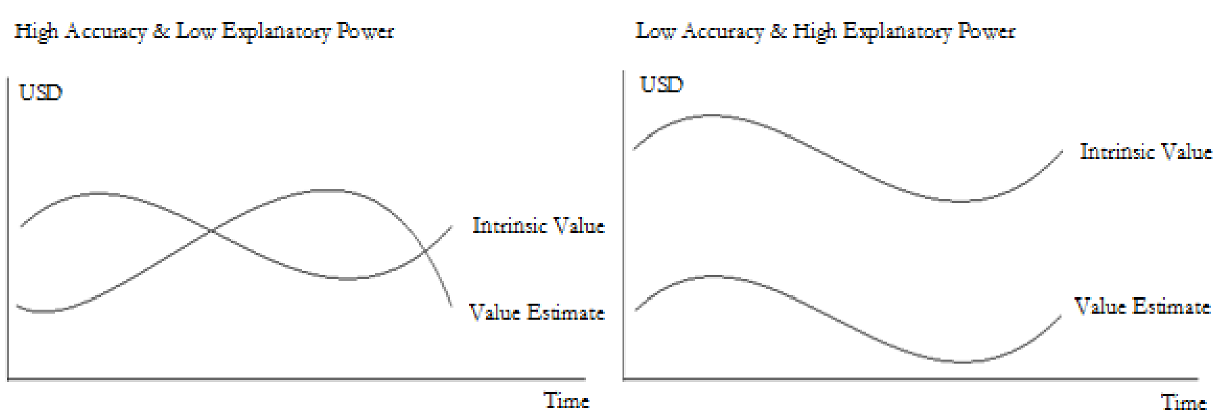
The second part of the suitability test is to measure the explanatory power of value estimate. The explanatory power is aimed at testing whether, and to what extent the movement of the value estimate is similar to the intrinsic value movement. The explanatory power test is based on the univariate regression given in equation (3). The explanatory power of the value estimate can be measured by the adjusted $R^2$ of the regression. If the value estimate is an unbiased predictor of the intrinsic value, the regression intercept and coefficient are not significantly different from 0 and 1, respectively.

$$MP_{t,s} = A_t + B_{t,s} VE_{t,s} + U_t \qquad t = 1, 2, \ldots, T. \qquad (3)$$

Where:

- $MP_{t,s}$ = market price of company s at valuation date t
- $A_t$ = intercept term is expected to become zero if the value estimate s is the unbiased estimator of the intrinsic value s
- $B_{t,s}$ = coefficient should equal to one if the value estimate s is the unbiased estimator of the intrinsic value s
- $VE_{t,s}$ = value estimate s for company s
- $U_t$ = valuation error.

**Figure 3.1 Accuracy and Explanatory Power**




Source: Kaplan and Ruback (1995)

### 3.3.4 Sample Combined Valuation Model Construction, Combination and Ranking

Following the ranking of the sample individual valuation models, the next step begins with the construction of the sample combined valuation models. First, according to the ranking, the current study randomly selects three individual valuation models from the top six individual valuation models in the ranking list of each sample sector. Thus, there are twenty different combined valuation models constructed for each sample sector. Although each combined valuation model only contains three individual valuation models, it is a good starting point for further extension by adding more suitable individual valuation models to satisfy any specific valuation objective. Second, since each combined valuation model produce three individual value estimates, the current study applies the partial least square regression approach (PLSR) to combine three individual value estimates into one combined value estimate. Third, the current study ranks the suitability of the sample combined valuation models in each sample industry by using the suitability test method shown in Section 3.3.3. The ranking is based on the suitability test on the combined value estimates produced by the sample combined valuation models.

Based on the methods suggested by Hoogerheide et al. (2010), Thordarson (2007), Yee (2004) and Yoo (2006), the current study uses the PLSR approach to objectively combine several individual value estimates into one combined value estimate without any subjective pricing error. The PLSR approach is flexible, which allows the users to customize it by adding or removing any individual valuation model to satisfy any specific valuation needs. Similarly to Francis et al. (2000), the PLSR approach is based on the assumption that the market prices are efficient at all the valuation dates, where the market prices are used as the proxies of the intrinsic value per share. The general expression of the PLSR approach is given in equation (4).

$$MP_{t,s} = \hat{V}_{t,s} + U_t = A_t + \sum_{i=1}^{n} W_{t,i} VE_{t,i} + U_t \qquad t = 1, 2, \ldots, T. \quad (4)$$

Where:

- t = valuation date
- $MP_{t,s}$ = market price for company s at valuation date t
- $\hat{V}_{t,s}$ = combined value estimate of company s produced by a combined valuation model
- $A_t$ = constant term at valuation date t
- $W_{t,i}$ = weight of individual valuation model i at valuation date t
- $VE_{t,i}$ = individual value estimate at valuation date t produced by individual valuation model i
- $U_t$ = valuation error which is the remaining part of the intrinsic value that is not captured by the combined valuation model. It is the difference between the intrinsic value and the combined value estimate at valuation date t

The rationale for the PLSR approach is straightforward. Every individual value estimate is an incremental piece of information, so relying on only one individual value estimate may ignore some valuable information. Therefore, the intrinsic value of a company is the aggregate value estimate equal to the weighted average sum of several individual value estimates (Yee, 2004).

The PLSR approach is based on the partial least square regression to eliminate the possible effect of multi-collinearity between the independent variables (VEt,i). Francis et al. (2000) indicated that many valuation models are theoretically equivalent, such as discount cash flow model and the discount dividend model which have a strong correlation with each other. The issue of multi-collinearity is a serious problem, which has to be resolved to ensure the validity of the regression results. This is particularly true when some individual valuation models in the combined valuation model are closely linked in some way. The common approaches to overcome the multi-collinearity effect are ridge, partial least square and principal component regression. The partial least square is preferred in the current study based on its superior capability to deal with the multiple independent variables and more accurate prediction of the dependent variable (Garthwaite, 1994).

The PLSR approach is under the time varying weighting scheme (TVW) proposed by Hoogerheide et al. (2010), Thordarson (2007) and Diebold and Pauly (1987). Since the importance and suitability of a valuation model tend to change over time, the constant weights may no longer apply in the future. For example, Demirakos et al. (2010) revealed that the price to earnings model is regarded as the one of the most important valuation models in boom time, but its suitability declines significantly during recession as the companies continue to make losses. Therefore, the time-varying weights are important, in which the PLSR approach generates different weights at different valuation dates by using certain ranges of time series data of value estimates. Alternatively, the PLSR approach can also estimate the time varying weights through peer groups. This requires the identification of the company's peers, and then uses the cross-sectional data of peers' value estimates at the same valuation date to estimate the weights.

Unlike the previous regression methods with restrictions that no constant term is added, and all weights must be non-negative and sum to one (Hoogerheide et al. 2010), the PLSR approach includes the constant term to avoid biases. Granger and Ramanathan (1984) revealed that the methods with constant terms are often more accurate than those using the restricted least squares weighting scheme. The PLSR approach further removes the restriction that the weights of different individual valuation models have to sum up to unity.

### 3.3.5 Target Price Setting

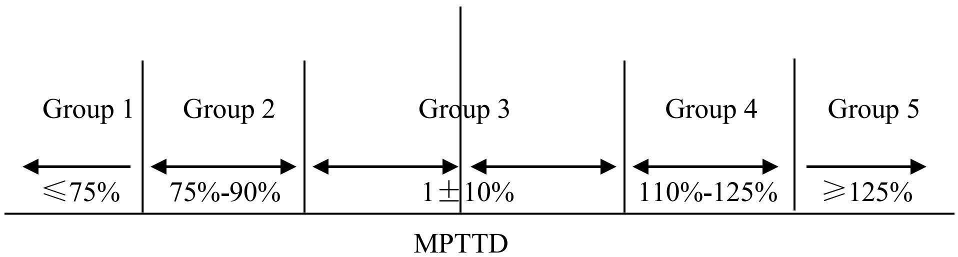
Following the ranking of the sample individual and combined valuation models, the current study selects the best individual and combined valuation models from the ranking list of each sample industry, and uses them to determine the target prices for the sample companies. First, the target price setting process begins with the application of the best industry-based individual and combined valuation models to estimate the intrinsic value of the sample companies. Second, each best industry-based combined valuation model consists of three individual valuation models and produces three individual value estimates. The current study combines the three individual value estimates into one combined value estimate by an improved combining method (the details are shown in Section 3.3.4). Third, the current study sets the target price based on the value estimate. The target price reflects the future intrinsic value, but the value estimate is the estimated intrinsic value at the current valuation date. Therefore, the "current" value estimate needs to be adjusted to better reflect the future intrinsic value. The current study predicts the future intrinsic value of a company based on the value estimate, and then sets the target price around the estimated future intrinsic value.

### 3.3.6 Reliability Test of the Target Price

Following the target price setting process, the next step begins with the reliability test of the target prices produced by the best industry-based individual and combined valuation models. The current study also tests the target prices produced by financial analysts, and judges whether the best industry-based individual and combined valuation models are able to produce more reliable target prices than financial analysts. The detailed test method on target price is presented below.

The reliability test method on target price used in the current study does not consider the effect of target price revisions. In order to avoid the influence of target price announcements on the market prices, the first step of the reliability test is to contrast the target prices (TP) with the market prices three trading days prior to the announcement or valuation dates (MPTTD). The current study then classifies the target prices into the following five groups (see Figure 3.2), thus that their reliability can be separately and accurately measured. The detailed classification methods are shown below:

**Figure 3.2 Target Price Classification Method**




- Group 1: The TPs are set equal to or less than 75% of the MPTTDs
- Group 2: The TPs are set within 75% to 90% of the MPTTDs
- Group 3: The TPs are set equal to or within (1±10%) of the MPTTDs
- Group 4: The TPs are set within 110% to 125% of the MPTTDs
- Group 5: The TPs are set equal to or more than 125% of the MPTTDs

Source: Examiners' comments

The second step tests whether the different groups of target prices have been achieved by using the following method, and labels them as "Realized" or "Unrealized". Based on the metrics recommended by Imam et al. (2013), the current study uses the following metrics to test the target price. For Groups 4 and 5, the target prices are met or realized if the maximum prices of the companies' shares during the next 12-month forecast horizon are greater than or equal to the target prices. For Groups 1 and 2, the target prices are met if the minimum prices during the 12-month forecast horizon are less than or equal to the target price. Similarly, for Group 3, the target prices are achieved if the maximum and minimum market prices during the 12-month forecast horizon are within approximately 1±15% of the target prices.

The third step measures the target prices in different groups labelled as "Realized". The first metric (%REALIZED) is the percentage of realized target prices in each group. Previous studies examined the percentage of targets met in and met at the end of forecast horizons. Based on Kerl (2011) study, the current study introduces a more logical metric (%DISTRIBUTION), which analyzes the distribution of target price achievement within the different time frames (e.g. quarter) in a year. The third metric is (%FREQUENCY). For Groups 4 and 5, it is the frequency or percentage of market prices equal to or above the target prices in the next 12 months. For Groups 1 and 2, the frequency of market prices is equal to or smaller than the target prices in the one year forecast horizon. For Group 3, their degrees of reliability are measured by the standard deviation of market prices within the next 12 months.

The last step examines the "Unrealized" target prices in the five groups. The first metric (%UNREALIZED) is the percentage of total unrealized target prices in each group. The second metric (%FORECAST_ERROR) reflects the level of forecast error for the unrealized target prices. Kerl (2011) and Demirakos et al. (2010) measured the forecast error by calculating the absolute difference between the closing price at the end of 12 months and the target price, then scaled it by the market price at the announcement date. The current study presents a more reasonable measurement as follows. Specifically, for Groups 4 and 5, it is the absolute difference between the maximum price during the next 12-month and the target price, then scaled by the target price or MPTTD. For Groups 1 and 2, it is the absolute difference between the minimum price and the target price, then scaled by the MPTTD. The measurement of forecast error for Group 3 is different. It is the absolute difference between the maximum (minimum) price and 1+15% (1-15%) of the target price, scaled it by the target price or MPTTD. The percentage of market prices within the range of 1±15% of the target prices can be another metric of error.

### 3.3.7 Out-of-Sample Test

Following the reliability test of the target price, the next step applies the out-of-sample test to verify the robustness of the research results. In the out-of-sample test, there are 35 new sample companies (see Table 3.4) and the out-of-sample period is from year 2013 to 2015.

**Table 3.4 Out of Sample Test: Sample Companies**

| Sample Industry | Sample Sector | New Sample Listed Company Code | | | | |
|---|---|---|---|---|---|---|
| Financial | Commercial Bank | ZION | STI | MBFI | KEY | BBT |
| | Insurance | AGII | AXS | CAN | SIGI | PGR |
| | Securities | JPM | SCHW | AMTD | DB | WDR |
| Information Technology | S&C Services | MSFT | ORCL | XRX | ACN | CACI |
| | Technology Hardware | NANO | COHR | MTSC | ITRI | TRMB |
| Health Care | Pharmaceutical | PFE | GSK | NVS | JNJ | SNY |
| | Biotechnology | NVO | CBM | ALXN | SHPG | VRTX |

Source: Thomson Reuters Datastream

## 3.4 Chapter Summary

This chapter presented the data and research methods used in the current study. Specifically, this chapter discussed the details of the study sample companies, sample period and data sources. In addition, this chapter presented the detailed research steps of the current study. These are: first, how to estimate the discount rates for the sample companies. Second, what are the individual valuation models used in the current study to estimate the intrinsic values of sample companies. Third, how to test the suitability of individual valuation models. Fourth, how to construct the combined valuation models, combine individual value estimates, and test the suitability of combined valuation models. Fifth, how to set the target price. Sixth, how to test the financial analyst's target price and the target prices produced by the best industry-based individual and combined valuation models. Last, how to verify the robustness of the research results by using the out-of-sample test.

# Chapter 4

# Research Results: Individual Value Estimates

## 4.1 Introduction

This chapter discusses the study sample companies' individual value estimates produced by the sample industry-based individual valuation models. It then identifies the appropriate industry-based individual valuation models according to the reliability of their individual value estimates. The chapter uses the individual value estimates to judge the suitability of individual valuation models in the study sample industries, where the individual value estimate is the direct product of the individual valuation model. The following discussion is based on the quarterly individual value estimates produced by the sample industry-based individual valuation models, for a sample of 35 companies between the years 2010 and 2012. The rest of the chapter is organized as follows: Section 4.2 presents the suitability ranking of the study sample industry-based individual valuation models. Section 4.3 compares the suitability of absolute with relative valuation models in the study sample industries. Section 4.4 compares the suitability of forward with trailing valuation models in the study sample industries. Section 4.5 compares the suitability of enterprise value with price valuation models in the study sample industries. The last section concludes the chapter.

## 4.2 Industry-based Individual Valuation Models

This section identifies the appropriate individual valuation models for the study sample industries. The valuation models often perform differently across different industries. The selection of an appropriate valuation model consistent with the general characteristics of the company/industry being valued is already a common practice in company valuation. Tables 4.1, 4.2 and 4.3 present the suitability rankings of the sample industry-based individual valuation models. The ranking lists provide effective practical guidance for financial analysts to properly select the valuation model. The ranking lists are for indicative purposes only and financial analysts should make appropriate choice based on the specific valuation need or objective. Stowe et al. (2002) revealed that one of the criteria for selecting valuation models is that it has to be consistent with the financial analyst's valuation purpose and perspective.

The suitability rankings of the sample industry-based individual valuation models are based on the reliability test of their individual value estimates. The reliability test consists of two parts: the accuracy is measured by using the absolute value of adjusted valuation error (Adj Valuation Error), and the explanatory power is measured by the adjusted R-square of the regression model (R-Sq). Specifically, the smaller the valuation error, the higher the degree of accuracy. Similarly, the larger the R-square, the higher the degree of explanatory power. A good industry-based individual valuation model is expected to have higher degrees of accuracy and explanatory power at the same time. Thus, the accuracy and explanatory power tests are two equally important parts of the reliability test, where each accounts for 50% weight of the "Overall Rank" in the tables. The details of the reliability test method are presented in Chapter 3. Sections 4.2.1 to Section 4.2.3 discuss the appropriate individual valuation models for the financial, information technology and health care industries based on the suitability rankings.

### 4.2.1 Financial Industry

Table 4.1 indicates that the forward dividend yield model (FDY) is the number one valuation model choice for commercial banks. The FDY model produces value estimates with the lowest adjusted valuation error (18.94%), and the third highest explanatory power (20.34%). In general, dividend is the residual income that belongs to the shareholders. Pinto et al. (2010) revealed that dividend is an effective value indictor for the mature commercial banks, especially for those with stable earnings history and well-established long term dividend payout policy. During the economic recovery stage following the 2008 global financial crisis, the enormous interest and fee income provided strong support for the ongoing and stable dividend payout plan. Thus, the future short term dividend is easy to forecast, and the future forecasted dividend based FDY model has been ranked as the number one valuation model choice for commercial banks. Similarly, the price to book value model (PBV) is also a suitable valuation model for them. The book value focuses on important equity capital. Fink (2012) and Wild et al. (2001) found that the book value is appropriate for the commercial banks with enormous marketable assets and "mark-to-market" accounting standards. Since the book values of commercial banks' assets may approximate their current market values, the book value is a reliable and exact value indicator of the intrinsic value (Pinto et al. 2010). In addition, Table 4.1 also presents the valuation advantage of the forward price to earnings model (FPE) in the commercial bank sector. The FPE model has a small adjusted valuation error of 24.87%, and a relatively higher explanatory power of 20.34%. The FPE model relies on the estimated future earnings to estimate the intrinsic value of commercial banks. However, Damodara (2009) found that the earnings of commercial banks are often overly sensitive to changes in interest rate and level of loan loss reserves. The volatile earnings increase the difficulty in forecasting the future earnings and reduce the effectiveness of earnings as a reliable value indictor, thus the FPE model is ranked as the third valuation model choice for commercial banks.

In general, the premium earned from the insurance policy underwriting, and the returns from investment are two major sources of income for the insurance companies. Hence, in the valuation of insurance companies, the selected valuation model should be able to simultaneously consider the operating and investment activities. For the cash flow based valuation models such as the DCF model and price to free cash flow model (PFCF), Nissim (2013) revealed that both models focus only on the operating activities of insurance companies, but omit another part of value creation (investment activities). Table 4.1 confirms the weakness of DCF and PFCF models in the valuation of insurance companies, where the value estimates produced by the DCF and PFCF models have considerably large valuation errors and significantly low explanatory power. In addition, unlike the high-technology companies with remarkable earnings growth driven by the commercialization of core technology, the insurance companies do not have significant growth prospects. They derive their earnings from the spread between the returns on invested assets and the claims paid to their policy holders (Damodaran, 2013). The slow earnings growth rate reduces the effectiveness of the price/earnings to growth model (PEG). The PEG model is designed for the fast growing companies, which focuses on the future long term growth prospects and relies on the forecasted future five year earnings growth rate to estimate the intrinsic value. Table 4.1 confirms that the PEG model is not a suitable valuation model for insurance companies, especially as the trailing PEG model has large valuation error (133.43%) and small explanatory power (30.90%). On the other hand, since the book values are good measures of most items on the insurance companies' balance sheets, the PBV model has been ranked as the first valuation model choice in Table 4.1. In addition, the earnings of insurance companies tend to be stable and less subject to the business cycle effect. Nissim (2013) found that the forecasted earnings based model of FPE can effectively estimate the intrinsic value of the insurance companies with sustainable earnings. Thus, the FPE model is also a good valuation model choice for insurance companies.

Table 4.1 shows that the FPE model is an effective valuation model for securities companies, which exhibit lower valuation error (31.55%) and higher explanatory power (28.20%). The FPE model is based on the forecasted future short term earnings and is suitable for the mature securities companies that focus on low risk brokerage, investment banking and asset management services. The stable profits of these mature securities companies are often easy to forecast, and subject less to the movement of the stock market. Zhang et al. (2010) found that the earnings are the chief value indictor for the matured securities companies operating in stable businesses, and the earnings based FPE model is the primary valuation model. On the other hand, the earnings cannot adequately reflect the value of young and less diversified securities companies, especially for the securities companies which concentrate on risky businesses such as proprietary stock trading. Liu and Zheng (2011) revealed that the risk of proprietary stock trading is significantly high, and its revenue is extremely sensitive to the investment decisions and the stock market condition. Therefore, the volatile and uncertain earnings are not good value indicators and the earning based valuation model is not suitable for the young and less diversified securities companies with unstable earnings. In fact, the book value provides a better intrinsic value measurement for the securities companies which concentrate on proprietary stock trading business. The book value focuses on the stable balance sheet rather than the volatile income statement. The PBV model is ideal for the young and less diversified securities companies with high operating and investment risks. In addition, Table 4.1 suggests that the RI model has superior performance in the valuation of securities companies, where it has the lowest valuation error (18.28%) and relatively higher explanatory power (27.60%). The RI model relies on the current book value and the forecasted future long term residual income to estimate intrinsic value, where the residual income has many more special advantages than the traditional value indictors. For example, Pinto et al. (2010) found that the residual income had excellent performance in the valuation of companies with negative earnings, negative cash flow or no dividend payment in the future. Thus, the RI model is an effective valuation model for the less diversified securities companies with high possibility of losses in the future. Copeland et al. (2000) highlighted that an important conceptual advantage of residual income is that it focuses on whether the company is generating a return in excess of the cost of capital, it is often a more meaningful company performance metric than earnings.

**Table 4.1 Suitability Ranking of Individual Valuation Models - Financial Industry**

1. Commercial Bank

| Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| Dividend Yield Model - Forward | 18.94% | 1 | 20.34% | 3 | 1 |
| Price to Book Value Model | 35.12% | 5 | 58.94% | 1 | 2 |
| Price to Earnings Model - Forward | 24.87% | 4 | 20.34% | 3 | 3 |
| Price/Earnings to Growth Model - Forward | 22.55% | 2 | 12.80% | 5 | 4 |
| Discounted Dividend Model | 22.69% | 3 | 12.20% | 6 | 5 |
| Price/Earnings to Growth Model - Trailing | 79.40% | 10 | 24.24% | 2 | 6 |
| Residual Income Model | 40.05% | 7 | 9.44% | 8 | 7 |
| Price to Earnings Model - Trailing | 38.74% | 6 | 6.64% | 10 | 8 |
| Price to Free Cash Flow Model | 62.41% | 9 | 8.34% | 9 | 9 |
| Discounted Free Cash Flow Model | 227.50% | 11 | 11.00% | 7 | 10 |
| Dividend Yield Model - Trailing | 45.43% | 8 | 4.54% | 11 | 11 |

2. Insurance

| Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| Price to Book Value Model | 24.85% | 1 | 90.04% | 1 | 1 |
| Price to Earnings Model - Forward | 31.20% | 2 | 49.00% | 5 | 2 |
| Dividend Yield Model - Forward | 37.40% | 5 | 86.60% | 2 | 3 |
| Discounted Dividend Model | 50.24% | 7 | 64.56% | 3 | 4 |
| Price/Earnings to Growth Model - Forward | 33.74% | 3 | 41.44% | 7 | 5 |
| Dividend Yield Model - Trailing | 40.32% | 6 | 48.14% | 6 | 6 |
| Residual Income Model | 78.17% | 9 | 59.08% | 4 | 7 |
| Price to Earnings Model - Trailing | 33.82% | 4 | 26.74% | 10 | 8 |
| Price to Free Cash Flow Model | 51.17% | 8 | 28.48% | 9 | 9 |
| Price/Earnings to Growth Model - Trailing | 133.43% | 10 | 30.90% | 8 | 10 |
| Discounted Free Cash Flow Model | 548.50% | 11 | 11.30% | 11 | 11 |

3. Securities

| Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| Price to Earnings Model - Forward | 31.55% | 2 | 28.20% | 3 | 1 |
| Residual Income Model | 18.28% | 1 | 27.60% | 4 | 2 |
| Price to Book Value Model | 61.82% | 6 | 56.42% | 1 | 3 |
| Dividend Yield Model - Trailing | 48.81% | 5 | 49.40% | 2 | 4 |
| Discounted Dividend Model | 40.01% | 3 | 26.42% | 5 | 5 |
| Price/Earnings to Growth Model - Forward | 41.21% | 4 | 17.86% | 9 | 6 |
| Price to Earnings Model - Trailing | 65.89% | 7 | 20.80% | 7 | 7 |
| Dividend Yield Model - Forward | 84.35% | 9 | 23.60% | 6 | 8 |
| Price to Free Cash Flow Model | 77.16% | 8 | 20.04% | 8 | 9 |
| Price/Earnings to Growth Model - Trailing | 127.58% | 10 | 8.00% | 11 | 10 |
| Discounted Free Cash Flow Model | 203.80% | 11 | 9.72% | 10 | 11 |

Note: "Accuracy" is measured by using the absolute value of adjusted valuation error (Adj Valuation Error); "Explanatory Power" is measured by the adjusted R-square of OLS regression (R-Sq); "Overall Rank" = rank of accuracy * 0.5 + rank of explanatory power * 0.5.

Source: Author's calculation

### 4.2.2 Information Technology Industry

Table 4.2 presents the suitability rankings of the sample individual valuation models, based on their performances in the valuation of companies from the software and computer services sector. Table 4.2 shows that the forward price/earnings to growth model (FPEG) is the number one valuation model choice with the largest valuation accuracy (25.06%), and the second highest explanatory power (66.74%). In fact, the FPEG model is the most suitable valuation model for the software and computer services companies in the growth stage. As the R&D process continues and the companies move into the growth stage, Robin and Malak (2009) revealed that as the certainty of success and receiving the anticipated cash flows rises substantially, the earnings of software and computer services companies become positive and increase sharply. In the valuation of fast growing software and computer services companies, Zhang et al. (2010) discovered that it is important to take into account the considerable growth prospects. The FPEG model is able to simultaneously consider both recent years' earnings and future long term earnings growth rate, it significantly outperforms the FPE model in the valuation of companies in the growth stage. In fact, the FPE model is more suitable for the mature software and computer services companies. Pinto et al. (2010) find that these companies often do not have too many reinvestment opportunities and their earnings tend to be stable and easy to predict. In addition, Table 4.2 shows that the DCF model is also a popular valuation model choice for the software and computer services companies, especially for those in the mature stage. Demirakos et al. (2004) and Imam et al. (2008) also recommend the DCF model as their preferred valuation model choice for the mature software and computer services companies with stable and sustainable cash flows. Since most of these companies have completed their R&D process of their core technologies and products, the technology uncertainty and overall business risk have reduced sharply. The current and future cash flows tend to be less volatile and more sustainable, and the difficulty in forecasting future cash flow declines. Therefore, this enables the forecasted cash flow based DCF model to estimate the intrinsic values better.

In the information technology industry, the technology hardware sector has apparent different characteristics in contrast with the software and computer services sector. The differences in characteristics cause the suitable valuation models to vary greatly across the two sectors. Table 4.2 shows that the FPE model is the most suitable valuation model for the technology hardware sector, with the highest level of accuracy (28.48%) and explanatory power (45.54%). The technology hardware sector is a traditional sector, which develops, manufactures and distributes a variety of electrical equipment. Most of the technology hardware companies are in their mature stages, where low but sustainable earnings is one of their most significant characteristics. The sustainable earnings largely reduce the difficulty in forecasting future earnings. The forecasted future short term earnings based FPE model is most suitable for the mature technology hardware companies with strong sustainable earnings. In the valuation of technology hardware companies, Table 4.2 shows that the current book value based valuation models of PBV and enterprise value to book value model (EVBV) also exhibit superior performance. Robin and Malak (2009) revealed that the book value is a reliable value indictor for the capital intensive-companies with the following features: large amounts of fixed assets, relatively stable book value, low return on assets, slow earnings growth rate and rampant rivalry with peers. However, the book value is not a good value indicator for the technology intensive-hardware producers such as the integrated circuits and computer chip manufacturers. These hardware companies require considerable capital and knowledge investment. The intangible assets such as technology and patents often account for a large percentage of the total assets of such companies. The book value has an inherent weakness in measuring the true value of intangible assets and thus it cannot estimate the intrinsic value adequately. Demirakos (2004) also argued that accounting measures of performance such as book value are less relevant for the intangibles-rich companies. Pinto et al. (2010) found that financial analysts devote little space to the accounting data in the valuation of companies with great amounts of intangible assets, since conventional accounting is often unable to fully capture the intrinsic value of such companies.

**Table 4.2 Suitability Ranking of Individual Valuation Models - Information Technology Industry**

1. Software & Computer Services

| Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| Price/Earnings to Growth Model - Forward | 25.06% | 1 | 66.74% | 2 | 1 |
| Price to Earnings Model - Forward | 34.06% | 2 | 75.20% | 1 | 2 |
| Discounted Free Cash Flow Model | 40.47% | 4 | 55.62% | 4 | 3 |
| Residual Income Model | 42.27% | 5 | 56.64% | 3 | 4 |
| Enterprise Value to Sales Model | 46.39% | 7 | 42.60% | 5 | 5 |
| Price to Earnings Model - Trailing | 39.06% | 3 | 35.34% | 9 | 6 |
| Price to Free Cash Flow Model | 53.25% | 9 | 40.76% | 6 | 7 |
| Price to Sales Model | 51.32% | 8 | 40.42% | 7 | 8 |
| Enterprise Value to EBITDA Model | 43.83% | 6 | 34.64% | 10 | 9 |
| Price/Earnings to Growth Model - Trailing | 62.61% | 10 | 39.68% | 8 | 10 |

2. Technology Hardware

| Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| Price to Earnings Model - Forward | 28.48% | 1 | 45.54% | 1 | 1 |
| Enterprise Value to Book Value Model | 34.63% | 3 | 36.12% | 4 | 2 |
| Price to Book Value Model | 39.55% | 5 | 37.42% | 3 | 3 |
| Price to Sales Model | 49.01% | 8 | 39.14% | 2 | 4 |
| Price/Earnings to Growth Model - Forward | 36.32% | 4 | 26.58% | 10 | 5 |
| Enterprise Value to Sales Model | 41.12% | 6 | 27.88% | 8 | 6 |
| Price to Free Cash Flow Model | 45.78% | 7 | 30.02% | 7 | 7 |
| Price to Earnings Model - Trailing | 50.09% | 9 | 35.86% | 5 | 8 |
| Enterprise Value to EBITDA Model | 30.52% | 2 | 16.90% | 13 | 9 |
| Discounted Dividend Model | 68.08% | 10 | 31.38% | 6 | 10 |
| Residual Income Model | 89.57% | 11 | 26.88% | 9 | 11 |
| Dividend Yield Model - Forward | 110.82% | 13 | 18.58% | 12 | 12 |
| Price/Earnings to Growth Model - Trailing | 157.79% | 15 | 22.18% | 11 | 13 |
| Dividend Yield Model - Trailing | 101.46% | 12 | 8.54% | 15 | 14 |
| Discounted Free Cash Flow Model | 120.92% | 14 | 13.78% | 14 | 15 |

Source: Author's calculation

### 4.2.3 Health Care Industry

Table 4.3 presents the overall suitability ranking of the sample individual valuation models in the pharmaceutical sector. Specifically, the historical dividend based trailing dividend yield model (TDY) is the number one valuation model choice with the smallest valuation error (25.40%) and highest explanatory power (72.80%). In general, the dividend is an exact value indictor for the mature companies, especially for the companies with long term dividend payout ratios consistent with their profitability (Pinto et al., 2010). In fact, the dividend based valuation models are particularly suitable for chemical pharmaceutical companies in the pharmaceutical sector without considerable growth prospects. In the developed economies, Trottier (2010) found that the pharmaceutical sector is often dominated by a small number of large chemical pharmaceutical companies. After a long period of development, the traditional chemical pharmaceutical technology becomes matured. There is little technical uncertainty and less demand for further technology development. Most chemical pharmaceutical companies prefer to distribute their earnings rather than retain them for reinvestment. In the valuation of chemical pharmaceutical companies with stable dividend payout plans, the historical dividend is a good value indictor and the historical dividend based TDY model has significant advantages. In addition, there is often little growth opportunity for the mature chemical pharmaceutical companies without new innovative medical products or technology. The earnings and cash flow of such companies often tend to be stable and easier to predict, and this significantly increase the suitability of the cash flow and earnings based valuation models such as PFCF and FPE. Demirakos et al. (2004) found that the earnings and cash flow based valuation models are particularly useful for pharmaceutical companies, which rely on low margin generic drugs to generate revenue. Table 4.3 confirms the valuation advantage of the PFCF and FPE models, where they are ranked as the second and third valuation model choices for the chemical pharmaceutical companies with matured cash flows and earnings.

In general, the intangibles rich-biotechnology companies have fewer fixed assets and derive most of their values from intangible assets such as technology, patents and licenses. The huge amounts of intangible assets largely reduce the suitability of many traditional valuation models such as the book value based models. Demirakos (2004) revealed that the accounting measurement is often unable to fully reflect the true value of intangible assets. In addition, there is great uncertainty in the development, regulatory approval and marketing stages of biotechnology products. These uncertainties largely increase the difficulty in forecasting the future long term cash flow, especially the inability to predict shifts in the factors influencing a new biotechnology product's ability to gain market share (Bird, 2009). Banerjee (2003) also argued that the traditional discounted cash flow method fails to capture the future value of biotechnology companies, since most of their values are embedded in the unexercised real options with uncertain future values.

Table 4.3 confirms the weakness of the future long term cash flow in the estimating the intrinsic value of biotechnology companies. The long term cash flow based DCF model is the most unsuitable valuation model for the biotechnology companies. In fact, the valuation model should be able to consider the fast earnings growth while overcoming the great uncertainty in the future long term period. Table 4.3 shows that the FPE model has highest level of valuation accuracy (40.67%) and explanatory power (61.02%). The FPE model relies on the forecasted short term earnings to estimate the intrinsic values of biotechnology companies. The future short term earnings are often easier to predict than the future long term earnings, and less subject to the uncertainties of technology and regulation. In addition, Table 4.3 shows that the historical accounting data based valuation models such as the trailing price/earnings to growth model (TPEG) and trailing price to earnings model (TPE) are also suitable valuation models for the biotechnology companies. This reflects that when the future cash flows such as the long term earnings are subject to great uncertainty and difficult to predict, the historical accounting data are able to provide a better estimation of intrinsic value.

**Table 4.3 Suitability Ranking of Individual Valuation Models - Health Care Industry**

1. Pharmaceuticals

| Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| Dividend Yield Model - Trailing | 25.40% | 1 | 72.80% | 1 | 1 |
| Price to Free Cash Flow Model | 41.08% | 3 | 34.34% | 6 | 2 |
| Price to Earnings Model - Forward | 55.44% | 5 | 36.28% | 5 | 3 |
| Dividend Yield Model - Forward | 32.00% | 2 | 27.45% | 9 | 4 |
| Discounted Dividend Model | 60.62% | 6 | 32.98% | 7 | 5 |
| Enterprise Value to Sales Model | 129.63% | 10 | 36.90% | 4 | 6 |
| Price to Sales Model | 381.75% | 13 | 44.10% | 2 | 7 |
| Price/Earnings to Growth Model - Trailing | 160.07% | 12 | 41.76% | 3 | 8 |
| Enterprise Value to EBITDA Model | 52.45% | 4 | 5.18% | 12 | 9 |
| Price to Earnings Model - Trailing | 64.62% | 7 | 5.40% | 10 | 10 |
| Residual Income Model | 107.27% | 9 | 32.20% | 8 | 11 |
| Discounted Free Cash Flow Model | 89.65% | 8 | 3.25% | 13 | 12 |
| Price/Earnings to Growth Model - Forwarc | 136.62% | 11 | 5.20% | 11 | 13 |

2. Biotechnology

| Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| Price to Earnings Model - Forward | 40.67% | 1 | 61.02% | 1 | 1 |
| Price/Earnings to Growth Model - Trailing | 47.45% | 3 | 42.00% | 5 | 2 |
| Price to Earnings Model - Trailing | 48.06% | 4 | 50.08% | 4 | 3 |
| Enterprise Value to Sales Model | 46.58% | 2 | 29.46% | 8 | 4 |
| Price/Earnings to Growth Model - Forward | 62.81% | 8 | 50.64% | 3 | 5 |
| Residual Income Model | 79.17% | 9 | 55.44% | 2 | 6 |
| Price to Sales Model | 50.21% | 5 | 34.30% | 7 | 7 |
| Enterprise Value to EBITDA Model | 51.04% | 6 | 35.68% | 6 | 8 |
| Price to Free Cash Flow Model | 60.37% | 7 | 27.08% | 9 | 9 |
| Discounted Free Cash Flow Model | 105.86% | 10 | 8.14% | 10 | 10 |

Source: Author's calculation

4.3 Absolute Valuation Models versus Relative Valuation Models

This section investigates whether the absolute valuation models have advantages over the relative valuation models. The present value based absolute valuation models and the "law of one price" based relative valuation models are two types of listed company valuation models. However, whether the absolute valuation models outperform the relative valuation models remains unclear. Table 4.4 compares the suitability of the sample absolute and relative valuation models across different sample sectors, based on the reliability test of their value estimates. The details of sample absolute and relative valuation models are presented in Table 3.3.

In general, Table 4.4 shows that the absolute valuation models do not have apparent valuation advantage. The absolute valuation models only slightly outperform the relative valuation models in the fast growing or risky sectors, such as pharmaceutical and software and computer services sectors, but their valuation advantage is not significant. Normally, the multi-stage and future based absolute valuation models have superior capability to deal with the volatile and uncertain future cash flows. Imam et al. (2008) also found that the forward-looking absolute valuation models such as DCF model are able to simultaneously consider the risk and growth faced by the emerging companies in the future. In general, the intrinsic value of a company consists of two parts: current and future parts. Specifically, the current part of intrinsic value has already been generated by the past and current company operating activities. On the other hand, the future part of intrinsic value is expected to be generated by the future operating activities. The absolute valuation models pay less attention to the current part of intrinsic value, but concentrate on the future part, especially the intrinsic value generated from the future infinite year (terminal value). Francis et al. (2000) concluded that the absolute valuation models often rely on the estimated terminal value to estimate the intrinsic value. Gode and Ohlson (2006) found that for the high growth companies, the terminal values estimated by absolute valuation models can account for as much as 80-90% of the value estimates. Therefore, the absolute valuation models are most suitable for the emerging sectors with little current intrinsic value, but with great potential to receive considerable amounts of intrinsic value from the future (especially from the future infinite year). The forward looking absolute valuation models focus on the future long term, they are able to effectively capture the large amounts of intrinsic value generated from the future stages of the emerging sectors.

On the other hand, Table 4.4 shows that the single-period and accounting based relative valuation models significantly outperform the absolute valuation models in most of the sample sectors. This is particularly true in the mature and traditional sectors such as insurance and technology hardware, where the current part of the intrinsic value accounts for a large percentage of the total intrinsic value. In general, the relative valuation models estimate intrinsic value based on the historical, current or future short term value indictors, and place large emphasis on the current part of the intrinsic value. Demirakos et al. (2004) also revealed that for the traditional companies with poor growth prospects but stable accounting data, the accounting based relative valuation models have significant valuation advantages. Thus, the relative valuation models are most suitable for the slow growing matured sector, where the intrinsic value generated from the past often accounts for a large percentage of its total intrinsic value.

## 4.4 Forward Valuation Models versus Trailing Valuation Models

This section investigates whether the forward valuation models have advantages over the trailing valuation models. The forward and trailing valuation models both belong to the relative valuation model, where the denominators of trailing valuation models are based on the last year's actual accounting figures. On the contrary, the denominators of forward valuation models are based on

**Table 4.4 Suitability Comparison: Absolute vs Relative Valuation Models**

| | # of Obs | Accuracy | Explanatory Power | # of Obs | Accuracy | Explanatory Power | # of Obs | Accuracy | Explanatory Power |
|---|---|---|---|---|---|---|---|---|---|
| | 1. Commercial Bank | | | 1. Software & Computer Services | | | 1. Pharmaceuticals | | |
| **Absolute** | 15 | 96.75% | 10.88% | 10 | 41.37% | 56.13% | 14 | 85.58% | 24.21% |
| **Relative** | 40 | 40.93% | 19.52% | 40 | 44.45% | 46.92% | 48 | 111.21% | 30.14% |
| **ANOVA-P** | – | 0.004 | 0.241 | – | 0.771 | 0.391 | – | 0.720 | 0.518 |
| | 2. Insurance | | | 2. Technology Hardware | | | 2. Biotechnology | | |
| **Absolute** | 15 | 225.64% | 44.98% | 15 | 92.86% | 24.01% | 10 | 92.51% | 31.79% |
| **Relative** | 40 | 48.24% | 50.17% | 59 | 59.61% | 28.90% | 40 | 50.90% | 41.28% |
| **ANOVA-P** | – | 0.000 | 0.622 | – | 0.083 | 0.534 | – | 0.002 | 0.395 |
| | 3. Securities | | | | | | | | |
| **Absolute** | 15 | 222.23% | 21.25% | | | | | | |
| **Relative** | 40 | 52.86% | 27.59% | | | | | | |
| **ANOVA-P** | – | 0.000 | 0.451 | | | | | | |

Note: "# of Obs" is the number of observations for the accuracy or explanatory power of the sample absolute or relative valuation models; "Accuracy" is measured by using the absolute value of adjusted valuation error (Adj Valuation Error); "Explanatory Power" is measured by the adjusted R-square of OLS regression (R-Sq); "Absolute" stands for the mean value of accuracy or explanatory power of the sample absolute valuation models; "Relative" stands for the mean value of accuracy or explanatory power of the sample relative valuation models; "ANOVA-P" is the p value in the one way ANOVA test (confidence level: 95%), it is used to judge whether the absolute valuation models have significant valuation advantage over the relative valuation models, in terms of accuracy or explanatory power. Similar to the t-test, the ANOVA test has been frequently used to compare the means of two or more groups. In fact, the t-test and ANOVA test are the same. Zimmerman and Zumbo (1993) reveal that the t-test is a special case of the one-way ANOVA test, the t-test and ANOVA test generate the same results when compare the means of two groups.

Source: Author's calculation

**Table 4.5 Suitability Comparison: Trailing vs Forward Valuation Models**

| | # of Obs | Accuracy | Explanatory Power | # of Obs | Accuracy | Explanatory Power | # of Obs | Accuracy | Explanatory Power |
|---|---|---|---|---|---|---|---|---|---|
| | 1. Commercial Bank | | | 1. Software & Computer Services | | | 1. Pharmaceuticals | | |
| **Trailing** | 15 | 54.52% | 11.81% | 10 | 50.84% | 37.51% | 14 | 87.50% | 37.64% |
| **Forward** | 15 | 22.12% | 17.83% | 10 | 29.56% | 70.97% | 14 | 77.74% | 22.66% |
| **ANOVA-P** | – | 0.015 | 0.430 | – | 0.058 | 0.013 | – | 0.820 | 0.199 |
| | 2. Insurance | | | 2. Technology Hardware | | | 2. Biotechnology | | |
| **Trailing** | 15 | 69.19% | 35.26% | 15 | 103.11% | 22.19% | 10 | 47.75% | 46.04% |
| **Forward** | 15 | 34.12% | 59.01% | 14 | 54.80% | 31.06% | 10 | 51.74% | 55.83% |
| **ANOVA-P** | – | 0.244 | 0.064 | – | 0.125 | 0.374 | – | 0.767 | 0.524 |
| | 3. Securities | | | | | | | | |
| **Trailing** | 15 | 69.19% | 24.40% | | | | | | |
| **Forward** | 15 | 34.12% | 23.19% | | | | | | |
| **ANOVA-P** | – | 0.244 | 0.919 | | | | | | |

Note: "Trailing" stands for the mean value of the accuracy or explanatory power of the trailing valuation models; "Forward" stands for the mean value of the accuracy or explanatory power of the forward valuation models.

Source: Author's calculation

the following year's forecasted data. Apparently, the forward valuation models are consistent with the forward-looking concept of company valuation. However, whether the forward valuation models outperform the trailing valuation models is debatable. Table 4.5 compares the suitability of sample trailing and forward valuation models in different sample sectors, based on the reliability test of their value estimates. The details of such models are discussed in Chapter 3.

Table 4.5 shows the forward valuation models outperform the trailing valuation models in the relatively stable sectors such as commercial bank. These sectors often have less risk and uncertainty, where their future cash flows are easier to predict. The forward valuation models rely heavily on the forecasted future short and middle term value indictors to estimate the intrinsic value. The forward valuation models have significant valuation advantages in the matured sectors with accurate forecast data. On the other hand, the trailing valuation models have slightly larger valuation accuracy in the biotechnology sector, and relatively higher explanatory power in the pharmaceutical and securities sectors, but their valuation advantage is not significant. This reflects that the actual accounting data provide a more accurate estimate of intrinsic value in the risky sectors with higher levels of uncertainty. The actual accounting data based trailing valuation models have significant valuation advantages when the forecast data are not available or reliable. Therefore, the forward valuation models are most suitable for the mature sectors with reliable forecast data. The trailing valuation models are good alternatives in the valuation of unstable sectors, where the future cash flows are subject to great uncertainty and are difficult to predict. Liu et al. (2002) and Lie and Lie (2002) also concluded that the forward valuation models are more accurate than trailing ones, especially when the consensus financial analysts' forecasts are available.

## 4.5 Enterprise Value Valuation Models versus Price Valuation Models

This section investigates whether the enterprise value valuation models have advantages over the price valuation models. The enterprise value and price valuation models both belong to the relative valuation model, which estimate the intrinsic value of a company in two opposing ways. Specifically, the enterprise value valuation models concentrate on the market value of a company's total capital, including equity and debt. The price valuation models only focus on the market price of a company's public stock on a per share basis. However, it is unclear whether it is necessary to use the enterprise value in company valuation practice, since the price valuation models are relatively easier to use. Table 4.6 compares the suitability of the sample enterprise value and price valuation models across different sample sectors, based on the reliability test of their value estimates. The details of such valuation models are discussed in Chapter 3.

The test result in Table 4.6 shows no significant difference between the suitability of the price and enterprise value valuation models in the study sample sectors. In fact, the price valuation models are more convenient in practice and they are more widely used than the enterprise value valuation models. Lundholm and Sloan (2004) discovered that some financial analysts focused on shareholder value more than enterprise value. The enterprise value based valuation models have very limited usage, which are appropriate only under certain circumstances. For example, with regard to companies with different levels of leverage, Pinto et al. (2010) revealed that the enterprise value valuation models exhibit better performance, they disregard the capital structure differences by considering the total value of equity and debt. In addition, the enterprise value models are able to better estimate the intrinsic value of companies with enormous amounts of real estate. Koller et al. (2010) revealed that the enterprise value models treat the real estate as a non-operating asset and separately appraise the fair value of real estate, and then add it to the value of the business operation to get the enterprise value. However, the enterprise value valuation models are not suitable in the valuation of certain sectors. For example, it is not appropriate to consider the enterprise value in the valuation of the commercial bank sector. Because of the unique role of debt in a commercial bank's capital structure, Damodaran (2013) argues that the debt should not be viewed as a source of capital, but as raw material for commercial banks to generate income.

**Table 4.6 Suitability Comparison: Enterprise Value vs Price Valuation Models**

| | # of Obs | Accuracy | Explanatory Power | # of Obs | Accuracy | Explanatory Power |
|---|---|---|---|---|---|---|
| | 1. Software & Computer Services | | | 1. Pharmaceuticals | | |
| **Enterpries Value** | 10 | 45.11% | 38.62% | 10 | 91.04% | 21.04% |
| **Price** | 30 | 44.23% | 49.69% | 38 | 116.51% | 32.54% |
| **ANOVA-P** | – | 0.940 | 0.358 | – | 0.789 | 0.288 |
| | 2. Technology Hardware | | | 2. Biotechnology | | |
| **Enterpries Value** | 15 | 35.43% | 26.97% | 10 | 48.81% | 32.57% |
| **Price** | 44 | 67.86% | 29.56% | 30 | 51.60% | 44.19% |
| **ANOVA-P** | – | 0.085 | 0.754 | – | 0.793 | 0.298 |

Note: "Enterprise Value"- the mean value of accuracy or explanatory power of the enterprise value valuation models; "Price" - the mean value of the accuracy or explanatory power of the price valuation models.

Source: Author’s calculation

## 4.6 Chapter Summary

Based on the reliability test results, this chapter discussed the sample companies’ individual value estimates produced by the sample industry-based individual valuation models. First, the chapter identified and ranked a series of industry-based individual valuation models based on the reliability of their individual value estimates. The best (number one in the suitability ranking list) individual valuation model for each industry and their special features are displayed in Table 4.7. The suitability ranking of industry-based individual valuation models has excellent practical relevance in company valuation, where the ranking provides effective practical guidance for the selection of valuation models. The reliability of valuation results is expected to improve as a result of more suitable valuation model selection. Second, the absolute valuation models are most suitable for the emerging sectors with little current intrinsic value. The relative valuation models have higher degrees of suitability in the valuation of traditional sectors, where their current parts of intrinsic values account for a large percentage of their total intrinsic values. Third, the forward valuation models are most suitable for the stable sectors with reliable forecasts. The trailing valuation models have good performance in the valuation of unstable sectors, where the future cash flows are subject to great uncertainty and difficult to predict. Fourth, in the study sample sectors, there is no significant difference between the suitability of the price and enterprise value valuation models. The price valuation models are more widely used in practice, the enterprise value valuation models have very limited usage and they are appropriate only under certain circumstances.

**Table 4.7 Best Industry-based Individual Valuation Models during Year 2010 – 2012**

| | Best Individual Valuation Model | Special Features |
|---|---|---|
| Financial Industry | | |
| Commercial Bank | FDY | Captures the intrinsic value of commercial bank via the effective future short term value indictor |
| Insurance | PBV | Consistent with the stable nature of insurance company |
| Securities | FPE | Takes into account the expected fast earnings growth rate of securities company in the future short term |
| Information Technology Industry | | |
| Software & Computer Services | FPEG | Simultaneously considers the fast earnings growth rate of S&C services company in the future short and middle term |
| Technology Hardware | FPE | Consistent with the low but sustainable earnings of technology hardware company |
| Health Care Industry | | |
| Pharmaceuticals | TDY | Historical dividend is an ideal value indictor for the matured pharmaceutical company with stable dividend plan |
| Biotechnology | FPE | Complies with the forward looking concept and compatible with the fast growth nature of biotechnology company |

Source: Author's summary

# Chapter 5

# Research Results: Combined Value Estimates

## 5.1 Introduction

This chapter discusses the sample companies' combined value estimates produced by the sample industry-based combined valuation models. It then identifies the suitable industry-based combined valuation models based on the reliability of their combined value estimates. In other words, this chapter uses the combined value estimates to judge the suitability of combined valuation models in the sample industries, where combined value estimate is the direct product of a combined valuation model. The following discussion is based on the quarterly combined value estimates produced by the sample industry-based combined valuation models, for a sample of 35 companies between the years 2010 and 2012. The rest of the chapter is organized as follows: Section 5.2 presents the suitability ranking of the study sample industry-based combined valuation models. Section 5.3 compares the suitability of combined with individual valuation models in the study sample industries. Section 5.4 compares the suitability of mixed with pure combined valuation models in the study sample industries. The last section concludes the chapter.

## 5.2 Industry-based Combined Valuation Models

This section identifies the appropriate combined valuation models for the study sample industries. The industry-based combined valuation models can largely improve the valuation methodology. Such valuation models benefit from not only the valuation advantage of considering the industry characteristics, but also from the synergy generated by the combination of individual valuation models. Tables 5.1, 5.2 and 5.3 present the suitability rankings of the sample industry-based combined valuation models, based on the reliability test of their combined value estimates. The details of the reliability test method are presented in Chapter 3. The ranking lists provide effective practical guidance for financial analysts to appropriately construct combined valuation models. The ranking lists are for indicative purposes only, financial analysts should make necessary adjustments based on the specific valuation need or objective.

The industry-based combined valuation models are constructed based on the suitability ranking of industry-based individual valuation models in Chapter 4 (see Tables 4.1, 4.2 and 4.3). According to the rankings, the study randomly selects three individual valuation models from the top six individual valuation models in the ranking list of each sample sector. Therefore, there are 20 different combined valuation models constructed for each sample sector, and each combined valuation model consists of three individual valuation models. With regard to the weights to combine three individual value estimates, the detailed weights estimation method is presented in Section 3.3.4 of Chapter 3, Appendix B shows the weights for the best combined valuation model for each sample sector. Sections 5.2.1 to Section 5.2.3 discuss the appropriate combined valuation models for the information technology, financial, and health care industries based on the suitability rankings.

### 5.2.1 Financial Industry

Table 5.1 shows the combined model of PBV, discounted dividend (DD) and FPEG is the number one combined valuation model for the commercial bank sector, which exhibits the highest level of accuracy (12.18%) and the third largest explanatory power (70.30%). The combined model of PBV, DD and FPEG estimates the intrinsic value of a bank by simultaneously considering four important value indictors. They are the current book value, future forecasted dividend, next year's forecasted earnings and forecasted future five years' earnings growth rate. Thus the combined model provides a comprehensive estimation of the bank’s intrinsic value via multi-value indictors and multi-valuation periods. Wild et al. (2001) revealed the book value is appropriate for the marketable asset rich commercial banks with “mark-to-market” accounting standards. In addition, the considerable interest and fee income generated during the economic recovery period after the 2008 global financial crisis not only accelerated the earnings growth speed, but also provided strong support to the ongoing and stable dividend payout plans. Therefore, it is important to simultaneously take into account the book value, dividends, earnings and earnings growth in the valuation of banks. On the other hand, Table 5.1 also shows that the combined model of FDY, FPE and FPEG has the worst valuation performance in the commercial bank sector with significantly low level of accuracy (16%) and explanatory power (32.84%). This combined model only looks at the future, and focuses on the volatile value indictors such as earnings and earnings growth rate. Damodaran (2013) revealed that the earnings of commercial banks are often sensitive to the changes in interest rate and the level of loan loss reserves, since the major source of earnings for commercial bank is the spread between the interests it pays and the interest it charges (Dong, 2008). The volatile earnings reduce the effectiveness of earnings based valuation models, such as the FPE and FPEG models.

Table 5.1 shows that the combined model of PBV, DD and FDY is the number one combined valuation model for the insurance companies and has the highest level of accuracy (7.33%) and explanatory power (94.98%). The superior valuation performance of this combined model reflects the strong stability of the insurance companies, regardless of the business cycle effect. Nissim (2013) reveals that the insurance companies derive their earnings from the spread between the return on invested assets and the claims paid to their policy holders. The mature insurance companies often do not have significant fast growth prospects. They prefer to distribute their earnings since there is little reinvestment opportunity, and this causes the dividends to become a reliable value indictor. Pinto et al. (2010) revealed that dividend is an effective value indictor for the mature insurance companies with stable earnings history and well-established long term dividend payout policy. In addition, Nissim (2013) examined the accuracy of a series of relative models in the valuation of U.S. insurance companies, and concluded that the book value based models have significantly valuation advantages. Therefore, the combined model of PBV, DD and FDY identifies the intrinsic value of insurance companies by estimating the current part of intrinsic value via historical book value, and the future part of intrinsic value via forecasted dividends. On the other hand, Table 5.1 shows that the combined model of TDY, FPE and FPEG has the worst performance in the valuation of insurance companies with the lowest levels of accuracy (11.82%) and explanatory power (77.06%). The combination of several unsuitable value indictors is the major reason for its underperformance, these unsuitable value indictors include the historical dividend and forecasted earnings growth rate. Specifically, the historical dividend based model of TDY is not appropriate for the insurance company. Damodaran (2013) revealed that the historical accounting figures only reflect the past information. For the matured insurance companies, the future dividend is preferred since it is often easy to predict. As the slow growth nature of insurance companies, the earnings growth speed based valuation model such as the FPEG model is also not a suitable valuation model.

In the financial industry, the securities companies often have higher levels of risk and uncertainty than the commercial banks and insurance companies. Liu and Zheng (2011) showed that securities companies often exhibit large positive beta, and their performance is closely correlated to the movement of the stock market. According to Table 5.1, the combined model of PBV, TDY and RI is the number one combined model for the securities companies. This combined model has the lowest level of valuation error (13.82%) and the highest explanatory power (82.93%). In general, the proprietary stock trading, brokerage, investment banking and asset management services are the top four common businesses of the securities companies. These businesses are very risky especially the proprietary stock trading and securities brokerage, which are positively and closely correlated to the movement of the stock markets. Liu and Zheng (2011) revealed that the risk of proprietary stock trading is significantly high, and its revenue is extremely sensitive to the investment decisions and the stock market condition. Therefore, the future performance of securities companies is often subject to great uncertainty and risk. In the valuation of uncertain companies such as the securities companies, the trailing value indictors outperform the forward value indictors. The historical accounting figures based models, such as the TDY is more accurate and reliable than the forecasted data based models. In addition, the book value focuses

**Table 5.1 Suitability Ranking of Combined Valuation Models - Financial Industry**

1. Commercial Bank

| Combined Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| PBV, DD and FPEG | 12.18% | 1 | 70.30% | 3 | 1 |
| PBV, FDY and FPE | 13.11% | 3 | 73.42% | 2 | 2 |
| PBV, DD and FPE | 12.73% | 2 | 70.18% | 4 | 3 |
| PBV, FDY and FPEG | 13.44% | 7 | 73.76% | 1 | 4 |
| PBV, FPE and TPEG | 13.21% | 4 | 69.66% | 7 | 5 |
| PBV, TPEG and FPEG | 13.40% | 5 | 69.48% | 8 | 6 |
| PBV, DD and FDY | 13.68% | 9 | 70.00% | 6 | 7 |
| PBV, DD and TPEG | 13.44% | 6 | 69.34% | 9 | 7 |
| PBV, FDY and TPEG | 14.82% | 11 | 70.02% | 5 | 9 |
| PBV, FPE and FPEG | 13.66% | 8 | 68.90% | 10 | 10 |
| DD, FDY and TPEG | 14.87% | 12 | 52.50% | 12 | 11 |
| FDY, FPE and TPEG | 15.45% | 16 | 52.64% | 11 | 12 |
| FPE, TPEG and FPEG | 15.37% | 13 | 39.16% | 15 | 13 |
| DD, FDY and FPE | 15.43% | 15 | 39.88% | 14 | 14 |
| DD, FDY and FPEG | 15.40% | 14 | 39.02% | 16 | 15 |
| DD, FPE and FPEG | 14.75% | 10 | 19.16% | 20 | 15 |
| FDY, TPEG and FPEG | 15.64% | 17 | 51.62% | 13 | 15 |
| DD, FPE and TPEG | 15.64% | 18 | 34.32% | 17 | 18 |
| DD, TPEG and FPEG | 15.73% | 19 | 32.84% | 18 | 19 |
| FDY, FPE and FPEG | 16.00% | 20 | 32.84% | 19 | 20 |

## 2. Insurance

| Combined Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| PBV, DD and FDY | 7.33% | 1 | 94.98% | 1 | 1 |
| PBV, FDY and FPEG | 8.20% | 3 | 94.62% | 2 | 2 |
| PBV, TDY and FDY | 8.14% | 2 | 94.40% | 4 | 3 |
| PBV, FDY and FPE | 8.32% | 4 | 94.60% | 3 | 4 |
| PBV, DD and TDY | 8.72% | 8 | 93.78% | 5 | 5 |
| PBV, TDY and FPEG | 8.37% | 5 | 93.00% | 10 | 6 |
| PBV, DD and FPEG | 9.11% | 11 | 93.72% | 6 | 7 |
| PBV, TDY and FPE | 8.99% | 10 | 93.06% | 8 | 8 |
| PBV, DD and FPE | 9.12% | 12 | 93.68% | 7 | 9 |
| DD, TDY and FDY | 8.55% | 6 | 92.26% | 13 | 9 |
| DD, FDY and FPEG | 8.57% | 7 | 92.42% | 12 | 9 |
| TDY, FDY and FPEG | 9.20% | 13 | 93.02% | 9 | 12 |
| FDY, FPE and FPEG | 8.98% | 9 | 92.10% | 14 | 13 |
| TDY, FDY and FPE | 9.52% | 16 | 92.66% | 11 | 14 |
| PBV, FPE and FPEG | 9.37% | 15 | 91.82% | 15 | 15 |
| DD, FDY and FPE | 9.21% | 14 | 91.42% | 16 | 15 |
| DD, TDY and FPEG | 10.67% | 17 | 85.72% | 17 | 17 |
| DD, TDY and FPE | 11.03% | 18 | 85.34% | 18 | 18 |
| DD, FPE and FPEG | 11.31% | 19 | 84.90% | 19 | 19 |
| TDY, FPE and FPEG | 11.82% | 20 | 77.06% | 20 | 20 |

## 3. Securities

| Combined Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| PBV, TDY and RI | 13.82% | 1 | 82.93% | 1 | 1 |
| PBV, DD and TDY | 14.60% | 2 | 81.30% | 3 | 2 |
| TDY, FPE and FPEG | 14.74% | 3 | 81.38% | 2 | 2 |
| PBV, TDY and FPE | 14.82% | 4 | 77.23% | 4 | 4 |
| PBV, TDY and FPEG | 15.85% | 5 | 77.23% | 4 | 5 |
| PBV, FPEG and RI | 16.96% | 9 | 74.32% | 7 | 6 |
| PBV, FPE and RI | 17.42% | 11 | 75.20% | 6 | 7 |
| PBV, FPE and FPEG | 16.80% | 7 | 69.42% | 12 | 8 |
| TDY, FPEG and RI | 17.71% | 12 | 73.78% | 8 | 9 |
| PBV, DD and RI | 18.21% | 13 | 71.54% | 10 | 10 |
| DD, TDY and FPEG | 18.31% | 14 | 72.03% | 9 | 10 |
| DD, TDY and RI | 17.40% | 10 | 68.88% | 14 | 12 |
| DD, FPE and FPEG | 16.47% | 6 | 60.30% | 18 | 12 |
| FPE, FPEG and RI | 16.83% | 8 | 62.66% | 17 | 14 |
| PBV, DD and FPE | 18.56% | 15 | 69.08% | 13 | 15 |
| PBV, DD and FPEG | 19.82% | 18 | 69.74% | 11 | 16 |
| TDY, FPE and RI | 18.68% | 16 | 68.53% | 15 | 17 |
| DD, TDY and FPE | 19.23% | 17 | 67.40% | 16 | 18 |
| DD, FPE and RI | 19.97% | 19 | 52.52% | 19 | 19 |
| DD, FPEG and RI | 20.35% | 20 | 49.10% | 20 | 20 |

Source: Author's calculation

on the stable balance sheet rather than the volatile income statement. The book value is ideal for the young securities companies with great operating and investment risks. In the estimation of securities companies' current part of intrinsic values, the PBV and TDY models exhibit great valuation advantages. In addition, Pinto et al. (2010) argued that the RI model is good at valuing companies with high possibility of negative earnings, negative cash flow or no dividend payment in the future. Thus, for the securities companies that concentrate on risky proprietary stock trading, the RI model is ideal to estimate their future part of intrinsic values.

### 5.2.2 Information Technology Industry

Based on the suitability ranking in Table 5.2, the combined model of TPE, FPEG and DCF has the best performance in the valuation of software and computer services companies. This combined model has considerably high levels of accuracy and explanatory power (12.10% and 88.32%, respectively). In general, the combined model of TPE, FPEG and DCF not only provides a comprehensive examination of a company's entire life, but also focuses on the corresponding and appropriate value indictors in each lifecycle stage. Since the software and computer services companies are often unstable companies with significant operating and technology uncertainty, it is important to take into account the actual earnings rather than the forecasted earnings. In general, when the future performance of a company is subject to great uncertainty and difficult to predict, the actual earnings based model of TPE is particularly reliable and useful. In addition to the high risk and uncertainty, the fast growth speed is another apparent characteristic of the software and computer services companies. In the valuation of emerging companies with optimistic prospects, Pinto et al. (2010) revealed that it is essential to consider the future long term earnings growth rate, and the FPEG model is the most suitable valuation model that takes into account the future earnings growth rate. In addition to the TPE and FPEG models which concentrate on the intrinsic value from the recent years and predictable future, the valuation advantage of this combined model is further strengthened by the DCF model. This model focuses on the intrinsic value delivered by the free cash flow from the infinite future (steady-state stage). In the mature stage, most software and computer services companies have completed the R&D process of their core technology and products, where the technology uncertainty and overall business risks are reduced sharply. Their cash flows tend to be more sustainable and the difficulty in forecasting future cash flow declines significantly. Hence, the free cash flow becomes an extremely reliable value indictor to reflect the intrinsic value from the mature and steady-state stages of a company. Demirakos et al. (2004) and Imam et al. (2008) also recommended the DCF model as their preferred valuation model choice for the mature software and computer services companies with stable and sustainable cash flows.

In contrast with the emerging software and computer services companies, Table 5.2 reveals that the traditional technology hardware companies have significantly different choices of combined valuation models. The suitability ranking in Table 5.2 shows that the combined model of FPE, FPEG and price to sales (PS) has the best performance in the valuation of technology hardware companies (12.98% of accuracy and 75.72% of explanatory power). The valuation advantage of this combined model is due to the synergy generated by a well-established combination of several suitable individual models. Although the intrinsic value generated from the future of a technology hardware company only contributes to a relatively small percentage of its total intrinsic value, the combined model takes into account the intrinsic value from both current and future periods at the same time. In general, the combined model of FPE, FPEG and PS estimates the intrinsic value of a technology hardware company by simultaneously considering the following three value indictors: the actual current year sales, forecasted next year earnings and forecasted long term earnings growth rate. The three value indictors are fully consistent with the characteristics of the technology hardware companies. Dong (2008) revealed that the tangible-rich technology hardware sector is a traditional sector with a large number of mature companies. Since their revenues are often subject to less uncertainty, distortion and are easy to predict, the sales based models such as the PS is particularly suitable. In addition to the stable revenues, the low but sustainable profit is another significant characteristic for the slow growing technology hardware companies. Their high sustainability largely reduces the difficulty in the forecast of future earnings and earnings growth rate, thus the forward models of FPE and FPEG are also suitable valuation models. Dong (2008) also recommended the forecasted earnings based model of FPE as the major valuation model for the companies with mature and stable earnings.

**Table 5.2 Suitability Ranking of Combined Valuation Models - Information Technology Industry**

1. Software & Computer Services

| Combined Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| TPE, FPEG and DCF | 12.10% | 1 | 88.32% | 2 | 1 |
| TPE, FPE and DCF | 12.78% | 3 | 88.44% | 1 | 2 |
| TPE, FPEG and RI | 12.45% | 2 | 86.76% | 4 | 3 |
| TPE, FPE and RI | 13.02% | 4 | 88.26% | 3 | 4 |
| FPEG, DCF and EVS | 13.47% | 6 | 84.94% | 9 | 5 |
| FPE, FPEG and DCF | 13.66% | 11 | 86.46% | 5 | 6 |
| FPEG, EVS and RI | 13.47% | 7 | 84.70% | 10 | 7 |
| FPE, EVS and RI | 13.66% | 10 | 85.14% | 8 | 8 |
| TPE, FPE and EVS | 14.08% | 13 | 85.44% | 6 | 9 |
| FPE, DCF and EVS | 13.55% | 8 | 84.28% | 11 | 9 |
| FPE, DCF and RI | 13.46% | 5 | 81.46% | 16 | 11 |
| TPE, FPEG and EVS | 14.52% | 15 | 85.22% | 7 | 12 |
| FPE, FPEG and RI | 13.58% | 9 | 83.52% | 14 | 13 |
| TPE, FPE and FPEG | 14.07% | 12 | 84.06% | 13 | 14 |
| FPE, FPEG and EVS | 14.83% | 16 | 84.16% | 12 | 15 |
| TPE, DCF and EVS | 14.28% | 14 | 80.10% | 17 | 16 |
| TPE, EVS and RI | 15.33% | 17 | 82.16% | 15 | 17 |
| FPEG, DCF and RI | 15.83% | 18 | 78.64% | 18 | 18 |
| DCF, EVS and RI | 16.14% | 19 | 73.80% | 19 | 19 |
| TPE, DCF and RI | 16.41% | 20 | 71.34% | 20 | 20 |

2. Technology Hardware

| Combined Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| FPE, FPEG and PS | 12.98% | 1 | 75.72% | 2 | 1 |
| FPEG, PBV and PS | 13.07% | 2 | 75.00% | 4 | 2 |
| FPEG, EVBV and PS | 13.40% | 5 | 76.52% | 1 | 2 |
| FPE, PBV and PS | 13.37% | 4 | 75.04% | 3 | 4 |
| FPE, EVS and PS | 13.20% | 3 | 74.80% | 5 | 5 |
| FPE, FPEG and EVS | 13.70% | 7 | 73.62% | 7 | 6 |
| FPE, EVBV and PS | 13.93% | 10 | 74.66% | 6 | 7 |
| FPE, FPEG and PBV | 13.67% | 6 | 70.60% | 11 | 8 |
| FPEG, PBV and EVBV | 14.25% | 13 | 72.86% | 8 | 9 |
| FPE, PBV and EVS | 14.23% | 12 | 71.32% | 10 | 10 |
| FPEG, EVS and PS | 13.74% | 8 | 68.66% | 15 | 11 |
| FPE, PBV and EVBV | 14.28% | 15 | 72.24% | 9 | 12 |
| EVBV, EVS and PS | 13.80% | 9 | 63.24% | 18 | 13 |
| FPE, FPEG and EVBV | 14.40% | 16 | 68.96% | 14 | 14 |
| FPE, EVBV and EVS | 14.27% | 14 | 66.92% | 16 | 14 |
| FPEG, PBV and EVS | 14.87% | 18 | 69.96% | 12 | 14 |
| FPEG, EVBV and EVS | 14.64% | 17 | 69.34% | 13 | 14 |
| PBV, EVS and PS | 14.05% | 11 | 60.94% | 20 | 18 |
| PBV, EVBV and PS | 14.91% | 19 | 66.70% | 17 | 19 |
| PBV, EVBV and EVS | 15.44% | 20 | 62.24% | 19 | 20 |

Source: Author's calculation

### 5.2.3 Health Care Industry

Table 5.3 presents the suitability rankings of the sample combined valuation models in the pharmaceutical sector. Specifically, the combined model of DCF, DD and TDY has the best performance in the valuation of pharmaceutical companies. This combined model has considerably high levels of accuracy and explanatory power (10.10% and 82.90%, respectively). The superior performance of this combined model is the result of two important factors: multi-valuation periods and multi-value indictors. Trottier (2010) revealed that the chemical science oriented-traditional pharmaceutical technology becomes mature after a long period of development, whereby most of the pharmaceutical companies turn into capital intensive companies with huge amounts of tangible assets but fewer intangible assets. For a traditional pharmaceutical company without technology innovation and growth opportunities, its current part of intrinsic value often accounts for a large percentage of its total intrinsic value. Therefore, it is essential for the combined valuation model to fully capture the current part of intrinsic value via the appropriate value indictors. Pinto et al. (2010) found that the dividend is an ideal and reliable value indictor for mature companies, especially for the companies with long term dividend payout plans which are sustainable and compatible with their profitability. As there is little technical uncertainty and less demand for further development of the chemical pharmaceutical technology, most traditional pharmaceutical companies tend to distribute their earnings rather than retain them (Trottier, 2010). Hence, the dividend based model of TDY can better capture the current part of intrinsic value generated from the recent operating activities of the pharmaceutical company. In addition to the forecasted dividend, the combined model of DCF, DD and TDY estimates the future part of intrinsic value via the value indictor of forecasted free cash flow. Since there is little growth opportunity for the mature pharmaceutical companies without innovative new medical products or technology, their future free cash flows are stable and easier to predict. Demirakos et al. (2004) found that for the traditional pharmaceutical companies which rely on the low margin generic drugs to generate revenue, the free cash flow based valuation models were particularly useful. Thus the free cash flow based DCF model can largely improve the capability of the combined model to estimate the future part of intrinsic value, which is derived from the later life stages of pharmaceutical companies.

Similarly to other fast growing but risky high-technology companies, the biotechnology companies have great amounts of intrinsic value created by their intangible assets and future operating activities. In the valuation of biotechnology companies, the forward-looking and non-book value based combined models exhibit significant valuation advantages. Demirakos (2004) argued that the accounting measurement such as book value is often difficult to fully reflect the true value of intangible assets. Table 5.3 also shows that the combined model which focuses on the future has better performance. Specifically, the combined model of FPE, FPEG and RI is the number one combined model with considerably high levels of accuracy and explanatory power (14.19% and 68.30%, respectively). The superior performance of this combined model is the result of a series of value indictors, which are fully compatible with the nature of biotechnology companies. These value indictors include the forecasted next year's earnings, forecasted future long term earnings growth rate, last year's book value and forecasted residual income. Banerjee (2003) concluded that the biotechnology companies are capital and technology intensive companies with little current intrinsic value, and most of their intrinsic values are embedded in the long and risky R&D still in progress. Once their core biotechnology products complete the development, regulatory approval and enter into the marketing stage, their earnings are expected to increase sharply. Thus, it is essential for the combined model to consider the possible and enormous amount of intrinsic value released from the future. The value indictor of the forecasted next year's earnings, especially the forecasted future long term earnings growth rate are able to capture the possible intrinsic value delivered by the commercialization of biotechnology R&D in the future. As the biotechnology product development is often subject to great technology risk and regulatory uncertainty, it is also important to take into account the possible loss in the future. In the valuation of companies with high possibility of negative earnings, Pinto et al. (2010) discovered that the value indictor of residual income has a significant valuation advantage.

## 5.3 Combined Valuation Models versus Individual Valuation Models

This section investigates whether the combined valuation models outperform the individual valuation models in the study sample industries. In recent years, the use of more than one individual valuation model has become a common practice in company valuation. According to

**Table 5.3 Suitability Ranking of Combined Valuation Models - Health Care Industry**

1. Pharmaceuticals

| Combined Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| DCF, DD and TDY | 10.10% | 3 | 82.90% | 1 | 1 |
| EVS, PCF and TDY | 9.81% | 1 | 80.68% | 4 | 2 |
| PCF, TDY and FDY | 10.35% | 5 | 81.08% | 2 | 3 |
| FPE, PCF and FDY | 10.09% | 2 | 79.13% | 6 | 4 |
| FPE, PCF and TDY | 10.66% | 8 | 80.70% | 3 | 5 |
| EVS, TDY and FDY | 10.48% | 6 | 80.58% | 5 | 5 |
| EVS, PCF and FDY | 10.15% | 4 | 78.75% | 8 | 7 |
| DD, TDY and FDY | 10.53% | 7 | 78.70% | 9 | 8 |
| FPE, EVS and TDY | 11.18% | 11 | 78.80% | 7 | 9 |
| FPE, TDY and FDY | 11.06% | 10 | 78.60% | 10 | 10 |
| EVS, DD and TDY | 10.78% | 9 | 77.60% | 12 | 11 |
| FPE, DD and TDY | 11.35% | 12 | 77.68% | 11 | 12 |
| EVS, DD and FDY | 12.41% | 13 | 71.15% | 13 | 13 |
| EVS, PCF and DD | 15.99% | 18 | 70.14% | 14 | 14 |
| DCF, DD and FDY | 13.71% | 15 | 64.40% | 17 | 14 |
| FPE, EVS and PCF | 15.97% | 17 | 65.56% | 16 | 16 |
| FPE, EVS and FDY | 13.65% | 14 | 59.40% | 19 | 16 |
| FPE, PCF and DD | 17.05% | 20 | 68.94% | 15 | 18 |
| FPE, DD and FDY | 14.66% | 16 | 54.43% | 20 | 19 |
| FPE, EVS and DD | 16.66% | 19 | 64.36% | 18 | 20 |

2. Biotechnology

| Combined Valuation Models | Accuracy | | Explanatory Power | | Overall Rank |
|---|---|---|---|---|---|
| | Adj Valuation Error (Abs) | Rank | R-Sq (adj) | Rank | |
| FPE, FPEG and RI | 14.19% | 3 | 68.30% | 6 | 1 |
| FPE, EVS and RI | 15.02% | 8 | 68.86% | 3 | 2 |
| TPE, FPEG and RI | 14.80% | 6 | 67.44% | 8 | 3 |
| FPE, TPEG and FPEG | 15.23% | 10 | 68.50% | 4 | 3 |
| FPE, TPEG and RI | 13.73% | 1 | 64.90% | 14 | 5 |
| FPE, TPEG and EVS | 15.83% | 14 | 68.88% | 2 | 6 |
| TPE, FPE and EVS | 15.73% | 12 | 68.38% | 5 | 7 |
| TPE, FPE and RI | 14.09% | 2 | 64.80% | 16 | 8 |
| TPE, EVS and RI | 14.40% | 5 | 65.88% | 13 | 8 |
| FPE, FPEG and EVS | 16.49% | 17 | 69.88% | 1 | 8 |
| FPEG, EVS and RI | 15.20% | 9 | 66.54% | 11 | 11 |
| TPE, FPE and FPEG | 16.05% | 15 | 67.96% | 7 | 12 |
| TPE, TPEG and RI | 14.32% | 4 | 62.38% | 20 | 13 |
| TPEG, EVS and RI | 14.98% | 7 | 64.20% | 17 | 13 |
| TPEG, FPEG and RI | 15.41% | 11 | 64.84% | 15 | 15 |
| TPE, FPEG and EVS | 16.92% | 18 | 67.26% | 10 | 16 |
| TPEG, FPEG and EVS | 17.05% | 19 | 67.42% | 9 | 16 |
| TPE, FPE and TPEG | 15.83% | 13 | 64.20% | 18 | 18 |
| TPE, TPEG and FPEG | 17.47% | 20 | 65.96% | 12 | 19 |
| TPE, TPEG and EVS | 16.33% | 16 | 62.86% | 19 | 20 |

Source: Author's calculation

the Institutional Factor Survey conducted by Merrill Lynch in 2006, institutional investors use an average of nine individual valuation models and financial ratios together in equity valuation. However, whether several individual valuation models have significant valuation advantages when they work as a group, and whether it is appropriate to combine certain individual valuation models together remain unsolved. Table 5.4 provides a detailed suitability comparison of the study sample combined valuation models with the sample individual valuation models, based on the reliability test of their value estimates.

Table 5.4 reflects the valuation advantage of the combined valuation models. In the study sample industries, the combined valuation models have higher degree of suitability than the individual valuation models. Vardavaki and Mylonakis (2007) confirmed that the proper use of more than one individual valuation model at the same time is able to produce more reliable value estimates. The authors also argued that the combined valuation model is more informative by providing better and accurate estimations of equity market values. Tiwari and Singla (2015) revealed that since the combined value estimate considers all bona fide information of individual valuation models, the combined valuation model is more reliable. Lie and Lie (2002) also discovered that the combination of several individual valuation models with opposite biases performed better than an individual valuation model.

However, it is not appropriate to combine certain individual valuation models together. Table 5.5 shows that certain individual valuation models perform better when they work as individuals rather than in a group. In general, the result reveals that the performance of a combined valuation model is determined by two important factors. The first is whether the individual valuation models in the combined valuation model are compatible with the characteristics of the company being valued. The second is whether the individual valuation models in the combined valuation model are complementary. Specifically, the second factor is hugely important as it directly determines whether synergy can be generated from the combined valuation model. The current study introduces two important valuation concepts to ensure that the individual valuation models in the combined valuation model are complementary and the synergy can be generated. First, a superior combined valuation model should be able to cover all the important life stages of a company (multi-valuation periods), especially the life stage with a large amount of intrinsic value generated. Any combined valuation model that focuses only on a single period often results in incomplete valuation results. Second, a superior combined valuation model should also fully disclose the intrinsic value generated in all the important life stages. In each important life stage, there should be at least one effective value indictor which is able to fully capture the intrinsic value produced during that life stage. Thus, there should be more than one suitable value indictor in total to simultaneously capture the intrinsic values from different important life stages (multi-value indictors). Yee (2004) argued that every value indicator reflects an incremental piece of intrinsic value, any combined valuation model that relies on just one value indicator may ignore some parts of the intrinsic value. Thus, the superior performance of an industry-based combined valuation model is only guaranteed when it fully complies with two important valuation concepts introduced in the current study: multi-valuation periods and multi-value indictors.

## 5.4 Mixed Combined Models versus Pure Combined Models

This section investigates whether the combinations of absolute and relative valuation models (mixed combined models) have significant valuation advantage over the combined models, which contain only the absolute or relative valuation model (pure combined models). In the construction of the combined model, whether it is necessary to include both absolute and relative

**Table 5.4 Suitability Comparison: Combined vs Individual Valuation Models**

| | # of Obs | Accuracy | Explanatory Power | # of Obs | Accuracy | Explanatory Power | # of Obs | Accuracy | Explanatory Power |
|---|---|---|---|---|---|---|---|---|---|
| | 1. Commercial Bank | | | 1. Software & Computer Services | | | 1. Pharmaceuticals | | |
| **Combined** | 20 | 14.79% | 60.77% | 20 | 13.66% | 84.49% | 20 | 11.12% | 78.14% |
| **Individual** | 6 | 23.78% | 20.34% | 6 | 39.77% | 56.13% | 6 | 48.26% | 35.31% |
| **ANOVA-P** | – | 0.001 | 0.001 | – | 0.000 | 0.000 | – | 0.000 | 0.000 |
| | 2. Insurance | | | 2. Technology Hardware | | | 2. Biotechnology | | |
| **Combined** | 20 | 9.05% | 92.83% | 20 | 13.99% | 70.96% | 20 | 15.32% | 66.90% |
| **Individual** | 6 | 35.57% | 56.78% | 6 | 37.93% | 36.77% | 6 | 47.75% | 50.36% |
| **ANOVA-P** | – | 0.000 | 0.000 | – | 0.000 | 0.000 | – | 0.000 | 0.000 |
| | 3. Securities | | | | | | | | |
| **Combined** | 20 | 17.41% | 70.64% | | | | | | |
| **Individual** | 6 | 40.61% | 27.90% | | | | | | |
| **ANOVA-P** | – | 0.000 | 0.000 | | | | | | |

Note: "# of Obs" is the number of observations for the accuracy or explanatory power of the sample combined or individual valuation models; "Accuracy" is measured by using the absolute value of adjusted valuation error (Adj Valuation Error); "Explanatory Power" is measured by the adjusted R-square of OLS regression (R-Sq). "Combined" means that in each sample sector, the median value of accuracy or explanatory power for 20 combined models (as shown in Table 5.1, 5.2 and 5.3); "Individual" is the median value of the accuracy or explanatory power, for the top 6 individual models in each sample sector (as shown in Tables 4.1, 4.2 and 4.3); "ANOVA-P" is the p value in the one way ANOVA test (confidence level: 95%), it is used to judge whether the sample combined valuation models have significant valuation advantage over the sample individual valuation models, in terms of accuracy or explanatory power.

Source: Author's calculation

**Table 5.5 Work as a Group vs Work as Individuals**

| | Accuracy | Explanatory Power | Accuracy | Explanatory Power | Accuracy | Explanatory Power |
|---|---|---|---|---|---|---|
| | 1. Commercial Bank | | 1. Software & Computer Services | | 1. Pharmaceuticals | |
| **% Outperformed** | 100.00% | 95.00% | 100.00% | 100.00% | 100.00% | 100.00% |
| | 2. Insurance | | 2. Technology Hardware | | 2. Biotechnology | |
| **% Outperformed** | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |
| | 3. Securities | | | | | |
| **% Outperformed** | 85.00% | 100.00% | | | | |

Note: "% Outperformed" means that in each sample sector, the percentage of combined models outperform all their own individual models. When "% Outperformed" is 100%, it indicates that individual models perform better when they work as a group rather than individual. The details of the table are presented in Appendix C.

Source: Author's calculation

valuation models remains unclear. Table 5.6 provides an answer to this question by comparing the suitability of the study sample mixed and pure combined models, based on the reliability test of their value estimates. The details of the sample mixed and pure combined models are illustrated in Appendix D.

The test result in Table 5.6 indicates that in general, the mixed combined models do not significantly outperform the pure combined models. In fact, the overall performances of the mixed combined models have been largely reduced by several mixed combined models that contain unbalanced and non-complementary individual valuation models. For the well-established mixed combined models, which comply with the concept of multi-valuation periods and multi-value indictors, they perform better than the pure combined models. Demirakos et al. (2004) found evidence that in valuation practice, the absolute valuation methods are frequently used in combination with relative valuation models. Jenkins (2006) confirmed that the effective combination of absolute and relative valuation models is able to focus both on the long-term forecasts as well as short-term forecasts. Imam et al. (2013) discovered that the use of an accrual based relative model alongside a cash flow based absolute model reduced valuation error, as accruals add value relevant information to cash flows. Therefore, it is necessary to simultaneously apply the absolute and relative valuation models.

Table 5.6 shows that the mixed combined models have good valuation performance in the emerging sectors such as biotechnology. The mixed combined models are consistent with the valuation concept of multi-valuation periods, where they simultaneously take into account the current and future parts of intrinsic value. Therefore, the mixed combined models have superior capability to deal with the volatile and uncertain future cash flow, they are good at capturing the enormous amount of intrinsic value generated from the future operating activities. On the other hand, for the companies in the traditional sectors with fewer future growth opportunities, most of their intrinsic values have already been generated by the past and current operating activities. Thus, their current parts of intrinsic values often account for large percentages of their total intrinsic values. For such traditional companies, there is less demand for the mixed combined models that focus on the future part of intrinsic value. It is necessary to adjust the mixed combined model by including more current intrinsic value based relative valuation models, while reducing the number of future intrinsic value based absolute valuation models in the combination.

**Table 5.6 Suitability Comparison: Mixed vs Pure Combined Models**

| | # of Obs | Accuracy | Explanatory Power | # of Obs | Accuracy | Explanatory Power | # of Obs | Accuracy | Explanatory Power |
|---|---|---|---|---|---|---|---|---|---|
| | 1. Commercial Bank | | | 1. Software & Computer Services | | | 1. Pharmaceuticals | | |
| **Mixed** | 10 | 14.81% | 46.19% | 16 | 13.56% | 84.49% | 10 | 13.06% | 70.65% |
| **Pure** | 10 | 14.24% | 69.19% | 4 | 14.30% | 84.69% | 10 | 10.57% | 78.96% |
| **ANOVA-P** | – | 0.963 | 0.194 | – | 0.530 | 0.515 | – | 0.073 | 0.158 |
| | 2. Insurance | | | 2. Technology Hardware | | | 2. Biotechnology | | |
| **Mixed** | 10 | 9.11% | 92.34% | – | – | – | 10 | 14.60% | 65.39% |
| **Pure** | 10 | 8.99% | 93.01% | – | – | – | 10 | 16.19% | 67.69% |
| **ANOVA-P** | – | 0.613 | 0.699 | – | – | – | – | 0.000 | 0.177 |
| | 3. Securities | | | | | | | | |
| **Mixed** | 16 | 17.96% | 69.41% | | | | | | |
| **Pure** | 4 | 15.33% | 77.23% | | | | | | |
| **ANOVA-P** | – | 0.031 | 0.128 | | | | | | |

Note: "Mixed" stands for the sample combined valuation models which consist of both absolute and relative valuation models; "Pure" stands for the sample combined valuation models which contain only absolute or relative valuation models; The "%" is the median value of accuracy or explanatory power for the sample mixed or pure combined models; The Technology Hardware industry only contains pure combined models, thus it is removed from Table 5.6.

Source: Author's calculation

## 5.5 Chapter Summary

Based on the reliability test results, this chapter discussed the sample companies' combined value estimates produced by the sample industry-based combined valuation models. First, the chapter identified and ranked a series of industry-based combined valuation models based on the reliability of their combined value estimates. The best (number one in the suitability ranking list) combined valuation models for each sample industry and their special features are displayed in Table 5.7. The suitability ranking of industry-based combined valuation models has excellent practical relevance in company valuation, where the ranking provides effective practical guidance for the construction of combined valuation models. The reliability of valuation results is expected to improve as a result of more suitable combined valuation model construction. Second, the test result clearly reflects the overwhelming valuation advantage of the industry-based combined valuation models. These models have significantly higher degrees of reliability than the industry-based individual valuation models. This is particularly true for the combined valuation models, which are compatible with the characteristics of the company being valued, and comply with the concept of multi-valuation periods and multi-value indictors. Third, in the construction of combined valuation models, it is critical to include both absolute and relative valuation models. The mixed combined valuation models are able to maximize the advantage of absolute and relative valuation models, while minimizing their drawbacks.

**Table 5.7 Best Industry-based Combined Valuation Models during Year 2010 - 2012**

| | Best Combined Valuation Model | Special Features |
|---|---|---|
| Financial Industry | | |
| Commercial Bank | PBV, DD and FPEG | Fully covers all the life stages of commercial bank through the current, future short, middle, long and infinite value indictors |
| Insurance | PBV, DD and FDY | Captures the current part of insurance company's intrinsic value via historical book value, and the future part of intrinsic value via estimated dividend |
| Securities | PBV, TDY and RI | Considers the great uncertainty and possible loss of securities company via the current book value, historical dividend and estimated residual income |
| Information Technology Industry | | |
| Software & Computer Services | TPE, FPEG and DCF | Captures the intrinsic value generated from the recent years, predictable and infinite future through earnings, earnings growth rate and free cash flow |
| Technology Hardware | FPE, FPEG and PS | Synergy generated by a combination of several suitable individual models which are consistent with the stable nature of technology hardware company |
| Health Care Industry | | |
| Pharmaceuticals | DCF, DD and TDY | Captures the current part of intrinsic value via historical dividend, and the future part of intrinsic value via estimated dividend and free cash flow |
| Biotechnology | FPE, FPEG and RI | Fully compatible with the long and risky nature of biotechnology R&D, and complies with the principle of multi-periods and multi-value indictors |

Source: Author’s summary

# Chapter 6

# Research Results: Target Prices

## 6.1 Introduction

This chapter discusses the sample companies' target prices produced by both financial analysts and the current study. First, the chapter analyzes the financial analysts' target prices produced in recent years. Second, the chapter tests the best industry-based individual and combined valuation models identified in Chapters 4 and 5, whether they are capable of producing target prices with higher degrees of reliability. The rest of the chapter is organized as follows: Section 6.2 discusses the financial analysts' target prices. Section 6.3 discusses the target prices produced by the best industry-based individual and combined valuation models. The last section compares the two categories of target prices and concludes the major findings.

## 6.2 Target Prices Produced by Financial Analysts

This section discusses the characteristics and performance of financial analysts' target prices. The discussion is based on the quarterly financial analysts' consensus target prices obtained directly from Zacks Investment Research, for 35 sample companies across three industries between the years 2010 and 2012. The term "consensus target price" refers to the future price of a stock that financial analysts have agreed on.

### 6.2.1 Target Price Characteristics

Table 6.1 presents the general characteristics of the financial analysts' target prices between the years 2010 and 2012. In general, there are more "positive" than "negative" target prices. The following sections offer detailed discussion on the characteristics of the financial analysts' target prices across the financial, information technology and health care industries.

Table 6.1 reveals that the Groups 4 and 5 target prices account for 77.78% of the total target prices, while Groups 1 and 2 target prices only account for 0.56% in the financial industry. Specifically, the securities sector exhibits the largest number of Groups 4 and 5 target prices (81.67%). The underlying reason for this phenomenon is straightforward. The financial industry recovered rapidly from the 2008 global financial crisis, where the performance of the financial industry is often positively and significantly correlated to the business cycle. Following the 2008 global financial crisis, M&A emerged and the financial intermediaries played an important role to assist the M&A and business reform activities, in the form of funds support and transaction services provision. The considerable commissions and interest incomes earned by the securities companies and commercial banks resulted in higher earnings forecast for themselves. Table 6.3 presents the high short term estimated earnings growth rates of the commercial bank and securities sectors for the years 2010, 2011 and 2012. Specifically, the securities sector exhibits the highest short term estimated earnings growth rate (from 53.83% to 130.57%) and growth/risk ratio (from 36.99 to 99.41) during the three years. Since the target price is the most likely price level in the next 12 months, the financial analysts often focus on the estimated future short term performance to set target prices. Thus, the financial analysts produced the largest number of Groups 4 and 5 target prices for the securities sector.

Table 6.1 shows that the financial analysts produced the most conservative target prices for the software and computer services sector, which exhibits the largest number of Group 3 target prices (36.67% of its total target prices). In addition, some financial analysts produced Group 1 target prices (1.67%). The cyclical software and computer services sector is highly risky, and its performance is extremely sensitive to the level of technology spending. The level of technology spending is often affected by the business cycle effects, where companies reduce their IT budgets and are less willing to spend on new IT products during difficult times. The software and computer services companies fall in value during the bottom and early-recovery stages of the business cycle. The short term earnings forecast and valuation have been depressed by the recent underperformance, where its earnings have been on a decline (see Table 6.3). The software and computer services sector had relatively low short term estimated earnings growth rates (from 7.01% to 14.86%) and growth/risk ratios (from 6.80 to 13.34) during the study sample period. Thus, the financial analysts produced conservative and negative target prices for this sector. On the contrary, the performance of the technology hardware sector was more stable during and after the 2008 globe financial crisis. Most of the technology hardware companies' products are electrical equipment, which is less elastic toward price changes and macroeconomic conditions. The financial analysts are more confident toward the future performance of the defensive technology hardware companies. Table 6.1 shows the technology hardware sector exhibits a large amount of Group 4 target prices (51.67%), and Group 5 target prices (20%).

Table 6.1 shows the pharmaceutical sector has the second largest number of Groups 4 and 5 target prices (81.66% of the total target price). The pharmaceutical sector is a medical science-based sector, which specializes in the development and provision of medicines. As the rigid demand for medical products, the performance of the pharmaceutical sector is often less sensitive to the economic recession. Therefore, the pharmaceutical sector was more resistant than most sectors during the recession and maintained a higher past five years' growth rate of 10.09% to 21.89% (see Table 6.3). On the other hand, the biotechnology sector has been seriously impacted by the 2008 global financial crisis, in which the past five years' growth rate of the biotechnology sector only ranges from -105.09% to 10.97% (see Table 6.3). Thus, Table 6.1 reflects the financial analysts' negative attitude towards the biotechnology sector. The biotechnology sector has the largest number of Groups 1 and 2 target prices (20%), while the smallest number of Groups 4 and 5 target prices (48.33%) in all the sample sectors. In general, the performance of biotechnology companies is highly dependent on the progress of R&D. However, the 2008 global financial crisis largely reduced the outsourcing development orders from the downstream companies, and resulted in significantly fewer funds to support the ongoing R&D. Therefore, the biotechnology sector exhibited poor performance.

**Table 6.1 Financial Analysts' Target Prices**

**Financial Industry**

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Total |
|---|---|---|---|---|---|---|
| 1. Commercial Bank | 0.00% | 1.67% | 21.67% | 50.00% | 26.67% | 100.00% |
| 2. Insurance | 0.00% | 0.00% | 25.00% | 56.67% | 18.33% | 100.00% |
| 3. Securities | 0.00% | 0.00% | 18.33% | 25.00% | 56.67% | 100.00% |
| **Average:** | 0.00% | 0.56% | 21.67% | 43.89% | 33.89% | |

**Information Technology Industry**

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Total |
|---|---|---|---|---|---|---|
| 1. Software & Computer Services | 1.67% | 0.00% | 36.67% | 50.00% | 11.67% | 100.00% |
| 2. Technology Hardware | 0.00% | 0.00% | 28.33% | 51.67% | 20.00% | 100.00% |
| **Average:** | 0.83% | 0.00% | 32.50% | 50.83% | 15.83% | |

**Health Care Industry**

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Total |
|---|---|---|---|---|---|---|
| 1. Pharmaceuticals | 0.00% | 0.00% | 18.33% | 33.33% | 48.33% | 100.00% |
| 2. Biotechnology | 20.00% | 0.00% | 31.67% | 33.33% | 15.00% | 100.00% |
| **Average:** | 10.00% | 0.00% | 25.00% | 33.33% | 31.67% | |

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|---|
| **Average:** | 3.10% | 0.24% | 25.71% | 42.86% | 28.10% |

Note: "%" above is the number of a specific group's target price, as a percentage of total target prices; the detailed target price classification method is presented in Table 6.2

Source: Author's calculation

**Table 6.2 Target Price Classification Method**

| | Type | TP vs MPTTD |
|---|---|---|
| Group 1 | Negative | The TPs are equal to or less than 75% of the MPTTDs |
| Group 2 | Negative | The TPs are within 75% to 90% of the MPTTDs |
| Group 3 | Conservative | The TPs are equal to or within (1±10%) of the MPTTDs |
| Group 4 | Positive | The TPs are within 110% to 125% of the MPTTDs |
| Group 5 | Positive | The TPs are equal to or more than 125% of the MPTTDs |

Note: "TP" - target price; "MPTTD" - market prices three trading days prior to the target price announcement dates or valuation dates;

Source: Author's conclusion

**Table 6.3 Growth and Risk**

| | Year 2010 | | | | | | Year 2011 | | | | | | Year 2012 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Growth Rate % | | | | Risk | Growth/Risk | Growth Rate % | | | | Risk | Growth/Risk | Growth Rate % | | | | Risk | Growth/Risk |
| | -5yr | -1yr | +1yr | +5yr | Current | +1yr/Current | -5yr | -1yr | +1yr | +5yr | Current | +1yr/Current | -5yr | -1yr | +1yr | +5yr | Current | +1yr/Current |
| **Financial Industry** | | | | | | | | | | | | | | | | | | |
| Banks | -18.12 | -42.20 | 62.82 | 6.25 | 1.09 | 57.71 | -0.39 | 17.84 | 14.81 | 7.00 | 1.14 | 13.00 | 11.74 | 23.21 | 12.06 | 7.25 | 1.19 | 10.10 |
| Insurance | 11.73 | 25.74 | -5.58 | 10.00 | 0.61 | -9.18 | 5.69 | 9.31 | 3.83 | 10.00 | 0.63 | 6.09 | -2.41 | -14.82 | 16.32 | 8.25 | 0.69 | 23.65 |
| Securities | -51.44 | -25.00 | 130.57 | 11.00 | 1.31 | 99.41 | -128.38 | -98.86 | 74.87 | 12.00 | 1.35 | 55.44 | -158.90 | -48.57 | 53.83 | 14.00 | 1.46 | 36.99 |
| **Information Technology Industry** | | | | | | | | | | | | | | | | | | |
| Software & Computer Services | 28.34 | 12.60 | 7.01 | 12.40 | 1.03 | 6.80 | 23.10 | 13.47 | 14.86 | 15.20 | 1.11 | 13.34 | 21.46 | 13.37 | 13.66 | 15.00 | 1.18 | 11.59 |
| Technology Hardware | 9.95 | -13.56 | 11.26 | 12.50 | 1.07 | 10.49 | 13.52 | 1.73 | 11.23 | 12.50 | 1.09 | 10.29 | 3.35 | 7.27 | 16.89 | 10.00 | 1.17 | 14.41 |
| **Health Care Industry** | | | | | | | | | | | | | | | | | | |
| Pharmaceuticals | 10.85 | 20.74 | 8.09 | 2.40 | 0.68 | 11.83 | 10.09 | 7.36 | -3.79 | 0.99 | 0.60 | -6.35 | 21.89 | 31.14 | -8.66 | 1.25 | 0.63 | -13.69 |
| Biotechnology | -105.09 | 19.66 | 11.92 | 15.00 | 0.57 | 21.04 | -26.86 | 17.70 | 13.75 | 15.75 | 0.57 | 24.00 | 10.97 | 27.74 | 11.53 | 17.00 | 0.50 | 22.98 |

Note: Growth and risk are two important elements in company valuation. They directly determine the level of a company's intrinsic value. In general, the less risky and faster growth the sector, the more bullish the target price.

"-5yr" - the actual past five years earnings average growth rate; "-1yr" - the actual past one year earnings growth rate; "+1yr" - the forecasted future one year earnings growth rate; "+5yr" - the forecasted future five years earnings average growth rate; "Risk" - the current raw beta; "Growth/Risk" - the forecasted future one year earnings growth rate divided by the current raw beta.

Source: Author's calculation

### 6.2.2 Target Price Performance

Tables 6.4, 6.5 and 6.6 present the general performance of the financial analysts' target prices in the study sample sectors between the years 2010 and 2012. In general, the percentage of realized target prices is low, which ranges from 22.42% to 55.42% across the three sample industries. This reflects the low reliability of the financial analysts' target prices, where only half of the target prices (55.42%) were achieved in the following 12 months after the initial target price announcement dates. In addition, the valuation forecast error is considerably high, ranging from 7.35% to 32.19% across the three sample industries. This reflects that the gap between the financial analyst's target price and market price in the following 12 months is huge, where the target price level is too high or low to reach. Sections 6.2.2.1 to Section 6.2.2.3 provide detailed discussion of the performance of the financial analysts' target prices across the financial, information technology and health care industries.

#### 6.2.2.1 Financial Industry

Table 6.4 shows that the securities sector has the largest percentage of Groups 4 and 5 target prices (81.67%). However, Table 6.4 also shows that the securities sector has the lowest percentage of realized target prices (22.42%), the lowest level of frequency (30.17%), and the highest level of valuation forecast error (21.76%). This reflects the low reliability of the financial analysts' target prices in the securities sector. In fact, the over-optimism of financial analysts toward the future performance of the securities companies often results in over-aggressive target prices. In general, there are two major reasons for the over-optimism of the financial analysts. First, they often concentrate on the recent events of a company, while paying less attention to the long term trends. Following the 2008 global financial crisis, the financial analysts' future short term earnings forecast have been irrationally pushed up by the short term outperformance of the securities companies. Table 6.3 shows the large future one year earnings growth rate estimated by financial analysts, which ranges from 53.83% to 130.57%. Thus, this results in higher levels of valuation and target prices. Second, the commission generated from the securities brokerage services is one of the major income sources for the financial analyst. The optimism of financial analysts was exacerbated by the incentives to generate more trading in the bull market after the 2008 global financial crisis. In order to attract more orders from their clients, the financial analysts have been motivated to produce positive target prices.

In fact, the over-optimism of financial analysts is harmful to the reliability of target prices and often causes the target price to become too high to achieve. For example, the most "aggressive" securities sector exhibits the worst target price performance. On the contrary, the most conservative insurance sector has the lowest numbers of Groups 4 and 5 target prices (75%), but it exhibits the best target price performance in the financial industry. Specifically, the insurance sector has the highest percentage of realized target prices (43.99%), the highest level of frequency (51.21%), and the lowest degree of valuation forecast error (7.35%).

Table 6.4 also presents the duration of the market prices reaching their target levels (as measured by % DISTRIBUTION). In general, the duration is simultaneously determined by the short term earnings growth rate and target price level. For the positive target prices, the less aggressive the target level and the faster the growth in the sector, the shorter the duration. Although the securities sector has the most aggressive target prices, Table 6.3 shows it also has the largest short term growth rate (53.83% to 130.57%). Thus, the securities sector has the second shortest duration in the financial industry, where 17.74% of the target prices have been achieved within six months. On the contrary, the insurance sector has the most conservative target prices, but also has the lowest growth rate (-5.58% to 16.32%). Thus, the insurance sector has the longest duration with only 14.7% of target prices achieved within six months and most target prices (19.52%) have been achieved in the fourth quarter after the initial target price announcement date. Hence, the target price setting process should fully consider the nature of the company being valued, and the target level must be consistent with the growth potential of the company.

**Table 6.4 Performance of Financial Analysts' Target Prices: Financial Industry**

1. Commercial Bank

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | **Overall** |
|---|---|---|---|---|---|---|
| % of Total Target Price | 0.00% | 1.67% | 21.67% | 50.00% | 26.67% | 100.00% |
| ***Realized Target Prices*** | | | | | | |
| % REALIZED | - | 100.00% | 0.00% | 53.33% | 18.75% | 43.02% |
| % DISTRIBUTION | | | | | | |
| 1st Quarter | - | 100.00% | - | 23.33% | 0.00% | 41.11% |
| 2nd Quarter | - | 0.00% | - | 6.67% | 12.50% | 6.39% |
| 3rd Quarter | - | 0.00% | - | 13.33% | 0.00% | 4.44% |
| 4th Quarter | - | 0.00% | - | 6.67% | 6.25% | 4.31% |
| % FREQUENCY | - | 35.04% | - | 48.15% | 26.88% | 36.69% |
| ***Unrealized Target Prices*** | | | | | | |
| % UNREALIZED | - | 0.00% | 100.00% | 46.67% | 81.25% | 56.98% |
| % FORECAST_ERROR | - | - | 10.96% | 7.74% | 12.98% | 10.56% |

2. Insurance

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | **Overall** |
|---|---|---|---|---|---|---|
| % of Total Target Price | 0.00% | 0.00% | 25.00% | 56.67% | 18.33% | 100.00% |
| ***Realized Target Prices*** | | | | | | |
| % REALIZED | - | - | 40.00% | 64.71% | 27.27% | 43.99% |
| % DISTRIBUTION | | | | | | |
| 1st Quarter | - | - | - | 14.71% | 0.00% | 7.35% |
| 2nd Quarter | - | - | - | 14.71% | 0.00% | 7.35% |
| 3rd Quarter | - | - | - | 17.65% | 0.00% | 8.82% |
| 4th Quarter | - | - | - | 11.76% | 27.27% | 19.52% |
| % FREQUENCY | - | - | 100.00% | 42.28% | 11.35% | 51.21% |
| ***Unrealized Target Prices*** | | | | | | |
| % UNREALIZED | - | - | 60.00% | 35.29% | 72.73% | 56.01% |
| % FORECAST_ERROR | - | - | 6.93% | 6.78% | 8.34% | 7.35% |

3. Securities

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Overall |
|---|---|---|---|---|---|---|
| % of Total Target Price | 0.00% | 0.00% | 18.33% | 25.00% | 56.67% | 100.00% |
| ***Realized Target Prices*** | | | | | | |
| % REALIZED | - | - | 0.00% | 46.67% | 20.59% | 22.42% |
| % DISTRIBUTION | | | | | | |
| 1st Quarter | - | - | - | 6.67% | 5.88% | 6.27% |
| 2nd Quarter | - | - | - | 20.00% | 2.94% | 11.47% |
| 3rd Quarter | - | - | - | 6.67% | 8.82% | 7.75% |
| 4th Quarter | - | - | - | 13.33% | 2.94% | 8.14% |
| % FREQUENCY | - | - | - | 31.05% | 29.30% | 30.17% |
| ***Unrealized Target Prices*** | | | | | | |
| % UNREALIZED | - | - | 100.00% | 53.33% | 79.41% | 77.58% |
| % FORECAST_ERROR | - | - | 28.74% | 11.76% | 24.78% | 21.76% |

Note: The study classifies the target prices estimated by financial analysts into two groups (Realized and Unrealized) and tests them differently. Details of the reliability test method including how to judge "Realized" and "Unrealized" are discussed in Chapter 3. A reliable target price is expected to have high degrees of "% REALIZED", short duration (measured by "% DISTRIBUTION"), high level of "% FREQUENCY", small "%UNREALIZED" and "% FORECAST_ERROR".

"% of Total Target Price"- the number of a specific group's target price, as a percentage of the total target price; "Overall" - the average value of the five groups, except "% of Total Target Price", which is the sum of the five groups.

"% REALIZED" - in a specific group, the realized target prices as a percentage of the total target prices in this group; "% DISTRIBUTION" - in a specific group, the percentage of target prices realized within a certain time period after the target price announcement date; "% FREQUENCY" - in a specific group, the frequency of market price reach or beyond the target level in the following 12 months; "%UNREALIZED" - in a specific group, the unrealized target prices as a percentage of the total target prices in this group; "% FORECAST_ERROR" - in a specific group, the valuation forecast errors of the unrealized target prices;

Source: Author's calculation

#### 6.2.2.2 Information Technology Industry

Table 6.5 provides a detailed performance summary of the financial analysts' target prices in the information technology industry. The results show the Group 4 target prices have better performances than the other groups of target prices. In fact, Group 4 target prices have good performances in all the study sample sectors. Specifically, they have the highest percentage of realized target prices, the shortest duration and the lowest valuation error across all the study sample sectors. The underlying reason for this phenomenon is straightforward. During the economic recovery stage after the 2008 global financial crisis, the most easily achieved target prices are Group 4 target prices. Since their target levels are just about 10% to 25% above the current price levels, these target levels can be easily achieved in the bull market.

On the other hand, Group 5 target prices exhibit significantly worse performances in all the study sample sectors. Table 6.5 shows that Group 5 target prices have lower percentages of realized target prices, longer duration and higher valuation error than Group 4 target prices. The reason is that Group 5 means the target level is more than 25% of above the current price levels, which causes the targets become too high to achieve during the economic recovery stage. The aggressive target price often results in poor degree of reliability, especially in the early stage of the bull market.

Table 6.5 demonstrates that the software and computer services sector has the largest number of conservative target prices. In general, this sector outperformed the bullish technology hardware sector, where it has more realized target prices (55.42%) and higher levels of frequency (72.62%). However, in contrast with Groups 3, 4 and 5 target prices, the software and computer services sector did not outperform the technology hardware sector. Table 6.5 shows Groups 3, 4 and 5 target prices have lower percentages of realized target prices and larger valuation forecast errors in the software and computer services sector. In contrast with the defensive technology hardware sector, the unstable software and computer services sector is more elastic towards the changes in macroeconomic condition. The cyclical software and computer services sector is extremely sensitive to the business cycle effect. It performed badly during the 2008 global financial crisis and was expected to continue its bad performance in the following economic early-recovery stage. Table 6.3 presents the low short term estimated earnings growth rate of the software and computer services sector, which ranges from 7.01% to 14.86%. Hence, their market prices moved slowly toward their target levels (as measured by "% DISTRIBUTION"), especially for the bullish target levels.

**Table 6.5 Performance of Financial Analysts' Target Prices: Information Technology Industry**

1. Software & Computer Services

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | **Overall** |
|---|---|---|---|---|---|---|
| % of Total Target Price | 1.67% | 0.00% | 36.67% | 50.00% | 11.67% | 100.00% |
| ***Realized Target Prices*** | | | | | | |
| % REALIZED | 100.00% | - | 4.55% | 60.00% | 57.14% | 55.42% |
| % DISTRIBUTION | | | | | | |
| 1st Quarter | 100.00% | - | - | 30.00% | 0.00% | 10.00% |
| 2nd Quarter | 0.00% | - | - | 23.33% | 14.29% | 12.54% |
| 3rd Quarter | 0.00% | - | - | 3.33% | 28.57% | 10.63% |
| 4th Quarter | 0.00% | - | - | 3.33% | 14.29% | 5.87% |
| % FREQUENCY | 99.21% | - | 100.00% | 53.41% | 37.88% | 72.62% |
| ***Unrealized Target Prices*** | | | | | | |
| % UNREALIZED | 0.00% | - | 95.45% | 40.00% | 42.86% | 44.58% |
| % FORECAST_ERROR | - | - | 25.01% | 15.92% | 55.63% | 32.19% |

2. Technology Hardware

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | **Overall** |
|---|---|---|---|---|---|---|
| % of Total Target Price | 0.00% | 0.00% | 28.33% | 51.67% | 20.00% | 100.00% |
| ***Realized Target Prices*** | | | | | | |
| % REALIZED | - | - | 5.88% | 64.52% | 58.33% | 42.91% |
| % DISTRIBUTION | | | | | | |
| 1st Quarter | - | - | - | 29.03% | 0.00% | 14.52% |
| 2nd Quarter | - | - | - | 9.68% | 33.33% | 21.51% |
| 3rd Quarter | - | - | - | 19.35% | 0.00% | 9.68% |
| 4th Quarter | - | - | - | 6.45% | 25.00% | 15.73% |
| % FREQUENCY | - | - | 100.00% | 43.57% | 20.02% | 54.53% |
| ***Unrealized Target Prices*** | | | | | | |
| % UNREALIZED | - | - | 94.12% | 35.48% | 41.67% | 57.09% |
| % FORECAST_ERROR | - | - | 21.71% | 7.70% | 9.53% | 12.98% |

Source: Author's calculation

#### 6.2.2.3 Health Care Industry

The financial analysts have significantly different views about the future performance of the pharmaceutical and biotechnology sectors. The pharmaceutical sector is a traditional and stable sector, where the rigid demand for medical products and devices causes the earnings of the pharmaceutical sector to be less sensitive to cyclical effects. Table 6.6 presents the market confidence towards its sustainable profitability, where the pharmaceutical sector has the second largest percentage of Groups 4 and 5 target prices (81.66%).

On the other hand, the R&D process of new biotechnology products was seriously delayed during the 2008 global financial crisis, and this resulted in a low and even negative earnings growth rate. Table 6.3 shows that in the year 2010, the past five year average earnings growth rate is -105.09%. In general, the costly R&D activities often require on-going capital investment, as R&D is important to the value creation of the intangibles-rich biotechnology companies. However, the decrease in outsourcing orders from downstream companies has put serious pressure on the operating incomes of the biotechnology companies. The decreased working capital significantly slowed down the R&D process, and resulted in lower valuation for the biotechnology companies. Table 6.6 reflects the low level valuation of the biotechnology sector, where it has the largest number of Groups 1 and 2 target prices (20%), and the smallest number of Groups 4 and 5 target prices (48.33%).

Although the biotechnology sector exhibits the most “negative” target prices, its target prices have a higher degree of reliability than the pharmaceutical sector. Table 6.6 reveals that the biotechnology sector exhibits the higher percentage of realized target prices (53.33%) and smaller valuation error (24.64%). Specifically, all Group 1 target prices reached their target levels, 80% of the Group 4 target prices and 33.33% of Group 5 target prices were also achieved.

On the contrary, the pharmaceutical sector exhibits a lower percentage of realized target prices (38.17%) and larger valuation errors (26.85%). Therefore, similarly to other industries in the study, a less aggressive target price often results in a better degree of reliability during the economic recovery period. This rule also applies to the health care industry.

**Table 6.6 Performance of Financial Analysts' Target Prices: Health Care Industry**

1. Pharmaceuticals

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | **Overall** |
|---|---|---|---|---|---|---|
| % of Total Target Price | 0.00% | 0.00% | 18.33% | 33.33% | 48.33% | 100.00% |
| ***Realized Target Prices*** | | | | | | |
| % REALIZED | - | - | 27.27% | 70.00% | 17.24% | 38.17% |
| % DISTRIBUTION | | | | | | |
| 1st Quarter | - | - | - | 15.00% | 3.45% | 9.22% |
| 2nd Quarter | - | - | - | 15.00% | 3.45% | 9.22% |
| 3rd Quarter | - | - | - | 20.00% | 3.45% | 11.72% |
| 4th Quarter | - | - | - | 15.00% | 6.90% | 10.95% |
| % FREQUENCY | - | - | 100.00% | 26.05% | 28.91% | 51.65% |
| ***Unrealized Target Prices*** | | | | | | |
| % UNREALIZED | - | - | 72.73% | 30.00% | 82.76% | 61.83% |
| % FORECAST_ERROR | - | - | 14.61% | 7.25% | 58.69% | 26.85% |

2. Biotechnology

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | **Overall** |
|---|---|---|---|---|---|---|
| % of Total Target Price | 20.00% | 0.00% | 31.67% | 33.33% | 15.00% | 100.00% |
| ***Realized Target Prices*** | | | | | | |
| % REALIZED | 100.00% | - | 0.00% | 80.00% | 33.33% | 53.33% |
| % DISTRIBUTION | | | | | | |
| 1st Quarter | 100.00% | - | - | 40.00% | 0.00% | 13.33% |
| 2nd Quarter | 0.00% | - | - | 20.00% | 0.00% | 6.67% |
| 3rd Quarter | 0.00% | - | - | 10.00% | 22.22% | 10.74% |
| 4th Quarter | 0.00% | - | - | 10.00% | 11.11% | 7.04% |
| % FREQUENCY | 64.80% | - | - | 55.42% | 21.14% | 47.12% |
| ***Unrealized Target Prices*** | | | | | | |
| % UNREALIZED | 0.00% | - | 100.00% | 20.00% | 66.67% | 46.67% |
| % FORECAST_ERROR | - | - | 41.09% | 12.86% | 19.97% | 24.64% |

Source: Author's calculation

## 6.3 Target Prices Produced by the Current Study

This section discusses the quarterly target prices produced by the current study for the 35 sample companies between the years 2010 and 2012. The discussion is based on the target prices produced in the current study by using the best industry-based individual and combined valuation models (see Table 4.7 and Table 5.7). For simplicity, the best industry-based combined valuation models are abbreviated to combined models, and the best industry-based individual valuation models are abbreviated to individual models in this section.

Tables 6.7 and 6.8 present the general characteristics and performance of the target prices produced by the current study. Specifically, Table 6.7 shows that the combined models are more conservative than the individual models. The combined models have significantly higher percentages of Group 3 target prices, which range from 70% to 100% of the total target prices across all the study sample sectors. On the contrary, the individual models have fewer Group 3 target prices, which range only from 25% to 38.33%. In general, the combined model has apparent advantages in overcoming the outlier effect by averaging away any extremely large or small target prices. The target prices estimated by the combined models are often more reasonable and they are able to better reflect the future intrinsic values. Table 6.8 confirms the significant valuation advantage of the combined models over the individual models. The target prices produced by the combined models have higher realization ratios (from 31.25% to 77.45%), shorter duration (as measured by "% DISTRIBUTION"), higher frequency (from 43.09% to 100.00%) and smaller valuation errors (from 7.83% to 28.97%). The following two sections provide a discussion on the target prices estimated by the individual and combined models.

The individual models tend to be over-optimistic toward the future performance of the securities and pharmaceutical sectors. Table 6.7 shows that the two sectors have the largest percentage of

Groups 4 and 5 target prices in the financial and health care industries, respectively. In fact, it is impossible for the mature sectors such as pharmaceutical to have such high levels of valuations due to their nature, these sectors often lack significant growth opportunities in the future. Table 6.3 shows that the future short term earnings growth rate of the pharmaceutical sector only ranges from -8.66% to 8.09%. In addition, it is also unreasonable for risky sectors such as securities to have over-optimistic target prices. The volatile securities sector is subject to great uncertainty since its performance is often closely related to the movement of stock markets. Table 6.3 reflects that the securities sector has the largest beta in all the study sample sectors. Thus, it is irrational to set over-optimistic target prices for a sector with great uncertainty. In fact, Table 6.8 shows the poor performance of target prices in the slow growing pharmaceutical sector, and in the volatile securities sector. Specifically, the pharmaceutical sector has the lowest number of realized target prices (34.34%) in the health care industry. In the financial industry, the securities sector has the lowest number of realized target prices (16.00%), the longest duration (measured by % DISTRIBUTION), the lowest frequency (35.67%) and the largest valuation error (43.29%). Overall, the individual models produce large target prices for the mature or uncertain sectors.

In general, the target prices estimated by the combined models are more compatible with the nature of the sector being valued. Table 6.7 summarizes the characteristics of the combined models' target prices, where the less risk and faster growth in the sector, the more bullish the target prices. Specifically, the commercial bank, technology hardware and biotechnology sectors have the largest number of Groups 4 and 5 target prices in the financial, information technology and health care industries, respectively. Groups 4 and 5 target prices in the commercial bank, technology hardware and biotechnology sectors range from 10% to 18.33% of the total target prices. Table 6.3 presents the high growth/risk ratio for the commercial bank, technology hardware and biotechnology sectors for the years 2010, 2011 and 2012. In general, a high growth/risk ratio often results in high levels of valuation and target price. Thus, the bullish target prices in the commercial bank, technology hardware and biotechnology sectors are reasonable and reliable. Table 6.8 confirms the superior reliability of these target prices. Specifically, the commercial bank has the highest realization ratio (67.55%) and the lowest valuation forecast error (7.83%) in the financial industry. The technology hardware sector has the shortest duration (as measured by % DISTRIBUTION), the highest level of frequency (72.89%) and the lowest level of valuation forecast error (12.51%) in the information technology industry. The biotechnology sector also has the highest realization ratio (59.92%) in the health care industry. The reliability test results in Tables 6.7 and 6.8 conclude that the combined models produce more reasonable target prices with higher degrees of reliability than the individual models.

## 6.4 Chapter Summary

This chapter discusses the sample companies' target prices produced by both financial analysts and the current study. The chapter summarizes the characteristics of the financial analysts' target prices produced between the years 2010 and 2012. There are more positive than negative target prices which reflects that the financial analysts were optimistic toward the future during the sample period, and produced many large target prices in the economic recovery stage after the 2008 global financial crisis. However, the reliability for these target prices is low. The reliability test results show the low percentage of realized target prices, long duration, low frequency, and large valuation forecast errors for the financial analysts' target prices.

The target prices produced by the current study exhibit significantly different characteristics and performances. Table 6.9 shows that the target prices estimated by the best industry-based combined valuation models are more conservative, where Group 3 target prices account for 70% to 100% of the total target prices across the sample industries. On the contrary, the financial analysts' target prices are more aggressive, where Group 3 target prices only account for 18.33% to 36.67%. However, during the economic recovery stage after the 2008 global financial crisis, conservative target prices exhibited higher degrees of reliability. Table 6.10 indicates that the best industry-based combined valuation models have overwhelming valuation advantages. The best industry-based combined valuation models significantly outperform the financial analysts in terms of target price performance. Specifically, there are more realized target prices, shorter duration, higher frequency and lower valuation forecast errors in all the study sample sectors. Thus, the best industry-based combined valuation models are able to improve the valuation methodology and the reliability of target prices.

**Table 6.7 Target Prices Produced by the Current Study (2010 - 2012)**

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Commercial Bank | | | | | Software & Computer Services | | | | | Pharmaceuticals | | | | |
| **Individual** | 28.33% | 8.33% | 35.00% | 16.67% | 11.67% | 15.00% | 21.67% | 31.67% | 25.00% | 6.67% | 0.00% | 0.00% | 38.33% | 21.67% | 20.00% |
| **Combined** | 0.00% | 8.33% | 81.67% | 8.33% | 1.67% | 1.67% | 8.33% | 85.00% | 5.00% | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% |
| | Insurance | | | | | Technology Hardware | | | | | Biotechnology | | | | |
| **Individual** | 16.67% | 30.00% | 36.67% | 13.33% | 3.33% | 8.33% | 21.67% | 25.00% | 18.33% | 26.67% | 28.33% | 3.33% | 33.33% | 5.00% | 30.00% |
| **Combined** | 0.00% | 0.00% | 96.67% | 3.33% | 0.00% | 0.00% | 6.67% | 81.67% | 11.67% | 0.00% | 0.00% | 11.67% | 70.00% | 15.00% | 3.33% |
| | Securities | | | | | | | | | | | | | | |
| **Individual** | 25.00% | 10.00% | 35.00% | 10.00% | 20.00% | | | | | | | | | | |
| **Combined** | 0.00% | 10.42% | 81.25% | 4.17% | 4.17% | | | | | | | | | | |

Note: "Individual" - the target prices estimated by the best industry-based individual valuation models; "Combined" - the target prices estimated by the best industry-based combined valuation models; "%" above is the number of a specific group's target price, as a percentage of total target prices

Source: Author's calculation

**Table 6.8 Target Prices Produced by the Current Study (2010 - 2012): Performance**

| | Financial Industry | | | | | | Information Technology Industry | | | | Health Care Industry | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Commercial Bank | | Insurance | | Securities | | S&C Services | | Technology Hardware | | Pharmaceuticals | | Biotechnology | |
| | Individual | Combined | Individual | Combined | Individual | Combined | Individual | Combined | Individual | Combined | Individual | Combined | Individual | Combined |
| **Realized Target Prices** | | | | | | | | | | | | | | |
| % REALIZED | 36.29% | 67.55% | 33.41% | 51.72% | 16.00% | 62.50% | 24.87% | 77.45% | 24.36% | 50.68% | 34.34% | 31.25% | 47.82% | 59.92% |
| % DISTRIBUTION | | | | | | | | | | | | | | |
| 1st Quarter | 15.00% | 13.33% | 6.25% | 100.00% | 10.42% | 53.33% | 8.59% | 24.44% | 8.39% | 55.36% | 0.00% | - | 25.08% | 46.83% |
| 2nd Quarter | 10.00% | 53.33% | 21.88% | 0.00% | 3.75% | 16.67% | 7.92% | 17.78% | 6.61% | 7.14% | 19.23% | - | 12.50% | 7.41% |
| 3rd Quarter | 9.01% | 0.00% | 12.50% | 0.00% | 4.17% | 6.67% | 6.67% | 11.11% | 7.67% | 12.50% | 3.85% | - | 12.58% | 3.70% |
| 4th Quarter | 8.97% | 13.33% | 0.00% | 0.00% | 1.67% | 6.67% | 7.92% | 0.00% | 6.11% | 0.00% | 15.38% | - | 4.17% | 3.70% |
| % FREQUENCY | 42.28% | 66.58% | 74.41% | 92.35% | 35.67% | 43.09% | 23.27% | 61.14% | 49.58% | 72.89% | 68.36% | 100.00% | 39.91% | 68.04% |
| **Unrealized Target Prices** | | | | | | | | | | | | | | |
| % UNREALIZED | 63.71% | 32.45% | 66.59% | 48.28% | 84.00% | 37.50% | 75.13% | 22.55% | 75.64% | 49.32% | 65.66% | 68.75% | 52.18% | 40.08% |
| % FORECAST_ERROR | 27.02% | 7.83% | 12.94% | 11.02% | 43.29% | 26.64% | 29.66% | 28.97% | 55.91% | 12.51% | 14.46% | 12.06% | 25.58% | 26.77% |

Source: Author's calculation

**Table 6.9 Target Prices Produced by Financial Analysts versus Target Prices Produced by the Current Study (2010 - 2012)**

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Commercial Bank | | | | | Software & Computer Services | | | | | Pharmaceuticals | | | | |
| **Analyst** | 0.00% | 1.67% | 21.67% | 50.00% | 26.67% | 1.67% | 0.00% | 36.67% | 50.00% | 11.67% | 0.00% | 0.00% | 18.33% | 33.33% | 48.33% |
| **Combined** | 0.00% | 8.33% | 81.67% | 8.33% | 1.67% | 1.67% | 8.33% | 85.00% | 5.00% | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% |
| | Insurance | | | | | Technology Hardware | | | | | Biotechnology | | | | |
| **Analyst** | 0.00% | 0.00% | 25.00% | 56.67% | 18.33% | 0.00% | 0.00% | 28.33% | 51.67% | 20.00% | 20.00% | 0.00% | 31.67% | 33.33% | 15.00% |
| **Combined** | 0.00% | 0.00% | 96.67% | 3.33% | 0.00% | 0.00% | 6.67% | 81.67% | 11.67% | 0.00% | 0.00% | 11.67% | 70.00% | 15.00% | 3.33% |
| | Securities | | | | | | | | | | | | | | |
| **Analyst** | 0.00% | 0.00% | 18.33% | 25.00% | 56.67% | | | | | | | | | | |
| **Combined** | 0.00% | 10.42% | 81.25% | 4.17% | 4.17% | | | | | | | | | | |

Source: Author's calculation

**Table 6.10 Target Prices Produced by Financial Analysts versus Target Prices Produced by the Current Study (2010 - 2012): Performance**

| | Financial Industry | | | | | | Information Technology Industry | | | | Health Care Industry | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Commercial Bank | | Insurance | | Securities | | S&C Services | | Technology Hardware | | Pharmaceuticals | | Biotechnology | |
| | Analyst | Combined | Analyst | Combined | Analyst | Combined | Analyst | Combined | Analyst | Combined | Analyst | Combined | Analyst | Combined |
| **Realized Target Prices** | | | | | | | | | | | | | | |
| %REALIZED | 43.02% | 67.55% | 43.99% | 51.72% | 22.42% | 62.50% | 55.42% | 77.45% | 42.91% | 50.68% | 38.17% | 31.25% | 53.33% | 59.92% |
| %DISTRIBUTION | | | | | | | | | | | | | | |
| 1st Quarter | 41.11% | 13.33% | 7.35% | 100.00% | 6.27% | 53.33% | 10.00% | 24.44% | 14.52% | 55.36% | 9.22% | - | 13.33% | 46.83% |
| 2nd Quarter | 6.39% | 53.33% | 7.35% | 0.00% | 11.47% | 16.67% | 12.54% | 17.78% | 21.51% | 7.14% | 9.22% | - | 6.67% | 7.41% |
| 3rd Quarter | 4.44% | 0.00% | 8.82% | 0.00% | 7.75% | 6.67% | 10.63% | 11.11% | 9.68% | 12.50% | 11.72% | - | 10.74% | 3.70% |
| 4th Quarter | 4.31% | 13.33% | 19.52% | 0.00% | 8.14% | 6.67% | 5.87% | 0.00% | 15.73% | 0.00% | 10.95% | - | 7.04% | 3.70% |
| %FREQUENCY | 36.69% | 66.58% | 51.21% | 92.35% | 30.17% | 43.09% | 72.62% | 61.14% | 54.53% | 72.89% | 51.65% | 100.00% | 47.12% | 68.04% |
| **Unrealized Target Prices** | | | | | | | | | | | | | | |
| %UNREALIZED | 56.98% | 32.45% | 56.01% | 48.28% | 77.58% | 37.50% | 44.58% | 22.55% | 57.09% | 49.32% | 61.83% | 68.75% | 46.67% | 40.08% |
| %FORECAST_ERROR | 10.56% | 7.83% | 7.35% | 11.02% | 21.76% | 26.64% | 32.19% | 28.97% | 12.98% | 12.51% | 26.85% | 12.06% | 24.64% | 26.77% |

Note: "Analyst" - the target prices estimated by financial analysts; "Combined" - the target prices estimated by the best industry-based combined valuation models. Since the target prices of pharmaceuticals sector estimated by the "Combined" models all belong to Group 3, "%DISTRIBUTION" is not applicable to Group 3. Source: Author's calculation

# Chapter 7

# Out-of-Sample Test

## 7.1 Introduction

This chapter applies the out-of-sample test to verify the robustness of the research results presented in Chapter 4, 5 and 6. The rest of the chapter is organized as follows: Section 7.2, 7.3 and 7.4 verify the robustness of the research results based on the out-of-sample results. Section 7.5 concludes the chapter.

## 7.2 Robustness of In-Sample Research Results: Individual Value Estimates

### 7.2.1 Industry-based Individual Valuation Models

In general, the suitability of a valuation model reflects its degree of applicability in the valuation of a specific sector. Based on the suitability rankings in Table 7.2, 7.3 and 7.4, the sample individual valuation models exhibit similar rankings in the sample period (2010-2012) and the out-of-sample period (2013-2015), the median value of rank difference is only ranges from 1 to 3.5 among the 7 sample sectors. The in-sample ranking is generally consistent with the out-of-sample ranking, which means that the in-sample ranking is reliable and its robustness has been confirmed by the out-of-sample test.

In addition, the small rank difference reveals that the suitability of sample individual valuation models in the sample sectors did not have significant change during the sample and out-of-sample period. Since the period of year 2010 to 2015 is within the current economic expansion stage, the characteristics of each of the sector did not have apparent changes during this period, especially for the traditional sectors such as technology hardware. In general, the technology hardware is mature sector with a large amount of tangible assets but little intangible assets such as proprietary technology and patents. Demirakos et al. (2004) found that for the traditional sectors without innovative technology, they often have slow but stable future earnings growth. The characteristics of technology hardware sector had little changes due to its low growth. Thus, the small characteristics difference results in little change of the valuation model suitability, the median value of rank difference in the technology hardware is only 1 (Table 7.3).

On the other side, the strong growth of the emerging biotechnology sector is largely driven by the R&D process. Banerjee (2003) concluded that most of intrinsic value of the biotechnology sector is embedded in the long and risky R&D still in progress. The earnings of biotechnology sector are expected to increase sharply once the core biotechnology products complete the development, regulatory approval and enter into the marketing stage. The strong growth of the R&D oriented biotechnology sector caused relatively larger change in characteristics during the period of year 2010 to 2015. Accordingly, the sample valuation models had certain degrees of suitability change, Table 7.4 shows that the biotechnology sector has the largest rank difference (median value 3.5) in all the sample sectors.

**Table 7.1 Suitability Ranking of Individual Valuation Models - Financial Industry**

1. Commercial Bank

| | Overall Rank | | |
|---|---|---|---|
| **Valuation Models** | **In Sample** | **Out of Sample** | **Rank Difference** |
| Dividend Yield Model - Forward | 1 | 6 | 5 |
| Price to Book Value Model | 2 | 2 | 0 |
| Price to Earnings Model - Forward | 3 | 1 | 2 |
| Price/Earnings to Growth Model - Forward | 4 | 6 | 2 |
| Discounted Dividend Model | 5 | 8 | 3 |
| Price/Earnings to Growth Model - Trailing | 6 | 4 | 2 |
| Residual Income Model | 7 | 11 | 4 |
| Price to Earnings Model - Trailing | 8 | 3 | 5 |
| Price to Free Cash Flow Model | 9 | 9 | 0 |
| Discounted Free Cash Flow Model | 10 | 10 | 0 |
| Dividend Yield Model - Trailing | 11 | 4 | 7 |
| **Median Value** | | | 2 |

2. Insurance

| Valuation Models | Overall Rank In Sample | Overall Rank Out of Sample | Rank Difference |
|---|---|---|---|
| Price to Book Value Model | 1 | 3 | 2 |
| Price to Earnings Model - Forward | 2 | 1 | 1 |
| Dividend Yield Model - Forward | 3 | 8 | 5 |
| Discounted Dividend Model | 4 | 6 | 2 |
| Price/Earnings to Growth Model - Forward | 5 | 2 | 3 |
| Dividend Yield Model - Trailing | 6 | 3 | 3 |
| Residual Income Model | 7 | 9 | 2 |
| Price to Earnings Model - Trailing | 8 | 6 | 2 |
| Price to Free Cash Flow Model | 9 | 5 | 4 |
| Price/Earnings to Growth Model - Trailing | 10 | 10 | 0 |
| Discounted Free Cash Flow Model | 11 | 11 | 0 |
| **Median Value** | | | 2 |

3. Securities

| Valuation Models | Overall Rank In Sample | Overall Rank Out of Sample | Rank Difference |
|---|---|---|---|
| Price to Earnings Model - Forward | 1 | 2 | 1 |
| Residual Income Model | 2 | 1 | 1 |
| Price to Book Value Model | 3 | 8 | 5 |
| Dividend Yield Model - Trailing | 4 | 5 | 1 |
| Discounted Dividend Model | 5 | 5 | 0 |
| Price/Earnings to Growth Model - Forward | 6 | 3 | 3 |
| Price to Earnings Model - Trailing | 7 | 10 | 3 |
| Dividend Yield Model - Forward | 8 | 3 | 5 |
| Price to Free Cash Flow Model | 9 | 7 | 2 |
| Price/Earnings to Growth Model - Trailing | 10 | 11 | 1 |
| Discounted Free Cash Flow Model | 11 | 9 | 2 |
| **Median Value** | | | 2 |

Note: "In-sample" means the research results presented in Chapter 4, 5 and 6 (sample period 2010-2012); "Out-of-sample" means the research results generated by the out-of-sample test; "Rank Difference" is the difference between the "In Sample" and "Out of Sample" rankings. Source: Author's calculation

**Table 7.2 Suitability Ranking of Individual Valuation Models - Information Technology Industry**

1. Software & Computer Services

| Valuation Models | Overall Rank In Sample | Overall Rank Out of Sample | Rank Difference |
|---|---|---|---|
| Price/Earnings to Growth Model - Forward | 1 | 1 | 0 |
| Price to Earnings Model - Forward | 2 | 2 | 0 |
| Discounted Free Cash Flow Model | 3 | 7 | 4 |
| Residual Income Model | 4 | 4 | 0 |
| Enterprise Value to Sales Model | 5 | 10 | 5 |
| Price to Earnings Model - Trailing | 6 | 3 | 3 |
| Price to Free Cash Flow Model | 7 | 7 | 0 |
| Price to Sales Model | 8 | 9 | 1 |
| Enterprise Value to EBITDA Model | 9 | 6 | 3 |
| Price/Earnings to Growth Model - Trailing | 10 | 5 | 5 |
| **Median Value** | | | 2 |

2. Technology Hardware

| Valuation Models | Overall Rank In Sample | Overall Rank Out of Sample | Rank Difference |
|---|---|---|---|
| Price to Earnings Model - Forward | 1 | 1 | 0 |
| Enterprise Value to Book Value Model | 2 | 6 | 4 |
| Price to Book Value Model | 3 | 2 | 1 |
| Price to Sales Model | 4 | 4 | 0 |
| Price/Earnings to Growth Model - Forward | 5 | 5 | 0 |
| Enterprise Value to Sales Model | 6 | 3 | 3 |
| Price to Free Cash Flow Model | 7 | 10 | 3 |
| Price to Earnings Model - Trailing | 8 | 7 | 1 |
| Enterprise Value to EBITDA Model | 9 | 9 | 0 |
| Discounted Dividend Model | 10 | 8 | 2 |
| Residual Income Model | 11 | 11 | 0 |
| Dividend Yield Model - Forward | 12 | - | - |
| Price/Earnings to Growth Model - Trailing | 13 | 13 | 0 |
| Dividend Yield Model - Trailing | 14 | - | - |
| Discounted Free Cash Flow Model | 15 | 12 | 3 |
| **Median Value** | | | 1 |

Source: Author's calculation

**Table 7.3 Suitability Ranking of Individual Valuation Models - Health Care Industry**

1. Pharmaceuticals

| Valuation Models | Overall Rank In Sample | Overall Rank Out of Sample | Rank Difference |
|---|---|---|---|
| Dividend Yield Model - Trailing | 1 | 7 | 6 |
| Price to Free Cash Flow Model | 2 | 7 | 5 |
| Price to Earnings Model - Forward | 3 | 1 | 2 |
| Dividend Yield Model - Forward | 4 | 2 | 2 |
| Discounted Dividend Model | 5 | 10 | 5 |
| Enterprise Value to Sales Model | 6 | 4 | 2 |
| Price to Sales Model | 7 | 2 | 5 |
| Price/Earnings to Growth Model - Trailing | 8 | 9 | 1 |
| Enterprise Value to EBITDA Model | 9 | 10 | 1 |
| Price to Earnings Model - Trailing | 10 | 6 | 4 |
| Residual Income Model | 11 | 12 | 1 |
| Discounted Free Cash Flow Model | 12 | 12 | 0 |
| Price/Earnings to Growth Model - Forward | 13 | 5 | 8 |
| **Median Value** | | | 2 |

2. Biotechnology

| Valuation Models | Overall Rank In Sample | Overall Rank Out of Sample | Rank Difference |
|---|---|---|---|
| Price to Earnings Model - Forward | 1 | 7 | 6 |
| Price/Earnings to Growth Model - Trailing | 2 | 9 | 7 |
| Price to Earnings Model - Trailing | 3 | 4 | 1 |
| Enterprise Value to Sales Model | 4 | 3 | 1 |
| Price/Earnings to Growth Model - Forward | 5 | 7 | 2 |
| Residual Income Model | 6 | 1 | 5 |
| Price to Sales Model | 7 | 5 | 2 |
| Enterprise Value to EBITDA Model | 8 | 9 | 1 |
| Price to Free Cash Flow Model | 9 | 2 | 7 |
| Discounted Free Cash Flow Model | 10 | 5 | 5 |
| **Median Value** | | | 3.5 |

Source: Author's calculation

### 7.2.2 Absolute Valuation Models versus Relative Valuation Models

The out-of-sample results in Table 7.5 show that the relative valuation models outperform the absolute valuation models in most of the sample sectors, especially in the traditional sectors such as technology hardware. This result is consistent with the in-sample results “relative valuation models significantly outperform the absolute valuation models in most of the sample sectors…the relative valuation models are most suitable for the slow growing matured sector” (p.83 & p.84). Demirakos et al. (2004) also revealed that for the traditional sectors with poor growth prospects but stable accounting data, the accounting based relative valuation models have significant valuation advantages. In addition, the out-of-sample results in Table 7.5 also indicate that the absolute valuation models only have relatively higher degree of accuracy in the biotechnology sector. This finding is in line with the in-sample result “the absolute valuation models only slightly outperform the relative valuation models in the fast growing or risky sectors” (p.82). Imam et al. (2008) found that the forward-looking absolute valuation models are able to simultaneously consider the risk and growth faced by the emerging companies in the future. In general, the in-sample and out-of-sample test results both conclude that the forward-looking absolute valuation model concentrate on the future, thus they are most suitable for the high growing emerging sectors with a large amount of intrinsic value generated from the future stage. The current value-based relative valuation models focuses on the intrinsic value already generated by the companies, they are ideal valuation models for the mature sectors with less growth prospect.

### 7.2.3 Forward Valuation Models versus Trailing Valuation Models

Based on the out-of-sample results in Table 7.6, the forward valuation models have significant valuation advantage in the mature and stable sectors such as pharmaceuticals with accurate forecast data. As the traditional chemical pharmaceutical technology gradually matures and there is little technology uncertainty and re-development opportunity. Trottier (2010) found that the pharmaceutical companies especially the chemical pharmaceutical companies often lack innovative new products and their future earnings are stable and easier to predict. Therefore, the future short term-based forward valuation models have significant advantage in the valuation of the stable pharmaceutical companies with adequate, reliable and accurate forecast financial data. This finding is consistent with the in-sample result "the forward valuation models are most suitable for the mature sectors with reliable forecast data" (p.86). Liu et al. (2002) and Lie and Lie (2002) also concluded that the forward valuation models are more accurate than trailing ones, especially when the consensus financial analysts' forecasts are available. On the other hand, the out-of-sample results show that the trailing valuation models have significant higher suitability in the high growing but risky sector such biotechnology. The biotechnology companies often have great risk and uncertainity in the R&D, regulatory approval and marketing stage, their future financial data are subject to great uncertainty and difficult to predict (Banerjee, 2003). The trailing valuation models focus on the historical data thus they have apparent advantage in the valuation of unstable business. This finding is consistent with the in-sample result "The trailing valuation models are good alternatives in the valuation of unstable sectors, where the future cash flows are subject to great uncertainty and are difficult to predict" (p.86).

### 7.2.4 Enterprise Value Valuation Models versus Price Valuation Models

The out-of-sample results in Table 7.7 show that in the sample sectors, the suitability difference between the enterprise value and price valuation models is not significant. This result is in line with the in-sample result "no significant difference between the suitability of the price and enterprise value valuation models in the study sample sectors" (p.86). The in-sample and out-of-sample research results both implied that in the valuation of the listed companies from the sample sectors, it is not necessary to consider the total value of a company's total capital (including equity and debt). The price valuation models focus on the market price per share of company and they are more convenient and easy to use in practice. Lundholm and Sloan (2004) also discovered that financial analysts focused on shareholder value more than enterprise value. The enterprise value valuation models are only appropriate under certain circumstance, such as in the valuation of companies with different levels of leverage (Pinto et al., 2010), or with a large amount real estate (Koller et al., 2010).

**Table 7.4 Suitability Comparison: Absolute vs Relative Valuation Models**

| | | # of Obs | AC | EP | # of Obs | AC | EP | # of Obs | AC | EP |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Commercial Bank | | | S &C Services | | | Pharmaceuticals | | |
| **In Sample** | **Absolute** | 15 | 96.75% | 10.88% | 10 | 41.37% | 56.13% | 14 | 85.58% | 24.21% |
| | **Relative** | 40 | 40.93% | 19.52% | 40 | 44.45% | 46.92% | 48 | 111.21% | 30.14% |
| | **ANOVA-P** | – | 0.004 | 0.241 | – | 0.771 | 0.391 | – | 0.720 | 0.518 |
| **Out of Sample** | **Absolute** | 15 | 91.25% | 12.34% | 10 | 50.57% | 25.58% | 15 | 46.56% | 16.73% |
| | **Relative** | 40 | 44.13% | 40.24% | 40 | 46.47% | 34.21% | 50 | 39.90% | 40.33% |
| | **ANOVA-P** | - | 0.023 | 0.002 | - | 0.725 | 0.444 | - | 0.733 | 0.009 |
| | | Insurance | | | Technology Hardware | | | Biotechnology | | |
| **In Sample** | **Absolute** | 15 | 225.64% | 44.98% | 15 | 92.86% | 24.01% | 10 | 92.51% | 31.79% |
| | **Relative** | 40 | 48.24% | 50.17% | 59 | 59.61% | 28.90% | 40 | 50.90% | 41.28% |
| | **ANOVA-P** | – | 0.000 | 0.622 | – | 0.083 | 0.534 | – | 0.002 | 0.395 |
| **Out of Sample** | **Absolute** | 15 | 151.99% | 18.92% | 15 | 92.72% | 15.32% | 10 | 50.71% | 47.22% |
| | **Relative** | 38 | 80.48% | 44.41% | 52 | 53.47% | 30.50% | 40 | 59.32% | 31.44% |
| | **ANOVA-P** | - | 0.336 | 0.008 | - | 0.024 | 0.076 | - | 0.049 | 0.159 |
| | | Securities | | | | | | | | |
| **In Sample** | **Absolute** | 15 | 222.23% | 21.25% | | | | | | |
| | **Relative** | 40 | 52.86% | 27.59% | | | | | | |
| | **ANOVA-P** | – | 0.000 | 0.451 | | | | | | |
| **Out of Sample** | **Absolute** | 15 | 49.50% | 40.04% | | | | | | |
| | **Relative** | 39 | 54.50% | 36.05% | | | | | | |
| | **ANOVA-P** | - | 0.608 | 0.666 | | | | | | |

Note: "AC" is accuracy; "EP" is explanatory power;
Source: Author's calculation

**Table 7.5 Suitability Comparison: Trailing vs Forward Valuation Models**

| | | # of Obs | AC | EP | # of Obs | AC | EP | # of Obs | AC | EP |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Commercial Bank | | | S &C Services | | | Pharmaceuticals | | |
| In Sample | Trailing | 15 | 54.52% | 11.81% | 10 | 50.84% | 37.51% | 14 | 87.50% | 37.64% |
| | Forward | 15 | 22.12% | 17.83% | 10 | 29.56% | 70.97% | 14 | 77.74% | 22.66% |
| | ANOVA-P | – | 0.015 | 0.430 | – | 0.058 | 0.013 | – | 0.820 | 0.199 |
| Out of Sample | Trailing | 15 | 38.06% | 29.58% | 10 | 44.57% | 40.50% | 15 | 76.96% | 28.74% |
| | Forward | 15 | 40.94% | 47.36% | 10 | 28.21% | 59.59% | 15 | 23.52% | 65.86% |
| | ANOVA-P | - | 0.901 | 0.140 | - | 0.203 | 0.199 | - | 0.122 | 0.003 |
| | | Insurance | | | Technology Hardware | | | Biotechnology | | |
| In Sample | Trailing | 15 | 69.19% | 35.26% | 15 | 103.11% | 22.19% | 10 | 47.75% | 46.04% |
| | Forward | 15 | 34.12% | 59.01% | 14 | 54.80% | 31.06% | 10 | 51.74% | 55.83% |
| | ANOVA-P | – | 0.244 | 0.064 | – | 0.125 | 0.374 | – | 0.767 | 0.524 |
| Out of Sample | Trailing | 15 | 151.25% | 34.27% | 11 | 93.83% | 21.42% | 10 | 77.89% | 40.18% |
| | Forward | 13 | 33.17% | 47.04% | 11 | 49.60% | 37.30% | 10 | 43.99% | 13.47% |
| | ANOVA-P | - | 0.308 | 0.294 | - | 0.216 | 0.283 | - | 0.120 | 0.018 |
| | | Securities | | | | | | | | |
| In Sample | Trailing | 15 | 69.19% | 24.40% | | | | | | |
| | Forward | 15 | 34.12% | 23.19% | | | | | | |
| | ANOVA-P | – | 0.244 | 0.919 | | | | | | |
| Out of Sample | Trailing | 15 | 64.04% | 19.94% | | | | | | |
| | Forward | 14 | 40.00% | 48.59% | | | | | | |
| | ANOVA-P | - | 0.008 | 0.012 | | | | | | |

Source: Author's calculation

**Table 7.6 Suitability Comparison: Enterprise Value vs Price Valuation Models**

| | | # of Obs | Accuracy | Explanatory Power | # of Obs | Accuracy | Explanatory Power |
|---|---|---|---|---|---|---|---|
| | | 1. Software & Computer Services | | | 1. Pharmaceuticals | | |
| In Sample | Enterpries Value | 10 | 45.11% | 38.62% | 10 | 91.04% | 21.04% |
| | Price | 30 | 44.23% | 49.69% | 38 | 116.51% | 32.54% |
| | ANOVA-P | – | 0.940 | 0.358 | – | 0.789 | 0.288 |
| Out of Sample | Enterprise Value | 10 | 49.04% | 15.45% | 10 | 23.27% | 20.53% |
| | Price | 30 | 45.62% | 40.46% | 40 | 44.05% | 45.28% |
| | ANOVA-P | - | 0.775 | 0.439 | - | 0.432 | 0.131 |
| | | 2. Technology Hardware | | | 2. Biotechnology | | |
| In Sample | Enterpries Value | 15 | 35.43% | 26.97% | 10 | 48.81% | 32.57% |
| | Price | 44 | 67.86% | 29.56% | 30 | 51.60% | 44.19% |
| | ANOVA-P | – | 0.085 | 0.754 | – | 0.793 | 0.298 |
| Out of Sample | Enterprise Value | 15 | 39.39% | 28.50% | 10 | 57.73% | 29.42% |
| | Price | 37 | 59.18% | 31.31% | 30 | 59.86% | 32.11% |
| | ANOVA-P | - | 0.262 | 0.760 | - | 0.895 | 0.817 |

Source: Author's calculation

## 7.3 Robustness of In-Sample Research Results: Combined Value Estimates

### 7.3.1 Combined Valuation Models versus Individual Valuation Models

Based on the out-of-sample results presented in Table 7.8, the combined valuation models significantly outperform the individual valuation models in all the sample sectors. In general, the combined valuation models contain more value-relevant information and they provide more comprehensive valuation of the target company (Vardavaki and Mylonakis, 2007). This result is consistent with the in-sample result "In the study sample industries, the combined valuation models have higher degree of suitability than the individual valuation models" (p.103). Tiwari and Singla (2015) also revealed that since the combined valuation model considers all bona fide information of individual valuation models, the combined valuation model is often more reliable.

However, the out-of-sample results in Table 7.9 show that it is not appropriate to combine certain individual valuation models together, not all the combined valuation models are able to outperform all their own individual valuation models. This is in line with the in-sample research result "certain individual valuation models perform better when they work as individuals rather than in a group" (p.103). In fact, Vardavaki and Mylonakis (2007) argued that the superior performance of a combined valuation model is only guaranteed when the proper use of more than one individual valuation model at the same time. Lie and Lie (2002) also discovered that the combination of several individual valuation models with opposite biases has better valuation performance. The current study introduces the important valuation concepts of multi-valuation periods and multi-value indictors, these two concept can assist financial analysts to properly construct combined valuation model.

**Table 7.7 Suitability Comparison: Combined vs Individual Valuation Models**

| | | Commercial Bank | | | S & C Services | | | Pharmaceuticals | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | # of Obs | AC | EP | # of Obs | AC | EP | # of Obs | AC | EP |
| In Sample | Combined | 20 | 14.79% | 60.77% | 20 | 13.66% | 84.49% | 20 | 11.12% | 78.14% |
| | Individual | 6 | 23.78% | 20.34% | 6 | 39.77% | 56.13% | 6 | 48.26% | 35.31% |
| | ANOVA-P | – | 0.001 | 0.001 | – | 0.000 | 0.000 | – | 0.000 | 0.000 |
| Out of Sample | Combined | 20 | 7.88% | 84.64% | 20 | 12.67% | 75.88% | 20 | 8.19% | 85.31% |
| | Individual | 6 | 32.42% | 37.65% | 6 | 30.65% | 40.50% | 6 | 23.22% | 43.91% |
| | ANOVA-P | – | 0.000 | 0.000 | – | 0.000 | 0.000 | – | 0.000 | 0.000 |
| | | Insurance | | | Technology Hardware | | | Biotechnology | | |
| In Sample | Combined | 20 | 9.05% | 92.83% | 20 | 13.99% | 70.96% | 20 | 15.32% | 66.90% |
| | Individual | 6 | 35.57% | 56.78% | 6 | 37.93% | 36.77% | 6 | 47.75% | 50.36% |
| | ANOVA-P | – | 0.000 | 0.000 | – | 0.000 | 0.000 | – | 0.000 | 0.000 |
| Out of Sample | Combined | 20 | 9.00% | 85.82% | 20 | 10.35% | 76.23% | 20 | 16.23% | 84.91% |
| | Individual | 6 | 27.97% | 41.48% | 6 | 36.42% | 42.03% | 6 | 51.77% | 47.22% |
| | ANOVA-P | – | 0.000 | 0.000 | – | 0.000 | 0.000 | – | 0.000 | 0.000 |
| | | Securities | | | | | | | | |
| In Sample | Combined | 20 | 17.41% | 70.64% | | | | | | |
| | Individual | 6 | 40.61% | 27.90% | | | | | | |
| | ANOVA-P | – | 0.000 | 0.000 | | | | | | |
| Out of Sample | Combined | 20 | 13.19% | 74.44% | | | | | | |
| | Individual | 6 | 43.86% | 48.55% | | | | | | |
| | ANOVA-P | – | 0.000 | 0.000 | | | | | | |

Source: Author's calculation

**Table 7.8 Work as a Group vs Work as Individuals**

| | Accuracy | Explanatory Power | Accuracy | Explanatory Power | Accuracy | Explanatory Power |
|---|---|---|---|---|---|---|
| | 1. Commercial Bank | | 1. Software & Computer Services | | 1. Pharmaceuticals | |
| In Sample | 100.00% | 95.00% | 100.00% | 100.00% | 100.00% | 100.00% |
| Out of Sample | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |
| | 2. Insurance | | 2. Technology Hardware | | 2. Biotechnology | |
| In Sample | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |
| Out of Sample | 100.00% | 100.00% | 100.00% | 90.00% | 100.00% | 100.00% |
| | 3. Securities | | | | | |
| In Sample | 85.00% | 100.00% | | | | |
| Out of Sample | 100.00% | 100.00% | | | | |

Note: "%" above means that in each sample sector, the percentage of combined models outperform all their own individual models
Source: Author's calculation

**Table 7.9 Suitability Comparison: Mixed vs Pure Combined Models**

| | | # of Obs | AC | EP | # of Obs | AC | EP | # of Obs | AC | EP |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Commercial Bank | | | S &C Services | | | Pharmaceuticals | | |
| **In Sample** | **Mixed** | 10 | 14.81% | 46.19% | 16 | 13.56% | 84.49% | 10 | 13.06% | 70.65% |
| | **Pure** | 10 | 14.24% | 69.19% | 4 | 14.30% | 84.69% | 10 | 10.57% | 78.96% |
| | **ANOVA-P** | – | 0.963 | 0.194 | – | 0.530 | 0.515 | – | 0.073 | 0.158 |
| **Out of Sample** | **Mixed** | – | – | – | 10 | 13.37% | 71.50% | – | – | – |
| | **Pure** | – | – | – | 10 | 11.89% | 80.67% | – | – | – |
| | **ANOVA-P** | – | – | – | – | 0.967 | 0.805 | – | – | – |
| | | Insurance | | | Technology Hardware | | | Biotechnology | | |
| **In Sample** | **Mixed** | 10 | 9.11% | 92.34% | – | – | – | 10 | 14.60% | 65.39% |
| | **Pure** | 10 | 8.99% | 93.01% | – | – | – | 10 | 16.19% | 67.69% |
| | **ANOVA-P** | – | 0.613 | 0.699 | – | – | – | – | 0.000 | 0.177 |
| **Out of Sample** | **Mixed** | 10 | 9.78% | 82.86% | – | – | – | 16 | 15.96% | 84.96% |
| | **Pure** | 10 | 8.72% | 88.07% | – | – | – | 4 | 17.83% | 84.91% |
| | **ANOVA-P** | – | 0.027 | 0.035 | – | – | – | – | 0.298 | 0.465 |
| | | Securities | | | | | | | | |
| **In Sample** | **Mixed** | 16 | 17.96% | 69.41% | | | | | | |
| | **Pure** | 4 | 15.33% | 77.23% | | | | | | |
| | **ANOVA-P** | – | 0.031 | 0.128 | | | | | | |
| **Out of Sample** | **Mixed** | 16 | 13.19% | 75.80% | | | | | | |
| | **Pure** | 4 | 12.99% | 71.19% | | | | | | |
| | **ANOVA-P** | – | 0.645 | 0.029 | | | | | | |

Source: Author’s calculation

### 7.3.2 Mixed Combined Models versus Pure Combined Models

According to Table 7.10, the out-of-sample test results show that in most of the sample sectors, the mixed combined models do not have significant valuation advantage. This is consistent with the in-sample result “in general, the mixed combined models do not significantly outperform the pure combined models” (p.106). In fact, the mixed combined models only outperform the pure combined models in terms of explanatory power in the securities sector. The securities sector is an emerging sector with high future earnings growth rate and great risk, the absolute valuation models contained in the mixed combined model are able to simultaneously take into account the growth and risk faced by the emerging companies in the future long term stage (Demirakos et al., 2004). This out-of-sample result is in line with the in-sample result “the mixed combined models have good valuation performance in the emerging sectors" (p.106). Since the importance of future long term stage in the valuation of emerging sector, Jenkins (2006) revealed that the effective combination of absolute and relative valuation models is able to focus both on the long-term forecasts as well as short-term forecasts. Demirakos et al. (2004) also found evidence that in the valuation practice of emerging sector, the relative valuation models are frequently used in combination with absolute valuation models. On the other hand, the out-of-sample test results in Table 7.10 also indicate that the pure combined models have significant higher degree of suitability in the traditional sectors such as insurance. Since the pure combined models in the current study only contain relative valuation models, the pure combined models concentrate on the current period and they are more suitable than the mixed combined models in the valuation of the traditional sectors without strong future growth. This is consistent with the in-sample research result "For such traditional companies, there is less demand for the mixed combined models" (p.107).+

## 7.4 Robustness of In-Sample Research Results: Target Prices

### 7.4.1 Target Prices Produced by Financial Analysts

In contrast with the sample period (2010-2012), Table 7.11 shows that the financial analysts produced less Group 4 and 5 target prices in the out-of-sample period (2013-2015) and they produced more Group 3 target price, which accounts for as high as 50% of the total target prices. This result reflects that in the out-of-sample period, the financial analysts became less optimistic than at the early phrase of the current economic expansion stage, the financial analysts exhibit more prudent investment attitude. However, the prudent attitude did not generate better target price performance. Table 7.11 shows that in most of the sample sectors, the target price performance (e.g. % REALIZED) in the out-of-sample period is worse than in the sample period.

**Table 7.10 Financial Analysts' Target Prices**

| | Financial | | Information Technology | | Health Care | | **Average** | |
|---|---|---|---|---|---|---|---|---|
| | In Sample | Out of Sample | In Sample | Out of Sample | In Sample | Out of Sample | In Sample | Out of Sample |
| Group1 | 0.00% | 0.56% | 0.83% | 0.00% | 10.00% | 5.00% | 3.10% | 1.85% |
| Group2 | 0.56% | 7.22% | 0.00% | 0.83% | 0.00% | 3.33% | 0.24% | 3.80% |
| Group3 | 21.67% | 61.67% | 32.50% | 50.83% | 25.00% | 37.50% | 25.71% | 50.00% |
| Group4 | 43.89% | 21.11% | 50.83% | 40.00% | 33.33% | 36.67% | 42.86% | 32.59% |
| Group5 | 33.89% | 9.44% | 15.83% | 8.33% | 31.67% | 17.50% | 28.10% | 11.76% |
| **Total** | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

Note: "%" above is the number of a specific group's target price, as a percentage of total target prices
Source: Author's calculation

**Table 7.11 Performance of Financial Analysts' Target Prices: Financial Industry**

| | Commercial Bank | | Insurance | | Securities | |
|---|---|---|---|---|---|---|
| | In Sample | Out of Sample | In Sample | Out of Sample | In Sample | Out of Sample |
| ***Realized Target Prices*** | | | | | | |
| % REALIZED | 43.02% | 32.83% | 43.99% | 23.06% | 22.42% | 27.72% |
| % DISTRIBUTION | | | | | | |
| 1st Quarter | 41.11% | 10.00% | 7.35% | 0.00% | 6.27% | 20.83% |
| 2nd Quarter | 6.39% | 10.00% | 7.35% | 29.17% | 11.47% | 12.50% |
| 3rd Quarter | 4.44% | 40.00% | 8.82% | 29.17% | 7.75% | 41.67% |
| 4th Quarter | 4.31% | 20.00% | 19.52% | 41.67% | 8.14% | 25.00% |
| % FREQUENCY | 36.69% | 65.31% | 51.21% | 58.26% | 30.17% | 44.59% |
| ***Unrealized Target Prices*** | | | | | | |
| % UNREALIZED | 56.98% | 67.17% | 56.01% | 76.94% | 77.58% | 72.28% |
| % FORECAST_ERROR | 10.56% | 7.90% | 7.35% | 49.14% | 21.76% | 16.79% |

Source: Author's calculation

**Table 7.12 Performance of Financial Analysts' Target Prices: Information Technology Industry**

| | S&C Services | | Technology Hardware | |
|---|---|---|---|---|
| | In Sample | Out of Sample | In Sample | Out of Sample |
| ***Realized Target Prices*** | | | | |
| % REALIZED | 55.42% | 57.84% | 42.91% | 40.22% |
| % DISTRIBUTION | | | | |
| 1st Quarter | 10.00% | 47.62% | 14.52% | 9.38% |
| 2nd Quarter | 12.54% | 9.52% | 21.51% | 25.00% |
| 3rd Quarter | 10.63% | 7.14% | 9.68% | 9.38% |
| 4th Quarter | 5.87% | 35.71% | 15.73% | 15.63% |
| % FREQUENCY | 72.62% | 55.14% | 54.53% | 61.81% |
| ***Unrealized Target Prices*** | | | | |
| % UNREALIZED | 44.58% | 42.16% | 57.09% | 59.78% |
| % FORECAST_ERROR | 32.19% | 14.35% | 12.98% | 16.37% |

Source: Author's calculation

**Table 7.13 Performance of Financial Analysts' Target Prices: Health Care Industry**

| | Pharmaceuticals | | Biotechnology | |
|---|---|---|---|---|
| | In Sample | Out of Sample | In Sample | Out of Sample |
| ***Realized Target Prices*** | | | | |
| % REALIZED | 38.17% | 27.05% | 53.33% | 30.39% |
| % DISTRIBUTION | | | | |
| 1st Quarter | 9.22% | 12.50% | 13.33% | 39.29% |
| 2nd Quarter | 9.22% | 12.50% | 6.67% | 17.86% |
| 3rd Quarter | 11.72% | 56.25% | 10.74% | 5.36% |
| 4th Quarter | 10.95% | 6.25% | 7.04% | 0.00% |
| % FREQUENCY | 51.65% | 45.77% | 47.12% | 25.05% |
| ***Unrealized Target Prices*** | | | | |
| % UNREALIZED | 61.83% | 72.95% | 46.67% | 69.61% |
| % FORECAST_ERROR | 26.85% | 11.05% | 24.64% | 14.36% |

Source: Author's calculation

### 7.4.2 Target Prices Produced by the Current Study

Similar to the in-sample result "combined models are more conservative than the individual models, the combined models have significantly higher percentages of Group 3 target prices" (p.123). The out-of-sample result in Table 7.15 also shows that in all the sample sectors, most of the target prices produced by the combined models belong to Group 3. In addition, the out-of-sample result also indicate that the combined models outperform the individual models in most of the sample sectors, Table 7.16 shows that the target prices produced by the combined models have higher degree of realization rate and frequency, and lower level of forecast error. This out-of-sample result is consistent with the in-sample result "combined models produce more reasonable target prices with higher degrees of reliability than the individual models" (p.125). Yee (2004) argued that since every valuation model discloses an incremental piece of intrinsic value, any valuation practice that relies on just one valuation model may ignore some parts of the intrinsic value. Therefore, the in-sample and out-of-sample result both implied that combined models simultaneously capture and consolidate multi-value relevant information, they are more informative and capable to produce more reliable target prices than individual models. In fact, the combined models also produce more reliable target prices than the financial analysts. The out-of-sample test result in Table 7.18 shows that the target prices produced by the combined models have higher degree of reliability than the financial analysts' target prices. This is in line with the in-sample result "combined valuation models significantly outperform the financial analysts in terms of target price performance" (p.126).

## 7.5 Chapter Summary

This chapter applies the out-of-sample test to verify the robustness of the in-sample results presented in Chapter 4, 5, and 6. In general, the in-sample and out-of-sample results are similar to each other, which means the in-sample result is reliable and its robustness has been confirmed by the out of sample test.

**Table 7.14 Target Prices Produced by the Current Study**

| | | Group1 | Group2 | Group3 | Group4 | Group5 | Group1 | Group2 | Group3 | Group4 | Group5 | Group1 | Group2 | Group3 | Group4 | Group5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Commercial Bank | | | | | S&C Services | | | | | Pharmaceuticals | | | | |
| **In Sample** | Individual | 28.33% | 8.33% | 35.00% | 16.67% | 11.67% | 15.00% | 21.67% | 31.67% | 25.00% | 6.67% | 0.00% | 0.00% | 38.33% | 21.67% | 20.00% |
| | Combined | 0.00% | 8.33% | 81.67% | 8.33% | 1.67% | 1.67% | 8.33% | 85.00% | 5.00% | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% |
| **Out of Sample** | Individual | 0.00% | 33.33% | 61.67% | 5.00% | 0.00% | 11.67% | 30.00% | 41.67% | 1.67% | 15.00% | 0.00% | 20.00% | 75.00% | 1.67% | 3.33% |
| | Combined | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 20.00% | 1.67% | 78.33% | 0.00% | 0.00% | 0.00% | 0.00% | 96.67% | 0.00% | 3.33% |
| | | Insurance | | | | | Technology Hardware | | | | | Biotechnology | | | | |
| **In Sample** | Individual | 16.67% | 30.00% | 36.67% | 13.33% | 3.33% | 8.33% | 21.67% | 25.00% | 18.33% | 26.67% | 28.33% | 3.33% | 33.33% | 5.00% | 30.00% |
| | Combined | 0.00% | 0.00% | 96.67% | 3.33% | 0.00% | 0.00% | 6.67% | 81.67% | 11.67% | 0.00% | 0.00% | 11.67% | 70.00% | 15.00% | 3.33% |
| **Out of Sample** | Individual | 10.00% | 31.67% | 31.67% | 16.67% | 10.00% | 6.67% | 13.33% | 53.33% | 23.33% | 3.33% | 15.00% | 5.00% | 13.33% | 16.67% | 50.00% |
| | Combined | 0.00% | 16.67% | 73.33% | 0.00% | 10.00% | 0.00% | 0.00% | 95.00% | 5.00% | 0.00% | 6.67% | 15.00% | 68.33% | 6.67% | 3.33% |
| | | Securities | | | | | | | | | | | | | | |
| **In Sample** | Individual | 25.00% | 10.00% | 35.00% | 10.00% | 20.00% | | | | | | | | | | |
| | Combined | 0.00% | 10.42% | 81.25% | 4.17% | 4.17% | | | | | | | | | | |
| **Out of Sample** | Individual | 51.67% | 15.00% | 20.00% | 8.33% | 5.00% | | | | | | | | | | |
| | Combined | 0.00% | 18.33% | 80.00% | 1.67% | 0.00% | | | | | | | | | | |

**Table 7.15 Target Prices Produced by the Current Study: Performance**

| | **Financial Industry** | | | | **Information Technology Industry** | | | | **Health Care Industry** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In Sample | | Out of Sample | | In Sample | | Out of Sample | | In Sample | | Out of Sample | |
| | Individual | Combined | Individual | Combined | Individual | Combined | Individual | Combined | Individual | Combined | Individual | Combined |
| ***Realized Target Prices*** | | | | | | | | | | | | |
| % REALIZED | 28.57% | 60.59% | 31.34% | 43.59% | 24.62% | 64.07% | 20.78% | 22.02% | 41.08% | 45.59% | 38.22% | 61.00% |
| % DISTRIBUTION | | | | | | | | | | | | |
| 1st Quarter | 10.56% | 55.55% | 31.06% | 11.25% | 8.49% | 39.90% | 5.19% | 0.00% | 12.54% | 46.83% | 8.48% | 25.00% |
| 2nd Quarter | 11.88% | 23.33% | 14.39% | 31.25% | 7.27% | 12.46% | 7.04% | 0.00% | 15.87% | 7.41% | 31.70% | 28.13% |
| 3rd Quarter | 8.56% | 2.22% | 0.00% | 7.50% | 7.17% | 11.81% | 26.85% | 0.00% | 8.22% | 3.70% | 8.48% | 31.25% |
| 4th Quarter | 3.55% | 6.67% | 28.01% | 20.00% | 7.02% | 0.00% | 23.52% | 0.00% | 9.78% | 3.70% | 6.70% | 3.13% |
| % FREQUENCY | 50.79% | 67.34% | 59.39% | 71.64% | 36.43% | 67.02% | 56.80% | 67.07% | 54.14% | 84.02% | 55.68% | 51.38% |
| ***Unrealized Target Prices*** | | | | | | | | | | | | |
| % UNREALIZED | 71.43% | 39.41% | 68.66% | 56.41% | 75.39% | 35.94% | 70.22% | 77.98% | 58.92% | 54.42% | 61.78% | 39.00% |
| % FORECAST_ERROR | 27.75% | 15.16% | 28.74% | 53.09% | 42.79% | 20.74% | 19.66% | 13.82% | 20.02% | 19.42% | 22.56% | 10.17% |

Source: Author's calculation

**Table 7.16 Target Prices Produced by Financial Analysts versus Target Prices Produced by the Current Study**

| | | Group1 | Group2 | Group3 | Group4 | Group5 | Group1 | Group2 | Group3 | Group4 | Group5 | Group1 | Group2 | Group3 | Group4 | Group5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Commercial Bank | | | | | S&C Services | | | | | Pharmaceuticals | | | | |
| **In Sample** | Analyst | 0.00% | 1.67% | 21.67% | 50.00% | 26.67% | 1.67% | 0.00% | 36.67% | 50.00% | 11.67% | 0.00% | 0.00% | 18.33% | 33.33% | 48.33% |
| | Combined | 0.00% | 8.33% | 81.67% | 8.33% | 1.67% | 1.67% | 8.33% | 85.00% | 5.00% | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% |
| **Out of Sample** | Analyst | 0.00% | 1.67% | 73.33% | 25.00% | 0.00% | 0.00% | 1.67% | 61.67% | 31.67% | 5.00% | 0.00% | 0.00% | 53.33% | 36.67% | 10.00% |
| | Combined | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 20.00% | 1.67% | 78.33% | 0.00% | 0.00% | 0.00% | 0.00% | 96.67% | 0.00% | 3.33% |
| | | Insurance | | | | | Technology Hardware | | | | | Biotechnology | | | | |
| **In Sample** | Analyst | 0.00% | 0.00% | 25.00% | 56.67% | 18.33% | 0.00% | 0.00% | 28.33% | 51.67% | 20.00% | 20.00% | 0.00% | 31.67% | 33.33% | 15.00% |
| | Combined | 0.00% | 0.00% | 96.67% | 3.33% | 0.00% | 0.00% | 6.67% | 81.67% | 11.67% | 0.00% | 0.00% | 11.67% | 70.00% | 15.00% | 3.33% |
| **Out of Sample** | Analyst | 1.67% | 11.67% | 60.00% | 13.33% | 13.33% | 0.00% | 0.00% | 40.00% | 48.33% | 11.67% | 10.00% | 6.67% | 21.67% | 36.67% | 25.00% |
| | Combined | 0.00% | 16.67% | 73.33% | 0.00% | 10.00% | 0.00% | 0.00% | 95.00% | 5.00% | 0.00% | 6.67% | 15.00% | 68.33% | 6.67% | 3.33% |
| | | Securities | | | | | | | | | | | | | | |
| **In Sample** | Analyst | 0.00% | 0.00% | 18.33% | 25.00% | 56.67% | | | | | | | | | | |
| | Combined | 0.00% | 10.42% | 81.25% | 4.17% | 4.17% | | | | | | | | | | |
| **Out of Sample** | Analyst | 0.00% | 8.33% | 51.67% | 25.00% | 15.00% | | | | | | | | | | |
| | Combined | 0.00% | 18.33% | 80.00% | 1.67% | 0.00% | | | | | | | | | | |

**Table 7.17 Target Prices Produced by Financial Analysts versus Target Prices Produced by the Current Study: Performance**

| | **Financial Industry** | | | | **Information Technology Industry** | | | | **Health Care Industry** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In Sample | | Out of Sample | | In Sample | | Out of Sample | | In Sample | | Out of Sample | |
| | Analyst | Combined | Analyst | Combined | Analyst | Combined | Analyst | Combined | Analyst | Combined | Analyst | Combined |
| ***Realized Target Prices*** | | | | | | | | | | | | |
| % REALIZED | 36.48% | 60.59% | 27.87% | 43.59% | 49.17% | 64.07% | 49.03% | 52.02% | 45.75% | 45.59% | 28.72% | 61.00% |
| % DISTRIBUTION | | | | | | | | | | | | |
| 1st Quarter | 18.24% | 55.55% | 10.28% | 11.25% | 12.26% | 39.90% | 28.50% | 0.00% | 11.28% | 46.83% | 25.89% | 25.00% |
| 2nd Quarter | 8.40% | 23.33% | 17.22% | 31.25% | 17.03% | 12.46% | 17.26% | 0.00% | 7.95% | 7.41% | 15.18% | 28.13% |
| 3rd Quarter | 7.00% | 2.22% | 36.94% | 7.50% | 10.16% | 11.81% | 8.26% | 0.00% | 11.23% | 3.70% | 30.80% | 31.25% |
| 4th Quarter | 10.66% | 6.67% | 28.89% | 20.00% | 10.80% | 0.00% | 25.67% | 0.00% | 9.00% | 3.70% | 3.13% | 3.13% |
| % FREQUENCY | 39.36% | 67.34% | 56.05% | 71.64% | 63.58% | 67.02% | 58.47% | 67.07% | 49.39% | 84.02% | 35.41% | 51.38% |
| ***Unrealized Target Prices*** | | | | | | | | | | | | |
| % UNREALIZED | 63.52% | 39.41% | 72.13% | 56.41% | 50.84% | 35.94% | 50.97% | 77.98% | 54.25% | 54.42% | 71.28% | 39.00% |
| % FORECAST_ERROR | 13.22% | 15.16% | 24.61% | 53.09% | 22.59% | 20.74% | 15.36% | 13.82% | 25.75% | 19.42% | 12.70% | 10.17% |

Source: Author's calculation

# Chapter 8

# Conclusion

## 8.1 Introduction

This chapter concludes the study. In general, this practice-oriented study improves the reliability of listed companies' value estimates and target prices via the improvement of the valuation methodology. A range of innovative company valuation concepts and techniques are presented in the study, which can be directly applied in company valuation practice. Specifically, the study introduces a new valuation concept of industry-based combined valuation model and further introduces two important valuation concepts to enhance the performance of the industry-based combined valuation model. They are multi-valuation periods and multi-value indictors. In addition, the study improves the discount rate estimation method, designs an enhanced target price setting approach, and presents an improved reliability test method for value estimate and target price. The rest of the chapter is organized as follows: Section 8.2 concludes the major research results. Section 8.3 discusses the implications of the research results. Section 8.4 discusses the research limitations and future research recommendations.

## 8.2 Research Results Summary

### 8.2.1 Research Objective One

Research objective one identifies the factors which influence the reliability of listed companies' target prices and value estimates.

The result in Table 8.1 shows that the reliability of the target price is largely affected by the value estimate. In general, a target price reflects the financial analyst's expectation of the future price level that a stock is most likely to reach within a certain time horizon (Huang et al., 2009).

Target price is based on the future intrinsic value per share of a company, where the future intrinsic value is often predicted by using the value estimate. The value estimate reflects the intrinsic value of a company at the current valuation date, in which the financial analysts use the value estimate to estimate the future intrinsic value. Therefore, the value estimate is the foundation of the target price, the quality of the value estimate has a direct and significant influence on the reliability of the target price. This current research result is consistent with the findings of Kerl (2011) who revealed that the financial analysts do not take the outcome of valuation (value estimate) at face value, they adjust the value estimate qualitatively to better reflect the expected future price level (target price), and the target price is the “final product” of the value estimate.

The result in Table 8.1 reveals that the reliability of the target price is also affected by the target price setting process, which is a series of adjustments that the financial analysts use to set target prices based on the value estimates. Specifically, these pricing adjustments involve a large amount of subjective assessments of the company being valued, where a number of factors determine the quality of adjustment. These factors include the financial analyst’s access to privately available information, the competency of the financial analyst in the forecasting of company performance, the degree of the financial analyst’s optimism, the size and reputation of the investment bank, etc. Therefore, the target price setting or pricing process determines the reliability of the target price to some extent. This current research result is consistent with the findings of Bradshaw et al. (2013), where the authors highlighted the importance of the target price setting in the determination of target price performance.

The result also presents a number of factors which directly affect the reliability of the value estimate (see Table 8.1). The influential factors include the quality of the accounting information, the accuracy of the company's performance forecast, the discount rate estimation method and the valuation model choice. In general, the reliability of a value estimate is not only affected by its "raw material" such as historical accounting data and performance forecast data, but also its "manufacturing technique" such as discount rate estimation method and valuation model. A number of other studies have documented similar findings. Gleason et al. (2013) found evidence that the accuracy of the value estimate is strongly associated with the accuracy of the earnings forecast, and the authors also highlighted the importance of both forecasting ability and the valuation model. Demirakos et al. (2010) showed that the valuation model choice does affect value estimate accuracy, since the valuation model often performs differently under different circumstances.

**Table 8.1 Reliability of Target Price and Value Estimate: Major Influential Factors**

| | Reliability of Target Price | Reliability of Value Estimate |
|---|---|---|
| Influential Factor | Value Estimate<br>Target Price Setting Process | Accounting Information<br>Company Performance Forecast<br>Discount Rate Estimation<br>Valuation Model |

Source: Author's conclusion

### 8.2.2 Research Objective Two

Research objective two improves the discount rate estimation method for listed company, which includes cost of equity, after-tax cost of debt and capital structure estimation technique.

The current study improves the cost of the equity estimation technique by introducing the expanded CAPM model. The details of the expanded CAPM model are shown in Table 8.2 and are based on the studies of Pratt (2002) and Pinto et al. (2010), which aimed to provide a more accurate estimation of the cost of equity by simultaneously considering the systematic and unsystematic risks. The unsystematic risk is often ignored by the traditional CAPM model, which assumes that unsystematic risk can be diversified away in a well-diversified portfolio. In fact, the unsystematic risk cannot be fully diversified away. Therefore, the current study introduces the expanded CAPM model to fully take into account the unsystematic risk. The cost of equity estimated by the expanded CAPM model is the sum of several factors, including risk free rate, industry risk premium, beta-adjusted size premium and company-specific risk premium. Specifically, Pinto et al. (2010) revealed that the sum of the risk-free rate and the industry risk premium is the average required return on equity for all the companies in a particular industry. The expanded CAPM model then adds a beta-adjusted size premium to reflect the average required equity return for a specific peer group within the industry. Finally, the company-specific risk premium is added to arrive at the cost of equity for a particular company within the peer group. In general, the expanded CAPM model follows the top down approach (industry-peer-company). The expanded CAPM model provides an accurate cost of equity estimation by simultaneously considering the systematic and unsystematic risks faced by a specific company. Thus, the expanded CAPM model is a good alternative to the traditional CAPM model.

Based on the studies of Koller et al. (2010), Pratt (2002), Pinto et al. (2010) and Jacobs and Shivdasani (2012), the current study presents an improved cost of debt estimation method (see Table 8.2). This method considers four possible scenarios in practice, and then estimates the cost of debt in different ways. First, for the companies with long-term publicly traded corporate bonds, the yield-to-mature (YTM) on newly issued long-term bonds can be selected as a proxy of cost of debt. Second, for the companies with only short-term publicly traded corporate bonds (and no credit rating), the possible credit rating and cost of debt can be estimated by comparing their key financial ratios to other comparable companies with credit ratings. Third, for the companies without publicly traded corporate bonds but with other forms of debts such as bank loans, the possible credit rating and cost of debt can be estimated by comparing their key financial ratios to other comparable companies with credit ratings. Lastly, for the companies without any form of debt or liability at any time, the cost of debt is zero. In general, this improved cost of debt estimation method has good practical relevance. The improved method considers four possible scenarios in practice, and then estimates the cost of debt separately using different techniques.

The current study improves the capital structure estimation method by concentrating on the target capital structure, which is the long term sustainable capital structure of a company. In the company valuation, the target capital structure is more meaningful than the current capital structure, especially when the current capital structure misrepresents the company's normal capital structure or the structure is expected to change in the future. Based on Pinto et al. (2010) and Koller et al. (2010), the current study presents the following estimation method for the target capital structure. First, for the mature companies at or near their target structures, the current market value of debt and equity can be directly used to estimate the target capital structure. Second, for the start-up or growing companies with unstable capital structure, a three-step approach suggested by Koller et al. (2010) is applied to find the possible target structure that the companies are likely to adopt in the long term period. This approach estimates a company's current capital structure by using the current market value of equity and debt, then judges the reasonableness of the estimated capital structure according to the comparable companies and adjusts it if necessary. Finally, this approach examines the company's approach to financing and its possible impact on the target capital structure. In general, this capital structure estimation method not only highlights the importance of the target capital structure in the company valuation practice, but also provides an effective method to estimate the target capital structure for both mature and growing companies. Table 8.2 outlines the key points of the improved target capital structure estimation method.

**Table 8.2 Improved Discount Rate Estimation Method**

**Improved Cost of Equity Estimation Method**

| | |
|---|---|
| Step One | Estimate risk free rate |
| Step Two | Estimate industry risk premium |
| Step Three | Estimate beta-adjusted size premium |
| Step Four | Estimate company-specific risk premium |
| Step Five | Add the aboves together to obtain the cost of equity |

**Improved Cost of Debt Estimation Method**

| Scenario | Cost of Debt |
|---|---|
| Company with long-term public traded corporate bonds | Yield-to-mature on newly issued long-term bond |
| Company with only short-term public traded corporate bonds | Compare the key financial ratios with other comparable companies with credit ratings |
| Company without public traded corporate bond | Compare the key financial ratios with other comparable companies with credit ratings |
| Company without any form of debt at any time | Cost of debt is zero |

**Improved Target Capital Structure Estimation Method**

| Scenario | Target Capital Structure |
|---|---|
| Matured company at or near its target structure | The current market value of debt and equity can be used to estimate the target capital structure |
| Start-up or growing company with unstable capital structure | Apply a three-step approach to estimate the target capital structure |

Source: Author's conclusion

### 8.2.3 Research Objective Three

Research objective three identifies the best industry-based individual and combined valuation models for the financial, information technology and health care industries.

The current research result shows the best individual valuation model for each sample sector (see Table 8.3). In general, the valuation advantage of the best industry-based individual valuation model is derived from its value indictor (the value indictors of sample valuation models are presented in Table 3.3 of Chapter 3). Its value indictor is fully consistent with the characteristics of the company/sector being valued, especially the value creation process and intrinsic value distribution. For example, most of the intrinsic value of the traditional insurance company has already been generated from the past and current life stages, thus the value indictor need to be good at estimating the current part of the intrinsic value. The current book value concentrates on the stable balance sheet of the insurance company, which is a good proxy of the current part of intrinsic value. Thus, the current book value based PBV model is able to better estimate the current part of the intrinsic value of the insurance company. The PBV model is the best individual valuation model for insurance companies. On the other hand, most of the intrinsic value of the emerging software and computer services company is expected to be generated from the future, so the value indictor should be able to cover the future period. The FPEG model contains two value indictors - estimated future one year earnings and estimated future five years earnings growth rates. The FPEG model covers the future short term via the estimated future one year earnings, and covers the future middle term via the estimated future five years earnings growth rate. Thus, the FPEG model is able to better estimate the intrinsic value of the software and computer services company.

The current research result also shows the best combined valuation model for each sample sector (see Table 8.3). In general, the valuation advantage of the best industry-based combined valuation model is derived from two important valuation concepts introduced by the current study, which are multi-valuation periods and multi-value indictors. Specifically, a good combined valuation model should be able to cover all the important life stages of a company (multi-valuation periods), especially the life stage with an enormous amount of intrinsic value produced. For each important life stage, there should be at least one effective value indictor which is able to fully capture the intrinsic value produced during that life stage. Thus, there should be more than one value indictor in total to simultaneously capture the intrinsic values from the different important life stages (multi-value indictors). The best industry-based combined valuation models shown in Table 8.3 should not only be able to cover all the important life stages of a company, but also fully capture the intrinsic value generated in each important life stage. Therefore, the best industry-based combined valuation models can better estimate the intrinsic value of a company, which are good alternatives to the best industry-based individual valuation models.

**Table 8.3 Best Industry-based Individual and Combined Valuation Models**

| | Best Individual | Best Combined |
|---|---|---|
| Financial Industry | | |
| Commercial Bank | FDY | PBV, DD and FPEG |
| Insurance | PBV | PBV, DD and FDY |
| Securities | FPE | PBV, TDY and RI |
| Information Technology Industry | | |
| Software & Computer Services | FPEG | TPE, FPEG and DCF |
| Technology Hardware | FPE | FPE, FPEG and PS |
| Health Care Industry | | |
| Pharmaceuticals | TDY | DCF, DD and TDY |
| Biotechnology | FPE | FPE, FPEG and RI |

Source: Author's conclusion

### 8.2.4 Research Objective Four

Research objective four improves the target price setting method to produce reliable listed companies' target prices.

Based on the methods suggested by Imam et al. (2008), Hoogerheide et al. (2010), Thordarson (2007), Yee (2004) and Yoo (2006), the current study improves the target price setting method by introducing a four-step approach (see Table 8.4). This approach begins with the estimation of the company's intrinsic value on the basis of the best industry-based combined valuation model. The second step applies the partial least square regression method (PLSR) to combine several value estimates produced from the combined valuation model. The third step predicts the future intrinsic value based on the combined value estimate. The last step sets the target price for the company based on the estimated future intrinsic value. In general, this four-step approach highlights the importance of both quantitative and qualitative methods in the target price setting process. A reliable target price should be based on an accurate combined value estimate and reasonable pricing adjustments.

The PLSR method used in step two has the following characteristics. First, it assumes that the market is efficient, where the market price of a company is used as the proxy of its intrinsic value per share. Second, the PLSR method estimates the regression equation by using the time-series data of market price and value estimate. The coefficients of the explanatory variables are used as the weights to combine several value estimates into one combined value estimate. Third, the partial least square regression is used to minimize the possible multi-collinearity effect between the explanatory variables. Fourth, for a specific company, the suitability of a valuation model may tend to change over time and the constant weight for a valuation model may no longer apply in the future. The PLSR method is able to generate time-varying weights for each valuation model in the combined model. Lastly, in order to improve the effectiveness of a combined value estimate, the combined value estimate is equal to the weighted average sum of several value estimates plus the constant term of the regression. In general, the PLSR method is the core element of the four-step target price setting approach. It provides an effective solution to the common practical question faced by many financial analysts, that is, how to effectively combine several value estimates produced by a combined valuation model. The PLSR is able to minimize the subjective pricing error by objectively estimating the weight for each value estimate generated from a combined valuation model.

**Table 8.4 Improved Target Price Setting Method**

| | Improved Target Price Setting Method |
|---|---|
| Step One | Estimate intrinsic value by using the best industry-based combined valuation model |
| Step Two | Apply the PLSR method to combine value estimates |
| Step Three | Predict the future intrinsic value based on the combined value estimate |
| Step Four | Set the target price on the basis of estimated future intrinsic value |

Source: Author's conclusion

### 8.2.5 Research Objective Five

Research objective five improves the reliability test method for listed companies' value estimates and target prices.

Based on the approaches of Kaplan and Ruback (1995), Francis et al. (2000), Cheng and McNamara (2000) and Liu et al. (2007), the current study designs an improved reliability test method for value estimates as shown in Table 8.5. This method highlights that the reliability of a value estimate depends on its two equally important aspects: accuracy and explanatory power. Specifically, the accuracy reflects how well the value estimate can disclose the intrinsic value, and the explanatory power indicates how well the value estimate can explain the variation of intrinsic value. In addition, the reliability test method is based on the assumption that the market price is efficient, where the market price is used as a proxy of the intrinsic value per share of the company. In the reliability test, the metric of accuracy is used to reflect the valuation error, which is the distance between the intrinsic value and the value estimate. On the other hand, the metric of explanatory power is designed to measure the degree of co-movement between the intrinsic value and the value estimate. In general, the reliability test method emphasizes the importance of both accuracy and explanatory power. The reliability test method can accurately measure the degree of reliability for a value estimate.

The current study also designs an improved reliability test method for the target price, based on the studies of Bonini et al. (2010), Imam et al. (2013), Kerl (2011) and Demirakos et al. (2010). This target price test method has four steps and the details are presented in Table 8.5. First, it contrasts the target prices with the market prices three trading days prior to the target price announcement dates or valuation dates, and then classifies the target prices into five groups. Second, it tests whether the target prices in the five groups have been achieved, and then labels them as "Realized" or "Unrealized". Third, it measures the degree of reliability for the target prices in the five groups labelled as "Realized". Lastly, it examines the "Unrealized" target prices in the five groups. In general, this reliability test method is able to better measure the degree of reliability for the target price. It does not attempt to test the target price directly, but classifies the target prices into five groups at first and then measures their reliability separately. By doing so, the target prices in different groups can be tested by corresponding metrics and their degree of reliability can be better measured.

**Table 8.5 Improved Reliability Test Method for Value Estimate and Target Price**

| | Improved Reliability Test Method for Value Estimate |
|---|---|
| Step One | Measure the degree of accuracy by comparing the value estimate with the market price at the valuation date |
| Step Two | Measure the degree of explanatory power by running OLS regression between the value estimates and the market prices at the valuation dates |

| | Improved Reliability Test Method for Target Price |
|---|---|
| Step One | Contrast the target prices with the market prices before announcement dates, and then classify target prices into five groups |
| Step Two | Test whether the target prices in the five groups have been achieved, and then label them as "Realized" or "Unrealized" |
| Step Three | Measure the degree of reliability for the target prices in the five groups labeled as "Realized" |
| Step Four | Examine the "Unrealized" target prices in the five groups |

Source: Author's conclusion

### 8.2.6 Out-of-Sample Test

#### 8.2.6.1 Individual Value Estimates

First, the sample individual valuation models have similar suitability rankings in the sample period and the out-of-sample period, the median value of rank difference is only ranges from 1 to 3.5 among the 7 sample sectors. The in-sample ranking is generally consistent with the out-of-sample ranking. Second, the in-sample and out-of-sample test results both conclude that the forward-looking absolute valuation model concentrate on the future, they are most suitable for the high growing emerging sectors with a large amount of intrinsic value generated from the future stage. The current value-based relative valuation models focuses on the intrinsic value already generated by the companies, they are ideal valuation models for the mature sectors with less growth prospect. Third, the in-sample and out-of-sample test results shows that the future short term-based forward valuation models have significant advantage in the valuation of the stable sector with adequate, reliable and accurate forecast financial data. The trailing valuation models focus on the historical data thus they have apparent advantage in the valuation of unstable sector. Last, the suitability difference between the enterprise value and price valuation models is not significant. The in-sample and out-of-sample results implied that in the valuation of the listed companies from the sample sectors, it is not necessary to consider the total value of a company's capital.

#### 8.2.6.2 Combined Value Estimates

First, the in-sample and out-of-sample test results both conclude that the combined valuation models significantly outperform the individual valuation models in all the sample sectors. In general, the combined valuation models contain more value-relevant information and they provide more comprehensive valuation of the target company. Second, the in-sample and out-of-sample test confirm that it is not appropriate to combine certain individual valuation models together, not all the combined valuation models are able to outperform all their own individual valuation models. Third, the in-sample and out-of-sample test reveal that the mixed combined models have good valuation performance in the emerging sectors, the pure combined models concentrate on the current period and they are more suitable than the mixed combined models in the valuation of the traditional sectors without strong future growth.

#### 8.2.6.3 Target Prices

First, the out-of-sample test result reflects that in the out-of-sample period, the financial analysts became less optimistic than at the early phrase of the current economic expansion stage, the financial analysts exhibit more prudent investment attitude. However, the prudent attitude did not generate better target price performance, the target price performance in the out-of-sample period is worse than in the sample period. Second, the in-sample and out-of-sample results both show that the combined models are more conservative than the individual models, the combined models have significantly higher percentages of Group 3 target prices. Third, the in-sample and out-of-sample result also indicate that the combined models outperform the individual models and financial analysts in most of the sample sectors, the target prices produced by the combined models have significant higher degree of realization rate and frequency, and lower level of forecast error.

## 8.3 Research Implications

The current research results have a series of important implications for academics and financial analysts. A good understanding of the research implications is essential for the improvement of the value estimate and target price reliability.

### 8.3.1 Reliability of Listed Companies' Value Estimates and Target Prices

The current research results show that financial analysts often set target prices on the basis of value estimates. This finding implies that the reliability of a target price is directly determined by both value estimate and target price setting process. Therefore, financial analysts should concentrate on the improvement of the value estimate quality and the effectiveness of the target price setting method, since they are two effective and direct approaches to improve the reliability of target prices.

The current study found that the quality of value estimates is not only influenced by the "raw material" such as company historical accounting data and performance forecast data, but also by the "manufacturing technique" such as discount rate estimation method and valuation model. The implication of this finding is that the data and the valuation methodology are equally important in the determination of the value estimate quality. Thus, improving the quality of data and the effectiveness of the valuation methodology are two important tasks in the company valuation practice. This current study focuses on the improvement of valuation methodology, and introduces a series of innovative valuation techniques which can be directly applied in the company valuation practice.

The current research results show that the target price setting is a pricing process which involves a series of subjective assessments of the company being valued. Specifically, the quality of the subjective assessment is influenced by several financial analyst-related factors such as the accessibility to privately available information, competency in the forecasting of the company performance, the degree of optimism, the size and reputation of the investment bank. This finding implies the subjective nature of the target price setting process, and the subjectivity causes significant reliability differences among the target prices produced by different financial analysts. In fact, the subjective target price setting process is harmful to the target price, whereby the target price reliability is often negatively correlated to the degree of subjective factor contained. Thus, financial analysts should attempt to quantify the target price setting to increase the reliability of target prices. The current study develops a quantized target price setting method to largely reduce the subjective pricing error.

### 8.3.2 Discount Rate Estimation Method

In practice, most of the financial analysts use the traditional CAPM model to estimate the cost of equity (Jacobs and Shivdasani, 2012). However, the traditional CAPM model does not consider the unsystematic risk which is actually faced by many companies. This implies that the cost of equity estimated by financial analysts has often been underestimated, since the premium for unsystematic risk has been ignored. In the company valuation, the underestimated cost of equity often causes the value estimate to be overestimated and makes the valuation result unreliable. Therefore, the financial analysts should improve their cost of equity estimation methods they use in practice, and comprehensively assess the risk faced by a company from multi-aspects. This current study introduces an expanded CAPM model to fully take into account the risk faced by a company via simultaneously considering the systematic and unsystematic risks.

In the estimation of a company’s capital structure, most of the financial analysts use the current book value or current market value based capital structure (Jacobs and Shivdasani, 2012). This means the financial analysts tend to use the current capital structure based discount rate to discount the future cash flows. In fact, the company valuation is a forward-looking process, the capital structure and discount rate should be able to fully reflect the possible risk that a company may encounter in the future. Therefore, the sustainable target capital structure should be the primary choice for financial analysts in the company valuation practice, especially when the current capital structure misrepresents the company's normal capital structure or the structure is expected to change in the future. This study highlights the importance of the target capital structure, and introduces an improved estimation method to effectively identify the target capital structure for both emerging and mature companies.

### 8.3.3 Industry-based Individual and Combined Valuation Models

The current study reveals that using more than one valuation model is a common practice in company valuation. However, it is also found that the existing academic research pays little attention to the combined valuation model, in particular there is no theoretical guidance on how to appropriately construct a combined valuation model based on the characteristics of the company being valued. The implication of this finding is that the gap between the academic research and company valuation practice is significant. Academic researchers should concentrate on the practical issues encountered in company valuation. This current study focuses on the construction of combined valuation models. This is also the first study to introduce an innovative valuation concept of industry-based combined valuation model to improve the reliability of valuation results. The current study also presents the reliability rankings for a series of industry-based individual and combined valuation models. The rankings provide effective practical guidance to assist financial analysts to appropriately select valuation models and construct the combined valuation models.

The current research result also has a number of other findings and implications. First, the result shows that the absolute valuation models have good valuation performance in the emerging industries, the relative valuation models perform better in the traditional industries. This implies that in the fast growing emerging industries with enormous amounts of intrinsic value generated from the future, the future long term value indictor based absolute valuation models have significant advantages. On the other hand, the relative valuation models are often based on historical or current short term value indictors. This means that the relative valuation models are suitable for the mature and traditional industries, where their current parts of intrinsic values often account for a large percentage of their total intrinsic values. Thus, the financial analysts should apply the absolute valuation models in the emerging industries and use the relative valuation models in the traditional industries. Second, the current research result reveals that the forward valuation models have good performance in stable industries, while the trailing valuation models perform better in the valuation of unstable industries. This implies that in the volatile industries, the future cash flows are subject to great uncertainty and are difficult to predict. The historical value indictor based trailing valuation models have significant advantage by concentrating on the actual data rather than the unreliable forecasted data. Therefore, the financial analysts should adopt the trailing valuation models in the unstable industries with unreliable forecasted data. The forecasted value indictor based forward valuation models should be the primary choices in the stable industries, where their future cash flows are easy to predict.

The current study also shows that the combined valuation models have significant valuation advantages over the individual valuation models, especially for the combined valuation models which contain both absolute and relative valuation models. This implies that there is no "perfect" individual valuation model in practice, since every individual valuation model has its own limitation. It is impossible for an individual valuation model to fully capture the intrinsic value of a company, while the effective combination of several individual valuation models is able to minimize their drawbacks while maximizing their advantages. Therefore, the financial analysts should understand the importance of simultaneously applying more than one suitable individual valuation model. In addition, this is the first study to introduce the innovative valuation concepts of multi-valuation periods and multi-value indictors. The two valuation concepts provide effective practical guidance to the financial analysts about how to properly apply several individual valuation models at the same time, and how to construct an appropriate combined valuation model. Multi-valuation periods and multi-value indictors imply that a good combined valuation model should not only cover all the important life stages of a company, but also fully capture the intrinsic value generated in each important life stage. These two valuation concepts are the theoretical basis of a superior combined valuation model.

### 8.3.4 Target Price Setting Method

The current study reveals that in the target price setting process, the financial analysts often set the target price based on the value estimates produced by several valuation models. However, the current study finds that there is no standard method to combine several value estimates into one value estimate. The existing literature also offers little theoretical guidance on this practical issue. In practice, the financial analysts prefer to use their own methods and judgments to subjectively combine several value estimates. In fact, the rule of thumb based combining process may introduce additional pricing error, which causes the financial analysts to apply different weight allocations for the same combined valuation model. The implication of these findings is that the valuation advantage of the combined valuation model can be negatively affected by the subjective combining process of the value estimates. Therefore, it is important for academics to further explore the target price setting method, especially how to effectively combine several value estimates produced by the combined valuation model. The current study introduces a quantized combining method to objectively estimate the weight for each value estimate produced from a combined valuation model. This quantized combining method is able to largely reduce the subjective pricing error and improve the reliability of the target price.

### 8.3.5 Suitability Test Method for Valuation Models

The current study shows that in the existing literature, most of the studies judge the suitability of a valuation model via purely theoretical analysis (e.g. Pinto et al, 2010, Banerjee, 2003). These studies concentrate on the characteristics of the valuation model and the company being valued, and then qualitatively assess the suitability of the valuation model from the theoretical perspective. In addition, some other studies have attempted to judge the suitability of valuation models via the financial analysts (e.g. Imam et al., 2008, Demirakos et al., 2004). These studies often conduct interviews with financial analysts and also on the content analysis on the valuation report, and then assess the suitability of the valuation model based on the observed financial analyst's usage and preference. This finding means that the lack of quantized measurement method in the existing literature, and the theory and observation based methods cannot accurately measure the degree of suitability of a valuation model. Therefore, the academics should attempt to apply a more objective method to accurately measure the suitability of a valuation model. This study designs an advanced suitability test method for valuation model based on the accuracy and explanatory power of its value estimate. This quantized suitability test method is able to accurately test the suitability of the valuation model from multi-aspects. The suitability of a valuation model in different industries can be better measured.

## 8.4 Research Limitations and Future Research Recommendations

There are several limitations in the current study related to sample selection and methodology. This section discusses the study limitations and presents the directions for future research.

- The current study results have the characteristics of timeliness and regionalism, where the study is based on the data of 35 American listed companies during the period of 2010 to 2012. Thus the current study results are best suited to the American capital market in the economic expansion stage, or other mature capital markets with similar characteristics. This is particularly true for the best industry-based individual and combined valuation models identified in the current study. The suitability of an individual or combined valuation model often tends to change in different markets and periods. Therefore, it is recommended that future research selects different sample periods and companies, in order to obtain the results that are suitable for specific capital markets and periods.

- The current study applies the constant discount rate to estimate the present values of the future cash flows. However, the risks behind the future cash flows from different life stages of a company are not the same, and the discount rate should fully reflect the underlying risk of each cash flow. Therefore, it is ideal that the discount rate is time-varying and the cash flow from each future stage is discounted by its corresponding rate. However, the estimation of different discount rates for the cash flows from different future stages is highly complex. In practice, the financial analysts prefer to apply a constant discount rate to all the future cash flows for simplicity. The existing literature also provides little guidance on this issue. Thus, further research on the time-varying discount rate is recommended. More accurate discount rate and reliable valuation results can be expected as a result of more advanced discount rate estimation methods.

- Each of the best industry-based combined valuation models identified in the current study only contains three individual valuation models. In practice, the financial analysts simultaneously apply an average of nine individual valuation models (*Institutional Factor Survey*, Merrill Lynch, 2006). In theory, different individual valuation models estimate the intrinsic value from different points of view and every individual valuation model has its own limitation. Thus, it is important to select more than one suitable individual valuation model to minimize their drawbacks while maximizing their advantages. The best industry-based combined valuation models identified in the current study are for indicative purposes only. The financial analysts are encouraged to customize them by adding more suitable individual valuation models to satisfy their specific valuation need or objective. Further research on the extension of the best industry-based combined valuation model is recommended (more than three individual valuation models in the combination).

- The current study selects only three major industries in the capital market as the sample industries. It is recommended to include more industries into the study of industry-based individual and combined valuation model. The result has excellent practical relevance in company valuation, which can effectively assist the financial analysts in the selection of individual valuation models and the construction of combined valuation models.

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# Appendix A

## Characteristics of Sample Companies and Sample Industries

### Financial Industry

| Commercial Bank | USB | RF | MTB | CMA | PNC | Sector Average |
|---|---|---|---|---|---|---|
| **Income** | | | | | | |
| PS Ratio | 3.40 | 1.94 | 3.35 | 2.54 | 2.68 | 2.90 |
| PE Ratio | 12.32 | 10.21 | 15.49 | 15.98 | 10.75 | 13.00 |
| Operating PE Ratio | 8.58 | 6.67 | 9.21 | 10.97 | 7.50 | 9.39 |
| Operating Margin | 39.61% | 29.02% | 36.35% | 23.15% | 35.70% | 31.96% |
| EV to EBIT | 13.03 | 7.78 | 9.93 | 10.37 | 9.20 | 13.33 |
| EV to Revenues | 6.08 | 2.72 | 4.32 | 2.77 | 3.96 | 5.24 |
| Earnings Yield | 8.12% | 9.79% | 6.45% | 6.26% | 9.30% | 7.69% |
| **Asset** | | | | | | |
| Price to Book Value | 1.63 | 0.62 | 1.19 | 0.90 | 0.87 | 1.09 |
| Return on Assets | 1.39% | 0.89% | 1.05% | 0.64% | 1.13% | 1.00% |
| Asset Utilization | 4.83% | 4.40% | 4.50% | 3.94% | 4.24% | 4.31% |
| **Cash Flow** | | | | | | |
| Price to Free Cash Flow | 8.29 | 5.19 | 9.90 | 10.63 | 7.37 | 16.96 |
| EV to Free Cash Flow | 14.83 | 7.30 | 12.79 | 11.60 | 10.88 | 25.39 |

| Insurance | TRV | WRB | ALL | ACE | CB | Sector Average |
|---|---|---|---|---|---|---|
| **Income** | | | | | | |
| PS Ratio | 1.36 | 1.04 | 0.77 | 0.99 | 2.15 | 1.20 |
| PE Ratio | 11.15 | 15.02 | 16.99 | 17.92 | 17.12 | 17.32 |
| Operating PE Ratio | 8.09 | 10.28 | 10.79 | 11.90 | 15.12 | 12.89 |
| Operating Margin | 16.79% | 10.15% | 7.17% | 10.28% | 14.24% | 9.64% |
| EV to EBIT | 7.41 | 10.11 | 10.13 | 13.30 | 20.14 | 14.05 |
| EV to Revenues | 1.35 | 1.21 | 0.81 | 2.30 | 3.22 | 1.49 |
| Earnings Yield | 8.97% | 6.66% | 5.89% | 4.81% | 5.84% | 5.77% |
| **Asset** | | | | | | |
| Price to Book Value | 1.44 | 1.52 | 1.40 | 1.12 | 1.31 | 1.22 |
| Return on Assets | 3.24% | 2.31% | 1.64% | 2.45% | 2.34% | 1.72% |
| Asset Utilization | 26.42% | 33.27% | 33.46% | 29.10% | 19.35% | 22.79% |
| **Cash Flow** | | | | | | |
| Price to Free Cash Flow | 8.93 | 8.50 | 7.93 | 9.10 | 12.14 | 17.06 |
| EV to Free Cash Flow | 8.85 | 9.81 | 8.32 | 11.34 | 18.17 | 16.18 |

| Securities | GS | ETFC | LAZ | GHL | MS | Sector Average |
|---|---|---|---|---|---|---|
| **Income** | | | | | | |
| PS Ratio | 2.23 | 4.60 | 1.73 | 1.89 | 1.47 | 1.75 |
| PE Ratio | 16.31 | 17.29 | 13.94 | 22.55 | 11.02 | 15.04 |
| Operating PE Ratio | 10.24 | 23.67 | 23.96 | 13.40 | 6.58 | 10.42 |
| Operating Margin | 21.73% | 19.43% | 10.31% | 14.10% | 22.33% | 17.20% |
| EV to EBIT | 20.39 | 17.42 | 11.11 | 12.89 | 16.78 | 20.45 |
| EV to Revenues | 8.35 | 4.38 | 1.69 | 1.96 | 5.12 | 5.09 |
| Earnings Yield | 6.13% | 5.78% | 5.36% | 4.43% | 9.08% | 6.65% |
| **Asset** | | | | | | |
| Price to Book Value | 0.79 | 1.08 | 3.29 | 1.77 | 0.71 | 1.10 |
| Return on Assets | 0.50% | 0.83% | 5.41% | 5.75% | 0.60% | 0.66% |
| Asset Utilization | 3.40% | 3.10% | 7.94% | 68.55% | 4.05% | 5.74% |
| **Cash Flow** | | | | | | |
| Price to Free Cash Flow | 5.70 | 4.70 | 5.43 | 6.78 | 2.49 | 26.43 |
| EV to Free Cash Flow | 4.90 | 4.48 | 5.30 | 7.03 | 8.68 | 12.46 |

## Information Technology Industry

| Software & Computer Service | IBM | IT | CSC | GIB | SYNT | Sector Average |
|---|---|---|---|---|---|---|
| **Income** | | | | | | |
| PS Ratio | 1.83 | 3.63 | 0.77 | 1.69 | 3.81 | 1.22 |
| PE Ratio | 11.52 | 43.76 | 27.48 | 17.70 | 14.22 | 16.89 |
| Operating PE Ratio | 10.49 | 26.85 | 12.61 | 13.01 | 12.56 | 12.80 |
| Operating Margin | 17.46% | 13.50% | 6.07% | 13.00% | 30.36% | 9.40% |
| EV to EBIT | 12.18 | 27.42 | 19.06 | 12.91 | 9.48 | 16.51 |
| EV to Revenues | 2.18 | 3.78 | 0.91 | 1.79 | 2.88 | 1.51 |
| Earnings Yield | 8.68% | 2.29% | 3.64% | 5.65% | 7.03% | 5.92% |
| **Asset** | | | | | | |
| Price to Book Value | 9.76 | 3.89 | 3.35 | 2.83 | 3.21 | 3.45 |
| Return on Assets | 11.44% | 9.25% | 2.72% | 8.76% | 19.41% | 6.44% |
| Asset Utilization | 71.82% | 111.00% | 97.99% | 91.65% | 72.30% | 89.74% |
| **Cash Flow** | | | | | | |
| Price to Free Cash Flow | 10.03 | 26.52 | 42.91 | 17.07 | 14.57 | 22.24 |
| EV to Free Cash Flow | 11.95 | 27.65 | 50.79 | 18.08 | 11.00 | 18.02 |

| Technology Hardware | BMI | CGNX | CW | ESE | ALOG | Sector Average |
|---|---|---|---|---|---|---|
| **Income** | | | | | | |
| PS Ratio | 2.64 | 8.34 | 1.78 | 1.88 | 1.92 | 2.70 |
| PE Ratio | 35.02 | 20.55 | 23.63 | 25.82 | 70.89 | 21.62 |
| Operating PE Ratio | 21.69 | 32.10 | 13.04 | 15.63 | 37.52 | 17.94 |
| Operating Margin | 12.19% | 25.99% | 13.64% | 12.01% | 5.11% | 14.14% |
| EV to EBIT | 22.86 | 27.77 | 14.54 | 16.30 | 32.23 | 19.75 |
| EV to Revenues | 2.79 | 7.22 | 1.99 | 1.96 | 1.65 | 2.98 |
| Earnings Yield | 2.86% | 4.87% | 4.23% | 3.87% | 1.41% | 4.63% |
| **Asset** | | | | | | |
| Price to Book Value | 4.40 | 4.25 | 2.85 | 1.73 | 1.88 | 2.81 |
| Return on Assets | 8.42% | 20.60% | 5.32% | 4.64% | 2.25% | 7.27% |
| Asset Utilization | 111.80% | 50.55% | 70.94% | 63.58% | 83.20% | 61.82% |
| **Cash Flow** | | | | | | |
| Price to Free Cash Flow | 38.11 | 29.42 | 10.44 | 25.58 | 28.74 | 31.09 |
| EV to Free Cash Flow | 40.17 | 25.45 | 11.65 | 26.68 | 24.68 | 28.84 |

## Health Care Industry

| Pharmaceuticals | MRK | LLY | AZN | ECTE | BMY | Sector Average |
|---|---|---|---|---|---|---|
| **Income** | | | | | | |
| PS Ratio | 4.16 | 4.20 | 3.08 | 3.21 | 7.32 | 3.72 |
| PE Ratio | 35.80 | 36.70 | 26.33 | 30.12 | 79.33 | 27.14 |
| Operating PE Ratio | 22.57 | 79.82 | 18.08 | 19.11 | 65.97 | 20.16 |
| Operating Margin | 18.42% | 5.26% | 17.04% | 20.11% | 11.09% | 18.43% |
| EV to EBIT | 27.43 | 30.93 | 24.79 | 23.21 | 51.11 | 22.12 |
| EV to Revenues | 4.40 | 4.61 | 3.65 | 5.31 | 7.44 | 4.10 |
| Earnings Yield | 2.79% | 2.72% | 3.80% | 2.89% | 1.26% | 3.69% |
| **Asset** | | | | | | |
| Price to Book Value | 3.67 | 5.86 | 5.18 | 3.31 | 8.56 | 4.21 |
| Return on Assets | 4.50% | 6.50% | 5.08% | 7.89% | 4.89% | 6.16% |
| Asset Utilization | 38.41% | 56.60% | 43.08% | 39.54% | 52.53% | 44.67% |
| **Cash Flow** | | | | | | |
| Price to Free Cash Flow | 14.98 | 49.91 | 29.68 | 32.54 | 30.91 | 41.45 |
| EV to Free Cash Flow | 15.86 | 54.78 | 35.17 | 40.12 | 29.71 | 37.19 |

| Biotechnology | AMGN | BIIB | GILD | UTHR | CELG | Sector Average |
|---|---|---|---|---|---|---|
| **Income** | | | | | | |
| PS Ratio | 5.39 | 5.14 | 3.87 | 3.67 | 8.75 | 6.41 |
| PE Ratio | 16.54 | 15.20 | 7.33 | 6.09 | 50.60 | 17.12 |
| Operating PE Ratio | 13.49 | 10.91 | 5.91 | 5.13 | 35.35 | 12.98 |
| Operating Margin | 39.94% | 47.11% | 65.39% | 71.49% | 24.75% | 44.28% |
| EV to EBIT | 12.02 | 10.89 | 5.85 | 2.69 | 34.47 | 14.52 |
| EV to Revenues | 5.21 | 5.12 | 3.86 | 2.55 | 8.90 | 7.16 |
| Earnings Yield | 6.05% | 6.58% | 13.64% | 16.42% | 1.98% | 5.84% |
| **Asset** | | | | | | |
| Price to Book Value | 4.09 | 5.25 | 8.52 | 2.87 | 15.96 | 6.27 |
| Return on Assets | 10.06% | 19.89% | 38.07% | 44.45% | 7.28% | 16.83% |
| Asset Utilization | 30.88% | 58.87% | 72.10% | 74.12% | 41.89% | 45.41% |
| **Cash Flow** | | | | | | |
| Price to Free Cash Flow | 13.53 | 17.16 | 7.16 | 16.03 | 36.86 | 50.80 |
| EV to Free Cash Flow | 13.09 | 17.09 | 7.15 | 11.13 | 37.51 | 25.62 |

Note: All ratios above are “TTM” (Trailing twelve months) ratios.

Source: Author’s calculation

# Appendix B

## Estimated Weights for the Best Industry-based Combined Valuation Models

### Financial Industry

| Commercial Bank | PB | DD | PEGF | Constant |
|---|---|---|---|---|
| USB | 1.76 | 0.51 | -0.03 | -11.83 |
| RF | 0.91 | 0.15 | 0.12 | -3.18 |
| MTB | 1.08 | 0.39 | -0.01 | -16.95 |
| CMA | 0.94 | 0.05 | 0.00 | -0.61 |
| PNC | 0.44 | -0.08 | 0.03 | 34.81 |

| Insurance | PB | DD | DYF | Constant |
|---|---|---|---|---|
| TRV | 0.61 | -0.02 | 0.31 | 0.60 |
| WRB | 0.55 | 0.09 | 0.56 | 7.85 |
| ALL | 0.82 | 0.20 | -0.06 | -4.80 |
| ACE | 0.91 | 0.07 | 0.25 | -12.32 |
| CB | 0.52 | 0.16 | 0.50 | -10.19 |

| Securities | PB | DYT | RI | Constant |
|---|---|---|---|---|
| GS | 1.44 | 0.10 | 0.15 | -74.31 |
| ETFC | 1.23 | 0.35 | 0.31 | -21.87 |
| LAZ | 1.43 | 0.40 | 0.23 | -3.73 |
| GHL | -1.31 | 0.42 | 0.68 | -14.90 |
| MS | 0.54 | 0.20 | -0.31 | 3.18 |

### Information Technology Industry

| Software & Computer Service | PET | PEGF | DCF | Constant |
|---|---|---|---|---|
| IBM | -0.05 | 0.90 | 0.29 | 2.69 |
| IT | 1.94 | -0.10 | 0.20 | -3.23 |
| CSC | 0.03 | 0.01 | -0.17 | 52.19 |
| GIB | 0.00 | 0.54 | 0.03 | 6.35 |
| SYNT | -0.10 | 1.07 | 0.34 | -17.38 |

| Technology Hardware | PEF | PEGF | PS | Constant |
|---|---|---|---|---|
| BMI | 0.23 | 0.30 | 0.26 | 6.46 |
| CGNX | 0.43 | -0.07 | 2.03 | -3.63 |
| CW | 0.24 | 0.00 | 0.09 | 15.55 |
| ESE | 0.78 | -0.01 | 0.14 | -5.41 |
| ALOG | 0.05 | 0.04 | 0.86 | 0.93 |

### Health Care Industry

| Pharmaceuticals | DCF | DD | DYT | Constant |
|---|---|---|---|---|
| MRK | -0.04 | 0.15 | 0.60 | 4.83 |
| LLY | 0.03 | -0.22 | 1.60 | -25.34 |
| AZN | -0.01 | 0.02 | 0.17 | 30.52 |
| ECTE | 0.09 | 0.21 | 0.89 | 20.11 |
| BMY | 0.00 | 0.19 | 0.96 | -7.73 |

| Biotechnology | PEF | PEGF | RI | Constant |
|---|---|---|---|---|
| AMGN | 0.92 | -0.03 | 0.01 | 6.50 |
| BIIB | 0.20 | 0.33 | 0.21 | -1.33 |
| GILD | 1.29 | -0.01 | -0.10 | -4.56 |
| UTHR | -0.08 | 0.11 | 0.06 | 31.44 |
| CELG | 0.14 | 0.24 | 0.12 | 39.74 |

Source: Author's calculation

# Appendix C

## Individual Valuation Models: Work as a Group vs Work as Individuals

### Financial Industry

1. Commercial Bank

| | Combined Model Rank | Abj Valuation Error (Abs) | R-Sq (adj) |
|---|---|---|---|
| Combined Model 1 - PBV, DD and FDY | 7 | Y | Y |
| Combined Model 2 - PBV, DD and FPE | 3 | Y | Y |
| Combined Model 3 - PBV, DD and TPEG | 7 | Y | Y |
| Combined Model 4 - PBV, DD and FPEG | 1 | Y | Y |
| Combined Model 5 - PBV, FDY and FPE | 2 | Y | Y |
| Combined Model 6 - PBV, FDY and TPEG | 9 | Y | Y |
| Combined Model 7 - PBV, FDY and FPEG | 4 | Y | Y |
| Combined Model 8 - PBV, FPE and TPEG | 5 | Y | Y |
| Combined Model 9 - PBV, FPE and FPEG | 10 | Y | Y |
| Combined Model 10 - PBV, TPEG and FPEG | 6 | Y | Y |
| Combined Model 11 - DD, FDY and FPE | 14 | Y | Y |
| Combined Model 12 - DD, FDY and TPEG | 11 | Y | Y |
| Combined Model 13 - DD, FDY and FPEG | 15 | Y | Y |
| Combined Model 14 - DD, FPE and TPEG | 18 | Y | Y |
| Combined Model 15 - DD, FPE and FPEG | 15 | Y | N |
| Combined Model 16 - DD, TPEG and FPEG | 19 | Y | Y |
| Combined Model 17 - FDY, FPE and TPEG | 12 | Y | Y |
| Combined Model 18 - FDY, FPE and FPEG | 20 | Y | Y |
| Combined Model 19 - FDY, TPEG and FPEG | 15 | Y | Y |
| Combined Model 20 - FPE, TPEG and FPEG | 13 | Y | Y |
| **Percentage of combined model outperforms its individual models:** | | 100% | 95% |

2. Insurance

| | Combined Model Rank | Abj Valuation Error (Abs) | R-Sq (adj) |
|---|---|---|---|
| Combined Model 1 - PBV, DD and TDY | 5 | Y | Y |
| Combined Model 2 - PBV, DD and FDY | 1 | Y | Y |
| Combined Model 3 - PBV, DD and FPE | 9 | Y | Y |
| Combined Model 4 - PBV, DD and FPEG | 7 | Y | Y |
| Combined Model 5 - PBV, TDY and FDY | 3 | Y | Y |
| Combined Model 6 - PBV, TDY and FPE | 8 | Y | Y |
| Combined Model 7 - PBV, TDY and FPEG | 6 | Y | Y |
| Combined Model 8 - PBV, FDY and FPE | 4 | Y | Y |
| Combined Model 9 - PBV, FDY and FPEG | 2 | Y | Y |
| Combined Model 10 - PBV, FPE and FPEG | 15 | Y | Y |
| Combined Model 11 - DD, TDY and FDY | 9 | Y | Y |
| Combined Model 12 - DD, TDY and FPE | 18 | Y | Y |
| Combined Model 13 - DD, TDY and FPEG | 17 | Y | Y |
| Combined Model 14 - DD, FDY and FPE | 15 | Y | Y |
| Combined Model 15 - DD, FDY and FPEG | 9 | Y | Y |
| Combined Model 16 - DD, FPE and FPEG | 19 | Y | Y |
| Combined Model 17 - TDY, FDY and FPE | 14 | Y | Y |
| Combined Model 18 - TDY, FDY and FPEG | 12 | Y | Y |
| Combined Model 19 - TDY, FPE and FPEG | 20 | Y | Y |
| Combined Model 20 - FDY, FPE and FPEG | 13 | Y | Y |
| **Percentage of combined model outperforms its individual models:** | | 100% | 100% |

3. Securities

| | Combined Model Rank | Abj Valuation Error (Abs) | R-Sq (adj) |
|---|---|---|---|
| Combined Model 1 - PBV, DD and TDY | 2 | Y | Y |
| Combined Model 2 - PBV, DD and FPE | 15 | Y | Y |
| Combined Model 3 - PBV, DD and FPEG | 16 | Y | Y |
| Combined Model 4 - PBV, DD and RI | 10 | Y | Y |
| Combined Model 5 - PBV, TDY and FPE | 4 | Y | Y |
| Combined Model 6 - PBV, TDY and FPEG | 5 | Y | Y |
| Combined Model 7 - PBV, TDY and RI | 1 | Y | Y |
| Combined Model 8 - PBV, FPE and FPEG | 8 | Y | Y |
| Combined Model 9 - PBV, FPE and RI | 7 | Y | Y |
| Combined Model 10 - PBV, FPEG and RI | 6 | Y | Y |
| Combined Model 11 - DD, TDY and FPE | 18 | Y | Y |
| Combined Model 12 - DD, TDY and FPEG | 10 | Y | Y |
| Combined Model 13 - DD, TDY and RI | 12 | Y | Y |
| Combined Model 14 - DD, FPE and FPEG | 12 | Y | Y |
| Combined Model 15 - DD, FPE and RI | 19 | N | Y |
| Combined Model 16 - DD, FPEG and RI | 20 | N | Y |
| Combined Model 17 - TDY, FPE and FPEG | 2 | Y | Y |
| Combined Model 18 - TDY, FPE and RI | 17 | N | Y |
| Combined Model 19 - DYT, PEGF and RI | 9 | Y | Y |
| Combined Model 20 - FPE, FPEG and RI | 14 | Y | Y |
| **Percentage of combined model outperforms its individual models:** | | 85% | 100% |

## Information Technology Industry

1. Software & Computer Services

| | Combined Model Rank | Abj Valuation Error (Abs) | R-Sq (adj) |
|---|---|---|---|
| Combined Model 1 - TPE, FPE and FPEG | 14 | Y | Y |
| Combined Model 2 - TPE, FPE and DCF | 2 | Y | Y |
| Combined Model 3 - TET, FPE and EVS | 9 | Y | Y |
| Combined Model 4 - TPE, FPE and RI | 4 | Y | Y |
| Combined Model 5 - TPE, FPEG and DCF | 1 | Y | Y |
| Combined Model 6 - TPE, FPEG and EVS | 12 | Y | Y |
| Combined Model 7 - TPE, FPEG and RI | 3 | Y | Y |
| Combined Model 8 - TPE, DCF and EVS | 16 | Y | Y |
| Combined Model 9 - TPE, DCF and RI | 20 | Y | Y |
| Combined Model 10 - TPE, EVS and RI | 17 | Y | Y |
| Combined Model 11 - FPE, FPEG and DCF | 6 | Y | Y |
| Combined Model 12 - FPE, FPEG and EVS | 15 | Y | Y |
| Combined Model 13 - FPE, FPEG and RI | 13 | Y | Y |
| Combined Model 14 - FPE, DCF and EVS | 9 | Y | Y |
| Combined Model 15 - FPE, DCF and RI | 11 | Y | Y |
| Combined Model 16 - FPE, EVS and RI | 8 | Y | Y |
| Combined Model 17 - FPEG, DCF and EVS | 5 | Y | Y |
| Combined Model 18 - FPEG, DCF and RI | 18 | Y | Y |
| Combined Model 19 - FPEG, EVS and RI | 7 | Y | Y |
| Combined Model 20 - DCF, EVS and RI | 19 | Y | Y |
| **Percentage of combined model outperforms its individual models:** | | 100% | 100% |

## 2. Technology Hardware

| | Combined Model Rank | Abj Valuation Error (Abs) | R-Sq (adj) |
|---|---|---|---|
| Combined Model 1 - FPE, FPEG and PBV | 8 | Y | Y |
| Combined Model 2 - FPE, FPEG and EVBV | 14 | Y | Y |
| Combined Model 3 - FPE, FPEG and EVS | 6 | Y | Y |
| Combined Model 4 - FPE, FPEG and PS | 1 | Y | Y |
| Combined Model 5 - FPE, PBV and EVBV | 12 | Y | Y |
| Combined Model 6 - FPE, PBV and EVS | 10 | Y | Y |
| Combined Model 7 - FPE, PBV and PS | 4 | Y | Y |
| Combined Model 8 - FPE, EVBV and EVS | 14 | Y | Y |
| Combined Model 9 - FPE, EVBV and PS | 7 | Y | Y |
| Combined Model 10 - FPE, EVS and PS | 5 | Y | Y |
| Combined Model 11 - FPEG, PBV and EVBV | 9 | Y | Y |
| Combined Model 12 - FPEG, PBV and EVS | 14 | Y | Y |
| Combined Model 13 - FPEG, PBV and PS | 2 | Y | Y |
| Combined Model 14 - FPEG, EVBV and EVS | 14 | Y | Y |
| Combined Model 15 - FPEG, EVBV and PS | 2 | Y | Y |
| Combined Model 16 - FPEG, EVS and PS | 11 | Y | Y |
| Combined Model 17 - PBV, EVBV and EVS | 20 | Y | Y |
| Combined Model 18 - PBV, EVBV and PS | 19 | Y | Y |
| Combined Model 19 - PBV, EVS and PS | 18 | Y | Y |
| Combined Model 20 - EVBV, EVS and PS | 13 | Y | Y |
| **Percentage of combined model outperforms its individual models:** | | 100% | 100% |

# Health Care Industry

## 1. Pharmaceuticals

| | Combined Model Rank | Abj Valuation Error (Abs) | R-Sq (adj) |
|---|---|---|---|
| Combined Model 1 - FPE, EVS and PCF | 16 | Y | Y |
| Combined Model 2 - FPE, EVS and DD | 20 | Y | Y |
| Combined Model 3 - FPE, EVS and TDY | 9 | Y | Y |
| Combined Model 4 - FPE, EVS and FDY | 16 | Y | Y |
| Combined Model 5 - FPE, PCF and DD | 18 | Y | Y |
| Combined Model 6 - FPE, PCF and TDY | 5 | Y | Y |
| Combined Model 7 - FPE, PCF and FDY | 4 | Y | Y |
| Combined Model 8 - FPE, DD and TDY | 12 | Y | Y |
| Combined Model 9 - FPE, DD and FDY | 19 | Y | Y |
| Combined Model 10 - FPE, TDY and FDY | 10 | Y | Y |
| Combined Model 11 - EVS, PCF and DD | 14 | Y | Y |
| Combined Model 12 - EVS, PCF and TDY | 2 | Y | Y |
| Combined Model 13 - EVS, PCF and FDY | 7 | Y | Y |
| Combined Model 14 - EVS, DD and TDY | 11 | Y | Y |
| Combined Model 15 - EVS, DD and FDY | 13 | Y | Y |
| Combined Model 16 - EVS, TDY and FDY | 5 | Y | Y |
| Combined Model 17 - DCF, DD and TDY | 1 | Y | Y |
| Combined Model 18 - DCF, DD and FDY | 14 | Y | Y |
| Combined Model 19 - PCF, TDY and FDY | 3 | Y | Y |
| Combined Model 20 - DD, TDY and FDY | 8 | Y | Y |
| **Percentage of combined model outperforms its individual models:** | | 100% | 100% |

## 2. Biotechnology

| | Combined Model Rank | Abj Valuation Error (Abs) | R-Sq (adj) |
|---|---|---|---|
| Combined Model 1 - TPE, FPE and TPEG | 18 | Y | Y |
| Combined Model 2 - TPE, FPE and FPEG | 12 | Y | Y |
| Combined Model 3 - TPE, FPE and EVS | 7 | Y | Y |
| Combined Model 4 - TPE, FPE and RI | 8 | Y | Y |
| Combined Model 5 - TPE, TPEG and FPEG | 19 | Y | Y |
| Combined Model 6 - TPE, TPEG and EVS | 20 | Y | Y |
| Combined Model 7 - TPE, TPEG and RI | 13 | Y | Y |
| Combined Model 8 - TPE, FPEG and EVS | 16 | Y | Y |
| Combined Model 9 - TPE, FPEG and RI | 3 | Y | Y |
| Combined Model 10 - TPE, EVS and RI | 8 | Y | Y |
| Combined Model 11 - FPE, TPEG and FPEG | 3 | Y | Y |
| Combined Model 12 - FPE, TPEG and EVS | 6 | Y | Y |
| Combined Model 13 - FPE, TPEG and RI | 5 | Y | Y |
| Combined Model 14 - FPE, FPEG and EVS | 8 | Y | Y |
| Combined Model 15 - FPE, FPEG and RI | 1 | Y | Y |
| Combined Model 16 - FPE, EVS and RI | 2 | Y | Y |
| Combined Model 17 - TPEG, FPEG and EVS | 16 | Y | Y |
| Combined Model 18 - TPEG, FPEG and RI | 15 | Y | Y |
| Combined Model 19 - TPEG, EVS and RI | 13 | Y | Y |
| Combined Model 20 - FPEG, EVS and RI | 11 | Y | Y |
| **Percentage of combined model outperforms its individual models:** | | 100% | 100% |

Note: "Y" means that the combined valuation model outperforms all of its own individual valuation models in terms of accuracy (valuation error) or explanatory power ($R^2$). The above tables reflect whether certain individual models perform better when they work as a group rather than individual.

Source: Author's calculation

# Appendix D

## Valuation Performance Comparison: Mixed vs Pure Combined Models

### Financial Industry

1. Commercial Bank

| Mixed Combined Models | Accuracy<br>Abj Valuation Error (Abs) | Explanatory Power<br>R-Sq (adj) | Model Rank |
|---|---|---|---|
| Combined Model 1 - PBV, DD and FDY | 13.68% | 70.00% | 7 |
| Combined Model 2 - PBV, DD and FPE | 12.73% | 70.18% | 3 |
| Combined Model 3 - PBV, DD and TPEG | 13.44% | 69.34% | 7 |
| Combined Model 4 - PBV, DD and FPEG | 12.18% | 70.30% | 1 |
| Combined Model 11 - DD, FDY and FPE | 15.43% | 39.88% | 14 |
| Combined Model 12 - DD, FDY and TPEG | 14.87% | 52.50% | 11 |
| Combined Model 13 - DD, FDY and FPEG | 15.40% | 39.02% | 15 |
| Combined Model 14 - DD, FPE and TPEG | 15.64% | 34.32% | 18 |
| Combined Model 15 - DD, FPE and FPEG | 14.75% | 19.16% | 15 |
| Combined Model 16 - DD, TPEG and FPEG | 15.73% | 32.84% | 19 |
| **Median:** | 14.81% | 46.19% | |

| Pure Combined Models | | | |
|---|---|---|---|
| Combined Model 5 - PBV, FDY and FPE | 13.11% | 73.42% | 2 |
| Combined Model 6 - PBV, FDY and TPEG | 14.82% | 70.02% | 9 |
| Combined Model 7 - PBV, FDY and FPEG | 13.44% | 73.76% | 4 |
| Combined Model 8 - PBV, FPE and TPEG | 13.21% | 69.66% | 5 |
| Combined Model 9 - PBV, FPE and FPEG | 13.66% | 68.90% | 10 |
| Combined Model 10 - PBV, TPEG and FPEG | 13.40% | 69.48% | 6 |
| Combined Model 17 - FDY, FPE and TPEG | 15.45% | 52.64% | 12 |
| Combined Model 18 - FDY, FPE and FPEG | 16.00% | 32.84% | 20 |
| Combined Model 19 - FDY, TPEG and FPEG | 15.64% | 51.62% | 15 |
| Combined Model 20 - FPE, TPEG and FPEG | 15.37% | 39.16% | 13 |
| **Median:** | 14.24% | 69.19% | |

2. Insurance

| Mixed Combined Models | Accuracy<br>Abj Valuation Error (Abs) | Explanatory Power<br>R-Sq (adj) | Model Rank |
|---|---|---|---|
| Combined Model 1 - PBV, DD and TDY | 8.72% | 93.78% | 5 |
| Combined Model 2 - PBV, DD and FDY | 7.33% | 94.98% | 1 |
| Combined Model 3 - PBV, DD and FPE | 9.12% | 93.68% | 9 |
| Combined Model 4 - PBV, DD and FPEG | 9.11% | 93.72% | 7 |
| Combined Model 11 - DD, TDY and FDY | 8.55% | 92.26% | 9 |
| Combined Model 12 - DD, TDY and FPE | 11.03% | 85.34% | 18 |
| Combined Model 13 - DD, TDY and FPEG | 10.67% | 85.72% | 17 |
| Combined Model 14 - DD, FDY and FPE | 9.21% | 91.42% | 15 |
| Combined Model 15 - DD, FDY and FPEG | 8.57% | 92.42% | 9 |
| Combined Model 16 - DD, FPE and FPEG | 11.31% | 84.90% | 19 |
| **Median:** | 9.11% | 92.34% | |

| Pure Combined Models | | | |
|---|---|---|---|
| Combined Model 5 - PBV, TDY and FDY | 8.14% | 94.40% | 3 |
| Combined Model 6 - PBV, TDY and FPE | 8.99% | 93.06% | 8 |
| Combined Model 7 - PBV, TDY and FPEG | 8.37% | 93.00% | 6 |
| Combined Model 8 - PBV, FDY and FPE | 8.32% | 94.60% | 4 |
| Combined Model 9 - PBV, FDY and FPEG | 8.20% | 94.62% | 2 |
| Combined Model 10 - PBV, FPE and FPEG | 9.37% | 91.82% | 15 |
| Combined Model 17 - TDY, FDY and FPE | 9.52% | 92.66% | 14 |
| Combined Model 18 - TDY, FDY and FPEG | 9.20% | 93.02% | 12 |
| Combined Model 19 - TDY, FPE and FPEG | 11.82% | 77.06% | 20 |
| Combined Model 20 - FDY, FPE and FPEG | 8.98% | 92.10% | 13 |
| **Median:** | 8.99% | 93.01% | |

3. Securities

| Mixed Combined Models | Accuracy<br>Abj Valuation Error (Abs) | Explanatory Power<br>R-Sq (adj) | Model Rank |
|---|---|---|---|
| Combined Model 1 - PBV, DD and TDY | 14.60% | 81.30% | 2 |
| Combined Model 2 - PBV, DD and FPE | 18.56% | 69.08% | 15 |
| Combined Model 3 - PBV, DD and FPEG | 19.82% | 69.74% | 16 |
| Combined Model 4 - PBV, DD and RI | 18.21% | 71.54% | 10 |
| Combined Model 7 - PBV, TDY and RI | 13.82% | 82.93% | 1 |
| Combined Model 9 - PBV, FPE and RI | 17.42% | 75.20% | 7 |
| Combined Model 10 - PBV, FPEG and RI | 16.96% | 74.32% | 6 |
| Combined Model 11 - DD, TDY and FPE | 19.23% | 67.40% | 18 |
| Combined Model 12 - DD, TDY and FPEG | 18.31% | 72.03% | 10 |
| Combined Model 13 - DD, TDY and RI | 17.40% | 68.88% | 12 |
| Combined Model 14 - DD, FPE and FPEG | 16.47% | 60.30% | 12 |
| Combined Model 15 - DD, FPE and RI | 19.97% | 52.52% | 19 |
| Combined Model 16 - DD, FPEG and RI | 20.35% | 49.10% | 20 |
| Combined Model 18 - TDY, FPE and RI | 18.68% | 68.53% | 17 |
| Combined Model 19 - TDY, FPEG and RI | 17.71% | 73.78% | 9 |
| Combined Model 20 - FPE, FPEG and RI | 16.83% | 62.66% | 14 |
| **Median:** | 17.96% | 69.41% | |

| Pure Combined Models | | | |
|---|---|---|---|
| Combined Model 5 - PBV, TDY and FPE | 14.82% | 77.23% | 4 |
| Combined Model 6 - PBV, TDY and FPEG | 15.85% | 77.23% | 5 |
| Combined Model 8 - PBV, FPE and FPEG | 16.80% | 69.42% | 8 |
| Combined Model 17 - TDY, FPE and FPEG | 14.74% | 81.38% | 2 |
| **Median:** | 15.33% | 77.23% | |

# Information Technology Industry

1. Software & Computer Services

| Mixed Combined Models | Accuracy<br>Abj Valuation Error (Abs) | Explanatory Power<br>R-Sq (adj) | Model Rank |
|---|---|---|---|
| Combined Model 2 - TPE, FPE and DCF | 12.78% | 88.44% | 2 |
| Combined Model 4 - TPE, FPE and RI | 13.02% | 88.26% | 4 |
| Combined Model 5 - TPE, FPEG and DCF | 12.10% | 88.32% | 1 |
| Combined Model 7 - TPE, FPEG and RI | 12.45% | 86.76% | 3 |
| Combined Model 8 - TPE, DCF and EVS | 14.28% | 80.10% | 16 |
| Combined Model 9 - TPE, DCF and RI | 16.41% | 71.34% | 20 |
| Combined Model 10 - TPE, EVS and RI | 15.33% | 82.16% | 17 |
| Combined Model 11 - FPE, FPEG and DCF | 13.66% | 86.46% | 6 |
| Combined Model 13 - FPE, FPEG and RI | 13.58% | 83.52% | 13 |
| Combined Model 14 - FPE, DCF and EVS | 13.55% | 84.28% | 9 |
| Combined Model 15 - FPE, DCF and RI | 13.46% | 81.46% | 11 |
| Combined Model 16 - FPE, EVS and RI | 13.66% | 85.14% | 8 |
| Combined Model 17 - FPEG, DCF and EVS | 13.47% | 84.94% | 5 |
| Combined Model 18 - FPEG, DCF and RI | 15.83% | 78.64% | 18 |
| Combined Model 19 - FPEG, EVS and RI | 13.47% | 84.70% | 7 |
| Combined Model 20 - DCF, EVS and RI | 16.14% | 73.80% | 19 |
| **Median:** | 13.56% | 84.49% | |

| Pure Combined Models | | | |
|---|---|---|---|
| Combined Model 1 - TPE, FPE and FPEG | 14.07% | 84.06% | 14 |
| Combined Model 3 - TPE, FPE and EVS | 14.08% | 85.44% | 9 |
| Combined Model 6 - TPE, FPEG and EVS | 14.52% | 85.22% | 12 |
| Combined Model 12 - FPE, FPEG and EVS | 14.83% | 84.16% | 15 |
| **Median:** | 14.30% | 84.69% | |

## Health Care Industry

### 1. Pharmaceuticals

| Mixed Combined Models | Accuracy<br>Abj Valuation Error (Abs) | Explanatory Power<br>R-Sq (adj) | Model Rank |
|---|---|---|---|
| Combined Model 2 - FPE, EVS and DD | 16.66% | 64.36% | 20 |
| Combined Model 5 - FPE, PCF and DD | 17.05% | 68.94% | 18 |
| Combined Model 8 - FPE, DD and TDY | 11.35% | 77.68% | 12 |
| Combined Model 9 - FPE, DD and FDY | 14.66% | 54.43% | 19 |
| Combined Model 11 - EVS, PCF and DD | 15.99% | 70.14% | 14 |
| Combined Model 14 - EVS, DD and TDY | 10.78% | 77.60% | 11 |
| Combined Model 15 - EVS, DD and FDY | 12.41% | 71.15% | 13 |
| Combined Model 17 - DCF, DD and TDY | 10.10% | 82.90% | 1 |
| Combined Model 18 - DCF, DD and FDY | 13.71% | 64.40% | 14 |
| Combined Model 20 - DD, TDY and FDY | 10.53% | 78.70% | 8 |
| **Median:** | 13.06% | 70.65% | |

| Pure Combined Models | | | |
|---|---|---|---|
| Combined Model 1 - FPE, EVS and PCF | 15.97% | 65.56% | 16 |
| Combined Model 3 - FPE, EVS and TDY | 11.18% | 78.80% | 9 |
| Combined Model 4 - FPE, EVS and FDY | 13.65% | 59.40% | 16 |
| Combined Model 6 - FPE, PCF and TDY | 10.66% | 80.70% | 5 |
| Combined Model 7 - FPE, PCF and FDY | 10.09% | 79.13% | 4 |
| Combined Model 10 - FPE, TDY and FDY | 11.06% | 78.60% | 10 |
| Combined Model 12 - EVS, PCF and TDY | 9.81% | 80.68% | 2 |
| Combined Model 13 - EVS, PCF and FDY | 10.15% | 78.75% | 7 |
| Combined Model 16 - EVS, TDY and FDY | 10.48% | 80.58% | 5 |
| Combined Model 19 - PCF, TDY and FDY | 10.35% | 81.08% | 3 |
| **Median:** | 10.57% | 78.96% | |

### 2. Biotechnology

| Mixed Combined Models | Accuracy<br>Abj Valuation Error (Abs) | Explanatory Power<br>R-Sq (adj) | Model Rank |
|---|---|---|---|
| Combined Model 4 - TPE, FPE and RI | 14.09% | 64.80% | 8 |
| Combined Model 7 - TPE, TPEG and RI | 14.32% | 62.38% | 13 |
| Combined Model 9 - TPE, FPEG and RI | 14.80% | 67.44% | 3 |
| Combined Model 10 - TPE, EVS and RI | 14.40% | 65.88% | 8 |
| Combined Model 13 - FPE, TPEG and RI | 13.73% | 64.90% | 5 |
| Combined Model 15 - FPE, FPEG and RI | 14.19% | 68.30% | 1 |
| Combined Model 16 - FPE, EVS and RI | 15.02% | 68.86% | 2 |
| Combined Model 18 - TPEG, FPEG and RI | 15.41% | 64.84% | 15 |
| Combined Model 19 - TPEG, EVS and RI | 14.98% | 64.20% | 13 |
| Combined Model 20 - FPEG, EVS and RI | 15.20% | 66.54% | 11 |
| **Median:** | 14.60% | 65.39% | |

| Pure Combined Models | | | |
|---|---|---|---|
| Combined Model 1 - TPE, FPE and TPEG | 15.83% | 64.20% | 18 |
| Combined Model 2 - TPE, FPE and FPEG | 16.05% | 67.96% | 12 |
| Combined Model 3 - TPE, FPE and EVS | 15.73% | 68.38% | 7 |
| Combined Model 5 - TPE, TPEG and FPEG | 17.47% | 65.96% | 19 |
| Combined Model 6 - TPE, TPEG and EVS | 16.33% | 62.86% | 20 |
| Combined Model 8 - TPE, FPEG and EVS | 16.92% | 67.26% | 16 |
| Combined Model 11 - FPE, TPEG and FPEG | 15.23% | 68.50% | 3 |
| Combined Model 12 - FPE, TPEG and EVS | 15.83% | 68.88% | 6 |
| Combined Model 14 - FPE, FPEG and EVS | 16.49% | 69.88% | 8 |
| Combined Model 17 - TPEG, FPEG and EVS | 17.05% | 67.42% | 16 |
| **Median:** | 16.19% | 67.69% | |

Source: Author's calculation