RELATIVE VALUATION:
A STUDY OF PRICE/EARNING AND PRICE/BOOK 
VALUATION ACCURACIES IN MALAYSIA

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JULY 2008
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SUBMITTED TO THE GRADUATE SCHOOL OF
BUSINESS, FACULTY OF BUSINESS AND
ACCOUNTANCY, UNIVERSITY OF MALAYA, IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF BUSINESS
ADMINISTRATION

JULY 2008
ACKNOWLEDGEMENT

I would like to express my heartfelt gratitude to the supervisor of my thesis, Dr. Norhayah Zulkifli, for her invaluable guidance and support. Her time and relentless effort spent in reviewing my work are very much appreciated.

I am also truly grateful for the support and love I received from my family. To my fellow MBA mates whom I get to know and love, Dalillah, Im Xaxa, Aziyah, Izan and Sairah; thank you for the wonderful times and great memories. The hours of sweats and trying times we went through together every semester are true tests to our perseverance and friendship. Lastly, my thanks go to Azean, Shuhada, Noel and Hisham for simply being there.
ABSTRACT

This research is motivated by the importance of valuation accuracy when valuing firms or equity. The study specifically focuses on relative valuation as one of the valuation methods commonly used by financial analysts due to its simplistic approach. In addition to being adoptable, in valuation, accuracy is vital because the determination of value is the foundation in making important financial decisions such as acquisitions and investments. Therefore, it is imperative that any valuation method being utilized by practitioners exhibits such attributes. Due to the significance of valuation accuracies, this study attempts to investigate the accuracies of relative valuation method with emphasis on Price/Earning and Price/Book multiples that are commonly used in the method. More specifically, this research also examines the valuation accuracies of the combination of Price/Earning and Price/Book multiples in relative valuation method. In this study, the multiples are combined by applying weights to analyze their impacts on achieving accuracy. The accuracy of relative valuation method for different basis of selection criteria of comparable firms is also evaluated. The selection of comparable firms are defined based on industry category, total assets, return on equity, the combination of industry category with total assets and the combination of industry category with return on equity. The research utilizes secondary data extracted from Bursa Malaysia database to capture financial information of 495 companies listed on the Main Board of Bursa Malaysia. The sample size for studying valuation accuracies is 76 firms, based on their 2007 financial data. These target firms are valued based on the valuations of their comparable companies using the relative valuation method. The results of the research indicate that valuation accuracies improve when weighted average is applied to the
combination of Price/Earnings and Price/Book valuation method. The research also finds that the optimal weight that gives greater valuation accuracy is by applying 90% weights to Price/Earnings and 10% weights to Price/Book multiple. The results also suggest that return on equity may be an important selection criterion when selecting comparable companies for valuing target firm.
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<table>
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<th>Description</th>
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<tr>
<td>CAPM</td>
<td>Capital Asset Pricing Model</td>
</tr>
<tr>
<td>CRSP</td>
<td>Center for Research in Security Prices</td>
</tr>
<tr>
<td>EBIT</td>
<td>Earning Before Interest and Tax</td>
</tr>
<tr>
<td>EBITDA</td>
<td>Earning Before Interest, Tax, Depreciation and Amortization</td>
</tr>
<tr>
<td>ETF</td>
<td>Exchange Traded Fund</td>
</tr>
<tr>
<td>GICS</td>
<td>Global Industry Classification Standard</td>
</tr>
<tr>
<td>IPC</td>
<td>Infrastructure Project Companies</td>
</tr>
<tr>
<td>MSCI</td>
<td>Morgan Stanley Capital International</td>
</tr>
<tr>
<td>NAICS</td>
<td>North American Industry Classification System</td>
</tr>
<tr>
<td>ROE</td>
<td>Return on Equity</td>
</tr>
<tr>
<td>SIC</td>
<td>Standard Industrial Classification</td>
</tr>
<tr>
<td>WACC</td>
<td>Weighted Average Cost of Capital</td>
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Chapter 1

RELATIVE VALUATION: A STUDY OF PRICE/EARNING AND PRICE/BOOK VALUATION ACCURACIES IN MALAYSIA

1.0 Introduction

Valuation accuracy is vital as the determination of value of an asset is the foundation in making important financial decisions. It is therefore imperative that any valuation method being utilized by practitioners exhibits such attribute, in addition to being simple and practical to adopt. Due to the significance of valuation accuracies, this study attempts to investigate the accuracies of valuation methods with emphasis on Price/Earning and Price/Book multiples that are commonly used in valuation.

Based on finance theories, valuation models are developed and applied to value companies, equity or any form of asset. While there are many valuation models established, analysts tend to apply the method that is easy and simple to use. Simple valuation methods are those that do not require complicated formula to apply. Valuation method is also appealing when it does not require determination of complex components for the formula. Often the difficult part is to make assumptions in determining the components in valuation formula (English, 2001). For example, in the discounted cash flow valuation method, analysts are required to determine terminal values for the cash flow. This needs assumptions that are based on reasons specific to the company or asset being valued. This is necessary as assumptions that are not acceptable may lead to inaccuracies in valuations (English, 2001). Clearly, the process involves more time as it
needs detailed analysis of the asset being valued. In practice, this is not practical. Analysts need a model that is not taxing and time consuming, while not compromising the accuracy of the estimates. Therefore there is a requirement for establishing a valuation method that is simple to adopt and produce accurate estimations.

One of the most common methods of valuation is the relative valuation method. This method values the firm based on how the market is valuing similar or comparable firms. In other words, it estimates a company’s stock price based on how investors or analysts value similar companies. Valuing against similar companies means that a firm can be comparable to other firms that are of similar characteristics. Thus, it requires controlling of differences that may exist among the firms in the market. For example, a company A may have a lower Price/Earning than its peers. This may be caused by the lower growth prospect possessed by company A, compared to its peers. The differences must then be controlled so as not to affect the accuracies when estimating the company stock price, also known as the target firm. This can be done by standardizing the companies based on earnings, book value or revenues (Damodaran, 2001). Thus, the relative valuation method involves selecting a set of firms that are comparable based on a predetermined characteristics and setting these firms as benchmarks. The method then utilizes the accounting-based valuation multiples, such as the Price/Earning ratio, Price/Book Value ratio and Price/Sales ratio and calculates these multiples for the comparable firms. The value of the target firm is then estimated from the multiples of these comparable firms (Lie and Lie, 2002).
Relative valuation method is used to estimate a target firm’s stock price in the market. In this method, stock price is regarded as an indicator of a firm’s value. As such, from an investor’s point of view, the valuation involved is equity valuation. The difference between equity valuation and company valuation is that the former estimates the values that are relevant to equity investors. As such, the components of valuations involved are in terms of cash flows to investors, such as dividends or earnings attributed to shareholders. This study focuses on studying the method of estimating target firm’s stock price based on how the market value similar or comparable firms.

1.1 Problem Statement

Many studies have researched on methods of improving the accuracy of the relative valuation method (Alford, 1992; Cheng and McNamara, 2000; English, 2001; Damodaran, 2001; Bhojraj and Lee, 2002; Meiner, 2006). However limited studies are available in identifying the set of comparable firms (Alford, 1992; Cheng and McNamara, 2000; Bhojraj and Lee, 2002; Bhojraj, Lee and Oler, 2003). The selection of comparable firms is the first step in relative valuation method (Meitner, 2006). As the value of the target firm is dependent on the set of comparable firms, it is clear that the accuracy in selecting comparable firms is just as important as the selection of multiples to make this valuation method accurate. As such, this research focuses on investigating how valuation accuracies can be improved by investigating performances of valuation multiples combined with predetermined sets of comparable firms.

It has been established that comparable firms must have similar characteristics (Alford, 1992; Damodaran, 2001; English, 2001; Bhojraj and Lee, 2002; Herrmann and Richter,
2003; Meitner, 2006). More specifically, these characteristics are drivers for the multiples used in the valuation. This is to ensure that the target firm is indeed similar, in terms of the components of the multiples with regards to its benchmark companies. The most common and easiest method to determine comparable firms are by taking firms that belong to the same industry. This is based on the assumption that firms that belong to the same industry tend to have similar risks, growth and cash flow that ensures comparability (Damodaran, 2001). Other characteristics that are considered in previous research include firm size, return on equity, profitability, leverage and growth (Alford, 1996; Bhojraj and Lee, 2002). Prior studies also attempt to develop alternative methods for determining comparable firms (Bhojraj and Lee, 2002) and compare the impact of industry classifications (Kahle and Walkling, 1996).

The second part of the relative valuation method involves selecting the best multiples to achieve the greatest accuracy in estimating the target firm’s value. Previous researches find earnings multiples, such as the Price/Earning multiple, tend to produce higher accuracy compared to other multiples (Yoo, 2006). Other studies have also researched on accuracies utilizing combination of valuation multiples (Cheng and McNamara, 2000; Yoo, 2006). Previous studies also compare the accuracies of using historical multiples and forward multiples (Yee, 2004; Yoo, 2006).

1.2 Research Approach

This study intends to extend previous work of Cheng and McNamara (2000) who study the accuracy of Price/Earning and Price/Book valuation method using a set of predetermined characteristics for comparable firms. Cheng and McNamara (2000)
compare valuation accuracies of relative valuation method using Price/Earning, Price/Book and combination of both multiples. In their study, Cheng and McNamara (2000) combine both multiples by applying equal weights to the combination of multiples. They find that combining both multiples has improved valuation accuracies. However, for simplicity, their study limits the combination of the multiples to application of equal weights. Due to their findings, this study extends their work by investigating whether the valuation accuracy of the combined Price/Earning and Price/Book multiples is further improved when applying different weights to the combined multiples. This approach is chosen because of the simplistic approach of the valuation method and the motivation of investigating whether the findings are applicable in Malaysia. By applying different weights to the combination, the study then attempts to find the optimal weight that produces the highest valuation accuracy. This study also aims to investigate whether the selection criteria for comparable firms found by Cheng and McNamara (2000) still hold when different weights are assigned to the respective Price/Earning and Price/Book multiples.

The study is however distinct than previous studies by Cheng and McNamara (2000) and Alford (1992) in that it uses the harmonic mean of comparable firm multiples instead of the median. Prior works by Alford (1992) and Cheng and McNamara (2000) utilize the medians of multiples by comparable firms to estimate the target firm’s price. However, based on a study by Liu, Nissim and Thomas (2002), the harmonic mean is found to improve valuation accuracy relative to median or mean of multiples of comparable firms.
Thus, this research decides to use harmonic mean instead of medians and means of comparable firms when estimating the target firm’s value.

The study is based on companies listed on the Main Board of Bursa Malaysia. The data is collected from annual reports extracted from Bursa Malaysia database. The scope of the research is one year of company financial data for the year 2007. The data on stock price is also obtained from Bursa Malaysia database. Therefore, the study aims to investigate the performance of relative valuation method based on the companies in Malaysia.

1.3 Research Objectives and Questions

The research intends to extend prior work by Cheng and McNamara (2000) by studying the accuracy of relative valuation applied to public-listed companies in Malaysia. Essentially, the objectives of the research are as follows:

1. To investigate the improvements in valuation accuracy when utilizing the combination of weighted Price/Earning and Price/Book multiples in relative valuation method.

2. To find the optimal weights of Price/Earnings and Price/Book that gives maximum accuracies when estimating target firm’s stock price.


4. To find the set of comparable companies that gives the most accurate valuation when combined with the best performing multiple between Price/Earning, Price/Book and weighted combination of Price/Earning and Price/Book.
More specifically, this study hypothesizes that the use of weighted average in the combination of Price/Earning and Price/Book ratio does improve valuation accuracy. The study also hypothesizes that the criteria for selecting comparable firms found in previous studies still apply to the results of this study.

Subsequently, the research questions to be answered by this study are as follows:

1. How do valuation accuracies improve when Price/Earning and Price/Book are combined by applying different weights respectively?
2. What is the best multiple that produces greater accuracies between Price/Earning, Price/Book and combination of both multiples?
3. What is the optimal weight of the combined Price/Earning and Price/Book that gives greater accuracy compared to other combinations of weight?
4. What is the selection of comparable companies that gives greater accuracy when combined with Price/Earning, Price/Book or the combined Price/Earning and Price/Book?

1.4 Research Contribution

Utilization of the relative valuation method is most needed when valuing Initial Public Offerings (IPOs), closely-held companies and during merger and acquisitions activities (Alford, 1996; Cheng and McNamara, 2000; Bhojraj and Lee, 2002). This is because there is no immediate information available to estimate value using other valuation methods (Alford, 1996; Cheng and McNamara, 2000; Bhojraj and Lee, 2002). As such the research hopes to address whether the relative valuation method is accurate in estimating stock prices in the Malaysian settings. The findings on the valuation accuracy
of this research is also hoped to assist financial analysts in determining the best multiples to use to achieve greater accuracy. This research also attempts to find whether there exists an optimal combination of multiples that produces greater accuracy when utilizing relative valuation method for valuing firms or equity. More importantly, this study hopes to contribute to the existing research in relative valuation method by finding the best combination of selection of comparable firms and the most optimal combination of multiples.

1.5 Summary

In summary, the research aims to investigate the valuation accuracies of the combined Price/Earning and Price/Book multiples when weighted average is applied. The research is an extension of previous work by Cheng and McNamara (2000) who study the performance of the combination of Price/Earning and Price/Book multiples in relative valuation. The study is conducted against 495 companies listed on the Main Board of Bursa Malaysia. Utilizing financial data for the year 2007, the study examines valuation accuracies by comparing the estimated price calculated using relative valuation against the actual stock price of sample firms.

Details of the study are elaborated further in the following chapters. Chapter 2 of the paper reviews the previous research related to the topic and presents the development of hypotheses. Chapter 3 elaborates on the sampling, selection of variables and data analysis approach. Chapter 4 summarizes the results, the tests of hypothesis and details of the findings. The paper concludes in Chapter 5, with discussions of the implication of the findings and suggestions for future work.
Chapter 2

LITERATURE REVIEW

2.0 Introduction

This section reviews the literature on the valuation techniques for valuing firms and equity. There are two main techniques for valuing firms and equity; they are the cash flow-based techniques and accounting-based techniques. In cash flow-based technique, the method is called the discounted cash flow method. As for the accounting-based technique, the relative valuation method is used (English, 2001).

2.1 Valuation Method: Discounted Cash Flow

In valuation theory, the fundamental method is the discounted cash flow. This method requires analysts to determine the cash flow, discount rate and terminal value. The method is derived from the present value principles that discount the future cash flow based on a terminal value. The terminal value is the cut-off value of the cash flow being evaluated. The method is then extended to value equity (Damodaran, 2001). While calculating the formula is quite straightforward, the most difficult part of this method is determining the three input variables. The three input variables are the cash flow, discount rate and terminal value.

In determining the discount rate, the analyst may use the Capital Asset Pricing Model (CAPM) to determine the cost of equity, $k$. For valuing firms, the discount rate is the firm’s weighted average cost of capital (WACC). The WACC involves the calculation of
the weighted average of both the firm’s cost of equity, \( k \) and cost of debt, \( d \). The followings are the general formula in calculating the value of equity and value of firm:

\[
\text{Value of equity} = \sum_{i=1}^{\infty} \frac{(\text{Cash flow to equity})_i}{(1 + k)^i}
\]

\[
\text{Value of the firm} = \sum_{i=1}^{\infty} \frac{(\text{Cash flow to the firm})_i}{(1 + \text{WACC})^i}
\]

Projecting the free cash flow accurately is challenging because it involves making assumptions relating to sales, growth, margin, working capital, and fixed investments. These assumptions are operational and investment-like in nature. As such, these assumptions have to be consistent. For example, in determining fixed investments, one has to ensure consistency with growth and production, which is related to cash flows from operations (English, 2001).

Determining terminal value is deciding when the cut off period is for the cash flow. The common assumption says that terminal value is when period \( t \) is equal to 5 years (English, 2001). Gray, Cusatis and Woodridge (1999) however suggest the “1-5-7-10” rule. The rule says that for companies that are in competitive and low margin industries, \( t \) is set to be 1 year. The \( t \) value is set equal to 5 years when companies valued are having reasonable prospects. The \( t \) value is equal to 7 and 10 years when companies are having growth potential and superior competitive advantage respectively (English, 2001).

An alternative method of valuing equity is the dividend discount model, where it discounts the expected dividends per share to find the value of equity. This model is
based on the assumption that the only cash flow applicable to equity investors is the dividends. The method assumes the Gordon growth model where the dividends are expected to grow at constant rate, \( g \) (English, 2001). The following is the formula to calculate price of equity \( P \) at time 0, where \( D_1 \) is next year’s dividend, \( k \) is the cost of equity and \( g \) is the long-term growth rate.

\[
P_0 = \sum_{i=1}^{\infty} \frac{D_1}{k - g}
\]

The model however does not apply when growth rate \( g \) is larger than \( k \), \( g > k \). The model clearly connects stock price with company performance, more specifically the dividend payout (English, 2001). However, it is important to note that for high-growth companies, it is common that dividends are not paid at a constant rate. In addition, companies often retain some of the cash for other reasons, such as investment and growth. In essence, this model only applies accurately when companies pay out all their cash as dividends. As such, the dividend discount model often may undervalue a company’s equity (Damodaran, 2001).

2.2 Valuation Method: Relative Valuation

In contrast to the discounted cash flow or dividend discount method, the relative valuation method is often adopted by analysts because of its simplicity and it has less restriction. While the previous methods are cash-flow based, where cash flow is discounted to the present at a discount rate, the relative valuation method is accounting-based. The relative valuation method utilizes multiples derived using information obtained from company’s accounting figures in financial statements. The equity value of a firm is estimated from accounting multiples of other comparable companies, hence the
name ‘relative valuation’. In essence, the equity value is derived based on how similar companies are priced in the market (Damodaran, 2001). Because of the ease of access for the input required in the model, the relative valuation method is more popular among the financial analyst community.

The multiples commonly used in the relative valuation method are earning multiples, book value multiples and revenue multiples (English, 2001; Damodaran, 2001). The earning multiples aim to find the value of the equity as a multiple of the earnings per share generated by the companies. The Price/Earning multiple is calculated by dividing the price of the equity today, \( P_0 \), by earnings per share. The earnings per share used can be the current year’s or next year’s earnings per share. When using current year’s earning per share, the ratio is called trailing Price/Earning because it is measuring the historical performance (Damodaran, 2001). Price/Earning derived from next year’s earnings per share is called the forward Price/Earning (Damodaran, 2001). Forward earnings are found to be more accurate in equity valuation compared to trailing earnings (Yee, 2004). As such, forward Price/Earning is more desirable in order to achieve more accuracy compared to trailing Price/Earning. Price/Earning multiple is therefore driven by growth, \( g \) because of the component of future earnings in the model, although the relationship is not linear (English, 2001). Price/Earning is also driven by the payout ratio, \( D_1/E_1 \) and cost of equity, \( k \). The equation for Price/Earning can be modified to be:

\[
P_0 = \frac{(D_1/E_1)}{E_1} \frac{1}{(k - g)}
\]
While the multiple is suitable for valuing equity, other measures such as the companies’ operating income or earning before interest, tax, depreciation and amortization (EBITDA) are commonly used for valuing companies (Damodaran, 2001).

Book value multiple is a measure that looks at the stock price as a multiple of book value of equity. When valuing a company, the book value used is the total book value for all assets while in equity valuation only the book value of equity is used. Similar to Price/Earning ratio, Price/Book multiple is also driven by the payout ratio, cost of capital and growth. Price/Book should also be forward looking, where it is directly proportional to next year’s return on equity (English, 2001). As such the multiple is also connected to company performance, where higher growth companies with high payout ratio tend to have higher Price/Book multiples. The equation for the Price/Book multiple, \( P_0/BV_0 \) is as follows, where the variables \( k, g, D_1/E_1, ROE_1 \) are cost of capital, growth, payout ratio and return on equity respectively.

\[
P_0 = \frac{(D_1/E_1) \times ROE_1}{BV_0 ((k - g))}
\]

Revenue multiple differs from the previous multiples in the sense that it is not affected by accounting rules and principles (Damodaran, 2001). In valuing equity, the value is measured as a multiple of sales per share. The Price / Sales ratio, where \( P_0 \) is the Price, is as follows:

\[
P_0 = \frac{(D_1/E_1) \times (E_1/S_1)}{S_1 ((k - g))}
\]
Another point of difference from the previous two multiples is that the multiple is driven by the net margin on sales, $E_1/S_1$. The net margin is calculated based on the projected earnings and projected sales. As projecting sales accurately is a challenge, the multiple is often calculated with historical sales. This may lead to inaccuracy when valuing equity (English, 2001). Similar to previous multiples, Price/Sales ratio is also driven by payout ratio $D_1/E_1$, cost of equity $k$ and growth, $g$. Since this multiple is not affected by accounting principles, the use of this multiple becomes an advantage when comparing firms in different markets, where accounting systems may differ (Damodaran, 2001).

These accounting multiples are the basis for the relative valuation method because the multiples calculated from a group of comparable firms are then used to estimate the multiple for a target firm (Bhojraj and Lee, 2002). Therefore it is clear that the estimation of the target firm is dependent on the selection of comparable firms. It is important that the firms selected to be comparable have to be similar in terms of the drivers involved in the multiples. Additionally, when doing multiples comparison across firms, it is important to control the value drivers that determine the multiples. In summary, the common value drivers for the earnings, book value and revenue multiples are growth, payout ratio and risk. Book value has additional driver that is the return on equity, while the revenue multiple is the net margin on sales (Damodaran, 2001; English, 2001).

2.3 Relative Valuation Method

There are two critical tasks when doing relative valuation. The first task involves selecting the set of comparable companies and the second task is determining the choice of valuation model. While these two tasks are interrelated, both are found to be
challenging to analysts and investors. According to Meitner (2006), a survey finds that more than 40% of respondents indicate that determining comparable companies is problematic, while more than 50% state that selecting a suitable valuation model is a problem.

2.3.1 Selection of Comparable Companies

There are two approaches in determining similarities of characteristics for comparable companies. The first approach is a theory-driven approach and the second is more practice-oriented approach.

In theory-driven approach, the characteristics that should be similar are payout ratio, growth rate and cost of equity when estimating a target company’s Price/Earning ratio. This is because the Price/Earning ratio is driven by these variables. As such, a target company must have similarities to its peer companies in terms of these three value drivers. In estimating target firm’s multiples, the required similar variables are those that drive the valuation multiple. Therefore, for the case of Price/Earning, the target firm and its peer companies should have similar values for payout ratio, growth rate and cost of equity (Damodaran, 2001).

In practice-oriented approach, the characteristics taken into consideration include risk, firm size, capital structure, products offered, accounting structure, degree of diversification and others (Meitner, 2006). This approach makes it more difficult to find a firm that is an exact match (Meitner, 2006). However, the challenge can be reduced by substituting some of the characteristics with industry classification. This is due to the
assumption that firms in the same industry tend to face same risks, similar products, level of competition, accounting principals and others (Damodaran, 2001). Although industry classification may group similar companies together, the selection of comparable companies is still under the discretion of the analysts. Financial analysts may exclude a company that is an outlier to reduce the possibilities of inaccuracy when estimating multiples for target firms.

2.3.2 Prior Research on Selection of Comparable Companies

Few researchers have done studies on the selection of comparable firms. Since industry classification is most common when selecting comparable companies, it is natural that most studies dwell on the industry-based method. While some study on industry-based method of selecting comparable firms, Bhojraj and Lee (2002) develop a valuation-based method to select comparable companies. They conclude that comparable firms are those that having the closest warranted multiples. They arrive to that conclusion when their results show that comparable firms selected using their warranted multiples method lead to more accuracy in predicting future multiples of target firms as compared to the industry-based method (Bhojraj and Lee, 2002).

Bhojraj and Lee’s (2002) paper is discussed by Sloan (2002) where he criticizes the method used by the authors. One of the questions raised is the need for Bhojraj and Lee (2002) to use actual multiples of comparable firms when they already have generated the warranted multiple using the forecasted model. He suggests that Bhojraj and Lee (2002) should have estimated the warranted multiples from the results of estimating warranted
firm values. He refers to a method done by Frankel and Lee (1998) where they estimate firm value from a non-linear valuation theory.

Another study comparing methods of industry classification is done by Bhojraj, Lee and Oler (2003). In this research, the authors compare four classification schemes that are the the NAICS (North American Industry Classification System) codes, GICS (Global Industry Classification Standard) system, the MSCI (Morgan Stanley Capital International) and the Fama and French (1997) method. Their results indicate that industry classification by the GICS is more accurate in explaining applications in capital market research. These applications include cross-sectional variations in valuation multiples, financial ratios, stock return movements and others. The GICS classification is found to be consistently superior from year to year and more apparent in large firms (Bhojraj, Lee and Oler, 2003).

A study on industry classification is also done by Kahle and Walkling (1996). In their study, Kahle and Walkling investigate the impact of industry classifications on financial research. They note that there are significant differences of industry classification between two databases that are often used in financial research, the Compustat and Center for Research in Security Prices (CRSP) database. In their study, they simulate tests for six financial characteristics, comparing them between a random sample of firms with control firms on the basis of size, or combination of size and industry. Their results show that for simulations with intended differences between the two groups, controlling for industry is important.
Other studies typically utilize industrial classifications and value drivers (risk, growth, return on equity) for selecting comparable companies in their research. In his study of accuracy of the Price/Earning valuation method of comparable firms, Alford (1992) selects comparable firms based on the industry, risk that is substituted by firm size and earning growth. His results show that selecting comparable companies based on industry membership or the combination of both risk and earning growth is the most accurate when testing for Price/Earning valuation. Alford also finds that this accuracy is higher for larger firms.

Similarly, Lie and Lie (2002), in their study of evaluating the different multiples used in estimating corporate values, select their comparable companies based on industry. They choose companies by matching the first 3-digit Standard Industrial Classification (SIC) codes. They reduce the requirements to 2-digit or 1-digit SIC codes for cases where there are less than five companies are similar. While agreeing that their selection of companies may not be optimal, they state that the basis of selecting companies in their study does not affect the relative performance of the multiples (Lie and Lie, 2002).

Cheng and McNamara (2000) study the valuation accuracy of Price/Earning, Price/Book and a combination of both Price/Earning and Price/Book relative valuation method. In their study, they select the comparable firms based on industry classification, size and return on equity. The results show that the best set of comparable firms are based on the
combination of industry classification and return on equity (Cheng and McNamara, 2000).

2.3.3 Prior Research on Valuation Multiples

The second part in relative valuation method is selecting the best multiples. There are a number of previous researchers (Penman, 1996; Cheng and McNamara, 2000; Nissam and Penman, 2001; Lie and Lie, 2002; Liu, Nissim and Thomas, 2002; Yee, 2004; Yoo, 2006; Yee, 2007) who attempt to study multiples used in relative valuation. Previous studies center on studying the performance of multiples and how valuation accuracies can be improved using these multiples.

Nissim and Penman (2001) study the financial statements analysis for equity valuation. They identify ratios that are useful for valuation and analyze the typical values of these ratios across a period of time. The ratios studied in their research include return on common equity, return on net operating assets and net borrowing cost. Lie and Lie (2002) study the trailing Price/Earning ratio, forward Price/Earning ratio, enterprise value / sales, enterprise value / book value, enterprise value / earning before interest, tax, depreciation and amortization (EBITDA) and enterprise value / earning before interest and tax (EBIT) where multiples involving enterprise value are adjusted for cash and cash equivalents. The results show that asset multiples are more precise compared to sales and earning multiples. They also find that using forward Price/Earning ratio is more accurate than trailing Price/Earning ratio. The same goes for EBITDA, that is found to be better than EBIT multiples. Their finding also indicates that performance of multiples varies with regards to firm size, profitability and the firm’s intangible value (Lie and Lie, 2002).
Consistent with Lie and Lie (2002), Liu, Nissim and Thomas (2002) find that multiples derived from forward earnings perform better in explaining stock prices. They also find that the performance is consistent for all industries, which disagrees with the popular beliefs that different industries rank multiples differently. Yee (2004) specifically studies on the performance of forward earning versus trailing earnings in equity valuation. Similar to other researchers, his studies also find that forward earning is more accurate in equity valuation than trailing earnings. More importantly, he concludes valuation accuracies can be further improved when the more forward the earning is.

Valuation accuracy is further explored by other researches in efforts to find ways in improving the accuracy. Yoo (2006) investigates the accuracy of equity valuation using the combination of multiples. His findings indicate that the combination of several multiple valuations with historical multiple of comparable firms is more accurate than multiple valuations using a single historical multiple. He also finds that the accuracy of multiple valuations using forward earning multiple is not improved when he combines valuation multiples based on forward earning multiples of comparable firms with valuation multiples based on historical multiples (Yoo 2006).

Liu, Nissim and Thomas (2002) investigate performance of multiples in which they find forward earning measures are ranked first. This is followed by historical earning measures, with cash flow measures and book equity come in third, and sales measures as the worst. These rankings appear to be consistent in all the industries in the study.
Penman (1996) focuses on Price/Earning ratio and Price/Book ratio to achieve a common understanding for how they relate to each other. Penman also provides the characteristics of both ratios. A study on Price/Earning and Price/Book is also done by Cheng and McNamara (2000) where they compare the valuation accuracies between Price/Earning, Price/Book and the combination of both. Their study concludes that Price/Earning valuation is superior to Price/Book, but the combination of Price/Earning and Price/Book is more accurate compared to Price/Earning or Price/Book separately.

Other research focuses on finding a more accurate valuation practice. Yee (2007) justifies the practice of averaging valuation estimates by developing a Bayesian framework. The framework combines several valuation estimates to come up with a more superior valuation estimate (Yee 2007). To understand the behavior of multiples, Fama and French (1995) investigate whether the behavior of stock prices reflects the behavior of earnings. They study stock price behavior in relation to size and book-to-market-equity. They find that market and size factors in earnings explain returns but not between book-to-market-equity factors in earnings and returns. Another study is done by Liu and Ang (2001) where they examine the extent of interest rates, risk, profitability and growth affect Price/Book ratio.

2.4 Development of Hypothesis

Based on previous research, this study extends the work by Cheng and McNamara (2000), by investigating whether valuation accuracy is improved when utilizing the combination of weighted Price/Earning and Price/Book multiples in relative valuation. In their study, Cheng and McNamara (2000) find that the combination of Price/Earning and
Price/Book multiples in relative valuation has improved valuation accuracy. Specifically, their study takes an average of Price/Earning and Price/Book multiples and compares its accuracy against Price/Earning and Price/Book multiples separately. Their findings indicate that valuation accuracies are improved when they take the average of Price/Earning and Price/Book compared to valuation results on each multiple independently. This study extends their findings by taking a weighted average of Price/Earning and Price/Book multiples and compares against an equally weighted Price/Earning and Price/Book, as well as Price/Earning and Price/Book separately. This research may be the first effort that examines the performance of weighted average of Price/Earnings and Price/Book in relative valuation method. However, the scope of the research only covers the Malaysian market. As such, the study may be an indicator of the performance for the weighted average approach if applied in another setting.

Besides evaluating the performance of combined Price/Earning and Price/Book multiples, Cheng and McNamara (2000) also examine the effect of selection of firms on valuation accuracies. Since the performance of relative valuation method also depends on the selection of firms, their study investigates selection of firms based on industry classification, firm size, return on equity and the whole market. They also study selection of firms based on the combination of industry classification with firm size and the combination of industry classification with return on equity. Their findings indicate that comparable firms selected based on industry classification is the best approach when combined with equally weighted Price/Earning and Price/Book multiples. This is compared to groupings by firm size, return on equity, combination of industry
classification with firm size, combination of industry classification with return on equity and the market in general.

This study attempts to find whether the same findings are also applicable here in the Malaysian market. More specifically, this research extends Cheng and McNamara’s (2000) work by examining whether industry classification is the best approach when combined with the weighted average of Price/Earning and Price/Book multiples. This is done by applying the same approach as that of Cheng and McNamara (2000) where valuation accuracies are tested when comparable firms are defined by industry classification, firm size and return on equity. Combination of industry classification with firm size and combination of industry classification with return on equity are also tested. However, the selection of comparable firms based on the whole market is dropped from the test because of the time constraint faced by this researcher. This exception is predicted not to affect the performance evaluation. This is because previous researches by Cheng and McNamara (2000) and Alford (1992) find that the market is never the best definition of comparable firms.

Based on the findings by Cheng and McNamara (2000) that indicate combination of Price/Earning and Price/Book multiples gives more accurate valuation than each multiple independently, this study then hypothesizes that valuation accuracy is further improved when taking a weighted average of Price/Earning and Price/Book multiples as compared to the equal weights of both multiple or the multiples independently.
H1: The use of weighted average of Price/Earning and Price/Book multiples gives more accurate valuations compared to that of equally weighted Price/Earning and Price/Book multiple or each multiple independently.

This study also hypothesizes that selecting comparable firms based on industry classification produces more valuation accuracy when combined with the use of weighted average of Price/Earning and Price/Book multiples.

H2: The combination of weighted average of Price/Earning and Price/Book multiples with selection of comparable firms based on industry classification gives more accurate valuation.

The definitions of measures for calculating price based on Price/Earning, Price/Book and their weighted average combination are presented in the next chapter. The formula for calculating valuation accuracies is also specified. The following chapter also explains the sampling and definitions of comparable companies to be tested in this research.

2.5 Summary

Previous researchers have done studies on the two parts of relative valuation method. Few research focus on the selection of comparable companies (Bhojraj and Lee, 2002; Bhojraj, Lee and Oler, 2003; Kahle and Walkling, 1996; Alford, 1992; Lie and Lie, 2002; Cheng and McNamara, 2000). Other research concentrate more on the multiples (Nissim and Penman, 2001; Lie and Lie, 2002; Liu, Nissim and Thomas, 2002; Yee, 2004; Yoo,
2006; Yee, 2007). Some of these studies also examine ways to improve valuation accuracies using the multiples. Based on these studies, the research develops the hypotheses that extend the work by Cheng and McNamara (2000). This study also intends to find out whether the factors in determining comparable firms affect the performance of relative valuation using Price/Earning and Price/Book. The next chapter presents the sampling design, selection of measures and data analysis approach conducted in this research.
Chapter 3

RESEARCH METHODOLOGY

3.0 Introduction

The objective of this research is to examine valuation accuracies of relative valuation method by utilizing different approaches in multiples and selection of comparable companies. The focus of this research is to extend prior work by Cheng and McNamara (2000) who study the improvements of valuation accuracies by combining equally Price/Earning and Price/Book multiples. This section elaborates further on the sampling design the method used by this research in calculating accuracies. Furthermore, detail description is presented for each of the variable used to select comparable companies. At the end of the section, the data analysis approach of this research is also specified.

3.1 Sampling Design

A total of 495 samples of firms are obtained from the firms listed on the Main Board of Bursa Malaysia. These firms belong to the following industries: Consumer Product, Construction, Finance, Hotel, Industrial Product, Infrastructure Project Companies, Plantation, Properties, Technology and Trade / Services. Firms’ data on Price/Earning, Price/Book, earnings, book value, total assets and return on equity are extracted and calculated from firms’ annual reports. The data collected is from the latest financial reports that are published in 2007. The reason for using only one year worth of data is because of the time constraint faced by the researcher. In addition, due to time constraint, the study also does not compare yearly performance of Price/Earning ratio as previously done by Alford (1992). Therefore all data required are obtained from firms’ latest annual
reports. The estimated stock price and actual price is extracted from Bursa Malaysia for target firms on the 29th of February, 2008. Therefore the percentage of error is derived from actual stock price and estimated stock price on the 29th of February, 2008. The reason for capturing stock price on the 29th of February is to allow for firms’ stock price to stabilize after their year-end announcements in 2007. 29th February 2008 is also chosen because it coincides with the time this study is being carried out. Capturing current stock price is easier because of its availability on Bursa Malaysia database. Historical stock price are not accessible for the researcher to extract. Therefore, with these limitations, the data is collected, tested and evaluated according to the approaches outlined in this chapter.

3.2 Selection of Measures

This section defines the measures that are used in the research. The measures include the formula in estimating target firm’s price using Price/Earning, Price/Book and combination of both multiples. The selection criteria for comparable firms are also defined in this section.

3.2.1 Estimating Target Firm’s Stock Price Using Price/Earning

In relative valuation method, the price of the target firm is estimated from the product of the firm’s earnings and the mean or median of the Price/Earning multiples derived from the set of comparable firms. In their research, Cheng and McNamara (2000) and Alford (1992) estimate the target firm’s stock price by first finding the median of the Price/Earning multiples of the set of comparable companies. The target firm stock price is
derived from the product of the target’s earning and the median of Price/Earning multiple of comparable companies.

This study differs from that of Cheng and McNamara (2000) and Alford (1992) because it finds the harmonic mean of the Price/Earning multiple instead of the median. Similar to median, this harmonic mean is derived from the Price/Earning multiples of the set of comparable firms. The target firm’s estimated stock price is then calculated by multiplying the harmonic mean with the target firm’s earnings. Harmonic mean is used because it is found to improve valuation accuracy as opposed to medians or means (Liu, Nissim and Thomas, 2002).

The Price/Earning ratio of each of the comparable firms is calculated using its stock price and earning per share. The stock price is obtained from Bursa Malaysia database, while earning per share is extracted from the firm’s annual report. The Price/Earning ratio is manually calculated because the researcher does not have access to any financial analysts’ database. The Price/Earning ratio, $PE_i$ for firm $i$ is derived using the following formula:

$$PE_i = \frac{\text{Price}_i}{\text{EPS}_i}$$

where $\text{Price}_i$ is the comparable firm $i$’s stock price and $\text{EPS}_i$ is its earning per share.

The harmonic mean for Price/Earning ratio, $PE_h$ is calculated as follows:

$$PE_h = \frac{n}{\sum_{i=1}^{n} (1/PE_i)}$$

where $n$ is the number of firms in the set of comparable firms. $PE_i$ is the Price/Earning multiple of each firm in the set of comparable firms as calculated in (1).
The estimated price of target firm is then calculated as follows:

Estimated price of target firm $i$ at time $t$, $PE'_{it}$,

$$PE'_{it} = PE_h \times EPS_{it} \quad (3)$$

where $PE_h$ is the harmonic mean of Price/Earning multiples for comparable firms calculated in (2), and $EPS_{it}$ is the target firm’s earning per share at time $t$.

### 3.2.2 Estimating Target Firm’s Stock Price Using Price/Book

Similar to estimation using Price/Earning multiple, the estimated target firm’s stock price is calculated from the product of target firm’s book value and the harmonic mean of Price/Book multiple of comparable firms. Price/Book ratio of comparable firms is first calculated using the following formula:

$$PB_i = Price_i / BVPS_i \quad (4)$$

where book value per share, $BVPS_i$, is obtained from the comparable firm $i$’s annual report. $Price_i$ is the stock price of comparable firm $i$ and $PB_i$ is the Price/Book for firm $i$.

Next, the harmonic mean Price/Book ratio of the set of comparable firms is derived as follows:

$$PB_h = \frac{n}{\sum_{i=1}^{n} (1/PB_i)} \quad (5)$$

where $n$ is the number of firms in the set of comparable firms and $PB_i$ is the Price/Book multiple of each firm in the set of comparable firm as calculated in (4).

The estimated price, $PB'_{it}$, of target firm $i$ at time $t$ is then calculated as follows:

$$PB'_{it} = PB_h \times BVPS_{it} \quad (6)$$
where $PB_h$ is the harmonic mean of Price/Book of comparable firms calculated in (5), and $BVPS_{it}$ is the target firm’s book value per share at time $t$. The target firm’s book value per share is obtained from the firm’s annual report.

3.2.3 Estimating Target Firm’s Stock Price Using Combination of Price/Earning and Price/Book

In addition to the Price/Earning and Price/Book approach, the research also estimates the target firm’s stock price using the combined approach of Price/Earning and Price/Book implemented by Cheng and McNamara (2000). To study the effect of the weighted average of Price/Earning and Price/Book, the estimated stock price using equal weight method is first calculated for comparison.

The combination of equally weighted Price/Earning and Price/Book is calculated using the following formula:

$$PEPB'_{it} = \frac{(PE'_{it} + PB'_{it})}{2}$$  \hspace{1cm} (7)

where $PEPB'_{it}$ is the estimated price of target firm $i$ at time $t$ using the equal combination of $PE'_{it}$ and $PB'_{it}$ obtained from (3) and (6) respectively. The reason for calculating equally weighted Price/Earning and Price/Book is to be able to compare the accuracy against the combination of weighted average of Price/Earning and Price/Book.

Subsequently, the combination of weighted average of Price/Earning and Price/Book is derived using the following formula:

$$PEPBW'_{it} = (PE'_{it} \times m) + (PB'_{it} \times n)$$  \hspace{1cm} (8)
where $PEPBW'_{it}$ is estimated price of target firm $i$ at time $t$. $m$ and $n$ are weights assigned to the price estimated using Price/Earning from (3) and the price estimated using Price/Book from (6). The weights $m$ and $n$ each ranges from 10% to 90%, with total weights must equal 100%. The most optimal weight is obtained by finding the lowest percentage error for $PEPBW'_{it}$ calculated. The percentage error is calculated using the formula for determining valuation accuracy. The formula for valuation accuracy is explained next.

### 3.2.4 Measuring Valuation Accuracy

Valuation accuracy is measured by calculating the absolute percentage of error between the target firm’s estimated stock price derived in (3), (6), (7) and (8) with the actual stock price of the target firm. Absolute percentage error is used because it measures how far the estimate is from the actual price, regardless whether the estimated price is lower or higher than the actual price. A low percentage error is regarded as high valuation accuracy, while a high percentage error indicates low accuracy. The formula used for determining valuation accuracy is as follows:

$$APE_{it} = \left| (P'_{it} - P_{it}) \right| / P_{it} \times 100\%$$

(9)

where $APE_{it}$ is the absolute percentage error for firm $i$ at time $t$, $P'_{it}$ is the estimated price of target firm $i$ at time $t$ and $P_{it}$ is the actual price of target firm $i$ at time $t$. $P'_{it}$ is the estimated price calculated by the different approaches in (3), (6), (7) and (8). The optimal weight among the weights applied in (8) is the one that produces the lowest absolute percentage error, $APE_{it}$ derived in (9).
3.2.5 Selecting Comparable Firms

The second task in implementing relative valuation method is determining the best definition of comparable firms. Defining comparable firms is equally important as determining the best multiple that brings most accuracy. As observed in the formula in the previous sections, the target firm’s stock price is estimated from the harmonic mean of these comparable firms. Indirectly, the definition of comparable firms is also important as it also affects the estimation done for the target firm. Therefore, the research attempts to define the selection of comparable firms.

The comparable firms are supposed to be similar to the target firm in terms of its cash flows, growth potential, and risks (Damodaran, 2001). These are the drivers that affect the multiples used in the valuation, more specifically the Price/Earning and Price/Book ratios. Ideally, the best comparable firm to the target firm is one that has identical cash flows, growth and risks. However, in reality, there is no such firm that is exactly identical to another firm. As such, analysts often define comparable firms of the target firm based on a certain criteria. These criteria are assumed to capture the similarities in terms of cash flows, growth and risks. An example of these criteria is industry classification, where the assumption is firms that belong to the same industry have the same cash flow profile, growth and risks (Damodaran, 2001).

To find the selection of comparable firms that contributes to more accurate valuation, the study selects comparable firms based on the following criteria:
Industry Classification: Firms are selected according to their industry classification on the Main Board of Bursa Malaysia. The industry categories studied in this research is Consumer Product, Construction, Finance, Hotel, Industrial Product, Infrastructure Project Companies (IPC), Plantation, Properties, Technology and Trade / Services. The industry categories are determined by Bursa Malaysia. This is different than Cheng and McNamara (2000), where their industry categories are determined by the United States’ Standard Industrial Classification (SIC) codes. In this approach, firms that share the same industry classification as the target firm is selected as the target firm’s comparable companies. Therefore, the number of firms in this set of comparable firms is equal to the number of firms that belong to the industry category.

Total Asset: Firm size is measured by its total asset. Firm size is a substitute for risk, which is one of the drivers in Price/Earning and Price/Book ratio. Alford (1992) finds that the use of beta as the measure of risk, derived from the Capital Asset Pricing Model (CAPM) is qualitatively similar to that of using total assets. This means that the use of beta as a measure of risk can be substituted by using total assets because the latter produce the same results as that of beta. Furthermore, beta is not available for closely-held firms. As such, although this study only utilizes data for public-listed firms, it chooses to use total assets for measuring risk. This is to ensure that the results can be applied to private firms as well. For this approach, the comparable firms are selected as those having the closest total assets to the target firm. The number of firms in this set of comparable firms is limited to six firms. This is due to the minimum number of firms that an industry category may have. To make it consistent with comparable firms based on
industry classification, the number of firms selected by total assets is also limited to six firms. Therefore, the six firms that are selected are those that have the closest total assets as the target firm.

Return on Equity: Return on equity is selected as a measure of growth. This is because return on equity is an indicator of profitability (Nissim and Penman, 2001) and a component of growth (Reilly and Brown, 2006). While growth is a driver for both Price/Earning and Price/Book, return on equity is also a driver of Price/Book ratio (Penman, 1996). Therefore it is necessary to have return on equity as one of the criteria in selecting comparable firms. The firms that have the closest return on equity to the target firm are selected as comparable firms. The number of firms in this selection of comparable firms is also limited to six, consistent with that of total assets.

Combination of Industry Classification and Total Assets: The reason this criterion is chosen is because the same grouping of industry and risk ensures that the firms that share the same industry and risk have similar Price/Earning and Price/Book multiples. Firms selected are those that fall within the same industrial category and further matched based on their total assets. Those that belong to the same industry and closest to the target firm in terms of total assets are selected as comparable companies. Similarly, the number of firms in this group is limited to six firms.

Combination of Industry Classification and Return on Equity: A different grouping is tested where firms that belong to the same industry and have similar growth are selected
as comparable companies to the target firm. Firms are first selected when they belong to
the same industrial category as the target firm. These firms are then selected based on
those that have the closest return on equity to the target firm. The number of firms in this
set of comparable companies is limited to six.

The different definitions of comparable firms are then tested against the different
multiples specified in the earlier section. The performance of the sets of comparable firms
and multiples is tested by calculating valuation accuracies of target firms. The following
section elaborates on the method of selecting target firms.

3.2.6 Selecting Target Firms

To calculate valuation accuracies for the different definitions of comparable firms and
multiples, target firms are selected as samples. This study selects 76 target firms out of
the 495 samples of firms from the Main Board of Bursa Malaysia. The target firms are
randomly selected using the random utility available from the analytical software, SPSS.
Although only 76 firms are studied as samples for valuation accuracies, the rest of the
firms in the sample are utilized to form comparable firms for these 76 target firms. The
target firms’ stock prices are estimated to measure the valuation accuracies of each
approach tested in this research. The different approaches are the combination of
multiples and selections of comparable firms. Each approach is evaluated based on its
accuracies against the target firm’s actual stock price. The difference between actual
price and estimated price measures the accuracy of the valuation method.
3.3 Data Analysis

The data on accuracies is obtained by calculating the absolute percentage error between the estimated price and actual price of target firms. The absolute percentage error is utilized to determine the performance of each multiple. Lower percentage error indicates more accurate valuation multiple. For each multiple, the performance is compared against each set of comparable firms. The performance of the multiple combined with each set of comparable firms is determined by applying the non-parametric Friedman test. For every multiple, the non-parametric test ranks the set of comparable firms to identify which set of comparable firm yields the highest valuation accuracy. This approach is applied for each multiple to compare the performance of comparable firms. The research also conducts pair-wise comparison for the sets of comparable firms by applying the non-parametric Wilcoxon test. The purpose of conducting pair-wise comparison is to determine superiority when comparing one set of comparable firms against another. Both Friedman and Wilcoxon tests are conducted for every multiple Price/Earning, Price/Book and the combination of Price/Earning and Price/Book multiples.

The research also applies Friedman test against the weighted average combination of Price/Earning and Price/Book multiples. The objective is to determine the performance of the multiple for every set of comparable firms. This test ranks the performance of the weighted average combination of Price/Earning and Price/Book multiples to identify which weighted combination of the multiples that produces the highest valuation accuracy. This is inline with one of the objectives of the research that is to determine the optimal weights applied to the combination of the multiples.
Subsequently, the research conducts the Wilcoxon test for pair-wise comparisons between the performance of Price/Earning, Price/Book and the optimally weighted combination of Price/Earning and Price/Book. The objective of conducting the test is to determine which combination of valuation multiple and comparable firms that is the most superior in producing valuation accuracy.

In summary, to analyze the data, the research performs the following test approach:
1. Friedman test for ranking the performance of comparable firms for each multiple
2. Wilcoxon test for pair-wise comparison between each set of comparable firms for each multiple
3. Friedman test for ranking the performance of multiples for each set of comparable firms

3.4 Summary
This chapter describes the sampling design conducted in the research. The total of 495 firms is extracted and 76 firms are randomly selected as target firms for the purpose of the research. The data being studied is the firms’ 2007 financial data. The measures used in the research are the Price/Earning, Price/Book and the combination of both multiples. The comparable firms are formed based on industry category, total asset, return on equity, the combination of industry category with total asset and the combination of
industry category with return on equity. For each approach, the accuracy is determined by calculating the percentage error between the estimated price and actual price of target firms. The data on accuracies is then tested by applying non-parametric tests to determine the performance of each approach. The following chapter presents the descriptive results and statistical analysis of the data tested using the non-parametric test.
Chapter 4

RESULTS

4.0 Introduction

This chapter presents the results of the research. The first section discusses the descriptive statistics of the data collected in this research. This is followed by the descriptive results of the sample data on valuation accuracies. The next sections discuss the analysis on the statistical tests conducted on the data. These sections focus on each method of relative valuation: the Price/Earning valuation method, Price/Book valuation method and the combined Price/Earning and Price/Book valuation method. This chapter also discusses the comparisons of the performance of each relative valuation method to determine which method produces the highest accuracy. The chapter ends with the summary of the findings and the results of the hypotheses being tested.

4.1 Descriptive Statistics: Data Sample

This section describes the descriptive results of the data collected. The total number of firms observed is 495. These firms that are included in the observation are those that report positive earnings in the year 2007. Firms with negative earnings are dropped from the observation because earning multiples are not applicable to loss-making firms (Bhojraj and Lee, 2002).

Data is collected according to industry categories that are obtained from Bursa Malaysia. These categories are Hotel, Infrastructure Project Companies, Technology, Finance, Construction, Plantation, Properties, Consumer Products, Industrial Products and
Trade/Services. Firms are grouped according to these industry categories. Of these categories, there are industry categories that are excluded from the observation because of the minimal number of firms that fall under those categories. These categories are Closed Fund, Mining, Loans and Exchange Traded Fund. The data is collected from companies’ annual reports obtained from Bursa Malaysia database. The annual reports studied in this research are for the financial data of the year 2007.

4.1.1 Number of Firms by Industry Category

Table 4.1 presents the number of firms by industry category as listed on the Main Board of Bursa Malaysia. The highest number of firms in an industry category is the Industrial Product category and the Trade Services category. Both categories have 115 firms, each amounting to 23.2% of the total number of firms. The smallest category with the most minimal number of firms is the Hotel category. The total number of observations for the Hotel category is 4.

This implies that the majority of firms listed on the Main Board of Bursa Malaysia belong to the Trade/Services and Industrial Product groups. This is possibly because these firms require larger funds that can be raised by being publicly-listed on Bursa Malaysia. The small number of firms that fall under the Hotel category may not indicate that firms operating hotels are not public-listed. However, the reason for this small number may be caused by the fact that some firms that own hotels are also diversified in other industry category. As such, these diversified firms may not necessarily be listed under the Hotel category, but may fall under Trade/Services category. Nevertheless, the
number of firms by industry category provides an indication of the majority of firms that are listed on the Main Board of Bursa Malaysia.

<table>
<thead>
<tr>
<th>Industry Category</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>4</td>
<td>.8</td>
<td>.8</td>
</tr>
<tr>
<td>Infrastructure Project Companies</td>
<td>6</td>
<td>1.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Technology</td>
<td>13</td>
<td>2.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Finance</td>
<td>33</td>
<td>6.7</td>
<td>11.3</td>
</tr>
<tr>
<td>Construction</td>
<td>34</td>
<td>6.9</td>
<td>18.2</td>
</tr>
<tr>
<td>Plantation</td>
<td>35</td>
<td>7.1</td>
<td>25.3</td>
</tr>
<tr>
<td>Properties</td>
<td>69</td>
<td>13.9</td>
<td>39.2</td>
</tr>
<tr>
<td>Consumer Product</td>
<td>71</td>
<td>14.3</td>
<td>53.5</td>
</tr>
<tr>
<td>Industrial Product</td>
<td>115</td>
<td>23.2</td>
<td>76.8</td>
</tr>
<tr>
<td>Trade/Services</td>
<td>115</td>
<td>23.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>495</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Source: Bursa Malaysia

4.1.2 Means for Price/Earning, Price/Book, Total Assets and Return on Equity

The descriptive results for Price/Earning, Price/Book, return on equity and total assets for the firms in the observation are described in Table 4.2. The descriptive results for these specific indicators are studied because this research utilizes these indicators to group the firms in the sample, in order to form the set of comparable firms for the relative valuation method.

The mean for Price/Earning in the observation is 30.62, while the mean for Price/Book is 8.76. Means for total assets and return on equity are 3,290.09 and 43.92 respectively. This observation implies that on average, the firms that are listed on the Main Board have
Price/Earning ratios of 30.62, while having Price/Book ratios at 8.76. This means that firms are priced higher as multiples of their earnings per share, while the multiples of firms’ share prices over book value per share are lower. This suggests that on average, investors are willing to pay a multiple of 30 times of the earnings per share. However, the lower Price/Book ratio may suggest that shares are priced closer to the intrinsic values of the firms (Reilly and Brown, 2006). The average size of assets at 3,290.09 indicates the average firm size, while the average return on equity of 43.92 suggests that on average the firms in the observation produces 43.92% return on the firms’ total equity. Since the data collected is only for one year, it is not possible to observe any increasing or decreasing trend for these indicators. As such, the researcher is not able to determine whether there is any improvement on Price/Earning, Price/Book and return on equity over the years.

Table 4.2: Means for Price/Earning, Price/Book, total assets and return on equity

<table>
<thead>
<tr>
<th>Indicators</th>
<th>No of Observations</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price/Earning</td>
<td>495</td>
<td>30.62</td>
<td>146.20</td>
</tr>
<tr>
<td>Price/Book</td>
<td>495</td>
<td>8.76</td>
<td>166.07</td>
</tr>
<tr>
<td>Total Assets</td>
<td>495</td>
<td>3,290.09</td>
<td>16,739.75</td>
</tr>
<tr>
<td>Return on Equity</td>
<td>495</td>
<td>43.92</td>
<td>474.06</td>
</tr>
</tbody>
</table>

The standard deviations displayed in the Table 4.2 show the high variations for each indicator, the Price/Earning, Price/Book, total assets and return on equity. This may be due to outliers that are not excluded from the observations. For example, the observation consists of very large and small firms in terms of assets. This is reflected in the high standard deviation for total assets. The reason these outliers are not being excluded because the research requires selection of comparable companies that are closest in size.
to the target firm. If the target firm happens to be a big company, then the set of comparable companies may include these large firms. Similarly, if the target firm is small in terms of assets, then the set of comparable firms will consist of smaller firms. That is why it is decided not to exclude any outliers, for they may be needed to form the set of comparable companies later in the research.

4.1.3 Means for Price/Earning by Industry Category

This section describes the means for Price/Earning by industry category. The means are presented in Table 4.3. The table shows that the category Consumer Product has the highest mean for Price/Earning at 57.25. The high mean implies that on average, investors are willing to pay high prices at a multiple of 57.25 for every earning per share for firms that belong to the Consumer Product category. Therefore, high Price/Earning suggests investors’ expectation that translate into their willingness to pay high price for every earning of the share they own. As such, based on the observation, investors are paying higher share price for firms that belong to Consumer Product category.

The lowest mean for Price/Earning is from the Technology industry. The low mean may indicate that on average the Technology industry has similar Price/Earning, without any firm with extreme Price/Earning values as outliers. Further descriptive analysis shows that these assumptions are true with the main outlier for extremely high Price/Earning value comes from the Consumer Product category. There is also no outlier from the Technology industry category, which confirms the reason behind the lowest Price/Earning mean for the category. In addition, the low mean for Price/Earning also may suggest that on average, investors are not willing to pay high price for Technology
firms. This further reflects investors’ expectations on Technology firms’ earnings. As the technology sector is known for its speed and growing technology, this may affect investors’ expectations on the performance of Technology firms. This shows that, despite the outliers, it is important to note the similar expectations of investors on Technology firms, as opposed to Consumer Product firms that have large outliers, implying varying degrees of investors’ expectations.

4.1.4 Means for Price/Book by Industry Category

As shown in Table 4.3, for Price/Book, the highest mean is from the Plantation industry category at 107.36. The Properties industry category has the lowest Price/Book mean at 0.69. Other industry category shows relatively consistent mean Price/Book value, ranging from 0.97 to 2.81. However, the low values of Price/Book, at multiples of 1.0 per book value, may indicate that the share prices are undervalued. In the case of Plantation category, the high Price/Book may be caused by an outlier from a firm in the Plantation category. Due to the outlier, the Price/Book mean for the total of all industry categories is at 8.76. However, the descriptive statistics show that if the outlier is removed, the trimmed mean is 1.04. This shows that the means for other industry categories are close to the trimmed mean. Therefore, the high mean for Price Book is actually due to an outlier in the Plantation category.

The implication of having the outliers in the industry suggests that some firms may be overvalued based on the high multiple of share price over book value. As relative valuation method predicts share price of a target firm based on the average multiple of comparable firms, an outlier from the set of comparable firms may also affect the
prediction. Therefore valuation accuracies may be affected. As such, including outliers in
the set of comparable firms must be conducted only when the target firm is closely
comparable to the outliers.

4.1.5 Means for Total Asset by Industry Category

The mean for total assets for all industry categories is 3,290.09. As shown in Table 4.3,
the highest mean from a category is 28,275.87 from the Finance category. The lowest
mean is from the Technology category at 437.57. Descriptive statistics indicate that the
high mean is caused by outliers from Finance. The trimmed mean for total assets if the
outliers are removed is 947.34. The big difference between the trimmed mean and the
mean from the total of all categories shows that the outliers are extremely high.
Comparing the individual industry categories with the trimmed mean, it is evident that
there are variations between each category’s means for total assets. This indicates that the
industry categories are not consistent in terms of their total assets. Therefore, the results
show that the firms in different industries are not similar in size.

This implication is important because firm size is one of the factors involved in forming
the set of comparable firms for the relative valuation method. Firm size is an indicator of
risk, which is one of the drivers in Price/Earning and Price/Book (Cheng and McNamara,
2000). Thus, varying firm size in an industry category suggests the effects of firm size
cannot be captured by simply selecting firms belonging to the same industry category.
Therefore, total assets may be a factor in selecting comparable companies. The study will
then examine whether valuation accuracies of the relative valuation method are improved
when comparable companies are selected based on total assets.
4.1.6 Means for Return on Equity by Industry Category

The mean for return on equity from the total of all industry categories is 43.92. The highest mean is from the Plantation industry, with return on equity mean at 284.71. The result is consistent with the high mean for Price/Book observed earlier. This is simply because return on equity is one of the drivers for Price/Book ratio. This is also reflected by the lowest return on equity mean from the Properties industry, similar to the analysis for Price/Book earlier. However, in comparing the means for return on equity from other categories, it is shown that the other industries are not consistent around the trimmed mean at 10.45.

4.1.7 Medians for Price/Earning, Price/Book, Total Assets and Return on Equity by Industry Category

Table 4.3 also presents the medians for Price/Earning, Price/Book, total assets and return on equity by industry category. For Price/Earning, the median for the categories in total is 11.17. The medians for the industry categories individually are mostly consistent around the total median, except for Plantation category. The median PE for this category is the highest at 22.49.

The median Price/Book for total of all categories is 0.81. This is however not consistently reflected by the categories respectively with the highest is 1.51 and the lowest is 0.54. Similar to mean, the highest median Price/Book is also from the Plantation category and the lowest median is from the Properties category.
For total assets, the median for overall category is 479.80. Comparing each category, the medians vary, ranging from the highest at 3,049.18 and the lowest at 243.05. The highest median is from Infrastructure Project Companies category and the lowest is from Consumer Product category.

The median for return on equity ranges from the highest at 17.85 to the lowest at 5.57. Similar to total assets, the medians for return on equity varies across all categories. The highest median is from Infrastructure Project Companies, while the lowest median is from Properties. The median for the total category is 9.41. Technology, Finance and Trade/Services categories are the categories that are closest to the overall median.

The observations on means and medians for Price/Earning, Price/Book, total assets and return on equity contribute to the research because they may provide indication on the valuation accuracies of the relative valuation method. For example, in the research, one of the criteria for selecting comparable companies is based on industry category. This means that the target firm’s share price is predicted using the industry mean of a multiple, for instance the Price/Earning multiple. If the industry mean for Price/Earning is pushed too high because of some outliers, then predicting target firm’s stock price may not be accurate. As such, outliers may drive the predicted price away from the actual price, thus producing inaccurate valuation.
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Consumer Product</th>
<th>Construction</th>
<th>Finance</th>
<th>Hotel</th>
<th>Industrial Product</th>
<th>IPC</th>
<th>Plantation</th>
<th>Technology</th>
<th>Properties</th>
<th>Trade Services</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PE</strong></td>
<td>Mean 57.25</td>
<td>20.52</td>
<td>35.09</td>
<td>44.11</td>
<td>16.75</td>
<td>10.99</td>
<td>27.93</td>
<td>10.47</td>
<td>38.11</td>
<td>28.91</td>
<td>30.62</td>
</tr>
<tr>
<td></td>
<td>Median 9.82</td>
<td>12.73</td>
<td>13.68</td>
<td>24.29</td>
<td>8.44</td>
<td>8.32</td>
<td>22.49</td>
<td>9.69</td>
<td>10.17</td>
<td>12.29</td>
<td>11.17</td>
</tr>
<tr>
<td></td>
<td>SD 354.79</td>
<td>32.88</td>
<td>86.90</td>
<td>50.11</td>
<td>42.17</td>
<td>7.76</td>
<td>23.76</td>
<td>3.72</td>
<td>102.04</td>
<td>62.39</td>
<td>146.20</td>
</tr>
<tr>
<td><strong>PB</strong></td>
<td>Mean 1.73</td>
<td>1.03</td>
<td>1.31</td>
<td>1.23</td>
<td>1.11</td>
<td>2.81</td>
<td>107.36</td>
<td>0.97</td>
<td>0.69</td>
<td>1.47</td>
<td>8.76</td>
</tr>
<tr>
<td></td>
<td>Median 0.79</td>
<td>0.78</td>
<td>0.86</td>
<td>1.07</td>
<td>0.77</td>
<td>1.41</td>
<td>624.42</td>
<td>0.86</td>
<td>0.54</td>
<td>0.85</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>SD 4.31</td>
<td>0.86</td>
<td>1.38</td>
<td>0.99</td>
<td>1.10</td>
<td>3.78</td>
<td>1.51</td>
<td>0.51</td>
<td>0.47</td>
<td>1.86</td>
<td>166.07</td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td>Mean 660.63</td>
<td>2456.90</td>
<td>28275.87</td>
<td>642.94</td>
<td>769.14</td>
<td>6150.14</td>
<td>1481.53</td>
<td>437.57</td>
<td>1028.58</td>
<td>2683.61</td>
<td>3290.09</td>
</tr>
<tr>
<td></td>
<td>Median 243.05</td>
<td>466.42</td>
<td>2036.89</td>
<td>637.57</td>
<td>353.39</td>
<td>3049.18</td>
<td>474.24</td>
<td>301.01</td>
<td>685.11</td>
<td>520.14</td>
<td>479.80</td>
</tr>
<tr>
<td></td>
<td>SD 1197.32</td>
<td>6178.48</td>
<td>57513.90</td>
<td>437.35</td>
<td>1364.30</td>
<td>9072.22</td>
<td>2831.20</td>
<td>458.06</td>
<td>1269.47</td>
<td>8201.76</td>
<td>16739.75</td>
</tr>
<tr>
<td><strong>ROE</strong></td>
<td>Mean 38.62</td>
<td>12.20</td>
<td>12.10</td>
<td>69.33</td>
<td>12.11</td>
<td>20.93</td>
<td>284.71</td>
<td>9.67</td>
<td>8.35</td>
<td>49.77</td>
<td>43.92</td>
</tr>
<tr>
<td></td>
<td>Median 11.07</td>
<td>7.86</td>
<td>9.80</td>
<td>15.38</td>
<td>11.26</td>
<td>17.85</td>
<td>7.30</td>
<td>9.77</td>
<td>5.57</td>
<td>9.51</td>
<td>9.41</td>
</tr>
<tr>
<td></td>
<td>SD 145.06</td>
<td>12.58</td>
<td>10.51</td>
<td>116.28</td>
<td>10.72</td>
<td>12.87</td>
<td>1634.14</td>
<td>4.10</td>
<td>14.06</td>
<td>378.67</td>
<td>474.06</td>
</tr>
<tr>
<td>N</td>
<td>71</td>
<td>34</td>
<td>33</td>
<td>4</td>
<td>115</td>
<td>6</td>
<td>35</td>
<td>13</td>
<td>69</td>
<td>115</td>
<td>495</td>
</tr>
<tr>
<td>% of Total N</td>
<td>14.3%</td>
<td>6.9%</td>
<td>6.7%</td>
<td>0.8%</td>
<td>23.2%</td>
<td>1.2%</td>
<td>7.1%</td>
<td>2.6%</td>
<td>13.9%</td>
<td>23.2%</td>
<td>100%</td>
</tr>
</tbody>
</table>

PE: Price/Earning multiple
PB: Price/Book multiple
ROE: Return on Equity
IPC: Infrastructure Project Companies
4.2 Descriptive Statistics: Valuation Accuracy

In this research, valuation accuracy of the relative valuation method is determined by finding the absolute percentage error between the estimated price and actual price. The researcher calculates the percentage error for each relative valuation method that uses the valuation multiples Price/Earning, Price/Book and combined Price/Earning and Price/Book to predict target firm’s share price. As an extension to previous research by Cheng and McNamara (2000), the study further calculates the percentage of error for relative valuation method that uses the combined weighted average of Price/Earning and Price/Book to value the target firm. Ultimately, the objective of the research is to find the optimal weighted average of the combined Price/Earning and Price/Book that gives the highest accuracy for the relative valuation method.

This section reports the descriptive statistics for the absolute percentage error for each valuation multiple of Price/Earning, Price/Book and combined Price/Earning and Price/Book. The statistics are reported by the selection criteria for determining comparable firms. These are the groupings by industry category, total assets, return on equity, combination of industry category and assets and combination of industry category and return on equity.

4.2.1 Means and Medians for Percentage Error of Price/Earning

The descriptive statistics for the percentage error are shown in Table 4.4. The percentage error is calculated using the different methods, broken down by methods of selecting comparable companies. For error percentage of Price/Earning multiple, the overall mean
is 58.86. The highest mean for error percentage of using Price/Earning multiple is 64.85, when selecting comparable companies using combination of industry membership and total assets. The lowest mean for Price/Earning is 54.14, when comparable companies are selected based on the combination of industry category and return on equity. This may indicate that relative valuation using Price/Earning multiple is most accurate when selecting the set of comparable companies based on similarities in return on equity and industry membership. This suggests that to estimate a target firm’s share price, the comparable firms for the target firm can be determined by finding those having the closest return on equity to the target firm as well as belonging to the same industry category as the target firm.

As shown in Table 4.4, the median for the percentage of error using Price/Earning is 48.89 from the overall total. However, the medians vary among the selection methods for comparable firms: industry category, total assets, return on equity, combination of industry and assets and combination of industry and return on equity. This may suggest the effects of selection of comparable companies on valuation accuracies. The tests conducted and discussed in the next section provide the possible effects of these methods of selecting comparable firms for the relative valuation method.

4.2.2 Means and Medians for Percentage Error of Price/Book

The mean of error percentage for Price/Book multiple is 65.52. The highest mean at 72.62 is from the selection of comparable firms based on return on equity. This implies that selecting comparable firms based on the closest return on equity may not provide high accuracies when using Price/Book multiple to estimate target firm’s share price.
The median for the percentage of error for Price/Book is also close to the mean, at 56.52. The lowest mean and median is for the set of comparable companies selected based on combination of industry membership and return on equity. This is similar to the relative valuation method using Price/Earning multiple. This implies that when using Price/Book multiple in relative valuation method, the highest accuracy may be achieved when comparable firms are defined as those that belong to the same industry as target firm and have the closest return on equity to the target firm.

4.2.3 Means for Percentage Error of Combined Price/Earning and Price/Book

While both Price/Earning and Price/Book multiple produce the lowest mean of percentage error when comparable companies are selected based on industry membership and return on equity, the research further explores the means of percentage error for the relative valuation method using combined multiples of Price/Earning and Price/Book. This is to later determine whether valuation accuracies can be further improved when using a weighted average of Price/Earning and Price/Book.

Table 4.4 shows the means for each weighted average of Price/Earning and Price/Book. It can be observed that the means for the weighted average of the overall method does not differ much against each other. Comparing the total means, the highest mean of percentage error for weighted average of Price/Earning and Price/Book relative valuation method is the weighted average of 10% Price/Earning and 90% Price/Book. This finding tallies with the observation that the mean for percentage error for Price/Book relative valuation method is the highest among all the multiples. The lowest mean among the weighted average is 54.78, that is, from the weighted average of 60% Price/Earning and
40% Price/Book relative valuation method. Based on the mean, this may suggest that 60/40 weighted combination of Price/Earning and Price/Book provides the most accurate valuation. However, this is yet to be confirmed during the tests conducted to determine the most accurate relative valuation method.

Comparing the different methods of selecting comparable companies, selection criteria based on industry membership mostly has the lowest mean for all combination of weighted average. The lowest mean for selection criteria based on industry membership is 51.53, for the weighted average of 60% Price/Earning and 40% Price/Book valuation method. This result however does not tally with Price/Earning and Price/Book valuation methods earlier that find the lowest mean of percentage error is for those comparable firms selected based on industry membership and return on equity. Tests conducted in the next section may suggest which valuation multiple and selection criteria for comparable firms provides the highest accuracy in estimating a target firm’s share price.
Table 4.4: Means, medians and standard deviations for percentage error of valuation

<table>
<thead>
<tr>
<th>Method</th>
<th>EPE</th>
<th>EPB</th>
<th>EPE50</th>
<th>EPE10</th>
<th>EPB50</th>
<th>EPB10</th>
<th>EPE20</th>
<th>EPB20</th>
<th>EPE40</th>
<th>EPB40</th>
<th>EPE60</th>
<th>EPB60</th>
<th>EPE80</th>
<th>EPB80</th>
<th>EPE10</th>
<th>EPB10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>54.77</td>
<td>65.48</td>
<td>52.07</td>
<td>61.01</td>
<td>57.46</td>
<td>54.84</td>
<td>53.12</td>
<td>51.53</td>
<td>51.57</td>
<td>51.95</td>
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<td>76</td>
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<td>76</td>
<td>76</td>
<td>76</td>
<td>76</td>
<td>76</td>
</tr>
<tr>
<td>SD</td>
<td>51.34</td>
<td>49.12</td>
<td>32.75</td>
<td>44.88</td>
<td>40.77</td>
<td>37.05</td>
<td>34.14</td>
<td>33.42</td>
<td>35.95</td>
<td>40.29</td>
<td>45.96</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>53.44</td>
<td>65.76</td>
<td>52.01</td>
<td>61.33</td>
<td>56.30</td>
<td>55.05</td>
<td>52.48</td>
<td>50.79</td>
<td>51.93</td>
<td>53.62</td>
<td>53.04</td>
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<td>60.55</td>
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<td>Median</td>
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<td>52.10</td>
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<td>47.62</td>
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</tbody>
</table>

EPE: Percentage error using Price/Earning multiple,  EPB: Percentage error using Price/Book multiple
EPE50EPB50: Percentage error using combination of Price/Earning and Price/Book, where X50Y indicate the weights per 100%
Method refers to the selection criteria for selecting comparable firms in the relative valuation method
Industry + Asset: Combination of industry category and total asset, Industry + Return on Equity: Combination of industry category and return on equity
4.3 Price/Earning Valuation Accuracy

Table 4.5 reports the performance of Price/Earning valuation method against the selection basis of comparable companies. The percentage of errors using Price/Earning valuation method is compared between the selection criteria of comparable companies that are in terms of similarities in industry category, return on equity, total assets, combination of industry category and total assets and combination of industry category and return on equity. This analysis intends to identify which set of comparable companies achieves the highest valuation accuracy when using Price/Earning relative valuation method.

To test for the performance of Price/Earning valuation method, non-parametric test for comparing three or more related groups (Friedman test) is conducted. The reason for choosing the non-parametric test is because of the small sample size used in the research. The number of target firms selected as samples in determining valuation accuracies is 76. These target firms are valued using the relative valuation methods studied in this research. In this section, the Friedman test is applied to study the effects of selecting comparable companies based on different criteria against the valuation accuracies using Price/Earning relative valuation method.

To identify the effects, the estimation of target firm price is done using the Price/Earning valuation method. The valuation method is fixed by using Price/Earning multiple while different selection criteria for selecting comparable firms are applied to determine the set of comparable firms for the target firm that gives most accurate estimation. The estimated
share price of the target firm is compared against the actual price to derive the percentage error for each selection criteria of comparable companies.

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>N</th>
<th>Mean Rank</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Percentiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>76</td>
<td>3.22</td>
<td>54.77</td>
<td>51.34</td>
<td>27.04</td>
</tr>
<tr>
<td>Return on Equity</td>
<td>76</td>
<td>2.74</td>
<td>50.80</td>
<td>48.68</td>
<td>19.39</td>
</tr>
<tr>
<td>Asset</td>
<td>76</td>
<td>3.09</td>
<td>63.29</td>
<td>70.52</td>
<td>27.44</td>
</tr>
<tr>
<td>Ind+Asset</td>
<td>76</td>
<td>2.97</td>
<td>64.85</td>
<td>90.17</td>
<td>23.60</td>
</tr>
<tr>
<td>Ind+ROE</td>
<td>76</td>
<td>2.97</td>
<td>54.14</td>
<td>61.06</td>
<td>26.08</td>
</tr>
</tbody>
</table>

Industry refers to selection of comparable firms based on industry category
Return on Equity refers to selection of comparable firms based on return on equity
Asset refers to selection of comparable firms based on total asset
Ind+Asset refers to selection of comparable firms based on combination of industry category and total asset
Ind+ ROE refers to selection of comparable firms based on combination of industry category and return on equity

Table 4.6: Friedman test for Price/Earning valuation method

<table>
<thead>
<tr>
<th>N</th>
<th>76</th>
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</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>3.931</td>
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<tr>
<td>Df</td>
<td>4</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.415</td>
</tr>
</tbody>
</table>

4.3.1 Price/Earning: Ranking for Selection of Comparable Companies

Based on the results shown in Table 4.5, the method of selecting comparable companies based on return on equity is ranked the best at mean rank of 2.74. This is followed by the selection criteria combination of industry category and return on equity at 2.97, combination of industry and asset at 2.97, asset at 3.09 and industry category at mean rank of 3.22. This means that selecting comparable companies based on return on equity provides the more accurate estimation when using Price/Earning relative valuation. Since the ranking is based on the percentage of error, therefore the lowest value for rank mean
is considered as the best criteria for selecting comparable companies. This means that the lower percentage of error, the better the ranking is for the selection criteria.

However the t-statistics on Table 4.6 reports that the differences between the groups are not significant at $X^2(4) = 3.931, p > .05$. Since the results are not significant, the study is not able to imply the effects of selecting comparable companies against the performance of Price/Earning valuation method. This means that despite the ranking of the selection method for comparable companies, there is no significant difference of Price/Earning performance between each method of selection. This implies that for Price/Earning relative valuation method, it does not matter which selection criteria is used to form comparable firms for the target firm. Each selection criteria gives the same level of valuation accuracy for Price/Earning relative valuation method.

Although the results are not significant, the ranking of selection criteria does not tally with previous work by Cheng and McNamara (2000). While their test shows significant difference between the selection criteria, they also rank the performance differently. Cheng and McNamara (2000) find the ranking for selection criteria in the following order: 1) combination of industry category and return on equity, 2) industry category, 3) combination of industry category and total assets, 4) return on equity, 5) total assets. This research however ranks the selection criteria in this order: 1) return on equity, 2) combination of industry and return on equity, 3) combination of industry and assets, 4) assets, 5) industry. The next test compares each selection criteria in pairs.
4.3.2 Price/Earning: Pair-Wise Comparisons for Selection of Comparable Companies

Further testing is conducted to compare the performance of selection criteria for selecting comparable companies by applying Wilcoxon paired-sample test. In this test, one selection criterion is ranked against another selection criterion. The purpose of the test is to find which selection method is more superior against another for Price/Earning valuation method (Cheng and McNamara, 2000). While previous Friedman test ranks the selection criteria, the Wilcoxon test determines superiority of each selection criteria when compared in pairs.

Table 4.7: Wilcoxon paired test for Price/Earning valuation method

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Industry</th>
<th>Return on Equity</th>
<th>Asset</th>
<th>Ind+Asset</th>
<th>Ind+ROE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on Equity</td>
<td>z</td>
<td>-.1289&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.197</td>
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</tr>
<tr>
<td>Asset</td>
<td>z</td>
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<td>-.916&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.521</td>
<td>.055</td>
</tr>
<tr>
<td>Ind+Asset</td>
<td>z</td>
<td>-.1470&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.854&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.141</td>
<td>.393</td>
</tr>
<tr>
<td>Ind+ROE</td>
<td>z</td>
<td>-.559&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.362&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.263&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.504&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

a. Selection of comparable firms in column is superior to selection of comparable firms in row
b. Selection of comparable firms in row is superior to selection of comparable firms in column

Industry refers to selection of comparable firms based on industry category
Return on Equity refers to selection of comparable firms based on return on equity
Asset refers to selection of comparable firms based on total asset
Ind+Asset refers to selection of comparable firms based on combination of industry category and total asset
Ind+ROE refers to selection of comparable firms based on combination of industry category and return on equity

Table 4.7 presents the results of the Wilcoxon paired test. The results indicate that there is no significant difference between each pair of selection criteria for Price/Earning relative valuation method, where $p > .05$. The statistic results tally with previous results.
of Friedman test that also indicates no significant differences between the selection groups.

Since the statistics do not indicate significant $p$ values, the study can not conclude that one selection criteria of comparable companies is significantly better than the other selection criteria. One possible explanation of the insignificant difference is because of the small number of cases observed for each definition of comparable companies. The number of cases is actually the number of target firm price estimation where the percentage error is recorded. Perhaps a bigger sample is able to show significance differences between each selection criteria of comparable firms.

The findings imply that the choice of selection criteria does not affect the valuation accuracy of Price/Earning relative valuation method. As such, this means that for analysts who use Price/Earning relative valuation to estimate a firm’s share price, it does not matter which selection criteria is used to select the target firm’s comparable firms. Therefore, the easiest method that can be applied by the analysts is by selecting firms that belong to the same industry category as the target firm.

4.4 Price/Book Valuation Accuracy

Table 4.8 presents the valuation accuracy using Price/Book valuation method, compared against different definitions of comparable companies. Similar to Price/Earning, the non-parametric Friedman test is run against the same set of data. The data analyzed here is the percentage error obtained from the differences between the estimated price and actual price. The estimation is done using the Price/Book relative valuation method. The
The number of target firms whose prices are estimated is 76. The target firms remains the same for all the valuation multiple studied in this research. This is to eliminate other factors that may affect the performance of each valuation multiple, other than the definition of comparable firms factor.

Table 4.8: Mean rank for Price/Book valuation method

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>N</th>
<th>Mean Rank</th>
<th>Mean 65.48</th>
<th>Std. Deviation 49.12</th>
<th>25th 40.11</th>
<th>50th (Median) 65.76</th>
<th>75th 86.17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>76</td>
<td>3.32</td>
<td>65.48</td>
<td>49.12</td>
<td>40.11</td>
<td>65.76</td>
<td>86.17</td>
</tr>
<tr>
<td>Return on Equity</td>
<td>76</td>
<td>2.83</td>
<td>78.22</td>
<td>142.57</td>
<td>26.32</td>
<td>50.58</td>
<td>72.00</td>
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<tr>
<td>Asset</td>
<td>76</td>
<td>3.03</td>
<td>67.86</td>
<td>64.51</td>
<td>32.37</td>
<td>55.86</td>
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<td>Ind+Asset</td>
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<td>71.72</td>
</tr>
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</table>

Industry refers to selection of comparable firms based on industry category
Return on Equity refers to selection of comparable firms based on return on equity
Asset refers to selection of comparable firms based on total asset
Ind+Asset refers to selection of comparable firms based on combination of industry category and total asset
Ind+ROE refers to selection of comparable firms based on combination of industry category and return on equity

Table 4.9: Friedman test for Price/Book valuation method

<table>
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<tbody>
<tr>
<td>Chi-Square</td>
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<tr>
<td>Asymp. Sig.</td>
<td>.216</td>
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</table>

4.4.1 Price/Book: Ranking for Selection of Comparable Companies

Table 4.8 shows the ranking for Price/Book valuation performance on the different definitions of comparable firms. The results differ from that of Price/earning, with selection criteria by combination of industry category and return on equity is ranked the best at mean rank 2.76. However, industry category remains the worst selection criteria, at mean rank 3.32. For Price/Book valuation method, the order of performance based on
the ranking by Friedman test is as follows: 1) combination of industry and return on equity, 2) return on equity, 3) total assets 4) combination of industry and total assets 5) industry. Compared against the findings by previous work of Cheng and McNamara (2000), their study ranks the groups in the following order: 1) industry and return on equity, 2) return on equity, 3) industry, 4) industry and total asset 5) total asset. While the combination of industry with return on equity and return on equity are similarly ranked, this research finds show industry category as the worst definition for selecting comparable firms. This is opposed to their study that finds total assets as the least accurate selection criteria for forming comparable firms.

However, the results of the Friedman test state that there is no significant difference between the performances of Price/Book against the different definitions of comparable firms. Table 4.9 reports the statistical results as $X^2 (4) = 5.787, p > .05$. The results imply that the selection of comparable firms that does not cause significant difference in terms of performance of Price/Book valuation method. Again, a possible explanation for this is the small number of cases for each selection criteria. The test may not be able to conclude significant difference when there exist minimal differences in performance between each selection group.

4.4.2 Price/Book: Pair-Wise Comparisons for Selection of Comparable Companies

The next test that is applied here is the non-parametric Wilcoxon paired test. Similar to Price/Earning, the purpose of running this test against the groups is to compare superiority of one definition against another definition (Cheng and McNamara, 2000). The different definitions are paired to test if there exist any significant difference in terms
the performance of Price/Book valuation method. Table 4.10 presents the results of the Wilcoxon test.

The results presented in Table 4.10 show that there is no significant difference between each pair of definition of comparable firms. All pairs state high $p$ values, $p > .05$ except for the comparison between the combination of industry category and return on equity with industry category where $p < .05$. The significance difference that exists between this pair tallies with the results in the Friedman test earlier, where industry is ranked the worst while the combination of industry category and return on equity is ranked the best. The lack of significance for other pair-wise comparisons implies that one definition of comparable firms is not significantly superior to the other definition. The lack of significant difference may be caused by the small number of cases for each definition. The non-parametric test may not be able to detect small differences between the different definitions of comparable firms.
Table 4.10: Wilcoxon test between pairs for Price/Book valuation method

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Industry</th>
<th>Return on Equity</th>
<th>Asset</th>
<th>Ind+Asset</th>
<th>Ind+ROE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on Equity</td>
<td>Z</td>
<td>-1.771&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.077</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset</td>
<td>Z</td>
<td>-0.647&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.994&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.518</td>
<td>.320</td>
</tr>
<tr>
<td>Sig.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ind+Asset</td>
<td>Z</td>
<td>-0.559&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.134&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.513&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Sig.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.513&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ind+ROE</td>
<td>Z</td>
<td>-2.573&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.461&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.610&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.853&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sig.</td>
<td>.010</td>
<td>.645</td>
<td>.107</td>
<td>.064</td>
<td></td>
</tr>
</tbody>
</table>

a. Selection of comparable firms in column is superior to selection of comparable firms in row
b. Selection of comparable firms in row is superior to selection of comparable firms in column

Industry refers to selection of comparable firms based on industry category
Return on Equity refers to selection of comparable firms based on return on equity
Asset refers to selection of comparable firms based on total asset
Ind+Asset refers to selection of comparable firms based on combination of industry category and total asset
Ind+ ROE refers to selection of comparable firms based on combination of industry category and return on equity

4.5 Weighted Average of Price/Earning and Price/Book Valuation Accuracy

The study intends to further investigate the performance of the combination of Price/Earning and Price/Book valuation method by comparing the different definitions of comparable companies. In their research, Cheng and McNamara (2000) study the performance of the combination of Price/Earning and Price/Book by giving equal weights to both methods. This study then explores further by giving different weights to both method. This is to investigate whether the valuation accuracies can be improved when using weighted average of Price/Earning and Price/Book valuation method.

Table 4.11 presents the ranking of the weighted average of Price/Earning and Price/Book valuation. The weighted average is calculated by giving different combinations of weights to Price/Earning and Price/Book. For instance, one combination is 10% weight
given to Price/Earning and 90% to Price/Book or 90% weight to Price/Earning and 10%
to Price/Book. Friedman test is applied here to compare the ranking for each combination
against the five definitions of comparable companies: industry, return on equity, total
assets, combination of industry category and total assets and combination of industry
category and return on equity.

4.5.1 Weighted Average of Price/Earning and Price/Book: Ranking for Selection of
Comparable Companies

The results in Table 4.11 show that for all combinations of Price/Earning and Price/Book,
selection of comparable companies based on return on equity and combination of
industry and return on equity are interchangeably ranked the first. The worst definition of
comparable firms remains to be industry category throughout the various combinations of
Price/Earning and Price/Book.
Table 4.11: Mean rank for selections of comparable companies

<table>
<thead>
<tr>
<th>Weighted Average Price/Earning and Price/Book</th>
<th>Industry</th>
<th>Return on Equity</th>
<th>Asset</th>
<th>Ind+Asset</th>
<th>Ind+ROE</th>
<th>Chi-Square</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPE10EPB90</td>
<td>3.32</td>
<td>2.80</td>
<td>3.01</td>
<td>3.08</td>
<td>2.79</td>
<td>5.765</td>
<td>.217</td>
</tr>
<tr>
<td>EPE20EPB80</td>
<td>3.33</td>
<td>2.84</td>
<td>2.95</td>
<td>3.04</td>
<td>2.84</td>
<td>4.943</td>
<td>.293</td>
</tr>
<tr>
<td>EPE30EPB70</td>
<td>3.36</td>
<td>2.88</td>
<td>2.83</td>
<td>3.07</td>
<td>2.87</td>
<td>5.818</td>
<td>.213</td>
</tr>
<tr>
<td>EPE40EPB60</td>
<td>3.32</td>
<td>2.88</td>
<td>2.79</td>
<td>3.08</td>
<td>2.93</td>
<td>5.133</td>
<td>.274</td>
</tr>
<tr>
<td>EPE50EPB50</td>
<td>3.28</td>
<td>2.92</td>
<td>2.83</td>
<td>2.95</td>
<td>3.03</td>
<td>3.510</td>
<td>.476</td>
</tr>
<tr>
<td>EPE60EPB40</td>
<td>3.29</td>
<td>2.99</td>
<td>2.82</td>
<td>2.95</td>
<td>2.96</td>
<td>3.721</td>
<td>.445</td>
</tr>
<tr>
<td>EPE70EPB30</td>
<td>3.30</td>
<td>3.00</td>
<td>2.87</td>
<td>2.82</td>
<td>3.01</td>
<td>4.274</td>
<td>.370</td>
</tr>
<tr>
<td>EPE80EPB20</td>
<td>3.24</td>
<td>2.97</td>
<td>2.89</td>
<td>2.88</td>
<td>3.02</td>
<td>2.552</td>
<td>.635</td>
</tr>
<tr>
<td>EPE90EPB10</td>
<td>3.17</td>
<td>2.86</td>
<td>3.04</td>
<td>2.88</td>
<td>3.06</td>
<td>2.157</td>
<td>.707</td>
</tr>
</tbody>
</table>

EPEXXEPBYY: Percentage error using combination of Price/Earning and Price/Book, where XX and YY indicate the weights per 100%

Industry refers to selection of comparable firms based on industry category
Return on Equity refers to selection of comparable firms based on return on equity
Asset refers to selection of comparable firms based on total asset
Ind+Asset refers to selection of comparable firms based on combination of industry category and total asset
Ind+ROE refers to selection of comparable firms based on combination of industry category and return on equity

It can also be observed from Table 4.11 how the mean ranks change as we apply weighted average across the combination of Price/Earning and Price/Book. When the definition of comparable companies is based on industry, the rank remains fairly consistent. This may imply how the combination of industry and weighted average Price/Earning and Price/Book does not affect the performance of valuation accuracies. When comparable companies are selected based on return on equity, the performance of valuation accuracies gets worse as we apply different weightage to Price/Earning and Price/Book combination. This can be observed from the increasing trends of mean ranks as the weightage of Price/Earning increases. Decreasing trends of mean ranks can also be observed for definitions based on total assets and combination of industry and total.
assets. However, the trends for mean ranks for each selection criteria do not exhibit significant movement as weightage is given to either Price/Earning or Price/Book. From here it can be observed that there is no significant effect of applying the weightage to the selections of comparable companies on valuation accuracies.

Although the results presented in Table 4.11 may indicate some interesting implications, it is not possible to conclude that a definition of comparable companies is superior to the other. This is because for each combination of weighted average, the statistics show that the groups of comparable companies are not significantly different than each other. All of the combinations are not significant at $p > .05$. Therefore this may mean that no matter what the selection basis of comparable companies is, it makes no difference to the performance of the valuation multiple.

4.5.2 Weighted Average of Price/Earning and Price/Book: Pair-wise Comparisons for Selection of Comparable Companies

As applied to previous multiples of Price/Earning and Price/Book, the Wilcoxon paired test is also conducted here to compare the performance of comparable firms against each other. While Friedman test is meant for comparing the groups, the Wilcoxon test is applied to compare one definition to another for every combination of weighted average for Price/Earning and Price/Book.

Table 4.12 reports the results of the paired non-parametric test. None of the comparisons shows significant differences, $p > .05$. This implies that there is no difference in the performance of the combination of Price/Earning and Price/Book valuation method when
compared based on the definitions of comparable companies. The lack of significant
differences may be attributed to the small number of cases for every grouping of
comparable companies.
<table>
<thead>
<tr>
<th>Weighted Average of Price/Earning and Price/Book</th>
<th>Selection Criteria</th>
<th>Industry</th>
<th>Return on Equity</th>
<th>Asset</th>
<th>Ind+Asset</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPE10EPB90</td>
<td>Return on Equity</td>
<td>z</td>
<td>-1.900&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.057</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asset</td>
<td>z</td>
<td>-981&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.057</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>.416</td>
<td>.320</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ind+Asset</td>
<td>z</td>
<td>-445&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.935&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-326&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>.656</td>
<td>.341</td>
<td>.744</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ind+ROE</td>
<td>z</td>
<td>-2.066&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.170&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.543&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
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<td>.893</td>
<td>.242</td>
<td>.123</td>
</tr>
<tr>
<td>EPE20EBP80</td>
<td>Return on Equity</td>
<td>z</td>
<td>-1.470&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td>-.223&lt;sup&gt;b&lt;/sup&gt;</td>
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</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>.462</td>
<td>.824</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ind+Asset</td>
<td>z</td>
<td>-7.787&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-3.388&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-1.109&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>Sig.</td>
<td>.431</td>
<td>.913</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Ind+ROE</td>
<td>z</td>
<td>-1.719&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.031&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-1.118&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
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<td>Sig.</td>
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<td>.975</td>
<td>.545</td>
<td>.264</td>
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<tr>
<td>EPE30EPB70</td>
<td>Return on Equity</td>
<td>z</td>
<td>-953&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
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</tr>
<tr>
<td></td>
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<td>-.280&lt;sup&gt;a&lt;/sup&gt;</td>
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</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>.422</td>
<td>.780</td>
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<tr>
<td></td>
<td>Ind+Asset</td>
<td>z</td>
<td>-580&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.078&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.549&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
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<td>.938</td>
<td>.583</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ind+ROE</td>
<td>z</td>
<td>-1.289&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.000&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.036&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
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<td></td>
<td>Sig.</td>
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<td>1.000</td>
<td>.971</td>
<td>.654</td>
</tr>
<tr>
<td>EPE40EPB60</td>
<td>Return on Equity</td>
<td>z</td>
<td>-626&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
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<td></td>
<td>Asset</td>
<td>z</td>
<td>-1.025&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.544&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>Sig.</td>
<td>.305</td>
<td>.587</td>
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<tr>
<td></td>
<td>Ind+Asset</td>
<td>z</td>
<td>-559&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.342&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-626&lt;sup&gt;b&lt;/sup&gt;</td>
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</tr>
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<td>-.083&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.632&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
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<td>Sig.</td>
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<td>.934</td>
<td>.528</td>
<td>.929</td>
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<tr>
<td>EPE50EPB50</td>
<td>Return on Equity</td>
<td>z</td>
<td>-585&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>.576</td>
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<td>Ind+Asset</td>
<td>z</td>
<td>-859&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.456&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.450&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Sig.</td>
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<td>.649</td>
<td>.652</td>
<td></td>
</tr>
<tr>
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<td>Ind+ROE</td>
<td>z</td>
<td>-891&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.171&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.704&lt;sup&gt;b&lt;/sup&gt;</td>
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<td></td>
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<td>.882</td>
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<td>Return on Equity</td>
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<td>-507&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>z</td>
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<td>-.440&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.305&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>.760</td>
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<td>Ind+ROE</td>
<td>z</td>
<td>-678&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.238&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Sig.</td>
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<td>.878</td>
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<td>Weighted Average of Price/Earning and Price/Book</td>
<td>Selection Criteria</td>
<td>Industry</td>
<td>Return on Equity</td>
<td>Asset</td>
<td>Ind+Asset</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-----------------</td>
<td>-------</td>
<td>-----------</td>
</tr>
<tr>
<td>EPE70EPB30</td>
<td>Return on Equity</td>
<td>z</td>
<td>-.404&lt;sup&gt;a&lt;/sup&gt;</td>
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<td></td>
</tr>
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<td></td>
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<td>Sig.</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>Asset</td>
<td>z</td>
<td>-.766&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.481&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sig.</td>
<td>.444</td>
<td>.630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ind+Asset</td>
<td>z</td>
<td>-1.160&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.186&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>.630</td>
<td>.852</td>
</tr>
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<td></td>
<td>Ind+ROE</td>
<td>z</td>
<td>-.663&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.362&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.450&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td></td>
<td></td>
<td>Sig.</td>
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<td>.717</td>
<td>.652</td>
</tr>
<tr>
<td>EPE80EPB20</td>
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<td>z</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
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<td>Asset</td>
<td>z</td>
<td>-.305&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.280&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sig.</td>
<td>.760</td>
<td>.780</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ind+Asset</td>
<td>z</td>
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<td>-1.66&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.259&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
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<td></td>
<td>Sig.</td>
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<td>.868</td>
<td>.796</td>
</tr>
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<td>Ind+ROE</td>
<td>z</td>
<td>-.404&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.321&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.041&lt;sup&gt;b&lt;/sup&gt;</td>
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<td></td>
<td></td>
<td>Sig.</td>
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<td>.748</td>
<td>.967</td>
</tr>
<tr>
<td>EPE90EPB10</td>
<td>Return on Equity</td>
<td>z</td>
<td>-.487&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sig.</td>
<td>.626</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asset</td>
<td>z</td>
<td>-.393&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-1.300&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sig.</td>
<td>.694</td>
<td>.194</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ind+Asset</td>
<td>z</td>
<td>-1.403&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.197&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.740&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sig.</td>
<td>.161</td>
<td>.844</td>
<td>.459</td>
</tr>
<tr>
<td></td>
<td>Ind+ROE</td>
<td>z</td>
<td>-.300&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.000&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-.621&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sig.</td>
<td>.764</td>
<td>1.000</td>
<td>.534</td>
</tr>
</tbody>
</table>

EPEXXEPBYY: Percentage error using combination of Price/Earning and Price/Book, where XX and YY indicate the weights per 100%

- a. Selection of comparable firms in column is superior to selection of comparable firms in row
- b. Selection of comparable firms in row is superior to selection of comparable firms in column
- c. Selection of comparable firms in row is equally superior to selection of comparable firms in column

Industry refers to selection of comparable firms based on industry category
Return on Equity refers to selection of comparable firms based on return on equity
Asset refers to selection of comparable firms based on total asset
Ind+Asset refers to selection of comparable firms based on combination of industry category and total asset
Ind+ ROE refers to selection of comparable firms based on combination of industry category and return on equity
4.6 Determining the Optimal Weighted Average for Price/Earning and Price/Book

Further testing is conducted to compare the performance of valuation accuracies when the definition of comparable companies is fixed. Friedman test is again applied here to compare valuation accuracies against the different combinations of weighted average Price/Earning and Price/Book. While previous tests are meant to compare the performance between different definitions of comparable companies, this test is to compare performance between the weighted averages of Price/Earning and Price/Book. The test is conducted for each selection criteria for comparable companies: industry category, total assets, return on equity, combination of industry and total assets and combination of industry and return on equity.

4.6.1 Comparable Companies: Ranking for Weighted Average of Price/Earning and Price/Book

Table 4.13 reports the means for the weighted average of Price/Earning and Price/Book for every definition of comparable companies. As the means signify the percentage error for every combination of Price/Earning and Price/Book, higher means show less accurate valuations while lower means imply more accurate valuations. For definition of comparable companies based on industry category, the lowest mean is from combination of 60% Price/Earning and 40% Price/Book. This may imply that these combination leads to more accurate valuations. On the other hand, the highest mean for comparable companies based on industry category is from 10% Price/Earning and 90% Price/Book. This may mean that this combination reduces valuation accuracies. The result is further reflected in Table 4.14, where the ranking for industry category shows that the
combination of 10% Price/Earning and 90% Price/Book (EPE10EPB90) is ranked the worst. However the ranking states that the combination of 90% Price/Earning and 10% Price/Book (EPE90EPB10) is ranked the best, instead of the combination of 60% Price/Earning and 40% Price/Book (EPE60EPB40). It is also important to note that the trend of the ranking shows that as the weightage for Price/Earning increases, the ranking improves. This implies that the higher the weightage given to Price/Earning, the valuation becomes more accurate. Table 4.14 also shows that for industry-based definition of comparable companies, the differences between the weighted average groups are significantly different at $X^2(8) = 65.032$, $p < .05$. Therefore it can be concluded that the effect of increasing the weightage for Price/Earning does improve valuation accuracies for industry-based definition of comparable companies.

4.6.2 Comparable Companies by Return on Equity: Ranking for Weighted Average of Price/Earning and Price/Book

For comparable companies defined based on return on equity, the highest mean reported by Table 4.13 comes from the combination of 10% Price/Earning and 90% Price/Book (EPE10EPB90). The lowest mean, which implies the most accurate weighted average is the combination of 90% Price/Earning and 10% Price/Book (EPE90EPB10). Similar to industry category, Table 4.14 reports the trending for the mean ranks improves as more weightage is given to Price/Earning. The statistics in Table 4.14 state that the groups of weighted average of Price/Earning and Price/Book differ significantly, where $X^2(8) = 61.460$, $p < .05$. Thus it can be concluded that the effects of increasing weightage to Price/Earning does improve valuation accuracies for comparable companies based on return on equity.
4.6.3 Comparable Companies by Total Asset: Ranking for Weighted Average of Price/Earning and Price/Book

For selection criteria of comparable companies based on total assets, the statistics indicate that the different combinations of weighed average do not differ significantly, $X^2(8) = 13.740, p > .05$. Table 4.13 reports that the highest mean for total assets is from the combination of 10% Price/Earning and 90% Price/Book (EPE10EPB90). This is consistent with the earlier results for industry category and return on equity. However, the lowest mean is from the combination of 60% Price/Earning and 40% Price/Book (EPE60EPB40). Unlike industry category and return on equity, it can be observed from Table 4.14 that there is no trend of improvement for ranking when increasing Price/Earning weightage. Interestingly, for total assets, the mean ranks improve as the weighted average approaches towards equally weighted Price/Earning and Price/Book. Although the statistics do not show significant differences, the results may imply that for total assets, the valuation becomes more accurate when both Price/Earning and Price/Book are given equal weightage.

4.6.4 Comparable Companies by Industry Category and Total Asset: Ranking for Weighted Average Price/Earning and Price/Book

For comparable companies defined based on combination of industry category and total asset, the highest mean is by the combination of 90% Price/Earning and 10% Price/Book (EPE90EPB10) while the lowest mean is from equally weighted Price/Earning and Price/Book (EPE50EPB50). Similar to total assets, Table 4.14 reports that the ranking
improves as the weightage for Price/Earning is increased. The statistics also indicate that the groups of weighted average differs significantly, $X^2(8) = 39.154, p < .05$. This implies that valuation accuracies improve as Price/Earning is given more weightage when combined with Price/Book. Although the results by total assets indicate that valuation is more accurate when Price/Earning and Price/Book are equally weighted, industry category still has greater effect on the valuation accuracies. This is shown by the fact that accuracy is higher when Price/Earning has higher weightage.

4.6.5 Comparable Companies by Industry Category and Return on Equity: Ranking for Weighted Average Price/Earning and Price/Book

Table 4.14 also presents that for comparable companies based on combination of industry category and return on equity, the statistics results are significant, $X^2(8) = 36.372, p < .05$. The lowest mean rank for this group is the combination of 90% Price/Earning and 10% Price/Book (EPE90EPB10) and the highest mean rank is the combination of 10% Price/Earning and 90% Price/Book (EPE10EPB90). Similar to selection criteria based on industry category and return on equity, the ranking of the means improves as Price/Earning is given more weights. This suggests that the accuracies improve as more weightage is given to Price/Earning. The trending of mean ranks tally with means reported in Table 4.13. This supports the implication that valuation accuracies improve as weightage for Price/Earning is increased.

When compared against the different definitions of comparable companies, it can be observed that the weighted average of 90% Price/Earning and 10% Price/Book (EPE90EPB10) gives the highest valuation accuracies. To determine the optimal
weighted average without the effects of comparable companies, Friedman test is applied again to rank the performance of valuation methods for Price/Earning, Price/Book and combination of Price/Earning and Price/Book.

4.6.6 Ranking for Price/Earning, Price/Book and Combination of Price/Earning and Price/Book

Table 4.15 displays the results of the Friedman test. The results show that the ranking improves as weights are given to Price/Earning. Interestingly, although it seems that Price/Earning improves valuation accuracies, the highest accuracy cannot be achieved if Price/Earning is given 100% weightage (EPE) as in Table 4.15. The mean ranks show that the highest accuracy is achieved when combining with Price/Book although in minimal weightage.

This implication is also reflected in the mean for each combination of Price/Earning and Price/Book. The lowest mean is for the combination of 60% Price/Earning and 40% Price/Book (EPE60EPB40) while the highest is Price/Book (EPB). Although the lowest mean is not the combination of 90% Price/Earning and 10% Price/Book (EPE90EPB10), the results still imply that higher accuracy can be achieved when Price/Earning is given more weightage when combined with Price/Book. This signifies that the means displayed in Table 4.15 tally with the mean ranks produced by the Friedman test. The statistics also show that the different combinations of Price/Earning and Price/Book are significantly different at $X^2(10) = 225.199, p < .05$. This suggests that the relative valuation method is most accurate for the combination of 90% of Price/Earning and 10% of Price/Book.
Therefore it can be concluded that the combination of 90% Price/Earning and 10% Price/Book (EPE90EPB10) is the most optimal weighted average found in this study.
Table 4.13: Means for combination of Price/Earning and Price/Book

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>EPE10</th>
<th>EPE20</th>
<th>EPE30</th>
<th>EPE40</th>
<th>EPE50</th>
<th>EPE60</th>
<th>EPE70</th>
<th>EPE80</th>
<th>EPE90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>61.01</td>
<td>57.46</td>
<td>54.84</td>
<td>53.12</td>
<td>52.07</td>
<td>51.53</td>
<td>51.57</td>
<td>51.95</td>
<td>52.64</td>
</tr>
<tr>
<td>Return on Equity</td>
<td>70.77</td>
<td>68.92</td>
<td>67.08</td>
<td>65.29</td>
<td>63.52</td>
<td>61.74</td>
<td>59.97</td>
<td>58.22</td>
<td>56.52</td>
</tr>
<tr>
<td>Asset</td>
<td>62.95</td>
<td>59.09</td>
<td>56.00</td>
<td>53.64</td>
<td>52.61</td>
<td>52.35</td>
<td>53.61</td>
<td>55.67</td>
<td>59.24</td>
</tr>
<tr>
<td>Ind + Asset</td>
<td>59.67</td>
<td>55.94</td>
<td>54.33</td>
<td>53.29</td>
<td>53.12</td>
<td>53.81</td>
<td>55.39</td>
<td>57.24</td>
<td>60.26</td>
</tr>
<tr>
<td>Ind + ROE</td>
<td>56.85</td>
<td>56.16</td>
<td>55.47</td>
<td>54.78</td>
<td>54.58</td>
<td>54.49</td>
<td>54.40</td>
<td>54.31</td>
<td>54.22</td>
</tr>
</tbody>
</table>

EPEXXEPBYY: Percentage error using combination of Price/Earning and Price/Book, where XX and YY indicate the weights per 100%

Industry refers to selection of comparable firms based on industry category
Return on Equity refers to selection of comparable firms based on return on equity
Asset refers to selection of comparable firms based on total asset
Ind+ Asset refers to selection of comparable firms based on combination of industry category and total asset
Ind+ ROE refers to selection of comparable firms based on combination of industry category and return on equity
Table 4.14: Mean ranks for combination of Price/Earning and Price/Book

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>EPE10</th>
<th>EPE20</th>
<th>EPE30</th>
<th>EPE40</th>
<th>EPE50</th>
<th>EPE60</th>
<th>EPE70</th>
<th>EPE80</th>
<th>EPE90</th>
<th>EPB10</th>
<th>Chi-Square</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>6.68</td>
<td>6.04</td>
<td>5.47</td>
<td>5.03</td>
<td>4.68</td>
<td>4.46</td>
<td>4.30</td>
<td>4.20</td>
<td>4.13</td>
<td>65.032</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Return on Equity</td>
<td>6.32</td>
<td>5.96</td>
<td>5.61</td>
<td>5.29</td>
<td>4.99</td>
<td>4.68</td>
<td>4.36</td>
<td>4.03</td>
<td>3.78</td>
<td>61.460</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Asset</td>
<td>5.68</td>
<td>5.22</td>
<td>4.89</td>
<td>4.63</td>
<td>4.55</td>
<td>4.59</td>
<td>4.80</td>
<td>5.09</td>
<td>5.53</td>
<td>13.740</td>
<td>.089</td>
<td></td>
</tr>
<tr>
<td>Ind + Asset</td>
<td>6.37</td>
<td>5.80</td>
<td>5.34</td>
<td>4.93</td>
<td>4.64</td>
<td>4.51</td>
<td>4.45</td>
<td>4.43</td>
<td>4.51</td>
<td>39.154</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Ind + ROE</td>
<td>6.03</td>
<td>5.75</td>
<td>5.47</td>
<td>5.20</td>
<td>4.96</td>
<td>4.74</td>
<td>4.51</td>
<td>4.29</td>
<td>4.05</td>
<td>36.372</td>
<td>.000</td>
<td></td>
</tr>
</tbody>
</table>

EPEXXEPBYY: Percentage error using combination of Price/Earning and Price/Book, where XX and YY indicate the weights per 100%

Industry refers to selection of comparable firms based on industry category
Return on Equity refers to selection of comparable firms based on return on equity
Asset refers to selection of comparable firms based on total asset
Ind+ Asset refers to selection of comparable firms based on combination of industry category and total asset
Ind+ ROE refers to selection of comparable firms based on combination of industry category and return on equity
Table 4.15: Mean ranks for Price/Earning, Price/Book and combination of Price/Earning and Price/Book

<table>
<thead>
<tr>
<th></th>
<th>EPE</th>
<th>EPB</th>
<th>EPE10</th>
<th>EPE20</th>
<th>EPE30</th>
<th>EPE40</th>
<th>EPE50</th>
<th>EPE60</th>
<th>EPE70</th>
<th>EPE80</th>
<th>EPE90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank</td>
<td>5.37</td>
<td>7.62</td>
<td>7.11</td>
<td>6.65</td>
<td>6.24</td>
<td>5.91</td>
<td>5.67</td>
<td>5.48</td>
<td>5.37</td>
<td>5.29</td>
<td>5.29</td>
</tr>
<tr>
<td>Mean</td>
<td>58.86</td>
<td>65.52</td>
<td>62.25</td>
<td>59.51</td>
<td>57.54</td>
<td>56.02</td>
<td>55.18</td>
<td>54.78</td>
<td>54.99</td>
<td>55.48</td>
<td>56.58</td>
</tr>
<tr>
<td>Chi-Square</td>
<td>225.199</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EPE: Percentage error using Price/Earning  
EPB: Percentage error using Price/Book  
EPEXXEPIBY: Percentage error using combination of Price/Earning and Price/Book, where XX and YY indicate the weights per 100%

4.7 Comparisons of Price/Earning, Price/Book and Optimal Weighted Average of Price/Earning and Price/Book

To find the best combination of valuation multiple and selection criteria of comparable firms, the Wilcoxon paired test is conducted against Price/Earning, Price/Book and the optimal weighted average of Price/Earning and Price/Book derived earlier, 90% Price/Earning and 10% Price/Book.

4.7.1 Comparable Companies by Industry Category: Pair-Wise Comparisons for Multiples

Table 4.16 reports the results of Wilcoxon paired test that compares the performance of Price/Earning, Price/Book and the optimal weighted average of Price/Earning and Price/Book derived from earlier tests, that is 90% Price/Earning and 10% Price/Book.
comparable companies selected based on industry category, statistics show that 
Price/Earning is superior to Price/Book where both are significantly different, at \( p < .05 \). The equally weighted and the optimally weighted Price/Earning and Price/Book are also shown be superior to Price/Book and significantly different, at \( p < .05 \). This implies that for relative valuation method that selects comparable companies based on industry membership, Price/Earning, weighted average of 50% Price/Earning and 50% Price/Book and weighted average of 90% Price/Earning and 10% Price/Book performs better than Price/Book.

4.7.2 Comparable Companies by Return on Equity: Pair-Wise Comparisons for Multiples

For comparable companies selected based on return on equity, all pairwise comparisons are found to be significantly different at \( p < .05 \). The results in Table 4.16 show that Price/Earning is superior to Price/Book, weighted average of 50% Price/Earning and 50% Price/Book as well as weighted average of 90% Price/Earning and 10% Price/Book. In addition, both weighted average of 50% Price/Earning and 50% Price/Book and weighted average of 90% Price/Earning and 10% Price/Book is found to be superior to Price/Book. Therefore for selection criteria return on equity, the performance of the multiple can be ranked in the following order: 1) Price/Earning, 2) 90% Price/Earning and 10% Price/Book, 3) 50% Price/Earning and 50% Price/Book, 4) Price/Book.

4.7.3 Comparable Companies by Total Asset: Pair-Wise Comparisons for Multiples

For comparable firms that are selected based on total assets, the comparison between Price/Earning and weighted average 90% Price/Earning and 10% Price/Book is statistically different at \( p < .05 \). The comparison shows that the weighted average 90%
Price/Earning and 10% Price/Book performs better than Price/Earning. Similarly, Wilcoxon test shows that the comparison between Price/Book and equally weighted Price/Earning and Price/Book is statistically different at $p < .05$. The equally weighted Price/Earning and Price/Book is found to be superior to Price/Book. These observations tally with earlier results for return on equity and industry category.

4.7.4 Comparable Companies by Combination of Industry and Total Asset: Pair-Wise Comparisons for Multiples

Table 4.16 shows that for combination of industry and total asset, the comparisons between Price/Earning, Price/Book, weighted average Price/Earning and Price/Book are significantly different. The results indicate that weighted average of 90% Price/Earning and 10% Price/Book performs better than Price/Earning. The results also show that equally weighted Price/Earning and Price/Book is superior to Price/Book. In addition, weighted average of 90% Price/Earning and 10% Price/Book is also found to be superior to Price/Book. Therefore, for comparable companies based on the industry and total assets, the following is observed: 90% Price/Earning and 10% Price/Book performs better than Price/Earning and Price/Book separately, and the equally weighted Price/Earning and Price/Book is superior to Price/Book.

4.7.5 Comparable Companies by Combination of Industry and Return on Equity: Pair-Wise Comparisons for Multiples

For combination of industry and return on equity, the only significant difference reported by the results is for the comparison between Price/Book and equally weighted
Price/Earning and Price/Book. Table 4.16 indicates that the equally weighted Price/Earning and Price/Book is superior to Price/Book. 

For other definitions of comparable companies, although the results may indicate some valuation methods as superior to the other, the statistics do not indicate that they are significant. As such, it cannot be concluded that any of the combination of selection criteria with valuation multiple is the most superior. However, from Table 4.16, it can be observed that the equally weighted Price/Earning and Price/Book is consistently superior to Price/Book valuation multiple.

Table 4.16: Comparisons of Price/Earning, Price/Book, equally weighted and optimally weighted average of Price/Earning and Price/Book

<table>
<thead>
<tr>
<th></th>
<th>Industry</th>
<th>Return on Equity</th>
<th>Asset</th>
<th>Ind+Asset</th>
<th>Ind+ROE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPE vs EPB</td>
<td>z</td>
<td>-2.842&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-3.003&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-994&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.641&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.004</td>
<td>0.003</td>
<td>0.320</td>
<td>0.101</td>
</tr>
<tr>
<td>EPE vs EPE50EPB50</td>
<td>z</td>
<td>-989&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-2.920&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.807&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-238&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.323</td>
<td>0.044</td>
<td>0.071</td>
<td>0.812</td>
</tr>
<tr>
<td>EPE vs EPE90EPB10</td>
<td>z</td>
<td>-404&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.014&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-3.174&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.542&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.686</td>
<td>0.044</td>
<td>0.002</td>
<td>0.011</td>
</tr>
<tr>
<td>EPB vs EPE50EPB50</td>
<td>z</td>
<td>-4.520&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-3.329&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-3.391&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-3.174&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>Sig.</td>
<td>0.000</td>
<td>0.001</td>
<td>0.001</td>
<td>0.002</td>
</tr>
<tr>
<td>EPB vs EPE90EPB10</td>
<td>z</td>
<td>-3.236&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-3.003&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-1.481&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.014&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.001</td>
<td>0.003</td>
<td>0.139</td>
<td>0.044</td>
</tr>
<tr>
<td>EPE50EPB50 vs EPE90EPB10</td>
<td>z</td>
<td>-1.165&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.967&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-1.372&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.72&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>Sig.</td>
<td>0.244</td>
<td>0.003</td>
<td>0.170</td>
<td>0.942</td>
</tr>
</tbody>
</table>

- a. Left multiple is superior to right multiple
- b. Right multiple is superior to left multiple
- c. Left multiple is equally superior to right multiple

EPE: Percentage error using Price/Earning
EPB: Percentage error using Price/Book
EPEXXEPBBYY: Percentage error using combination of Price/Earning and Price/Book, where XX and YY indicate the weights per 100%
Industry refers to selection of comparable firms based on industry category
Return on Equity refers to selection of comparable firms based on return on equity
Asset refers to selection of comparable firms based on total asset
Ind+Asset refers to selection of comparable firms based on combination of industry category and total asset
Ind+ ROE refers to selection of comparable firms based on combination of industry category and return on equity
The results of the test suggest that when doing relative valuation, the valuation multiple that provides more accuracy in price estimation is the weighted average Price/Earning and Price/Book. More specifically, despite the findings earlier that indicates the optimal weighted average of Price/Earning and Price/Book is the 90% Price/Earning and 10% Price/Book combination, results on Table 4.16 only shows that the equally weighted combination is consistently superior to Price/Book for all selection criteria. Therefore, it can be observed that Price/Book valuation multiple does not provide more accuracy when combined with the various selection criteria for comparable firms.

4.8 Testing of Hypotheses

Based on the results, the hypotheses stated for the research are tested. H₁ states that valuation is more accurate when using a weighted average of Price/Earning and Price/Book multiples in relative valuation method. The results earlier indicate that all selection criteria except for total assets show significant differences for improvement of valuation accuracies. However, if definitions of comparable companies are not taken into account, results show that valuation accuracies do improve as weighted average is applied to Price/Earning and Price/Book valuation method. Therefore, H₁ is accepted.

H₂ states that valuation is more accurate when weighted average of Price/Earning and Price/Book is combined with selection of comparable companies based on industry category. The test results report that for comparable companies selected based on industry category, valuation accuracies improve when weights are applied to Price/Earning and Price/Book combined valuation method. However, the comparison test does not indicate statistically that weighted average Price/Earning and Price/Book is
superior to Price/Earning or Price/Book independently. Therefore it cannot be concluded that the weighted average valuation method combined with comparable companies selected based on industry category improve accuracies compared to other valuation methods combined with same method of selection comparable companies. As such, H2 is rejected.

The acceptance of H1 suggests a significant improvement in improving valuation accuracies in relative valuation method. This implies that the usage of weighted average of combined Price/Earning and Price/Book has the effect on improving valuation accuracies. This also means that analysts may use weighted average of the combined Price/Earning and Price/Book in addition to their current practice of using Price/Earning or Price/Book independently when estimating a company’s share price. Since the task of combining Price/Earning and Price/Book is practical and not complicated, it may be beneficial for analysts to utilize the weighted average of valuation multiple method.

The rejection of H2 signifies that in relative valuation method, the method of selecting comparable companies does not contribute towards improving valuation accuracies. This means that analysts may be able to stick to the easiest method of selecting comparable companies, via industry category membership. Further research may be needed to examine in more detail the effects of selection criteria on the performance of relative valuation method.
4.9 Summary

Based on the tests conducted, the important findings are summarized in this section. For Price/Earning valuation method, selection of comparable companies based on return on equity is ranked the best, although the statistics are not significant. The ranking for Price/Earning valuation method is in the following order: 1) return on equity, 2) combination of industry and return on equity, 3) combination of industry and total assets, 4) total assets, 5) industry. For Price/Book valuation method, the ranking shows the following order: 1) combination of industry and return on equity, 2) return on equity, 3) total assets, 4) combination of industry and total assets, 5) industry. There is no significant difference exist between the groups. As for the combination of Price/Earning and Price/Book valuation method, selection of comparable companies based on return on equity and combination of industry and return on equity are often ranked the best. The results are consistent for all combination of weighted average of Price/Earning and Price/Book valuation method.

Ranking improves for comparable companies selected according to industry membership when combined with Price/Earning and Price/Book valuation method. The rank improves as more weights are applied to Price/Earning. This may imply an improvement to valuation accuracies. For comparable companies selected based on return on equity, accuracies also increases as more weights are applied to Price/Earning. For total assets, valuation accuracies improve as Price/Earning and Price/Book are given equal weights, but no significant difference is reported by the statistics. For combination of industry and total assets, valuation accuracies improve as more weights given to Price/Earning, with
significant differences exist between the groups. Similarly for combination of industry and return on equity, valuation accuracies improve as more weights given to Price/Earning and significant differences exist between the groups. The results also show that the optimal weighted average combination of Price/Earning and Price/Book is 90% Price/Earning and 10% Price/Book.

Comparisons between valuation methods indicate that Price/Book is less superior to Price/Earning, equally weighted Price/Earning and Price/Book and combination of 90% Price/Earning and 10% Price/Book. The superiority between Price/Earning, equally weighted Price/Earning and Price/Book and combination of 90% Price/Earning and 10% Price/Book cannot be concluded because only some of the statistics show significant difference between the groups.
Chapter 5

IMPROVEMENTS IN VALUATION ACCURACIES FOR PRICE/EARNING, PRICE/BOOK AND ITS COMBINATION

5.0 Introduction

This section discusses the research findings on valuation accuracies of Price/Earning, Price/Book and the combination of both multiples. This is followed by the implications of the research and research limitation. The recommendations for future research are presented and finally this is followed by the conclusion of the paper.

The objective of the study is to examine whether valuation accuracy is improved when multiples are combined. This study also intends to investigate the factor that affects the accuracies in relative valuation method, specifically the definition of comparable companies. In studying the definition of comparable companies, the research groups the companies according to industry category, return of equity, total assets. Furthermore, the research also groups the companies according to the combination of industry category with total assets and industry category with return of equity. The objective is to find the definition of comparable companies that enhances the accuracies of the relative valuation method. When testing for the most accurate definition, the valuation accuracies are calculated using the following valuation multiples: Price/Earning, Price/Book and combination of Price/Earning and Price/Book.
5.1 Valuation Accuracy of Price/Earning

The results of the test indicate that for Price/Earning, the selection of comparable companies that gives highest accuracy is the selection that is based on return on equity. This means that when valuing a target firm using its Price/Earning, the best method to define its set of comparable companies is by finding those that have the closest return on equity to the target firm. The finding is however different than that of Cheng and McNamara (2000). Their study finds that the best definition is when selecting comparable companies based on the combination of industry and return on equity. Although this finding differs in terms of the selection criteria for comparable companies for Price/Earning valuation method, the ranking derived from this study has similarities with their ranking. This study ranks the performance of the definitions in the following order: return on equity, industry and return on equity, industry and total assets, total assets, industry. On the other hand, Cheng and McNamara (2000) rank their definitions in this order: industry and return on equity, industry, industry and total assets, return on equity, total assets. It is interesting to note that this study does not acknowledge the advantage of industry or total assets separately. This may imply that in this sample the study acknowledge the benefits of combined selection criteria. This is evident when return on equity or combination of industry with return on equity and total assets capture much of the information on companies to give more accurate valuations. Furthermore, this study finds that the industry membership as the worst performer in giving accurate valuations. This fact may suggest that industry membership alone does not sufficiently capture the information required in relative valuation to provide accurate valuation.
However, when industry membership is combined with return on equity or total assets, the combination provides more accuracy.

This effect is illustrated in the Figure 5.1. Target firm X, may have more similarities with those comparable companies grouped based on return on equity than industry category. The similarities are in terms of factors that affect Price/Earning valuation accuracies. The possible explanation for this is that firms grouped by industry category are not the same firms that are grouped by return on equity. Therefore accuracies may be affected by other characteristics possessed by these firms. However, the fact that combination of industry category and return on equity performs better than industry category alone may indicate that those factors captured by return on equity improves valuation accuracies for Price/Earning multiple. This suggests that these factors do not complement each other, but return on equity have stronger effects on Price/Earning valuation accuracies.

![Diagram](image)

Figure 5.1: Comparable companies for Price/Earning multiple

### 5.2 Valuation Accuracy of Price/Book

For Price/Book valuation method, the study ranks the definitions of comparable firms in the following order: combination of industry and return on equity, return on equity, asset, combination of industry and asset, and industry. The ranking does not differ much than that of Cheng and McNamara (2000). Their ranking is as follows: combination of
industry and return on equity. Note that the selection of comparable companies based on the combination of industry with return on equity and return on equity alone top the ranking for both studies although differ in terms of position. However, the ranking for industry completely contrasts that of Cheng and McNamara (2000). The result implies that both selection criteria return on equity and combination of industry and return on equity capture information for Price/Book as opposed to Price/Earning earlier that only requires return on equity to achieve valuation accuracy. As shown in Figure 5.2, the factors that affect Price/Book accuracies exist in both groupings of comparable firms. Groupings based on industry category reduce accuracies, signifying that information captured in industry category is not sufficient to value target firms correctly. The fact that the ranking improves when industry is combined with return on equity implies the strong effect of return on equity in determining firm value via Price/Book method. However, the results are not proven statistically as the groupings do not indicate significant differences. Nevertheless, the results suggest that when valuing using Price/Book, selecting comparable firms based on return on equity gives more accurate valuation as compared to other grouping methods.

Figure 5.2: Comparable companies for Price/Book multiple
5.3 Valuation Accuracy of Combination of Price/Earning and Price/Book

Similar to Cheng and McNamara (2000), the study examines the selection of comparable firms that gives accuracy for combination of Price/Earning and Price/Book valuation method. The combination of Price/Earning and Price/Book are given different weights for further testing on optimal weights. For purpose of comparing to Cheng and McNamara (2000), for equal weights of Price/Earning and Price/Book, the study ranks the definitions in the following order: total assets, return on equity, combination of industry and total assets, combination of industry and equity, and industry. In contrast, Cheng and McNamara (2000) rank the methods in the following order: industry, combination of industry and return on equity, industry and total assets, return on equity, total assets. However, the statistics derived from this research show that there is no significant difference within the groupings of comparable companies. The results suggest that for combined Price/Earning and Price/Book multiple, total assets captures the information needed for valuing target firms correctly. On the other hand, industry membership groups firms that may not have similarities in factors that affect accuracies. A possible explanation for the results is because the small number of samples that are used in this study. The small samples also may lead to the lack of significant differences among the groupings. Therefore it cannot be concluded that the ranking really signifies the effects of the selections of comparable firms.

The research proceeds to examine the second part of relative valuation methods that is the accuracy of the valuation methods used. The accuracy is studied for different definitions of comparable companies. The research extends previous work by Cheng and McNamara.
(2000) by testing the accuracies for different weights of Price/Earning and Price/Book. The results state that for comparable companies derived based on industry category, valuation accuracies improve as more weights are applied to Price/Earning and less weights to Price/Book. This suggests that Price/Earning multiple has more effects on achieving accuracies. This is supported by the significant differences indicated by the statistics. The same results are obtained when applying different weights against the different groups of comparable companies: return on equity, combination of industry and return on equity and combination of industry and total assets. Only comparable companies that are formed based on total assets show greater accuracy when equal weights are applied to Price/Earning and Price/Book. This implies that when grouping companies based on firm size, it is most appropriate to apply equal weights to Price/Earning and Price/Book. However, all other grouping methods show that more weights should be applied to Price/Earning as opposed to Price/Book. This means that Price/Earning has more effects in achieving valuation accuracies. This fact however does not imply that it is better to use Price/Earning alone to value target firms. The tests show that a minimal amount of Price/Book improves accuracies as opposed to Price/Earning alone. This suggests that Price/Book is still needed to achieve accuracies and that Price/Earning and Price/Book complement each other. As such, the optimal weight found in this research is the combination of 90% weights on Price/Earning and 10% on Price/Book.

For each method of comparable companies, the research further conduct pair-wise comparison between Price/Earning, Price/Book, equal weights of Price/Earning and
Price/Book and the optimal weights of Price/Earning and Price/Book. The results show that the weighted 90% Price/Earning and 10% Price/Book is superior to Price/Earning, Price/Book and equally weighted Price/Earning and Price/Book. The statistics show that this is followed Price/Earning, equally weighted Price/Earning and Price/Book and lastly, Price/Book. There are significant differences when these multiples are compared in pairs. However, the results are not able to conclude which method is the best as not all the pair-wise comparisons report significant differences. Nevertheless the results do imply that valuations using Price/Book multiple may lead to lack of accuracies.

5.4 Research Implications
The research accomplishes its objective in proving the first hypothesis. The results indicate that valuation accuracies do improve when weighted average is applied to the combination of Price/Earning and Price/Book. The implication of the results is that it provides an alternative valuation method by combining Price/Earning and Price/Book when doing relative valuation. More specifically, if the results are consistent with possible future research, this may become another valuation method that is established in valuing companies.

The optimal weight found in this research may also be an indicator of the roles of Price/Earning and Price/Book in relative valuation. It may lead to establishing the correlations between the multiples and valuation accuracies. The weight also may suggest which multiple is more prominent in predicting stock price. This can be influenced by the growth or earning component embedded in the multiples.
The relative valuation method suggested by the research is also easy to adopt. The combination is also not far-fetched from the existing practice of using Price/Earning or Price/Book in relative valuation method. As such, the method is adoptable as compared to other valuation methods such as the discounted cash flow method. Relative valuation method has always been popular among financial analysts because of its simplicity. Thus, efforts to improve its accuracies are very much needed. Since the optimal weight suggested by this study is simple to apply, the research may contribute towards improving relative valuation methods practiced by financial analysts.

The research also attempts to find the best definition of comparable companies. Previous works have studied on the definition of comparable companies by studying the effects of the groupings on valuation accuracies. The results from this study indicate that comparable companies are those belonging to the same industry and having the closest return on equity. This is inline with previous works by Alford (1992) and Cheng and McNamara (2000). However, it is worth to note that the industry category in Malaysia may not have the same characteristics as the Standard Industrial Classification (SIC) codes in the United States. Therefore there may be implications that are caused by the category method. Nevertheless the study has shown that the results still reflect the findings of previous researchers (Alford, 1992; Cheng and McNamara, 2000).

The relative valuation method studied here is also known for its usability when valuing private firms. Therefore there is already a need to establish a more accurate method to value private firms. With the results of this research and previous works help to define
comparable firms, it is hoped that the valuation methods for private firms are improved. The proposed combination of Price/Earning and Price/Book multiples also may encourage financial analysts to compare their methods of using different multiples when doing valuations. The fact that the combination is simple to use makes it more possible for analysts to test and apply the results found by this research and previous works.

5.5 Research Limitation

The study finds that the optimal weights are 90% on Price/Earning and 10% Price/Book. It is suggested for future research to study the robustness of the weights by applying against a larger sample. This research only applies the tests to small samples of target firms. Therefore the results may not be significant enough to indicate any strong trend for the improved accuracies. This may explain some of the insignificant statistics that are found by the research. A larger sample may lead to more concrete conclusion whether the weights are really optimal in achieving maximum accuracies.

This study limits the groups of comparable companies to six firms, following previous work by Cheng and McNamara (2000). It is recommended that future research test the results against a larger group of comparable companies. It is worth to study the effects of the peer group size on the valuation accuracies. It is possible that smaller groups improve accuracies due to less outliers. However, it is also possible that larger groups may influence accuracies if the group’s characteristics have strong impact on accuracies. Therefore it is possible for future research to study the effects of comparable group size on valuation accuracies. This may help to give an indication to analysts as to what the optimal size is for selecting comparable companies to help improve accuracies.
5.6 Recommendations for Future Research

It is recommended for future research to study other combinations of valuation multiples that may improve valuation accuracies. This include other valuation multiples like Price/Sales ratio and others. Future research may test the findings against these other multiples to check whether the results still hold for other multiples. It is also possible that future research may discover better combinations of multiples that give greater accuracies.

Possible extension of this research also may want to study the effects of comparable companies’ selection and the choice of multiples on valuation accuracies. This may help financial analysts to be more focused on selecting the best definition of comparable companies or utilizing the best multiples in valuing companies.

This study utilizes trailing Price/Earning in its valuation method because of the data availability in annual reports. Future research may use forward Price/Earning in studying valuation accuracies. It may also test whether the optimal weights still hold when using forward Price/Earning. This is because it is already found by previous works that forward Price/Earning gives more accurate valuations as compared to trailing Price/Earning (Lie and Lie, 2002; Liu, Nissim and Thomas, 2002; Yee, 2004). Therefore it is suggested to study the effects of forward Price/Earning in the Price/Earning and Price/Book combined valuation method.
As this research only studies the companies listed in Malaysia, it is suggested for future works to compare whether the results still hold when conducted in other countries. This is especially for testing the effects of industry category as other countries may have different definitions of grouping by industry.

5.7 Conclusion

In essence, this study finds that the combination of valuation multiples has improved valuation accuracies. The results has shown that the performance of the combination of valuation multiples is superior to valuation multiple independently. This means that financial analysts may want to combine valuation multiples when doing valuation so as to improve their valuation accuracies. This study also shows that selection of comparable companies may not be based on industry category. The results indicate that selection of comparable companies based on industry category does not improve valuation accuracies. As such, financial analysts may utilize other criteria to determine the set of comparable companies.

As relative valuation is the most common method practiced by financial analysts in valuing companies, this study hopes to contribute towards improving the accuracies in the method. The research is also hoped to encourage more studies in defining comparable firms and utilizing the best multiples in valuing companies. As the relative valuation method has two parts that affect its accuracies, that is the comparable companies’ selection and valuation multiples, more studies can be conducted to find the best combinations of both parts. It is thus hoped that an established method is then successfully derived for industry practice in the near future.
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