Mean approach and beta approach in stock-investing assignment

Business

1. INTRODUTION This report aims at implement two distinct approaches, which can indicate the expected return and risk of a two-stock portfolio, to generate a practical solution to risk-analyzing for stock-investing. The two approaches are Mean-Variance Approach and CAPM Approach. While we apply the Mean-Variance Approach to determine the expected return and standard deviation, we employ the CAPM approach to measure the beta and expected return of each stock.

The calculations of the aforesaid mathematical characteristics will contain the weekly returns during a seven-year time period integrated with the ASX all ordinaries Accumulation Index as a substitute for the market index and Official Cash Rate (thereafter, OCR, which is the interest rate paid by banks in the overnight money market in Australia and New Zealand) as a substitute as rate of return on risk-free asset. In this report, the data of stocks are from David Jones Ltd (DJS) and BHP respectively.

DJS is Australia’s third-largest department store company operating more than 30 stores across Australia, which also stakes the claim as the world’s oldest continuously operating department store (Cengage, 2006). BHP Billiton is the world’s largest mining company; it is also the largest company in Australia by Market capitalization, which was created in 2001 by the merger of Australia’s Broken Hill Proprietary Company (BHP) and the UK’s Billiton (BHP profile, 2010). 2. MEAN-VARIANCE APPROACH 2. Selection of Sample Frequency and Sample Period To calculate the expected return and the standard deviation of each stock, it is necessary to obtain the relevant and accurate data on share price of historical time series. Evidently, the more the observation points and the longer sample period are employed, the

more the reliable assessable consequences can be generated. Ordinarily, the daily data, weekly data and monthly data of share price can be selected for calculating the expected return and the standard deviation of each stock.

The considerations for determining the sample frequency are as the following: On the one hand, daily data is quite unstable and affected by massive unrelated factors although it is high in sample frequency. On the other hand, monthly data inconsiderably relies on the choice of reference day (Daniella and Nigel, 2007) although it is relatively stable. And thus, to achieve the reliable analysis, weekly data as a compromise may be the optimal choice. When it comes to determine the length of sample period, we consider that around seven years the performance of each stock can be assessed reliably.

The main reason for the determination is we intend to seek a sample period as long as possible, and BHP was listed on the ASX since 2003. Accordingly, 1st Apr. 2003 was chosen as the beginning time of weekly closing share price of BHP. To keep the consistency, we selected the same time as the beginning for DJS. Furthermore, for the sake of guaranteeing this report in accordance with practical significance, 29th Mar. 2010 was selected as the closing time. Namely, there are 366 data points in total, which provides adequate time series of data. 2. 2 Calculation of each parameter Formula for calculating the risk of a security: pic] Decision Rule: The higher the standard deviation of returns, the higher the range of possible outcomes and hence the more risk is associated with stock-market investment (Frino et al. , 2006). Method for Calculating parameters of portfolios: Covariance of two

stocks [pic] Decision Rule: If the result of calculation is positive, it means that the returns on two securities are positively correlated. Conversely, if the result of calculation is negative, it means that the returns on two securities are negatively correlated (Frino et al. , 2006). Formula for calculating the risk of portfolios: pic] Just two stocks are involved in the calculation, thus the calculation is: [pic] The lowest outcome of ? p2 will be favorable in that it shows the lowest risk of stock-market investment. 2. 3 Application of parameters and ratio analysis The weekly expected return and standard deviation for DJS were 0. 516550% and 4. 776287%, while the weekly expected return and standard deviation for BHP were 0. 535115%and 4. 866364%. As for the portfolio, the expected return for a portfolio is the weighted average of the expected rates of return for the individual investments in the portfolio.

The variance of the portfolio returns is a weighted sum of the covariance and variance terms associated with the assets in the portfolio. 41 possible portfolios contains DJS and BHP with different weights starting at 100% invested in BHP and increasing the weight at 2. 5% intervals until it reaches 100% in DJS. See Appendix A3 for the table | Portfolio No. | DJS | BHP | Expected Return | Standard deviation | | 1 | 0. 00% | 100. 00% | 0. 535115% | 4. 66364% | | 22 | 52. 50% | 47. 50% | 0. 525368% | 4. 179564% | |… |… |… |… |… | | 41 | 100. 00% | 0. 00% | 0. 516550% | 4. 776287% | The following line graph displays the 41 possible portfolios. The x-axis shows standard deviation, while the y-axis in the graph shows expected return.

The graph indicates the impact of the values of portfolio risk and return that occur as the percentage of capital invested in each stock is varied. In terms of identifying the optimal portfolio, the investor pursues a minimum of risk. See Appendix A3 for the Graph [pic] On the basis of the Mean-Variance approach, it can be concluded from the graph above that the optimal portfolio is the portfolio No. 22, combining 52. 5% of DJS and 47. 5% of BHP, and generating a mean of 0. 525368% and a standard deviation of 4. 645503%. No. 22 portfolio fulfills a successful diversification for the unsystematic risk.

Namely, it provides the lowest risk among all possible portfolios, which meets our request for investment. 3. CAPM Approach The Capital Asset Pricing Model (CAPM) has been regarded as a simple and potent theory of asset pricing for over 20 years, which is originally presented by Sharpe (1964), Lintner (1965) and J. Mossin (1966) along with the suggestions of mean variance optimization by Markowitz. CAPM indicates that in equilibrium, assets should be priced as that the expected return equals the risk-free rate of interest plus a premium for risk.

The premium for risk equals the risk of the asset multiplied by the market risk premium. The assessment of risk in relation to the CAPM is beta–the covariance of the asset’s returns with the market return, standardized by the variance of market returns. Ultimately, Sharp (1964) and others established the CAPM in the expression of formulas below: [pic]=[pic]+[pic][pic] [pic] Where [pic] [pic] [pic] [pic]= the market rate of return during interval t [pic]= the risk free rate of return during interval t [pic]= the return on stock i

during interval t . 1 Selection of Market Index: Market index which contains more securities gives rise to more accurate estimates. From Brailsford et al (1997), “ more consistent with the true market portfolio as defined in the theory of the CAPM”. Meanwhile, Brailsford et al (1997) also emphasize how important a broad market index is, then introduce the possibility of utilizing a global market portfolio. In theory, the All Ordinaries Accumulation Index (AOAI) represented around 97. 7% of the market capitalization of all Australian stocks listed on the ASX (Frino et al. , 2006).

Accordingly, AOAI is selected as the market index in this report in that it comprehensively measures the movement of both capital and dividend to yield a more precise beta. 3. 2 Selection of risk-free rate: The risk-free rate of return can be regarded as the benchmark in which lie the rates of return on assets. However, a real risk-free asset is inexistent in practice. Consequently, equivalent values for the risk-free assets may be obtained from either the ‘ cash rate’–the overnight money market interest rate, or the observable rates for securities which are relatively high in grade and low in risk, such as government bonds.

A general approach to measure the risk-free rate is to use 10-year government-bond rates consistent with a long-term asset. Nevertheless, for the past few years, government bonds are subject to a high risk due to a series of economic crises, the national bankruptcy in Iceland, for instance, incurred a high risk to its government bonds overwhelmingly. And thus, using cash rate which is lower in yielding interest can be more reasonable for reflecting “ risk-free”. Therefore, cash rate (which is offered yearly, and thus

should be shifted to the effective weekly basis for the sake of calculation) from 1st Apr. 2003 to 29th Mar. 010 is treated as the proxy for the risk-free asset in this report. 3. 3 Selection of Sample Period and Sampling Frequency It is vital to choose a suitable sample period to get a precise beta in using CAMP approach. According to Time Brailsford, Richard Heaney and Chris and Bilson(2006), a beta of the firm may vary over time. Circumstances may extensively alter the sensitivity of a firm in terms of market-price movement. Valentin Dimitrov and Suresh Govindardj(2007) affirmed that results from calculating either monthly or daily returns are unreliable???" monthly returns are likely to vary across reference days.

The end result is abnormal monthly returns, parameter estimates, and inferences that may vary substantially across reference days, thus casting a shadow of doubt on previous findings. Our results suggest that similar problems may arise for studies using daily returns. (report of Reference-Day Risk: Observations and Extensions)" For the sake of avoiding above-mentioned problems, a moderate estimating cycle should be determined, and the weekly return is always a practical solution in point. To select the sample period, we should weigh the pros and cons between the pplication of the updated data which is related to the period over which the beta assessments are to be employed, and the necessity for a sufficient sample to obtain reliable statistical estimates. According to Gonedes(1973) and Kim(1993), beta estimates appear to be reasonably stable over a four to five year period. Hence, the weekly data from 3rd Dec. 2006 to 29th Mar. 2010 was used at the first glance. Then, in order to obtain a more accurate result,

we consider that during around seven years the beta can be assessed reliably.

Since BHP was listed on ASX in 2003, seven-year sample period is the longest sample time period we can obtain. Thus, we ultimately decide to use the weekly data from 1st Apr. 2003 to 1st Apr. 2010 to calculate the relevant parameters. 3. 4 Calculation of beta The method of estimating beta in this report contains the use of ordinary least squares (OLS) regression, which is often called ‘ market model’. The table below shows the interpretation of Beta (?) (Frino et al. , 2006) : | IF | Interpretation of Beta (?) | |? 1 | The risk of the security is equal to the average market risk | |? ; 1 | The risk of the security is higher than the average market risk | |? ; 1 | The risk of the security is lower than the average market risk | 3. 5 Application of parameters and outcomes analysis 3. 5. 1 Application of parameters and outcomes analysis in 5-year sample period If we select the sample period as five years, during that time, the expected return for DJS and BHP are 0. 004661% and -0. 21682% respectively, while the beta for DJS and BHP are 1. 157481 and 1. 471892 respectively. It can be clearly seen that both betas are more than one which indicates the risks of the securities are higher than the average market risk. Compared with the beta of DJS, the beta of BHP is larger which can imply that stock BHP is more sensitive to market environments. A series of portfolios of the two stocks by varying the weights of each at 2. 5% intervals (Starting at 100% invested in BHP and increasing in the weight of DJS at 2. 5% intervals until it reaches 100%). Thus there are 41 portfolio combinations.

The line graph below presents such 41 possible portfolios containing DJS and BHP with different weights. The y-axis in the graph shows expected return while x-axis shows Beta. For the sake of identifying the optimal portfolio, the investor looks for a minimum of risk. See Appendix C3 for the graph [pic] According to CPAM approach, the optimal portfolio is the portfolio No. 1, which only contains DJS. It provides a 0. 004661% expect return and a 1. 154781 Beta. The smallest positive beta it provides indicates a lowest risk among all possible choices, which meet our request of the investment.

Meanwhile, it provides the highest expect return as well. Based on analysis above, a reasonable investor should select holding stock DJS only. However, for the sake of achieving a more reasonable investing decision, a longer and more comprehensive sample period is needed. After all, the negative relationship between expect return and Beta is abnormal. According to the data used in this report, the expect market return is slightly lower than the yield of bond. These might occur in that the latest global economic crisis since 2008 give rise to the poor performance of the stock market. . 5. 2 Application of parameters and outcomes analysis in 7-year sample period During a longer sample period, the expected return for DJS and BHP are 0. 181081% and 0. 211599% respectively, while the beta for DJS and BHP are 1. 114255 and 1. 534428 respectively. It can be clearly seen that both betas are more than one which indicates the risks of the securities are higher than the average market risk. Once again, compared with the beta of DJS, the beta of BHP is larger which can imply that stock BHP is more sensitive to market environments.

A series of portfolios of the two stocks by varying the weights of each at 2. 5% intervals (Starting at 100% invested in BHP and increasing in the weight of DJS at 2. 5% intervals until it reaches 100%). Thus there are 41 portfolio combinations. See Appendix B3 for the table | Portfolio No. | DJS | BHP | Beta of portfolio | Expected return of portfolio | | 1 | 0. 00% | 100. 00% | 1. 534428 | 0. 211599% | | 2 | 2. 50% | 97. 50% | 1. 23024 | 0. 210836% | |... |... |... |... | ... | | 41 | 100. 00% | 0. 00% | 1. 114255 | 0. 181081% | The line graph below presents the 41 possible portfolios containing DJS and BHP with different weights. The y-axis in the graph shows expected return while x-axis shows Beta. During identifying the optimal portfolio, the investor still looks for a minimum of risk. pic] According to CPAM approach, the highest-return portfolio is the portfolio No. 1, which only contains BHP. It provides a 0. 211599% expect return and a 1. 534428 Beta. And the lowest-risk portfolio is the portfolio No. 41, which only contains DJS. It provides a 1. 114255 Beta and a 0. 181081% expect return. Accordingly, the consequence does not support the theory that holding a portfolio can assist to reduce risk. Based on this positive correlation between expect return and risk from the graph, the meaning of optimal portfolio is in line with the risk preference of the investor. . Analyses and Recommendation 4. 1 A Critique of the Models applied 4. 1. 1 Assumptions behind Mean-variance Approach The Mean-Variance approach is widely used in statistics and econometrics sphere. Markowitz (1959) brought this method into finance area to analyze portfolio risk and return. Specifically, three assumptions are involved as following: (1) The random process that generated returns in the past is also the process that will generate returns in the future (2) An observed set of historical returns

represents a random draw from an underlying distribution. 3) The security returns are generated from a normal distribution and the sample mean generated is representative of the population (Frino et al. , 2006). With respect to the first two assumption, the sample random of historical data cannot be completely consistent with the future data in that a host of distinct internal and external factors affect the final results during two different periods. Therefore, there must be some weaknesses under the random draw. Moreover, when it comes to the third assumption, the actual stock returns may not be shown as a normal distribution and may be more volatile.

In practice, equities tend to be extensive in deviation. Lonergan (2003) asserted that large swings (3-6 standard deviations from the mean) occur in the market more frequently than the normal distribution would expect. Thus, all aforesaid factors may impair the feasibility of Mean-Variance Approach. In spite of those criticisms, Clare’s (1996) research report presents a forceful support of mean-variance approach by employing portfolio of stock traded on the London Stock Exchange. 4. 1. 2 Assumptions behind CAPM Approach (1) Investors hold diversified portfolios It means unsystematic risk has been discarded or can be ignored.

Hence, investors will only consider the return of the systematic risk of their portfolios. (2) Single-period transaction horizon CAPM set a standardized holding period for the sake of obtaining comparable returns on different securities. For instance, a return over six months cannot be compared to the one over 12 months. In practice, 1-year holding period is used frequently. (3) Investors can lend/borrow at the risk-free rate of return This is achieved by

portfolio theory, from which the CAPM was developed, and provides a minimum level of return required by investors. 4) Perfect capital market This assumption indicates that all securities are valued correctly and that their returns will plot onto the SML. A perfect capital market requires: 1) there are no taxes or transaction costs; 2) perfect information is freely available to all investors who, as a result, have the same expectations; 3) all investors are risk averse, rational and desire to maximize their own utility; and 4) there are a large number of buyers and sellers in the market. (Miles, A. J. and Ezzell, R. J. , 1980) 4. 1. 3 The critique of two approaches

Based on the previous analyses in this report, it is obvious that the key concepts and assumptions underlying these two models are of importance. However, in practice, many of these simple statistical conditions are unrealistic (Yurtsever, 2007). If the normality assumption is not satisfied, then standard deviation will give an inaccurate estimate of risk. Therefore, there may be some practical limitations when considering the investment, although each method has its strengths. Frino (2006) emphasized that, as one of the vital concepts for the CAPM, a well-diversified portfolio can eliminate non-systematic risk.

If non-systematic risk is removed, there is only systematic risk, and then all we should take into consideration is the beta value ??? the portfolio’s correlation with the market. Nonetheless, the portfolio (combining DJS and BHP only) we choose, is not diversified. Thus non-systematic risk should not be ignored. Moreover, CAPM is more appropriate for estimating the risk of

individual stock, since it considers the expected return on individual security and the counterpart on the market as a whole.

Meanwhile, it is difficult to find a risk-free asset. In addition, “ the simplifying assumption that the beta of debt is zero will lead to inaccuracy in the calculated value of the project-specific discount rate. (Watson, D. and Head, A. , 2007)” While the mean-variance approach measures the risk by the variance or standard deviation of expected returns, each possible portfolio can be showed in the efficient frontier in CAPM. Combinations along this line represent portfolios which reflect lowest risk for a given level of return.

Conversely, for a fixed amount of risk, the portfolio on the efficient frontier representing the combination provides the optimal possible return. The maximum level of risk an investor will take on determines the position of the portfolio on the line. It is easier to determine the expected risk and return of a portfolio with less estimating error for there has fewer assumptions considered. On the basis of the analysis above, CAMP will not be employed as a major method for selecting the lowest-risk portfolio in this report. Alternatively, we will apply mean-variance approach to seek the optimal portfolio. 4. Recommendation According to the above critique of the two approaches, the mean-variance approach is more appropriate than the CAPM approach in determining the optimal portfolio, when there are only two different stocks contained in the portfolio. After all, investors hold diversified portfolios is a key precondition to apply CAMP to achieve the accurate result. See Appendix A3 for the Graph [pic] In accordance with the mean-variance approach used for seeking the investing solution from the above graph, if an

investor pursues the minimum investing risk, he should consider the expected return with the minimum risk.

Thus, the investor should hold such a portfolio–with 52. 5% invested in DJS and 47. 5% invested in BHP. 5. Reference Bhpbilliton, 2009, ‘ About BHP Billiton’, Company Profile, 19th Apr. 2010, Brailsford, T. , Faff, R. & Oliver B. , 1997, Research Design Issues in the Estimation of Beta, McGraw-Hill, Sydney. Brailsford T. , Heaney R. , Bilson C. , 2006, Investments: Concepts and Applications in Australia (Thomson Learning, ?) Brailsford, T. , Josev, T. , 1997, The impact of the return interval on the estimation of systematic risk, Pacific-Basin Finance Journal 5, 357-376. Cengage, G. 2004, International Directory of Company Histories. Ed. Grant, T.. Vol. 60. eNotes. com. , 2006. 19 Apr, 2010 Clare, A. , Smith, P. & Thomas, S. , 1996, “ UK Stock Returns and Robust Tests of Mean Variance Efficiency”, Journal of Banking and Finance, 21, p. 641-660 Daniella Acker, and Nigel W. Duck, 2007, Reference-Day Risk and the Use of Monthly Returns Data, Journal of Accounting, Auditing and Finance 527-558 Dimtrov, V. , Govindaraj, S. , 2007, Reference-Day Risk: Observations and Extensions, Journal of Accounting, Auditing and Finance 559-572 Frino, A. , Chen, Z. , Hill, A. , Forde, C. Kelly, S. , 2006, Introduction to Corporate Finance (Pearson Education Australia, Sydney, ?). Lintner, J. , 1956, Distribution of Incomes of Corporations Among Dividends, Retained Earnings, and Taxes, American Economics Review 46, 97-113. Lonergan, W 2003, The Valuation of Businesses, Shares and Other Equity, 4th edition, Allen Unwin, NSW, Australia Markowitz, H. , 1959. Portfolio Selection: Efficient Diversification of Investments, Basil Blackwell, Cambridge

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