The University of Sydney

The Investment Value of Australian Security Analyst Recommendations:

An Application of the Black-Litterman Asset Allocation Model

Peng William He

SID: 305218980

Supervisors: Joel Fabre & Andrew Grant

Certificate of Originality

I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, nor materials which to a substantial extent has been accepted fir the award of any other degree or diploma at the University of Sydney or at any other educational institution, except where due acknowledgement is made in the thesis.

Any contribution made to the research by others, with whom I have worked at the University of Sydney or elsewhere, is explicitly acknowledged in the thesis.

I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project's design and conception or in style, presentation and linguistic expression is acknowledged.

Print Name……………………......................Signed……………………………….

Release of Thesis

I, Peng William He, understand that if I am awarded an honours degree that this thesis entitled "The Investment Value of Security Analyst Recommendations for Stocks Listed on the Australian Securities Exchange" will be held by the Discipline of Finance and be available after three months for the use by academic staff or students in research or other academic purposes. I agree that the Chair of Discipline or the Honours Coordinator may allow perusal of a copy of the thesis to an individual for research or study.

Print Name……………………......................Signed……………………………….

Copyright Statement:

Student Permission

I hereby grant to The University of Sydney or its agents the right to archive and to make available my Honours thesis in the Sydney eScholarship Repository in all forms of media, now or hereafter known. I retain all proprietary rights, such as patent rights. I also retain the right to use in future works (such as articles or books) all or part of this Honours thesis.

Name: ______________________________

Date: ______________________________

Signature: ____________________________

Supervisor Permission

I hereby grant to The University of Sydney or its agents the right to archive and to make available the Honours thesis of my student _______________, in the Sydney eScholarship Repository in all forms of media, now or hereafter known.

_____________,retains all proprietary rights, such as patent rights and also retains the right to use in future works (such as articles or books) all or part of this Honours Thesis.

Name: ______________________________

Date: ______________________________

Signature: ____________________________

Acknowledgements

I would like to thank the University of Sydney for four years of quality education. Thanks to the Finance Discipline, and the Honours Class of 2008, and Andrew Lepone, our Honours coordinator for your support. Thanks to Gaurav Sharma and Paul Somers for your suggestions, and Greg Dwyer for helping me with econometrics. I extend my sincere appreciation to all the Honours Years instructors, my supervisors Joel Fabre and Andrew Grant, for your teaching and guidance. I am deeply grateful to my friend Lei Yang for teaching me and helping me with object-oriented programming that is needed for my model. Finally, to my parents: thank you for everything.

Synopsis

The study empirically examines the investment value of analyst recommendations on constituent stocks of the S&P/ASX 50 index. For the period from 30 June 1997 to 30 October 2007, we find that stocks with favourable consensus recommendations ("strong buy" and "buy") on average earn a higher return than the market, whereas stocks with unfavourable recommendations ("strong sell" and "sell") earn a lower return. An investment strategy using the Black-Litterman asset allocation model that overweights (underweights) stocks with favourable (unfavourable) consensus recommendations, in conjunction with daily rebalancing, outperforms the market in terms of raw return and risk adjusted performance measures. The investment strategy involves high levels of trading and, as a result, no significant abnormal returns are achieved after accounting for transaction costs. Less frequent rebalancing, under most situations, causes a decrease in both performance and turnover. Filtering of dated recommendations causes an increase in turnover, whilst having mixed effects on investment returns.

Table of Contents

List of Tables

List of Figures

Appendices

The Investment Value of Australian Security Analyst Recommendations: An Application of the Black-Litterman Asset Allocation Model

1. Introduction

Security analysts form an important part of financial markets. They provide stock recommendations and earnings forecasts for their clients who rely on their research to make investment decisions. Analysts gather large amounts of economic, industry and firm-specific information to perform prospective analysis on listed companies, and identify discrepancies between the intrinsic value and market price of securities. In making a stock recommendation, analysts explicitly express their opinion about the relative performance of an individual company compared to the market. As Elton, Gruber & Grossman (1986) observe, stock recommendations represent "one of the few cases in evaluating information content where the forecaster is recommending a clear and unequivocal course of action rather than producing an estimate of a number, the interpretation of which is up to the user." The question that we seek to examine in this paper is whether investment strategies based on analyst recommendations are profitable to investors?

On the one hand, the semi-strong form of market efficiency posits that investors should not be able to trade profitably on the basis of publicly available information (Fama 1998), such as analyst recommendations. On the other hand, "the survival of analysts in a repeat game framework seem to suggest that their ability to efficiently process information is a valuable service to clients and is reason to suspect that in doing so they introduce new information to the market" (Fabre & Snape 2007). Research departments of brokerage houses spend large sums of money on security analysis in the attempt to generate higher returns for their clients (Barber Lehavy, McNichols, & Trueman 2001). The 1999 Reuters Survey of Australia and New Zealand identifies broker research as the most important factor in the allocation of brokerage commission, and the majority of institutions have a formal system for measuring and rewarding brokerage research and service (Aitken, Muthuswamy, & Wong 2000).

The possibility that profitable investment strategies could be formed on the basis of analyst research are suggested by the findings of Stickel (1995) and Womack (1996), whose event studies around analyst recommendation announcements show that favourable (unfavourable) recommendations are accompanied by positive (negative) abnormal returns and post-announcement price drifts in the same directions. Barber et al. 2001) study the investment value of analyst research by empirically testing the profitability of calendar-time portfolios constructed on the basis of consensus analyst recommendations. They construct portfolios of stocks with favourable and unfavourable consensus recommendations and show that a gross abnormal return of over 4% p.a. could be made by buying (shorting) the most (least) favourably recommended groups. However, persistent debates prevail about potential conflicts of interest in the analyst recommendation process and its impact on investors. Investment banks and brokerage firms are the primary producers of security research. They distribute investment advice in the form of earnings forecasts and security recommendations with the intention of generating brokerage income from investors while at the same time attracting corporate investment banking clients. Boni & Womack (2002) find that existing and potential investment banking relationships influence the judgement of analysts. Jegadeesh, Kim, Krische & Lee (2004) find that analysts from sell-side firms are more inclined to recommend "glamour" stocks (growth stocks with high trading volume), because these firms also tend to be widely held by the institutional clients who place trades with brokerages. Growth stocks also make attractive investment banking clients. In Australia, the Australian Securities and Investment Commission (ASIC) govern the dissemination of analyst recommendations to help prevent market manipulation, and misleading and deceptive conduct. The risks of adverse reputation and legal prosecution, to a certain degree, dissuade analyst bias and limit potential distortion from manipulation.

This study examines the profitability in following the course of action recommended by security analysts on stocks in the S&P/ASX 50 Index. Constituents of the S&P/ASX 50 Index are amongst the largest and most liquid stocks trading in the Australian stock market, and are heavily covered by analysts. Consequently, their pricing should be relatively efficient. Our empirical motivation is to test the investment value of security analyst recommendations for these stocks and the efficiency of the Australian market in response to these recommendations. We take a calendar-time approach to measure the profitability of various implementable investment strategies. These strategies are mainly based on consensus recommendations of stocks, as they incorporate the information implied by all analysts with outstanding coverage. A calendar-time approach allows the direct evaluation of gross abnormal returns, and to estimate the turnover and associated transaction costs of the investment strategies. As a result, analysis could be made as to net profitability of investment strategies. By examining whether investors can profit after trading costs, we contribute to the debate on market efficiency. Assessing the investment value of analyst recommendations is an ideal way to test whether it is possible to profit abnormally using publicly available information (as opposed to studies on corporate events), because security analyses are carried out with the explicit purpose of improving investment performance (Barber et al. 2001).

We contribute to the existing literature in the following ways. This study is the first to empirically assess the investment value of analyst recommendations using the calendar-time approach for the Australian stock market. In contrast to the US, where recommendations are released to the public shortly after its simultaneous release to clients, recommendations in Australia are not released instantaneously to all clients (Aitken, Muthuswamy & Wong 2000). The staggered release in Australia may result in different abnormal returns and a prolonged price discovery process. Secondly, we are the first to apply the Black-Litterman asset allocation model to incorporate real life analyst recommendation data and evaluate its performance in calendar-time. Unlike a simple strategy, which buys or sells portfolios of covered stocks based on consensus recommendations, the Black-Litterman approach is a more realistic portfolio management strategy, which measures the performance of the weight adjusted market portfolio based on expected relative performance of different stocks. Finally, we examine the effect of transaction costs, infrequent portfolio rebalancing, filtering of dated outstanding recommendations and variations of input parameters to the Black-Litterman model on investment performance

The results show that, stocks with favourable consensus recommendations on average outperform stocks with unfavourable recommendations. An investment strategy using the Black-Litterman asset allocation model that overweights (underweights) stocks with favourable (unfavourable) consensus recommendations, in conjunction with daily rebalancing, consistently outperforms the market in terms of raw return and risk adjusted performance measures. It also outperforms the favourably recommended consensus groups of stocks. This investment strategy involves high levels of trading and no significant abnormal return can be achieved after accounting for transaction costs. Less frequent rebalancing, under most situations causes a decrease in both performance and turnover. Filtering of dated recommendations causes an increase in turnover, while creating mixed effects on investment returns.

This research is of interest to finance academics, and practitioners. From an academic perspective, the study contributes to a better understanding of analysts' abilities as processors of financial information, and the efficiency of the market in incorporating the information content of analyst recommendations. From the perspective of industry, it assesses the usefulness of analyst recommendations in investment decisions, and profitability of trading on them using various strategies. Finally, brokers issuing the recommendations have a vested interest because they spend large amounts of resources to produce them with the intention of generating commissions.

The remainder of this paper is organized as follows. Section II provides a review of the relevant literature regarding analyst recommendations and the Black-Litterman model. Section III describes the data used in this study. The research design and methods are explained in Section IV. Section V presents the results, and examines impact on them by varying our investment strategies. We end the paper with a conclusion in Section VI.

2. Relevant Literature

This section provides a review of relevant literature covering the background of analyst recommendations research, the calendar-time performance of analyst recommendations and the Black-Litterman asset allocation model. A table that contains annotations of main references used by our study is presented in Appendix A.

2.1 Background Literature of Analyst Recommendations

There has been wide-ranging literature on the impact and value of brokerage analyst recommendations dating back to the seminal work of Cowles (1933). The motivation for Cowles' (1933) research is to examine the success of applied economics in investment decision making, by assessing the stock selection and market timing ability of security analysts in financial service firms, insurance firms, Wall Street Journal editorials and other financial publications. He finds that on average the recommendations issued by analysts perform poorly against the market. Cowles (1944) re-examines the recommendations of eleven of the financial publications and finds evidence of more favourable performance, but still concludes that they do not have predictive ability. However, the survival of equity analyst research on stock markets since Cowles (1933) seminal work seems to suggest that they provide value to clients and as a result trading commissions for brokerages. In fact, a large number of prior studies find the information that security analysts produce promotes market efficiency by helping investors to more effectively evaluate investment opportunities. Schipper (1991) and Brown (1993) provide a comprehensive review of analyst literature in this area. Ramnath, Rock & Shane, (2008) develop a taxonomy of research examining the role of financial analysts in capital markets, which builds on the foundation provided by Schipper (1991) and Brown (1993), and focuses on more recent literature. Section 4 of Ramnath et al. (2008) review the literature about 'analyst and market efficiency' and is of particular relevance to this study. Literatures that consider the effectiveness of analysts in processing publicly available information, and whether the market incorporates recommendation information efficiently are reviewed in more detail below.

A significant amount of literature focuses on analyst recommendation revisions for stocks in the US, documenting price reactions and subsequent performances of recommendation changes. Stickel (1995) examines a sample of 17,957 recommendations from Zacks Investment database to test the hypothesized factors influencing the price reaction to recommendation revisions. In studying the performance of security analysts he finds that buy (sell) recommendations issued by brokerages influence share prices favourably (unfavourably). The magnitude of price impact from recommendation changes is positively related to the strength of the recommendation, the magnitude of change, the reputation of the analyst, and the marketing ability of the brokerage. The effect of the analyst recommendations also depends on the information environment, and whether contemporaneous earnings revisions are being released. Specifically, the author finds that smaller companies have greater price reactions to recommendation revisions than larger companies, and recommendations issued contemporaneously with a same-sign earnings forecast revision have greater price impact.

Past researches into brokers' recommendations focusing predominately on price impact generally find that recommendations have permanent price impact, which suggests that security analysts have predictive ability. Womack (1996) and Elton et al. (1986) shows firms receiving buy (sell) recommendations tend to earn higher (lower) abnormal returns. Elton et al. (1986) also demonstrate that consensus recommendations perform better than individual ones. Womack (1996) records large share price reactions at the time of the recommendations, even though few recommendations coincide with public news or provide previously unavailable information. They document post-recommendation stock price drifts, which Womack finds to last up to one month for upgrades and six months for downgrades. The larger and more sustained reaction for sell recommendations suggest that the market does not fully incorporate the information in them.

Internationally, Jegadeesh & Kim (2006) examine analyst recommendations in the G7 countries and find that stock prices react significantly to recommendation revisions on the day of recommendation and on the following day in all of the G7 countries except Italy. They find that stock prices drift up and down for upgrades and downgrades respectively over the next two to six months, and "is most prominent in the US, followed by Japan indicating that the value of analyst recommendations is the largest in these countries".

Ball, Brown & Finn, (1978) study recommendations on Australian stocks published in two financial journals and find that abnormal returns are highest in the months leading up to the announcement of the recommendations. They find smaller returns in the month of the announcement but no evidence of abnormal returns in the post-recommendation period. This suggest that the recommendations under examination have only minimal information content and price impact as they are mostly impounded before the recommendation releases. Finn (1984) examines the information content of recommendations produced by the in-house analysts of a financial institution in Australia and finds the price movement of the stocks to be consistent with the direction of the recommendations. The most significant evidence of abnormal returns is found in the first month after a recommendation. There is an average cumulative abnormal return of -3.56% for sell recommendations, whereas for buy recommendations it is +1.11%. The author also finds that "where the direction of earnings forecast and a recommendation are in conflict, the opportunity to earn excess returns is in line with the recommendation".

Aitken, Muthuswamy & Wong (2000) study the impact of stock recommendations in the Australian equity market and finds that stocks issued with a buy-type recommendation experience positive price impact but partial price reversal subsequent to the announcement day, sell-type recommendations have a permanent impact on prices and stocks receiving hold recommendations exhibit negative pre-recommendation returns but positive post-recommendation returns. Given the evidence of significant abnormal returns, the authors suggest that the recommending brokers have stock picking ability. Abnormal returns in the pre-recommendation period are however observed to be higher, which the authors attribute to three possible explanations: 1) brokers may not be as skilful in their timing ability, 2) they may be reactive rather than pro-active in recommending stocks, 3) there may be information leakage to select clientele or front running by proprietary traders. The authors also find evidence of significant increases in trading volume around the issuance of analyst recommendations.

2.2 Calendar-time Performance of Analyst Recommendations

Our study is related to a paper in the Journal of Finance by Barber, Lehavy, McNichols & Trueman (2001) – "Can Investors Profit from the Prophets? Security Analyst Recommendations and Stock Returns". Barber et al. (2001) document the potential to earn higher returns by buying the most highly recommended stocks and short selling the least favourably recommended stocks. Their methodology is different from the event-time approach of prior researches (Stickel (1995) and Womack (1996)), which measure the price reaction to changes in individual analysts' recommendations. Event-time analyses used in Stickel (1995) and Womack (1996) assess the magnitude of mispricing that analysts detect when they revise their recommendations. However, as Barber et al. (2001) points out, Stickel and Womack's event time analysis does not examine the profitability of analyst recommendations on an implementable investment strategy. In Barber et al. (2001), portfolios containing covered stocks with different consensus analyst recommendations are constructed. Portfolios of stocks with favourable (unfavourable) consensus recommendations are bought (sold). They document significant abnormal returns of 4.13% (4.91%) per year by purchasing (shorting) stocks with favourable (unfavourable) recommendations, after controlling for market risk, size, book-to-market, and price momentum. They also find that the level of abnormal performance depends on fast reaction to recommendation changes and frequent portfolio rebalancing. However, after accounting for transaction cost, the abnormal returns become statistically insignificant. Despite this, the authors suggest that analyst recommendations remain valuable to investors who are otherwise considering trading.

Similar results are found for recommendations issued by fee-paying investment advisory services and investment newsletters. Choi (2000) finds evidence that Value Line recommendations exhibit performance beyond what is predicted by existing models of expected return. Similar to Barber et al. (2001) once transactions costs are accounted for, abnormal returns become insignificant. Jaffe and Mahoney (1999) examine the performance of investment newsletters and find that they do not on average outperform their relative market benchmarks.

Barber et al. (2002) study the returns to analysts' stock recommendations over the 1996-2001 period. During this time analysts appear to become increasingly involved in the investment banking side of their business and the investment value of recommendations issued by them deteriorates. The authors show that the more highly recommended stocks earn greater market-adjusted returns during the 1996-99 period than those less highly recommended. However, during 2000 and 2001, the least favourably rated stocks earn the highest returns, whereas the most favourably recommended stocks perform the worst. The poor performance of analyst recommendation prevail during most months of 2000 and 2001 and is robust for both tech and non-tech stocks.

Jegadeesh, Kim, Krische and Lee, (2004) show that stocks more favourably recommended by analysts, on average, outperform stocks less favourably recommended by them. Like Jegadeesh et al. (2004) implement the strategy of buying the most favourably recommended quintile of stocks and shorting the least favourably recommended quintile of stocks, and find that this strategy yields positive abnormal profits. However, they suggest that analysts do not fully take into account various stock characteristics in making their decisions, and the direction of the bias is in line with economic incentives of sell-side firms. They find that analysts from sell-side firms generally recommend "glamour" stocks, which have positive momentum, high growth, high volume, and are relatively expensive and that recommendation level based strategy profits largely from the price and earnings momentum, rather than from the recommendations' predictive ability. According to the authors, this bias in recommendations is because growth firms and firms with higher trading activity make for more attractive investment banking clients. These firms also tend to be widely held by the institutional clients who place trades with the brokerage houses. Jegadeesh et al. (2004) document the average analyst rating over the 1985 to 1999 period to be close to a “buy”, and sell-type recommendations make up less than five percent of all recommendations.

This is consistent with Lin & McNichols (1998), Michaely & Womack (1999) and Boni & Womack (2002), whom also show that existing, and potential, investment banking relationships affect analyst decisions. Despite inherent biases extant literature have generally found that analyst recommendations do add value (e.g. Stickel (1995) and Womack (1996) document that recommendation upgrades tend to more favourable price impact than downgrades, and Barber et al. (2001), Jegadeesh et al. (2004), Boni and Womack(2003) and Green (2006) find that stocks with favourable recommendations outperform stocks with unfavourable ones). They indicate that investors can still benefit from analysts’ recommendations if they focus on the relative levels of recommendations and their revisions.

Mikhail, Walther, & Willis (2004) and Li (2005) investigate whether security analysts exhibit persistence in their stock picking ability and find that analysts whose recommendation revisions earn the most (least) excess returns in the past continue to outperform (underperform) in the future. Li (2005) suggests that more information is contained in above-median performing analysts’ recommendations and investor reaction to this information is incomplete. Mikhail et al. (2004) find that the market does not fully recognize these performance differences, and excess returns in the one and three trading months following the revision are significant and positively associated with analysts' prior performance. A trading strategy that takes long (short) positions in stocks experiencing recommendation upgrades (downgrades) conditional on an analyst's prior performance generates excess returns, but is insufficient to cover transactions costs.

The profitability of trading on analyst recommendations depends on the fast reaction to recommendations revisions. Green (2003) finds evidence that early access to stock recommendations provides brokerage firm clients with incremental investment value. After controlling for transaction costs, purchasing (selling short) following upgrades (downgrades) result in average two-day returns of 1.02% (1.50%). Short-term profit opportunities persist for two hours following the premarket release of recommendation changes. The gradual price response is in contrast to Busse & Green (2002), who find that profit opportunities dissipate within seconds following the televised broadcast of analyst recommendations. According to Green (2003), a calendar-time based strategy produces annualized returns of over 30%, and the results are robust during both bull and bear markets. By focusing on the short-term informational advantage of brokerage firm clients and carefully controlling for trading costs using intraday transaction data, Green (2003) finds evidence that analyst recommendations do contain investment value. The results indicate that the performance of recommendations based investment strategies, such as those in Barber et al. (2001), Boni & Womack (2003), and Jegadeesh et al. (2004), may be significantly enhanced by transacting quickly following recommendation changes.

The profitability of trading on analyst recommendations also depends on transaction costs. Anand, Badrinath, Chakravarty & Wood (2006) examine the empirical question whether the release of analyst recommendations generate additional information asymmetry that would cause the widening of bid-ask spreads, and hence increase execution costs around such events. They analyze changes in spreads, depth and trading activity around recommendation changes on NYSE and AMEX listed securities, by examining 5,863 revisions. Contrary to the conventional wisdom that spread will widen around the release of recommendations due the adverse selection of information associated with analyst reports, Anand et al. (2006) find that transaction costs do not increase around analyst recommendation changes. In fact, the stability of spreads, combined with the increased depth and volume around these changes actually increase liquidity. The authors attribute this result to the presence of contrarian traders willing to transact against analyst advice. Irvine (2003) finds similar results when studying the incremental price and liquidity impact of analyst initiation (the first time an analyst makes a recommendation on a firm) over continued coverage. He finds that analyst following enhances liquidity.

Fabre & Snape (2007) study the liquidity surrounding sell-side equity analyst recommendation revisions on the Australian Securities Exchange. Over a sample of 10,959 recommendation revisions, they find analyst recommendation revisions to be liquidity enhancing events. Transaction costs do not increase from the release of new information embedded in the recommendations. Instead, bid-ask spreads (as proxies of transaction cost) remain unchanged, whereas trading volume and depth increase. This evidence suggests that the market is sufficiently liquid to process new information without changes in transaction costs.

2.3 The Black-Litterman Asset Allocation Model

Our study assesses the investment value of analyst recommendations using the calendar-time portfolio approach for the Australian stock market. In addition to the trading strategies used in Barber et al. (i.e. long favourably recommended stocks and short unfavourably recommended stocks), we apply the Black-Litterman asset allocation model to construct our portfolio and incorporate analyst recommendations as investor views. We will review the relevant literature here.

In the field of quantitative asset allocation, Markowitz (1952) leads the way with his seminal work on portfolio mean-variance optimization. Under Markowitz's portfolio optimization framework, the notion of risk reduction through diversification is given rigorous mathematical justification.

In a standard portfolio optimization problem, the inputs are expected returns of the "N" different assets expressed by a ($N \times 1$) matrix "r" and the covariance between them expressed by a ($N \times N$) matrix "Σ". Both "r" and "Σ" are assumed to be known, and are used to solve for the optimal weighting of assets within the portfolio represented by "w", an (N×1) matrix. Therefore the expected return of a portfolio and its risk can be express as:

$$E(r_p) = w'r \qquad \text{and} \qquad \sigma_p = \sqrt{w'\Sigma w}$$

Markowitz assumes that investors have a quadratic utility function towards risk and return.

$$U = w'r - \tfrac{1}{2}\lambda w'\Sigma w$$

The optimal asset allocation of a portfolio is found by maximizing investor utility by varying the weighting of each asset.

$$\max_{w} w'r - \tfrac{1}{2}\lambda w'\Sigma w$$

$$\delta U / \delta w = r - \lambda \Sigma w \qquad => \qquad w = (\lambda \Sigma)^{-1} r$$

As risk aversion of the investor changes the optimal mean-variance combination changes, thus resulting in a set of optimal portfolios, which make up the efficient frontier. When a risk free rate of return is introduced, only one optimal portfolio (the tangency portfolio) exists, and leverage of the portfolio is used to adjust for risk aversion.

Although theoretically appealing, the model has failed to gain popularity amongst industry practitioners. This is due a number of the model's practical weaknesses, which often result in unintuitive and highly skewed portfolio allocations. Firstly, Markowitz's theory requires, as inputs, the expected returns and the expected variance-covariance structure for all assets in the investment universe. Yet, an investor typically has opinions about only some of the assets in that universe, resulting in poor estimates of expected return inputs to the model. Secondly, asset weighting decision under the optimization process is highly sensitive to the input assumptions. The unreliable estimation of required inputs coupled with the model's high sensitivity to them often lead to unreasonable results (Drobetz 2001).

The Black-Litterman asset allocation model is a sophisticated portfolio optimization method that addresses the problem of unintuitive, highly-concentrated portfolios, input-sensitivity, and estimation error maximization – the three main reasons suggested by Idzorek (2004) for the breakdown of Markowitz's mean-variance optimization in practical applications. It is developed by Fischer Black and Robert Litterman during their time at Goldman Sachs as in house portfolio management paper. It is expanded in Black & Litterman (1992) and then published in the Financial Analysts Journal and is discussed in greater detail in Drobetz (2001) and He & Litterman (1999).

The Black-Litterman model combines the CAPM (Sharpe 1964), reverse optimization (Sharpe 1974), mixed estimation (Theil 1971), and mean-variance optimization (Markowitz 1952). It uses a Bayesian approach to overcome the practical issues in using the Markowitz framework by allowing the portfolio manager to express their own views regarding the performance of various assets with the market equilibrium in a manner that results in intuitive, diversified portfolios. The Black-Litterman model allows the incorporation of both absolute views (expected rate of return) and relative views (outperforming vs. underperforming) with various degrees of confidence on the selected assets. The adjusted returns resulting from the investor's view and the covariance between the assets, then serve as a consistent input for the performance of mean-variance optimization.

In our case, the opinions and views are represented by analyst recommendations. Black and Litterman starts with a benchmark portfolio. The natural choice for the benchmark portfolio is the market portfolio (since it could clear the market if all investors hold homogeneous views). The expected returns of constituent assets should be the equilibrium implied expected returns derived from reverse optimization, assuming that the market portfolio is efficient (Drobetz 2001). The Black-Litterman model gravitates towards the neutral (i.e. market capitalization weighted) portfolio and tilts in the direction of assets favoured in the views of the investor. It starts with the market weights; reverse optimized to find the equilibrium implied rates of expected return. The rates of return on some assets are then adjusted to reflect the view of the investor. The mean-variance optimization is then performed with the revised expected returns to generate adjusted weighting of assets. The extent of deviation from equilibrium depends on the degree of confidence the investor has in each view.

The Model Itself:

Black and Litterman (1992) offer a model to incorporate investor's views into asset-pricing. Unlike Markowitz's mean-variance optimization, Black-Litterman assumes the current market capitalization weightings are optimal in absence of investor opinion, and reverse optimizes it to find the equilibrium implied rate of return:

$$\Pi = \lambda \Sigma w_{market}$$

The investor can then incorporate her personal views and confidence intervals about expected returns into the model to adjust the market cap implied rate of return.

$$P \bullet E(r) = q + \varepsilon$$

Given the views of the investor the mean and variance of expected return can be written as:

$$E(r_{BL}) = [(\tau \Sigma)^{-1} + P'\Omega^{-1}P]^{-1}[(\tau \Sigma)^{-1} \prod + P'\Omega^{-1}q]$$

$$Var(r_{BL}) = [(\tau \Sigma)^{-1} + P'\Omega^{-1}P]^{-1}$$

where

$E(r_{BL})$ is the new (posterior) Combined Return Vector (N x 1 column vector)

τ is the shrinkage factor for the covariance matrix;

Σ is the covariance matrix of excess returns (N x N matrix);

P is a matrix that identifies the assets involved in the views (K x N matrix);

Ω is a diagonal covariance matrix of error terms from the expressed views representing the uncertainty in each view (K x K matrix);

Π is the equilibrium implied return vector (N x 1 column vector); and,

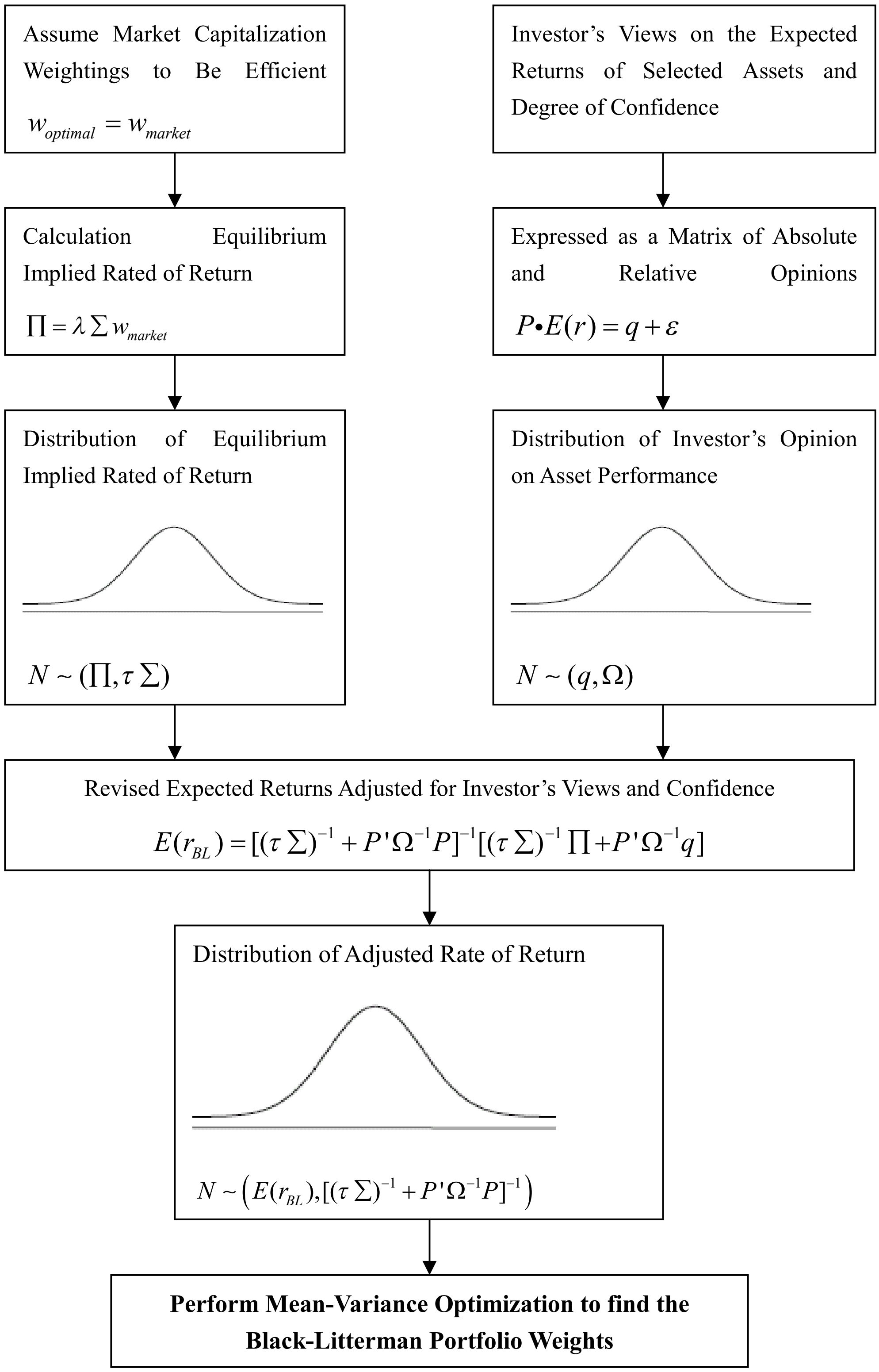
Q is the view vector (K x 1 column vector).

In order to calculate the optimal weights for the portfolio the mean variance optimization is now repeated using the revised expected returns as inputs:

$$\max_{w} w'E(r_{BL}) - \tfrac{1}{2}\lambda w'\Sigma w \qquad \text{subject to} \qquad w'l = 1$$

where l is an (n×1) matrix of ones

Figure 1: An Intuitive Derivation of the Black-Litterman Asset Allocation Model



3. Data and Index Background

3.1 Index Background

The investment universe of this study is the S&P/ASX 50 Index. The S&P/ASX 50 is Australia's most prominent large cap equity index, representing 50 of the largest and most liquid index-eligible stocks listed on the ASX by float-adjusted market capitalization (Standard and Poor's). In order to be eligible for inclusion in any of the S&P/ASX indices stocks must meet certain criteria: listing, size, liquidity, free float. The constituent companies must be listed on the ASX, maintain adequate market capitalization over the previous six month, have a public float of at least 30% for issued stocks and are actively and regularly traded (Standard and Poor's). Constituents are rebalanced quarterly to ensure that the criteria are adequately met by using the previous six months' worth of data. Quarterly rebalancing changes take effect on the third Friday of March, June, September and December. When there is a change in the composition of the S&P/ASX 50 index, our portfolio is adjusted to reflect its constituents.

3.2 Data

Two sets of data are used for this study – Security Analyst Recommendations and Stock Price Performance. Security analyst recommendations are made by financial institutions on stocks listed on the Australian Securities Exchange (ASX). Stock performances are calculated by using price data for the stocks for our sample period.

3.2.1 Recommendations Data

The analyst recommendations data in this study come from the Institutional Brokers Estimate System (I/B/E/S) database (now part of Thomson Reuters). I/B/E/S's extensive historical data presents a unique opportunity for testing investment strategies based on analyst recommendations. The recommendation data used for this study is from brokerage houses in Australia. The relevant period analyzed will be from 30 June 1997 to 30 October 2007. I/B/E/S provides a Summary File containing consensus recommendations as well as a Detail Recommendations File containing analyst-by-analyst recommendations for all individual updates and revisions. Although analysts from different brokerages can have different investment ratings, I/B/E/S standardizes the recommendations by establishing its own rating system – a rating of 1 reflects a strong buy recommendation, 2 a buy, 3 a hold, 4 a sell, 5 a strong sell and 6 for termination of coverage. When a contributing analyst sends in a recommendation, it is mapped onto one of I/B/E/S's ratings. This normalized file structure is commonly used by recommendation databases, and allows flexible updates and manipulation of the data. Consensus analysts' recommendations are calculated from the I/B/E/S Detail Recommendations File by simply averaging the normalized ratings of outstanding recommendations. In the Results Section, we also explore the effect on investment performance of filtering dated recommendations from the consensus recommendation calculation, by applying a time cut-off to outstanding recommendations.

The dataset arrives in the form of an international analyst database encompassing all non-US recommendations. Recommendations are identified as Australian by home market codes. The data consists of three individual datasets; a broker identification file, a recommendation file and an initiation of analyst coverage file. To administer this data, a remote mySQL server is set up to get the data into manageable format and programs are written to sort and analyze them to produce descriptive results and generate daily trade lists for portfolio rebalancing. This results in a dataset that includes the recommended firms ASX code, the raw and adjusted analyst recommendations, date the recommendation was made, and the analyst / firm issuing it. The recommendation day for our analysis is defined to be the announcement date recorded by I/B/E/S, which is the day that recommendations are officially released to a broker's clients.

Table 1

Discriptive Statistics of Analyst Recommendations for S&P/ASX 50 Index Constituent Stocks from 1997 to 2007

					Individual Recommendation Distribution					Consensus Group Distribution		
Year	Average Estimator per Covered Stock	Average Covered Stock per Estimator	Percentage of Coverage	Average Rating	1	2	3	4	5	Group 1	Group 2	Group 3
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
30/6/97 - 30/6/98	10.53	32.12	89.7%	2.45	27.7%	19.4%	41.0%	4.8%	7.1%	11.5%	74.2%	14.4%
1/7/98 - 30/6/99	11.24	25.27	92.7%	2.42	28.2%	20.5%	43.0%	2.9%	5.4%	20.0%	64.0%	15.9%
1/7/99 - 30/6/00	11.06	23.42	94.6%	2.15	34.3%	25.3%	34.7%	2.2%	3.5%	37.6%	57.7%	4.7%
1/7/00 - 30/6/01	12.38	23.14	94.6%	2.28	30.5%	21.9%	42.3%	1.7%	3.6%	23.1%	69.6%	7.3%
1/7/01 - 30/10/02	13.26	24.48	93.5%	2.24	31.2%	21.3%	42.6%	1.7%	3.2%	23.7%	73.3%	3.0%
31/10/02 - 30/10/03	11.28	21.47	97.8%	2.40	20.2%	29.1%	43.5%	4.2%	3.1%	14.9%	74.2%	10.9%
31/10/03 - 30/10/04	10.18	22.31	97.7%	2.50	17.1%	26.9%	47.3%	4.6%	4.1%	10.4%	77.2%	12.4%
31/10/04 - 30/10/05	10.33	23.59	97.7%	2.48	18.7%	25.6%	47.8%	5.1%	2.8%	10.8%	78.8%	10.4%
31/10/05 - 30/10/06	10.66	21.99	99.4%	2.55	19.0%	22.8%	47.0%	7.2%	4.0%	8.5%	75.2%	16.3%
31/10/06 - 30/10/07	11.07	20.69	100.0%	2.54	19.5%	23.8%	45.0%	8.3%	3.3%	14.3%	66.3%	19.5%
30/6/97 - 30/10/07	11.20	23.85	95.8%	2.40	24.6%	23.7%	43.4%	4.3%	4.0%	17.5%	71.1%	11.5%
Buy:Sell	5.84											

This table presents the summary statistics of the recommendations dataset used in this study. Estimators referred to in the second and third columns are brokerages or investment banks that provide the recommendations on the stocks. Percentage of coverage shows the proportion of S&P/ASX 50 stocks that are covered by analyst (i.e. have outstanding recommendations) in a given period. Individual recommendation Distribution shows the percentage of "strong buy", "buy", "hold", "sell" and "strong sell" recommendations outstanding in a given period. Consensus Group Distribution shows the percentage of covered stocks with consensus recommendations falling into Group 1 ($1 \le A \le 2$), Group 2 ($2 < A \le 3$) and Group 3 ($A > 3$).

There are 13,332 recommendation changes during our sample period for the constituents of the S&P/ASX 50 Index. In our dataset, buy-type signals outweigh sell-type signals by approximately 5.84:1. This coincides with Wong (2002) who finds a higher propensity for Australian analysts to make "sell" and "hold" recommendations over their international counterparts. Stickel (1995) calculates the ratio for U.S analysts as 7:1. According to Aitken et al. (2000), theory that has often been put forward to explain the imbalance between buy, hold and sell recommendations is that brokers are reluctant to issue pessimistic recommendations on companies with which they have a potential or ongoing corporate relationship.

Table 1 provides the summary statistics for the recommendation dataset used in this study. Overall, "strong buy" recommendations account for approximately 24.6% of all recommendations during this period, while "buy" recommendations account for approximately 23.7% and "hold" recommendations 43.4%. "Sell" and "strong sell" recommendations make up only 8.3%. On average, 17.5% of stocks during this period had a consensus rating between "strong buy" and "buy"; 71.0% of stock fell between "buy" and "hold", while 11.5% of stocks had a consensus rating between "hold" and "strong sell"

The average percentage of stocks under coverage is 95.8% and that figure has steadily increased to nearly 100% at the end of the sample period (Column 4 of Table 1). This is consistent with the conventional wisdom that indexed firms are heavily covered by analysts, because they are more liquid and widely held by institutional investors. This means that they tend to be heavily traded and publicized, which in turn would generate substantial brokerage commissions for the sell-side analysts' firms.

From 30 June 1997 to 30 October 2007, the mean number of estimators (brokerages) per covered stock has remained relatively constant at around 11, while the mean number of covered stocks per estimator has gradually decreased from 32 to 21. This seems to suggest that the number of brokerages contributing to the recommendation database has steadily increased, while each covers a smaller number of index constituents. Column 5 of Table 1 shows that the average level of analyst recommendations has generally remains steady around a mean of 2.4, which is between a "buy" and a "hold". During financial years 2000 to 2002 the average recommendation level is at its most favourable - approximately 2.2, or close to a buy. In recent years, however, analysts have become more prudent with issuing favourable recommendations. As a result the average outstanding recommendation is closer to 2.5 and the end of the period. This is possibly a correction to the overly optimistic forecasts which are made during the financial years 2000 to 2002. During this period the most favourably recommended stocks underperform the market while the least favourably recommended stocks outperform. This is consistent with Figure 6 which shows the cumulative market adjusted return consensus recommendation portfolios. The cumulative abnormal returns of Portfolios 1 and 3 during the period converge towards zero. This follows Barber et al. (2002) which found that analyst

Table 2

Transition Matrix of Analyst Recommendations on S&P/ASX 50 Index Constituent Stocks
(Count and Median Interval) from 30/6/1997 to 30/10/2007

From Recommendation of	To Recommendation of 1	2	3	4	5	Dropped	Total
1	223	293	1,107	21	36	573	2,253
	100	84	128	95	139	231	16.90%
2	381	308	1,496	65	43	530	2,823
	98	57	102	111	97	170	21.17%
3	1,025	1,532	423	540	439	1,079	5,038
	107	91	63	103	121	172	37.79%
4	21	69	509	64	26	142	831
	82	81	70	21	60	84	6.23%
5	30	27	475	26	16	126	700
	153	90	77	179	66	195	5.25%
Dropped	305	440	730	101	58	53	1,687
	59	9	7	3	30	2	12.65%
Total	1,985	2,669	4,740	817	618	2,503	13,332
	14.89%	20.02%	35.55%	6.13%	4.64%	18.77%	100.00%

Median Interval Between Recommendation Transitions	103 Days
Mean Interval Between Recommendation Transitions	192 Days

This table shows the median number of days between changes in or reiterations of analyst recommendations issued on S&P/ASX 50 Index constituent stocks. Each row represents the recommendations that have changed from a 1 (strong buy), 2 (buy), 3 (hold), 4 (sell), 5 (strong sell), 6 (dropped), while each matching column shows the transition of the recommendations to 1 (strong buy), 2 (buy), 3 (hold), 4 (sell), 5 (strong sell), 6 (dropped). Fractional recommendations and median number of days are rounded to the nearest integer.

recommendations performed poorly during 2000-2001 across both tech and non-tech stocks.

Table 2 is a transition matrix of recommendation updates for constituents of the S&P/ASX 50 Index during our sample period. Each cell (*f* : *t*) contains two numbers. The top one is the number of observations in which an estimator has updated its recommendation on a certain stock from *f* to *t*. The bottom number is the median time interval between the announcement of a recommendation and when it is updated. The diagonal elements of the transition matrix represent reiterations. Entries above the diagonal represent recommendation downgrades while entries below the diagonal are recommendation upgrades. The transition counts are more concentrated on the third row and column due to the large number of hold recommendations in our sample. Analysts' tendency to issue "buy" and "hold" recommendations rather than "sells" is reflected in the concentration of observations in the upper left 3 x 3 range. The mean interval between recommendation updates is 192 days, while the median interval stands at 103 days. This reflects the tendency of some analysts to leave their recommendations unchanged for long periods of time causing the distribution to be positively skewed. In our sample, there is no apparent difference in the time it takes to revise or reiterate an outstanding recommendation.

The average seven day cumulative market adjusted abnormal return on recommendation updates are reported in Table 3. The results are similar in nature to

Table 3

Seven Day Cumulative Market Adjusted Return Matrix of Analyst Recommendations on S&P/ASX 50 Index Constituent Stocks (Count and Mean) from 30/6/1997 to 30/10/2007

From	To Recommendation of						
Recommendation of	1	2	3	4	5	Dropped	Total
1	223	293	1,107	21	36	573	2,253
	0.1194%	-0.4432%	-0.2617%	-0.1632%	-0.0085%	0.3470%	
2	381	308	1,496	65	43	530	2,823
	0.2749%	-0.2057%	-0.3791%	0.3444%	-0.4856%	0.3740%	
3	1,025	1,532	423	540	439	1,079	5,038
	0.4986%	0.6114%	-0.2054%	-0.7205%	-0.2495%	0.1224%	
4	21	69	509	64	26	142	831
	-0.5720%	0.1188%	0.7629%	0.3715%	-1.1912%	-0.0203%	
5	30	27	475	26	16	126	700
	1.0272%	-1.4836%	0.3922%	-0.5333%	-0.5273%	-0.3658%	
Dropped	305	440	730	101	58	53	1,687
	0.4401%	0.2596%	0.0034%	-0.1166%	-0.3586%	-4.0108%	
Total	1,985	2,669	4,740	817	618	2,503	13,332

Weighted Average Cumulative Abnormal Return for Recommendation Upgrades	0.16%
Weighted Average Cumulative Abnormal Return for Recommendation Downgrades	-0.11%

This table shows the percentage market-adjusted returns measured for the week (including the announcement day) following the release of the recommendation changes or reiterations. Each row represents the recommendations that have changed from a 1 (strong buy), 2 (buy), 3 (hold), 4 (sell), 5 (strong sell), 6 (dropped), while each matching column shows the transition of the recommendations to 1 (strong buy), 2 (buy), 3 (hold), 4 (sell), 5 (strong sell), 6 (dropped). Fractional recommendations and median number of days are rounded to the nearest integer.

those of Stickle (1995) and Womack (1996), whose event study approach found positive (negative) abnormal returns following analyst upgrades (downgrades). Most upgrades (downgrades) show positive (negative) market adjusted abnormal return, except for (4:1), (5:2), (2:4), which had a very small number of observations. Overall, the weighted average 7 day cumulative abnormal returns for upgrades and downgrades are 0.16% and –0.11% respectively.

3.2.2 Price Data

To measure and track the performance of the portfolio of stocks under examination, we use historical return data sourced from the Securities Industry Research Centre of Asia-Pacific (SIRCA). These prices are used to calculate any abnormal returns on portfolios constructed following analyst recommendations.

We measure the total return of portfolios (including capital gains and dividend returns) over the period from 30 June 1997 to 30 October 2007 by using the accumulation share price. Like an accumulation index, this is the price assuming all dividends are reinvested into the share value. Therefore, all dividends and stock splits (including bonus share issues and other dilution of share value by way of issuance) are accounted for. This in effect gives the accumulated total return for an investment in a stock.

In this study, we assume all trades are executed at the closing price, but test the robustness using different execution strategies. The execution assumptions are described below:

1) Daily closing price

All trades are assumed to be executed at the closing price for that trading day. Therefore, the accumulation closing price for all S&P/ASX 50 constituent stocks is used for every trading day.

2) Daily Volume Weighted Average Price – VWAP

VWAP is calculated by summing the dollars traded for every transaction (price multiplied by number of shares traded) and then dividing by the total shares traded for the day.

$$VWAP = \frac{\sum NumberOfSharesTraded \times Share\,\mathrm{Pr}\,ice}{TotalNumberOfSharesTraded}$$

3) Daily VWAP for buyer-initiated trades and seller-initiated trades

All buy orders are executed at the accumulated VWAP of all buyer-initiated trades for that day, and all sell orders are executed at the accumulated VWAP of all seller-initiated trades for that day. Buyer-initiated (Seller-initiated) trade is defined as any trade that occurs at a price above (below) the mid-price of the bid-ask spread prevailing in the non-overlapping market just prior to a trade.

$$BuyerInitiatedVWAP = \frac{BuyerInitiatedTrades : \sum NumberOfShares \times Share\Pr ice}{BuyerInitiatedTotalNumberOfShares}$$

$$SellerInitiatedVWAP = \frac{SellerInitiatedTrades : \sum NumberOfShares \times Share\Pr ice}{SellerInitiatedTotalNumberOfShares}$$

4. Research Design

This section presents the methods used to implement our recommendation based investment strategies and measures their performances over time. The first part describes the method for creating portfolios containing stocks with different consensus recommendation levels. This is followed by the methods that are used to evaluate performance and calculate turnover. The application of the Black-Litterman asset allocation model is then discussed in detail.

4.1 Consensus Recommendation Portfolio Construction

To assess the investment value of analyst recommendations in Australia, we construct calendar-time portfolios based on the consensus recommendations of stocks. In addition to measuring the abnormal performance of portfolios of stocks with favourable and unfavourable consensus recommendations relative to the market, we apply these abnormal performance figures as investor views to the Black-Litterman asset allocation model to examine the profitability of trading on analyst recommendations in a portfolio optimization context. The investment universe for this study is the constituent stocks of the S&P/ASX 50 Index. The estimation period for relative performance is from 30 June 1997 to 31 October 2002. The relative performance figures then form the inputs to the Black-Litterman model's view matrix for the period from 31 Oct 2002 to 30 Oct 2007.

Our definition of a consensus recommendation $\overline{A}_{it-1}$ is the simple average of recommendations for stock i on date t-1. It is calculated by adding all outstanding recommendations A_{ijt-1} (j represents individual recommendations) together and dividing by n (the number of outstanding recommendations):

$$\overline{A}_{it-1} = \frac{\sum_{j=i}^{n_{it-1}} A_{ijt-1}}{n_{it-1}}$$

Covered stocks are grouped into three different consensus recommendations portfolios depending on a stock's average rating, on a daily basis. The first portfolio includes stocks most favourably recommended by security analysts, for which the consensus recommendation is between a "strong buy" and a "buy" $1 \leq A \leq 2$. The second portfolio contains stocks with a consensus recommendation between a "buy" and a "hold" $2 < A \leq 3$. The third portfolio comprises of the least favourably recommended stocks for which the consensus is between a "hold" and a "strong sell" $A > 3$. The arbitrary cut-off for each consensus recommendation level is set so that Portfolios 1 & 2 would contain stocks with favourable consensus recommendations of “strong buy” to “hold”, while Portfolio 3 would contain stocks with unfavourable consensus recommendations of “hold” to “strong sell”. Since buy recommendations are more often issued than sell recommendations the consensus group is further separated into two groups. Due to the limited number of stocks and analyst recommendation observations, the consensus portfolios are not further separated into quintiles as in Barber et al. (2001). Doing so causes an absence of stocks from certain quintiles for extended periods of time.

The consensus recommendation of a stock is recalculated every time an outstanding recommendation is revised and when coverage of a stock is initiated or terminated. As the consensus recommendation of a covered stock changes, it moves between consensus groups. The portfolios are rebalanced on a daily basis at the close. The stocks in the consensus recommendation portfolios are held proportional to their market capitalization. That is a covered stock’s weight in its consensus portfolio is calculated by dividing its market capitalization by the total market capitalization of the portfolio. There are two reasons for holding a value weighted portfolio of stocks rather than an equally weighted portfolio. Firstly, in a portfolio context, companies should be held in proportion to its market capitalization if investors have homogeneous views. Secondly, to maintain the equally weighted portfolio of stocks the rebalancing trades would generate excessive amount of turnover and transaction costs as stock prices change. In a market capitalization weighted portfolio, the value of the firms and stock price change proportionally, hence reducing the need for rebalancing.

To measure the performance of our portfolios, the weighted average returns of the respective portfolios are calculated:

$$R_{pt} = \sum_{i=1}^{n_{pt-1}} w_{it-1} R_{it}$$

w_{it-1} is the market value of equity for firm *i* as of the close of trading on date t - 1 divided by the aggregate market capitalization of all firms in portfolio *p* as of the close of trading on that date,

R_{it} is the return on the common stock of firm *i* on date t, and

n_{pt-1} is the number of firms in portfolio *p* at the close of trading on date t -1

To find the return for a period of interest, the daily rebalancing returns are compounded:

$$R_{pT} = \prod_{t=1}^{n} (1 + R_{pt}) - 1$$

4.2 Performance Evaluation

To evaluate the profitability of investment strategies with respect to analyst recommendations we apply three main performance measurements, namely the market adjusted rate of return, the Sharpe Ratio and the Sortino Ratio. The market adjusted rate of return is the focus of our performance evaluation, since with the Black-Litterman asset allocation model results in a weight adjusted market portfolio to reflect analyst opinions. Furthermore, Brown & Warner (1980) evaluate various method of measuring stock price performance and find that the market adjusted return performs well under a wide variety of conditions, and there is no evidence to suggest that more complicated methodologies convey any benefits. It is given by $R_{pT} - R_{mT}$ for portfolio *p* in month *T*, where R_{mT} is the S&P/ASX 50 Accumulation Index's return in month *T*. Sharpe ratios and Sortino Ratios are calculated to account for the difference in the level of volatility and downside risk of each of the portfolios.

The Sharpe Ratio, developed by William F. Sharpe, measures risk adjusted performance of an investment portfolio. The Sharpe ratio is calculated by subtracting the risk-free rate from the portfolio return and dividing it by the portfolio standard deviation. The greater a portfolio's Sharpe ratio, the higher the amount of excess return for every unit of risk. It is represented as follows:

$$SharpeRatio = \frac{\overline{R}_{pT} - R_{fT}}{\sigma_{pT}}$$

where

$\overline{R}_{pT}$ is the rate of return achieved by the portfolio,

R_{fT} is the risk free interest rate, and

σ_{pT} is the standard deviation of the portfolio

The Sortino ratio, developed by Frank A. Sortino, measures the downside-risk adjusted return of an investment portfolio. It differentiates between upside and downside volatility, and only penalizes those returns falling below a pre-specified benchmark (the risk free rate of return), whereas the Sharpe ratio penalizes both upside and downside volatility equally. Therefore the Sortino Ratio provides a risk adjusted measure without penalizing variability in upward price changes. The Sortino ratio is characterized as follows:

$$SortinoRatio = \frac{\overline{R}_{pT} - R_{fT}}{DR_{pT}} \qquad DR = \left(\int_{-\infty}^{R_f} (R_f - x)^2 f(x) dx \right)^{1/2}$$

where

$\overline{R}_{pT}$ is the rate of return achieved by the portfolio,

R_{fT} is the risk free interest rate, and

$f()$ is the probability distribution function of the returns, and

DR is the down side risk of the portfolio calculated from a sequence of historical returns x, the root mean square underperformance U, where $U = x - R_{fT}$ if $x - R_{fT} < 0$, otherwise $U = 0$.

4.3 Turnover and Transaction Cost

The investment strategies utilized in this study are all active portfolio management strategies. As a result they require frequent rebalancing and high levels of trading in order to be executed effectively. To determine the costs that are incurred as a result of our trading, the turnover of the portfolios needs to be measured. At the end of every trading day, portfolio stocks are rebalanced, at their closing price. The difference in constituent stocks or weightings between day t-1 and day t gives us the trades that needs to be executed to rebalance the portfolios in accordance to recommendation updates. The value of shares bought and sold for a portfolio on day t should be equal. Turnover for portfolio *p* during trading day t is defined as the percentage of the portfolio's holdings that has been sold (the proceeds from which are used to buy other shares) as of the close of trading. That is the percent of the portfolio that has been "turned over" into some other set of stocks.

The net profitability of a trading strategy depends critically on the amount of transaction cost it incurs. Transaction cost could be classified as explicit and implicit. Explicit transaction cost may include brokerage commissions, while implicit transaction cost mainly involves market impact cost. Gallagher & Looi (2003) studied market impact cost incurred by active equity funds managers in Australia. They estimate that, on average, active fund managers incur a market impact cost of 0.27% for a round trip trade package. In this study, we assume this to be market impact component of our transaction cost. The increase in liquidity of an individual stock around recommendation announcements documented by prior studies may cause the market impact cost for consensus recommendation portfolios to be slightly over-estimated. This, however, would have little effect on the Black-Litterman portfolio, because the view matrix changes the weighting for all stocks. The explicit component of transaction cost is assumed to be 0.2% for a round trip transaction. The two components of transaction cost sum to 0.47%. This figure is then applied to the turnover figure to estimate transaction costs incurred by our trading and to calculate the net returns of the portfolios.

4.4 Application of the Black-Litterman Asset Allocation Model

As mentioned earlier, the primary method for evaluating the investment value of analyst recommendations in this study is an application of the Black-Litterman asset allocation model. The objective is to assess the profitability of an investment strategy that adjusts the weighting of the index constituents in accordance to analyst predictions. This section of the study briefly describes the intuition of the Black-Litterman Model. Particular focus is given to the details of combining market equilibrium expected returns with "analyst recommendations" to generate a new vector of expected returns. The Black-Litterman asset allocation model, created by Fischer Black and Robert Litterman, uses a Bayesian approach to combine the subjective views of the investor on the expected performance of one or more assets with the market equilibrium implied rate of return of the portfolio to form an update set of return estimates. To implement this trading strategy, we start with a market weighted neutral portfolio and assume that it is optimal if all market participants have the same expectations. It is then reverse optimized to produce the equilibrium implied rate of return. These returns are changed to incorporate information from analyst recommendations. This posterior distribution of asset returns will then be the input for portfolio optimization, which leads to intuitive asset allocation and reasonable weights.

4.4.1 Reverse Optimization

The Black-Litterman model uses equilibrium implied rates of return as the prior distribution of asset returns, which serve as a starting point to incorporating "analyst views" about future performance. If no views are expressed by the investor, the resulting optimum portfolio should be the neutral portfolio. Black & Litterman (1992) define the neutral portfolio as one that could clear the market if all investors held identical views – the market portfolio. This study assumes an investment universe of the constituents of the S&P/ASX 50 Index and uses it as our neutral portfolio. This could be expanded to include a wider range of stocks and assets. The true market portfolio, which should include all assets, is impossible to indentify or construct (Roll 1977). The equilibrium returns for assets in our portfolio are derived using reverse optimization, where the set of returns implied by market weights are calculated by multiplying the investors risk aversion, and the covariance matrix of the assets with their market weights:

$$\Pi = \lambda \Sigma w_{market}$$

Where

Π is the equilibrium implied excess (above the risk free rate) return (N x 1 vector)

λ is the risk aversion of the investor

Σ is the covariance matrix of excess returns (N x N matrix)

w_{market} is the market capitalization weight of portfolio constituents (N x 1 Vector)

The covariance matrix is calculated on a daily basis using return data from the past 3 months. We use this time frame because the index constituents change every quarter and there is a limited amount of price data on hand. The 3 month bank accepted bill rate (continuous maturity) is used as the risk-free rate of return in all excess return calculations and optimization procedures.

4.4.2 Risk Aversion

The risk aversion coefficient represents the trade-off between risk and expected return. It can be viewed as a scaling factor in both the reverse optimization and optimization processes. The higher the risk aversion, the greater the excess return required to compensate for per unit of risk, which in turn will increase implied rate of return in the reverse optimization and reduce the asset allocation's sensitively to excess return in the optimization process. The implied risk aversion coefficient (λ) for a market can be estimated by dividing the long term expected excess return by the variance of the portfolio (Grinold & Kahn 1999):

$$\lambda = \frac{E(r)_m - R_f}{\sigma_m{}^2}$$

where

$E(r)_m$ is the expected market (or benchmark) total return;

R_f is the risk-free rate; and,

$\sigma_m{}^2$ is the variance of the market (or benchmark) excess returns.

Dimson, Marsh & Staunton (2003) estimate Australia's long term average market risk premium to be around 8% p.a. Using their estimate, we calculate the risk aversion of investors in Australia to be approximately 3. Idzorek (2004) estimates the risk aversion using for the global market to be 3.07, and uses 3 for his Black-Litterman model. Drobetz (2001) also uses a risk aversion of 3 for a study based on the Dow Jones STOXX indices for European sectors over the period from June 1993 to November 2000.

4.4.3 View Expression

Investors are now able to incorporate their personal views and confidence levels about expected returns into the model to adjust the market weight implied rate of return. To translate the consensus analyst recommendations into the views of the portfolio manager, we have to assume relative percentages outperformance (underperformance) for stocks with favourable (unfavourable) consensus recommendations compared to the market. We track the performance of the three portfolios formed on the basis of consensus analyst recommendations to estimate the relative performance of these stocks against the market, and then use them as the input to construct the view matrix in the Black-Litterman asset allocation model. In this study, the time from 30 June 1997 to 31 Oct 2002 is used as an estimation period to estimate the long-term abnormal performance of stocks receiving favourable and unfavourable recommendations relative to the market. From 31 Oct 2002 to 30 Oct 2007, we apply the relative performance figures generated in the estimation period to construct an optimized portfolio, which incorporates the long term abnormal returns as a view matrix into the Black-Litterman model. It is assumed that the average over and under performance of consensus recommendation portfolios relative to the market remains constant through time.

Views of the Black Litterman model could be expressed in either relative or absolute terms. For example, one can express the view that stock A will outperform Stock B by

5% p.a. or that stock C will return 10% p.a. In the present study, views of relevant consensus recommendation portfolios in this study are expressed in relative terms against the market portfolios. They are expressed in the following form:

$$P \bullet E(r) = Q + \varepsilon$$

where

P is a matrix that identifies the assets involved in the views (K x N matrix),

Q is the view that includes the relative performance figures (K x 1 column vector),

ε is an error term associated with the uncertainty of the investor's view.

The model does not require the investor to have a specific view on all assets. In this case, all covered stocks with outstanding consensus analyst recommendations will be included in the view matrix. Specifically, we express three views:

1) Portfolio 1 outperforms the market by Q1 bps per trading day,

2) Portfolio 2 outperforms the market by Q2 bps per trading day, and

3) Portfolio 3 underperforms the market by Q3 bps per trading day.

To achieve this relative performance against the market, one would long the respective consensus portfolio and short the market. Therefore the P matrix would take positive positions in the constituents of a consensus portfolio weighted by their market capitalizations relative to the portfolio's market capitalizations, and then short all the constituents of the index weighted by their market capitalizations relative to the aggregate value of the index.

This is an example, where on a certain trading day assets 1 and 2 falls into Portfolio 1; assets 3 and 4 falls into Portfolio 2 and assets 5 and 6 falls into Portfolio 3. Note that assets can move into different portfolios each day due to changes to consensus. Their weights in respective views are equal to their market capitalization weights in the consensus portfolios (for the first view, W_{1p} is equal to asset 1's market cap divided by the sum of Asset 1 and 2's market cap), minus their weights in the index (W_{1m} is equal to Asset 1's market cap divided by the index market cap).

$$P = \begin{bmatrix} W_{1p} - W_{1m} & W_{2p} - W_{2m} & -W_{3m} & -W_{4m} & -W_{5m} & -W_{6m} & -W_{7m} & \cdots\cdots & -W_{nm} \\ -W_{1m} & -W_{2m} & W_{3p} - W_{3m} & W_{4p} - W_{4m} & -W_{5m} & -W_{6m} & -W_{7m} & \cdots\cdots & -W_{nm} \\ -W_{1m} & -W_{2m} & -W_{3m} & -W_{4m} & W_{5p} - W_{5m} & W_{6p} - W_{6m} & -W_{7m} & \cdots\cdots & -W_{nm} \end{bmatrix}$$

$$Q = \begin{bmatrix} R_{p1} - R_m \\ R_{p2} - R_m \\ R_{p3} - R_m \end{bmatrix} \qquad \Omega = \begin{bmatrix} \omega_1 & 0 & 0 \\ 0 & \omega_2 & 0 \\ 0 & 0 & \omega_3 \end{bmatrix}$$

The uncertainty of the view results is represented by the error term ε, which is normally distributed random variable, with a mean of zero. The variances of the error terms are represented by the Ω matrix, which acts as a proxy for confidence. The Ω matrix is a diagonal matrix of variances of each view that is expressed by the investor.

Once Matrix P is defined, one can calculate the variance of each individual view portfolio. The variance of an individual view portfolio is $P_k \sum P_k'$, where k is the number of views being expressed. According to Idzorek (2004) the respective variance of each individual view portfolio is "an important source of information regarding the certainty, or lack thereof, of the level of confidence that should be placed on a view". In this study, we do not express our subjective confidence on each of the views, but allow the confidence to vary with the variance of the view portfolio. Thus in volatile times, we would put less weight on the relative performance views, and reduce the investment departures from market weights, whereas, when view vector variances are low, the portfolio weights will be tilted more aggressively due to the increase in confidence.

4.4.4 Updated Return

The mean and variance of the expected return given the views of the investor could be calculated by:

$$E(r_{BL}) = [(\tau \Sigma)^{-1} + P'\Omega^{-1}P]^{-1}[(\tau \Sigma)^{-1} \prod + P'\Omega^{-1}Q]$$

$$Var(r_{Bl}) = [(\tau \Sigma)^{-1} + P'\Omega^{-1}P]^{-1}$$

Where

$E(r_{BL})$ is the new (posterior) Combined Return Vector (N x 1 column vector) τ is the shrinkage factor for the covariance matrix;

Σ is the covariance matrix of excess returns (N x N matrix);

P is a matrix that identifies the assets involved in the views (K x N matrix);

Ω is a diagonal covariance matrix of error terms from the expressed views representing the uncertainty in each view (K x K matrix);

Π is the equilibrium implied return vector (N x 1 column vector); and,

Q is the view that includes the relative performance figures (K x 1 column vector).

The mean-variance optimization process is then performed using the revised expected returns as inputs to the model in order to calculate the optimal weights of the portfolio:

$$\max_{w} w' E(r_{BL}) - \tfrac{1}{2} \lambda w' \Sigma w \qquad \text{subject to} \qquad w' l = 1$$

where l is an (n×1) matrix of ones

Based on consensus analyst recommendations, the optimization procedure is re-performed to generate a new portfolio using the Black-Litterman model. Therefore the weightings of stocks under analyst coverage are adjusted depending on their level of consensus recommendation. The consensus recommendation is recalculated every time an outstanding recommendation is revised and when coverage of a stock is initiated or terminated. As the consensus recommendation of a covered stock changes, it is over or underweight by the Black-Litterman model. The portfolios are rebalanced on a daily basis at the close. The difference between the optimal portfolio one day and the previous day will determine the trades that need to take place the rebalance the portfolio. Trade lists are generated and the investment performance of the portfolio is tracked in calendar time.

4.4.5 Covariance Shrinkage

In this study, the covariance matrix is multiplied by a shrinkage factor of 0.05 to reduce the model's sensitivity and improve its stability. Benninga (2008) suggest the shrinkage method to produce more reliable estimates of the covariance matrix, while pointing out that there is little theory about choosing the proper shrinkage factor. Ledoit & Wolf (2003) and most prior literature suggest against using the sample covariance matrix for the purpose of portfolio optimization as it contains "estimation error of the kind most likely to perturb a mean-variance optimizer". They strongly recommend using the matrix obtained from the sample covariance matrix through shrinkage. Black & Litterman (1992) posit that the covariance matrix of expected returns is proportional to the historical one, rescaled by a shrinkage factor. Since uncertainty of the mean is lower than the uncertainty of the returns themselves, the value of τ should be close to zero. Blamont and Firoozye (2003) interpret τ as the standard error of estimate of the equilibrium implied return vector (Π); thus, the scalar τ should be approximately 1 divided by the number of observations. Wai Lee, who has considerable experience working with variants of the Black-Litterman model, recommends the value of τ to be between 0.01 and 0.05 (Idzorek 2004).

In our study, the Black-Litterman model has been performed using tau values other than 0.05. A higher τ value (0.1) causes increase in abnormal return, risk and turnover, whereas a lower τ (0.01) value causes a reduction in abnormal return, risk and turnover. The shrinkage factor of 0.05 produced the higher Sortino ratios out of the three, indicating a higher rate of return for every unit of downside risk.

Table 4: Inputs to the Black-Litterman Asset Allocation Model

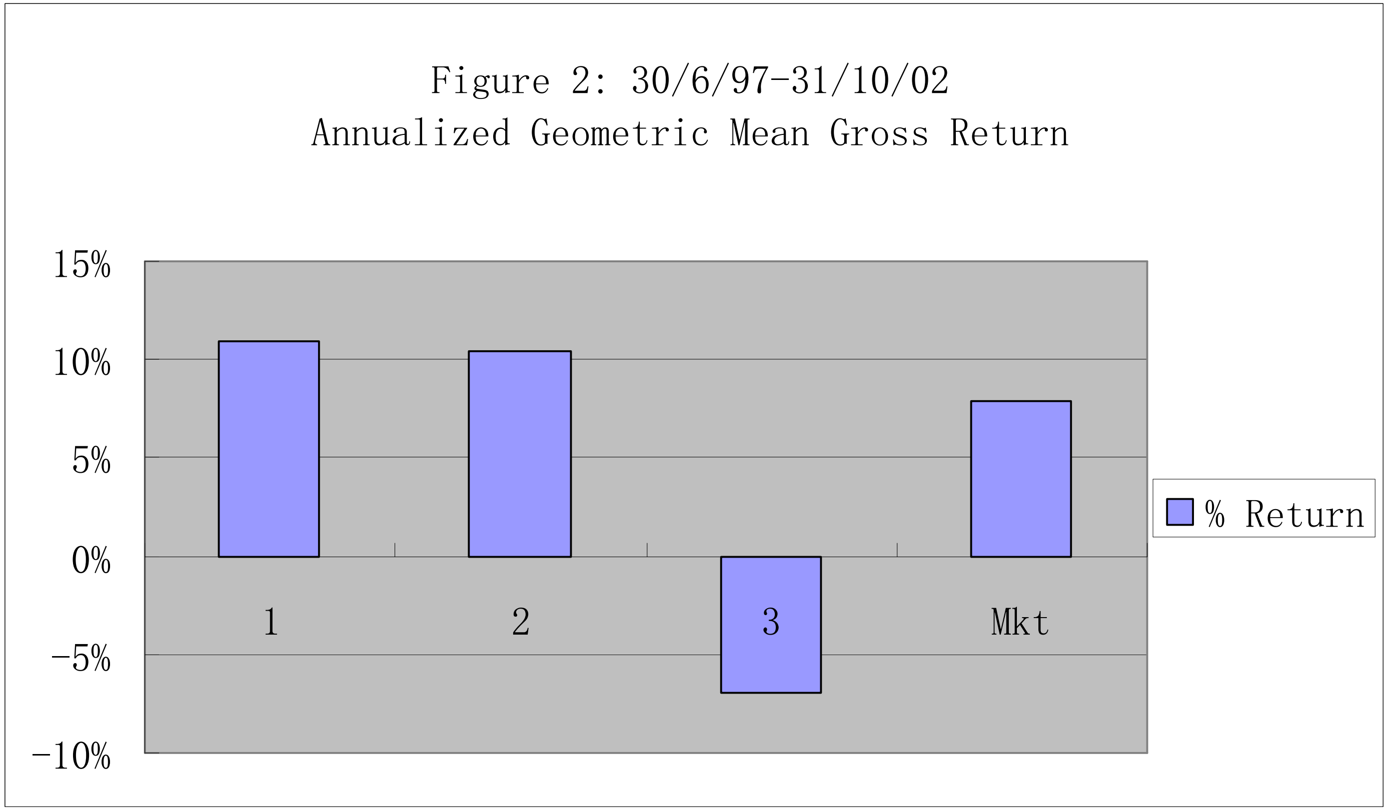
Parameter	Name	Effect:
λ	Risk Aversion	Increasing λ means that the investor is more risk averse and is more willing to sacrifice return to reduce risk.
τ	Weight on Views	Increasing τ increases the uncertainty of equilibrium implied returns and places more emphasis on the investor views.
Ω	View Variance	Increasing Ω increases the uncertainty in the views, which means that the investor has less confidence in them

5. Results

Tables 5.1 to 5.5 show the main results of this study, which provides support to the hypothesis that analyst recommendations have investment value, and that a trading strategy based on overweighting (underweighting) stocks with favourable (unfavourable) recommendations through a Black-Litterman Model is profitable before transaction cost. We will first present the performances of consensus recommendation portfolios and the Black-Litterman Portfolio. This is followed by an examination of the effects of infrequent portfolio rebalancing, filtering of dated recommendations and variations on the inputs to the view matrix. Investment performances are then looked at separately in bull markets and bear markets, and for different trade execution assumptions.

5.1 Consensus Recommendation Portfolios' Performance from 30 June 1997 to 31 October 2002

For the estimation period from 30 June 1997 to 31 October 2002, the most favourably recommended Portfolio 1 earns an annualized geometric mean gross return of 10.89%, whereas holding the least favourably recommended Portfolio 3 generates an annualized geometric mean return of -6.89% (Figure 2). Portfolio 2 which contains stocks with a consensus recommendation between "buy" and "hold" earns 10.41%p.a., roughly the same level of gross return as Portfolio 1. Both favourably recommended



Annualized geometric mean gross return earned by portfolios formed based on the consensus of all analyst recommendations, in the period from 30/6/97 to 31/10/02. Daily rebalancing is assumed to happen at the close of each day, and trades executed at the close price.

portfolios outperform the unfavourably recommended portfolio by more than 15% p.a. During this time the annualized geometric mean return for the S&P/ASX 50 Accumulation Index is 7.87%. Figure 6 graphs the cumulative market adjusted return consensus recommendation portfolios from 30/6/1997 to 31/10/2002. It shows that despite performance fluctuations, Portfolio 1 and 2 outperform the market while Portfolio 3 significantly underperforms the market.

Table 5.1 shows the monthly performance of consensus group portfolios for the estimation period 30 June 1997 to 31 October 2002. Consensus Portfolio 1 earns an average monthly raw return of 1.02%, outperforming the market by 0.30%. Portfolio 2 earns an average monthly raw return of 0.92%, and a market adjusted abnormal return of 0.19%. The least favourably recommended Portfolio 3 falls by an average of 0.37% per month, and has an abnormal return of –1.09% against the market. The abnormal returns reported are not significant at the 10% level of significance. This is mainly due to the high levels of volatility in the consensus portfolio returns.

To evaluate the risk adjusted performance of each portfolio, we calculate the Sharpe and Sortino ratios to measure the portfolios' return for every unit of volatility and downside risk. The risk adjusted measures show that consensus portfolios formed on the basis of favourable (unfavourable) analyst recommendations outperform (underperform) the market. During the period, Portfolio 1 has a Sharpe Ratio of 0.94

Table 5.1: Performances of the Black-Litterman Portfolio and Consensus Recommendation Portfolios (assuming daily rebalancing)

30 June 1997 to 31 October 2007

Portfolio	Monthly Mean Raw Return	Monthly Mean Market Adjusted Return	Sharpe Ratio	Sortino Ratio	Monthly Turnover	Monthly Return Net of Transaction Cost	Monthly Market Adjusted Return Net of Transaction Cost
P1	1.02%	0.30%	0.94	1.18	77%	0.66%	-0.06%
		0.802					-0.169
P2	0.92%	0.19%	1.03	1.43	37%	0.74%	0.02%
		1.380					0.140
P3	-0.37%	-1.09%	-0.92	-1.50	78%	-0.73%	-1.42%
		-1.438					**-1.960**
Market	0.72%		0.62	0.84		0.72%	

31 October 2002 to 30 October 2007

Portfolio	Monthly Mean Raw Return	Monthly Mean Market Adjusted Return	Sharpe Ratio	Sortino Ratio	Monthly Turnover	Monthly Return Net of Transaction Cost	Monthly Market Adjusted Return Net of Transaction Cost
BL	1.86%	0.35%	4.03	5.86	79%	1.49%	-0.02%
		2.824					-0.188
P1	1.61%	0.10%	2.03	3.62	76%	1.25%	-0.26%
		0.228					-0.613
P2	1.61%	0.10%	3.64	5.75	30%	1.47%	-0.05%
		1.020					-0.510
P3	0.53%	-0.98%	0.14	0.18	86%	0.13%	-1.38%
		-2.954					**-4.168**
Market	1.51%		3.27	5.22		1.51%	

This table presents the mean monthly returns Sharpe and Sortino Ratios of consensus portfolios formed on the basis of analyst recommendations and the Black-Litterman Portfolio formed on the basis of relative performance between consensus recommendation groups. The number below the return figures are t-statistics pertaining to the null hypothesis that the associated return is zero. Abnormal returns that are significant at the 10% level have their t-statistics shown in bold. Net performances are calculated assuming a roundtrip transaction cost of 0.47%. The returns are achieved by daily rebalancing of the portfolios. The consensus recommendations are calculated using all outstanding recommendations. The Black-Litterman Portfolio uses tau = 0.05.

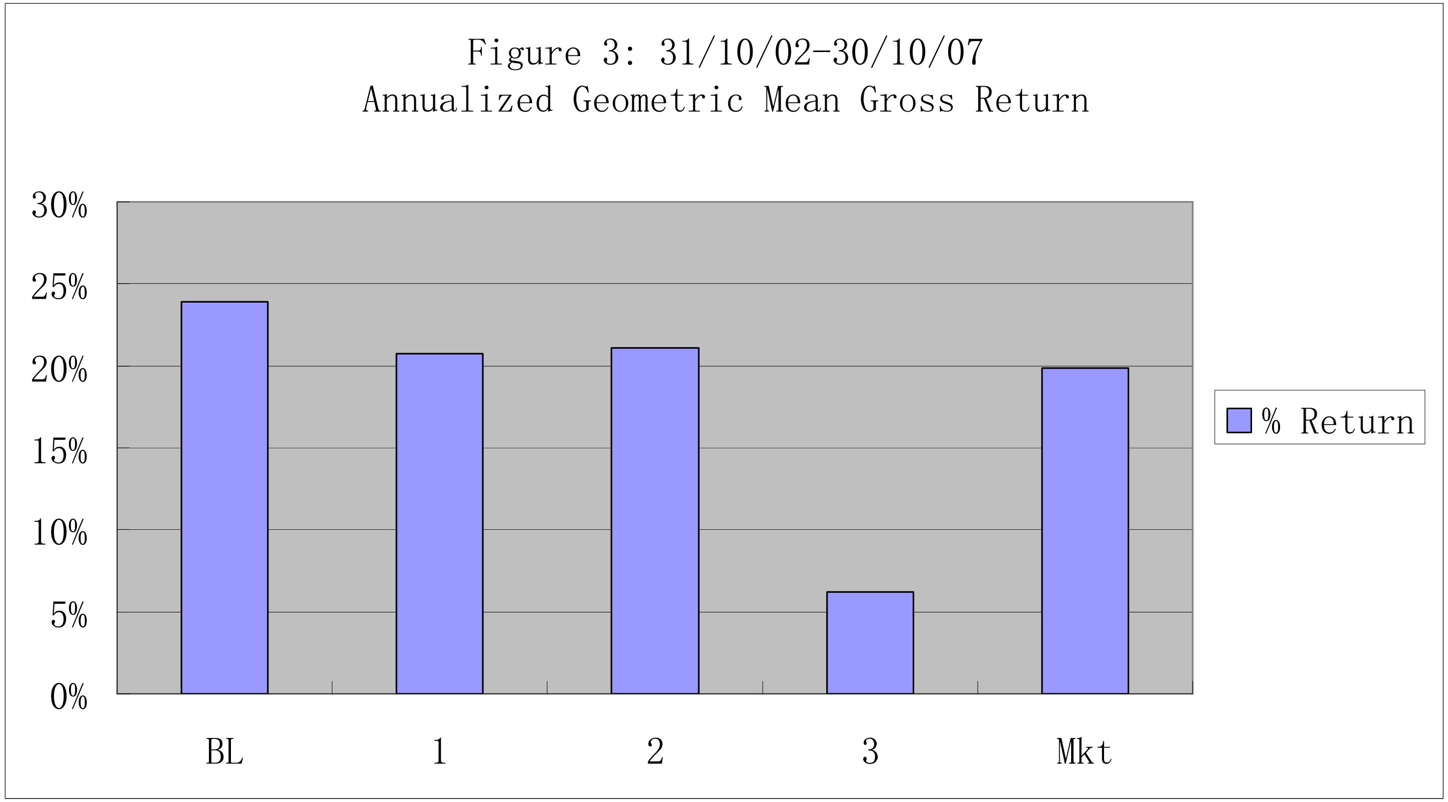
and a Sortino Ratio of 1.18 outperforming the market's 0.62 and 0.84. Despite earning a smaller raw return, Portfolio 2 performs better after adjusting for risk, posting a higher Sharpe Ratio of 1.03 and Sortino Ratio of 1.43. A possible explanation could be that Portfolio 2 contains the majority of covered stocks in the index and hence is better diversified. Portfolio 3 underperforms the market after adjusting for risk.

The reported returns thus far are gross of transaction costs associated with the high levels of trading involved in our investment strategies. As shown in Table 5.1, the implementation of our daily rebalancing strategies generates significant turnover. To take into account transaction cost, we multiply each portfolio's monthly turnover by the assumed transaction cost of 0.47%. Interestingly, the monthly turnover of Portfolio 2 is 37%, much lower than that of Portfolio 1 and 3, which had an average monthly turnover of 77% and 78% respectively. This is likely a result of the fact that more stocks fall into Portfolio 2 during the sample period, and hence each stock represents a lower proportion of the total portfolio value. According to the summary statistics in Table 1, 71% of stocks on average receive a consensus rating between a "buy" and a "hold" hence falling into Portfolio 2, while Portfolio 1 and 3 only contains 17.5% and 11.5% of stocks respectively. As stocks move from one consensus group to another, Portfolio 1 & 3 will be required to turnover a higher proportion of their total holdings to rebalance. After account for transaction cost, the net abnormal returns for the two favourably recommended portfolios are close to zero, whereas hold Portfolio 3 would cause a significant loss of 1.42% per month.

5.2 Black-Litterman and Consensus Recommendation Portfolios' Performance from 31 October 2002 to 30 October 2007

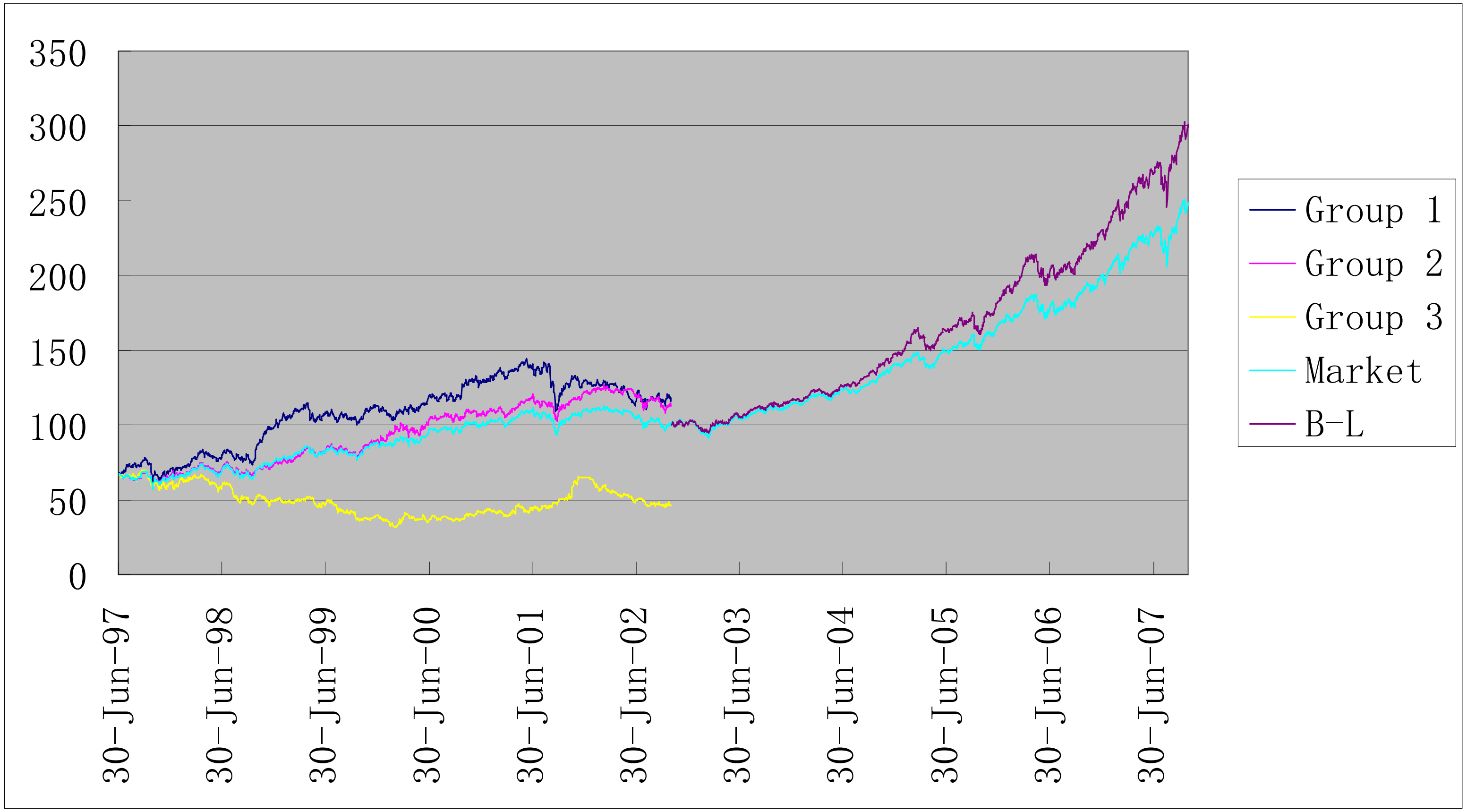
The directions of market adjusted abnormal performances of consensus portfolios are robust for the two sample period partitions. For the periods from 30 June 1997 to 31 October 2002 and from 31 October 2002 to 30 October 2007, portfolios of stocks with favourable recommendations outperform the market, and stocks with unfavourable recommendation underperform the market. An optimized portfolio of index constituents using the Black-Litterman asset allocation model to incorporate expected relative performance of stocks with different consensus recommendations consistently outperforms individual consensus group portfolios and the market.

For the period from 31 October 2002 to October 30 2007, holding the most favourably recommended Portfolio 1 generates an annualized geometric mean gross return of 20.72%, whereas holding the least favourably recommended Portfolio 3 would generate an annualized geometric mean return of 6.22% (Figure 3). Portfolio 2 which contains stocks with a consensus recommendation between "buy" and "hold" earns 21.09% p.a., slightly outperforming Portfolio 1. Figure 7 graphs the cumulative market adjusted return consensus recommendation portfolios from 31 October 2002 to 30 October 2007. Although Portfolio 1 achieves a higher cumulative abnormal return at the end of the period, its performance during the period is very unstable.



Annualized geometric mean gross return earned by portfolios formed based on the consensus of all analyst recommendations, in the period from 31/10/02 to 30/10/07. Daily rebalancing is assumed to happen at the close of each day, and trades executed at the close price.

Figure 4: Black-Litterman Portfolio Formed on the basis of Relative Consensus Recommendation Portfolio Performances in the Estimation Period



These performances are based on daily rebalancing at the close, with all recommendations included in the consensus calculation. The Black-Litterman model uses constant relative performance views, updated confidence levels and tau = 0.05

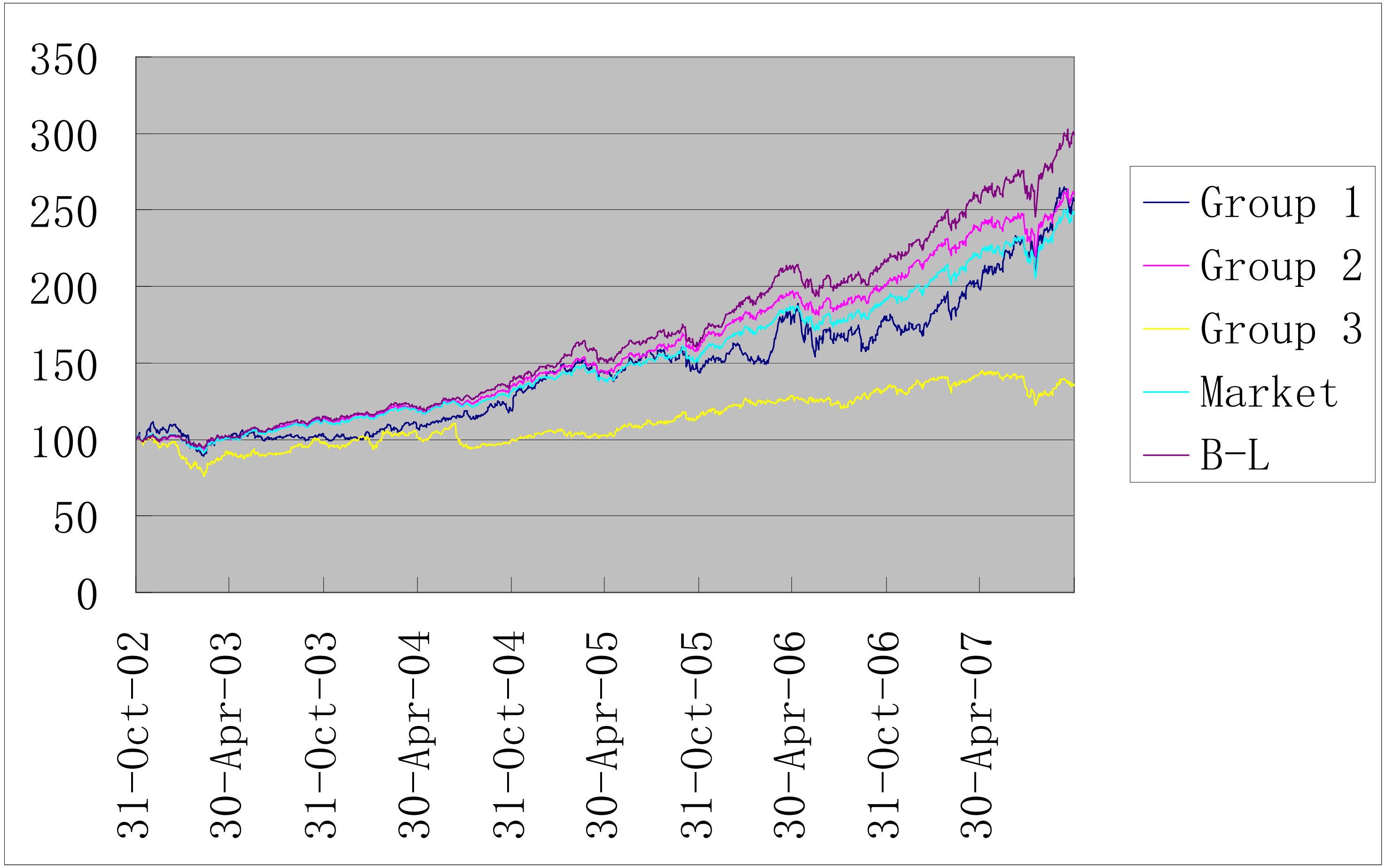
There are points in time where it underperforms the market, indicating the relative performance may not be consistent in the short term. This suggests that over the longer term, following analysts may pay off but it is highly path dependent and may not necessarily pay off in shorter time frames. Similar to in the estimation period, the favourably recommended Portfolios 1 & 2 outperform the unfavourably recommended Portfolio 3 by around 14.5%p.a. The Black-Littman Portfolio constructed on the basis of the consensus groups' relative performance in the estimation period performs very well. It earns an annualized geometric mean gross return of 23.91%. During this time the annualized geometric mean return for the S&P/ASX 50 Accumulation Index is 19.84%.

Table 5.1 shows the monthly performance of consensus recommendation portfolios for the period from 31 October 2002 to October 30 2007. Consensus Recommendation Portfolios 1 & 2 earn an average monthly raw return of 1.61% each, outperforming the market by an insignificant 0.10% per month. The least favourably recommended Portfolio 3 earns an average of 0.53% per month, and has an abnormal return of –0.98% against the market, significant at the 1% level. The Black-Litterman Portfolio earns an average monthly return of 1.86%, which is 0.35% above the market's monthly mean return. This result is statistically significant at the 1% level. This result suggest that, not only does the Black-Litterman Portfolio earn a higher market adjusted abnormal return, that outperformance is also more consistent and less volatile.

We calculate the Sharpe and Sortino ratios to measure the portfolios' return for every unit of volatility and downside risk. Once again, similar to in the estimation period, Portfolio 2 performs best among the consensus groups after adjusting for risk, posting a Sharpe Ratio of 3.64 and a Sortino Ratio of 5.75 compared to Portfolio 1's 2.03 and 3.62. During this period, both Portfolio 1 and 3 underperform the market, after adjusting for volatility and downside risk. Black-Litterman Portfolio outperforms the market as well as all individual consensus groups after adjusting for risk, achieving a Sharpe Ratio of 4.03 and a Sortino Ratio of 5.86.

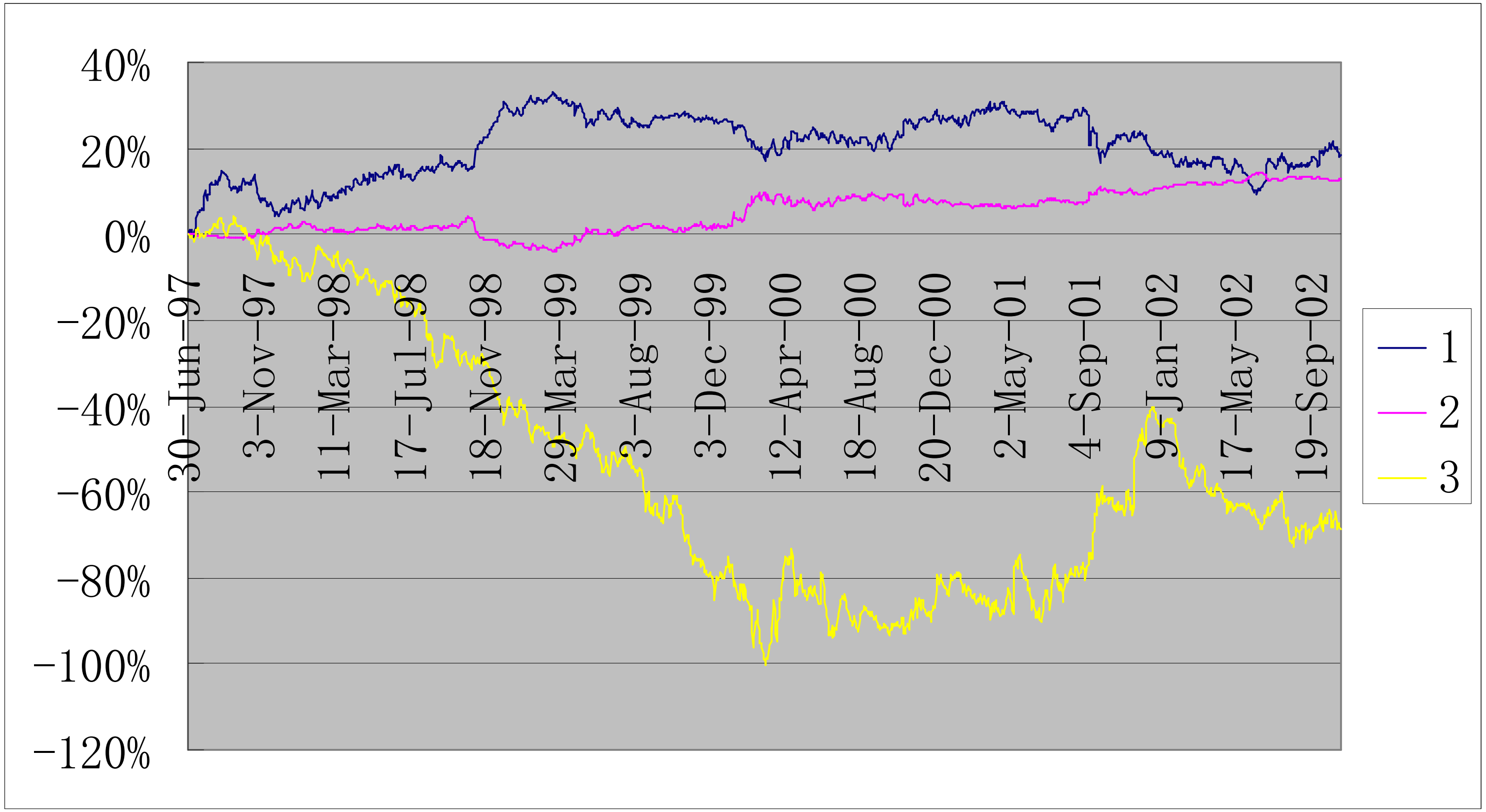
From the above we can see that the Black-Litterman Portfolio exhibits higher return, and lower volatility and downside risk. This is a result of overweighting (underweighting) stocks with favourable (unfavourable) analyst recommendations by incorporating their relative performance into a mean-variance optimization context. This consistency in the performance of the Black-Litterman Portfolio is evident in Figure 7, which shows the cumulative percentage market adjusted returns of portfolios from 31 October 2002 to October 30 2007. The steady divergence of the Black-Litterman Portfolio's cumulative abnormal return contrasts with the unstable performances of consensus Portfolio 1. Over the 5 year period, the Black-Litterman Portfolio constructed on the basis of relative performance of consensus recommendation groups outperforms the market by over 20% with little downside risk.

Figure 5: Performance of the Black-Litterman Portfolio, Consensus Portfolios and the S&P/ASX 50 Index from 31/10/02 to 30/10/07



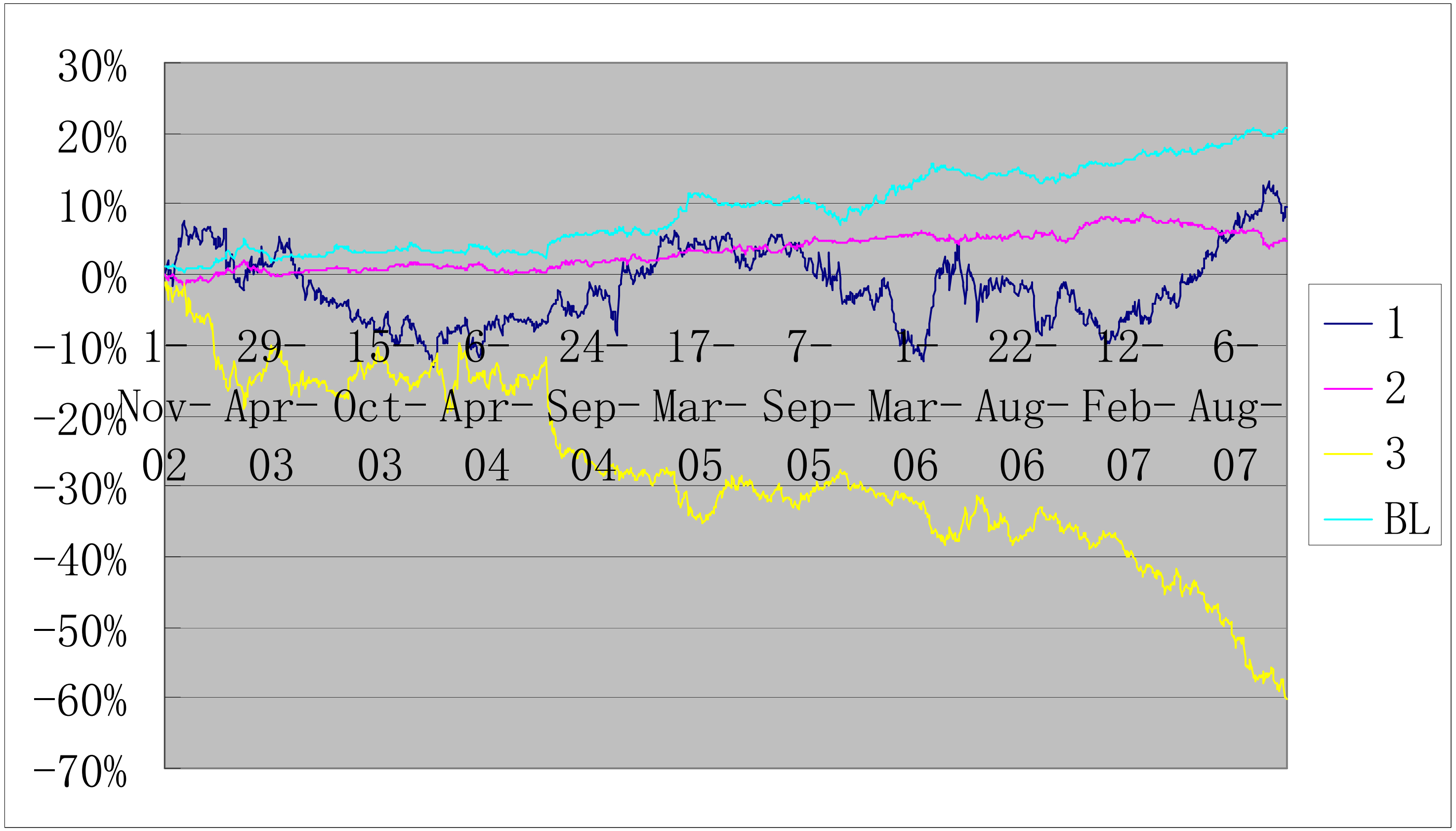
These performances are based on daily rebalancing, at the close with all recommendations included in the consensus calculation. The Black-Litterman model uses constant relative performance views, updated confidence levels and tau = 0.05

Figure 6: Cumulative Percentage Market Adjusted Return Earned by Portfolios Formed on the Basis of Consensus Analyst Recommendations from 30/6/1997 to 31/10/2002



These performances are based on daily rebalancing at the close, with all recommendations included in the consensus calculation. The Black-Litterman model uses constant relative performance views, updated confidence levels and tau = 0.05

Figure 7: Cumulative Percentage Market Adjusted Return Earned by the Black-Litterman Portfolio and Consensus Group Portfolios from 31/10/2002 to 30/10/2003

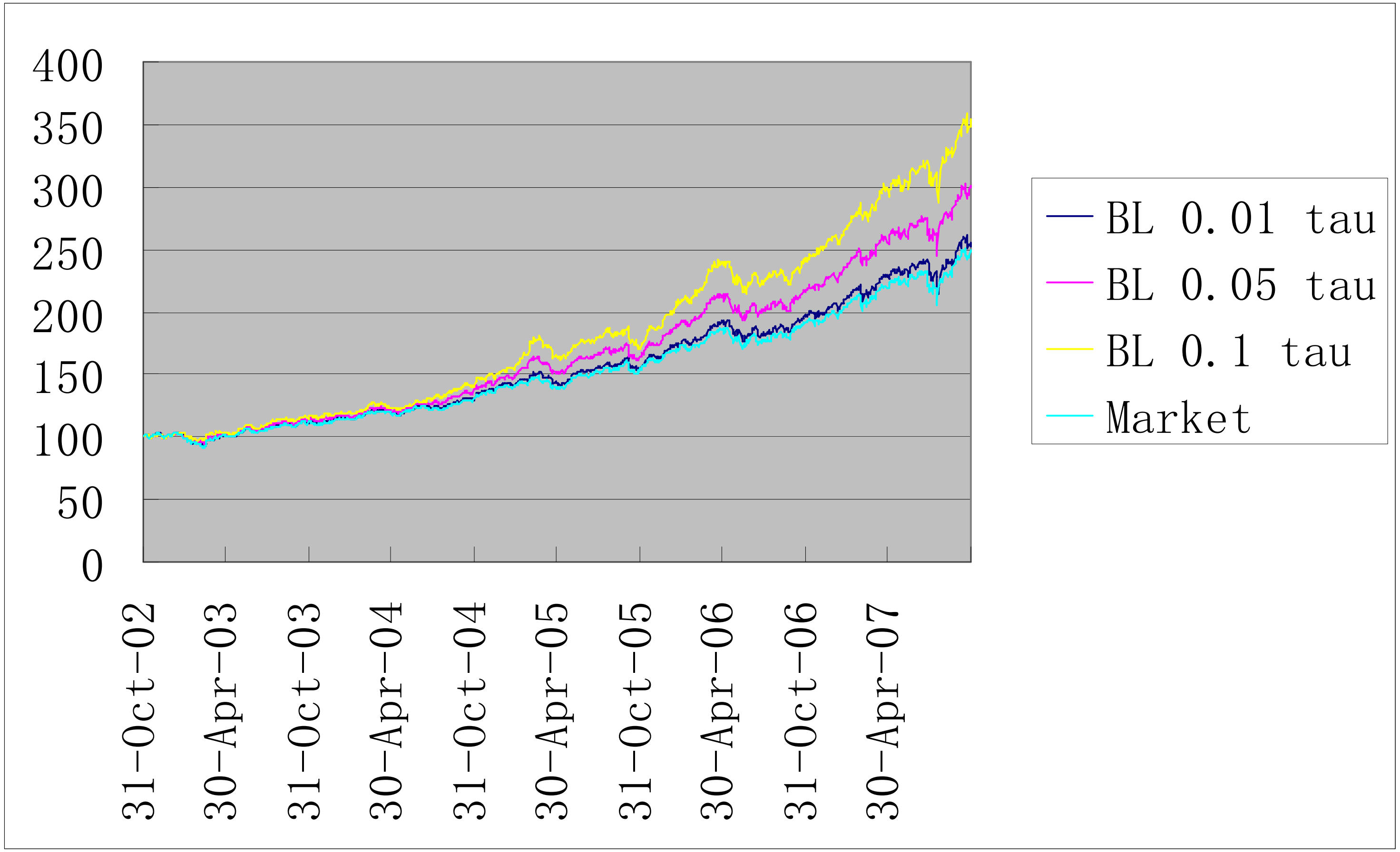


These performances are based on daily rebalancing at the close, with all recommendations included in the consensus calculation. The Black-Litterman model uses constant relative performance views, updated confidence levels and tau = 0.05

The reported performance measures above are gross of transaction costs. As have been shown, the implementation of our daily rebalancing strategies generates significant turnover. The Black-Litterman Portfolio turns over 79% of its value every month. The monthly turnover of Portfolio 2 is 30%, again much lower than that of Portfolio 1 and 3, which have an average monthly turnover of 76% and 86% respectively. After accounting for transaction cost, the net abnormal returns for the Black-Litterman Portfolio and the two favourably recommended portfolios are negative but statistically insignificant, whereas hold Portfolio 3 would cause a statistically significant loss of 1.38% per month.

We also test the performance of the Black-Litterman Portfolio using different covariance shrinkage factors – the results shown in Table 5.5 and Figure 8. Increasing (decreasing) the covariance shrinkage factor τ increases (decreases) the uncertainty of equilibrium implied returns and places more (less) emphasis on the investor views. Consequently the asset allocations are tilted more (less) aggressively. Thus a larger (smaller) τ is likely to cause increases in return, risk and turnover. Consistent with expectations, we find that a higher τ (0.1) causes increase in monthly abnormal return to 0.65%, while a lower τ (0.01) value causes a reduction in monthly abnormal return to 0.09%. Risk and turnover also increase (decrease) with the increase (decrease) in τ. The Black-Litterman Portfolio consistently outperforms the market given different shrinkage factors (see Figure 8). The gross abnormal returns with different covariance shrinkage factors remain statistically significant, whereas all net abnormal returns are

Figure 8: The Performance of Black-Litterman Portfolios with Different Levels of Covariance Shrinkage



These performances are based on daily rebalancing at the close, with all recommendations included in the consensus calculation. The Black-Litterman model uses constant relative performance views, updated confidence levels at an insignificant –0.02% per month. The shrinkage factor of 0.05 produces the higher Sortino ratios out of the three, suggesting that every unit of downside risk is compensated by a higher rate of return. The results indicate that a decrease in τ causes a reduction performance as well as portfolio variance, and hence the gross abnormal return remain significant for $\tau = 0.01$. An increase in τ to 0.1 causes an increase in raw returns, but that is balanced out by the additional transaction cost generated from higher turnover.

5.3 The Effect of Infrequent Rebalancing

The investment performance figures reported in this study are achieved assuming that investors have access to analyst recommendations on the day of their release and rebalance their portfolios daily to reflect revisions in analyst recommendations. In reality this investment strategy generates excessive amounts of trading and transaction costs for the investor. This section examines whether frequent rebalancing is essential in order to capture the abnormal returns associated with analyst recommendations. According to Barber et al (2001), less frequent rebalancing should cause abnormal returns to diminish, because investors will be less likely to capture the price drift occurring in the early days after a stock enters a particular portfolio, and they will continue to hold a stock after it moves from the portfolio. In this section, we track the performance of the consensus recommendation portfolios as well as the Black-Litterman Portfolio achieved through rebalancing at the end of every month.

The consensus recommendation of each covered stock is calculated as of the close the last trading day of every month. The stocks are not traded again until the end of the next month when the consensus recommendations are recalculated and portfolios are rebalanced. Portfolio return and turnover are calculated again (as described in the Research Design Section).

Table 5.2 shows the monthly performance results of consensus group portfolios for the estimation period from 30 June 1997 to 31 October 2002, achieved though monthly rebalancing. Consensus Recommendation Portfolio 1 earns an average monthly raw return of 1.15%, outperforming the market by 0.43%. Contrary to our hypothesis, this result is slightly better than the return achieved through daily rebalancing. All other portfolios' performances are as expected, where returns of favourably (unfavourably) recommended portfolios achieved through monthly rebalancing is lower (higher) than returns achieved through daily rebalancing. This is because the delay in reaction will decrease the impact of both favourable and unfavourable recommendations on stock prices. Also as expected, turnover decreases significantly as a result of infrequent rebalancing. Portfolio 2 earns an average monthly raw return of 0.81%, and a market adjusted abnormal return of 0.09%, which is lower than the returns from daily rebalancing. The least favourably recommended Portfolio 3 falls by an average of 0.30% per month, and has an abnormal return of –1.03% against the market (slightly higher than the –1.09% through daily rebalancing). The abnormal returns reported are not significant at the 10% level of

Table 5.2: Performances of the Black-Litterman Portfolio and Consensus Recommendation Portfolios (assuming monthly rebalancing)

30 June 1997 to 31 October 2007

Portfolio	Monthly Mean Raw Return	Monthly Mean Market Adjusted Return	Sharpe Ratio	Sortino Ratio	Monthly Turnover	Monthly Return Net of Transaction Cost	Monthly Market Adjusted Return Net of Transaction Cost
P1	1.15%	0.43%	1.08	1.38	30%	1.01%	0.29%
		1.086					0.728
P2	0.81%	0.09%	0.81	1.06	15%	0.74%	0.02%
		1.380					0.152
P3	-0.30%	-1.03%	-0.88	-1.36	37%	-0.48%	-1.20%
		-1.366					-1.596
Market	0.72%		0.62	0.84		0.72%	

31 October 2002 to 30 October 2007

Portfolio	Monthly Mean Raw Return	Monthly Mean Market Adjusted Return	Sharpe Ratio	Sortino Ratio	Monthly Turnover	Monthly Return Net of Transaction Cost	Monthly Market Adjusted Return Net of Transaction Cost
BL	1.71%	0.19%	3.50	5.04	22%	1.61%	0.09%
		1.371					0.648
P1	1.57%	0.05%	2.18	3.50	32%	1.42%	-0.10%
		0.138					-0.254
P2	1.57%	0.06%	3.41	5.45	10%	1.53%	0.01%
		0.628					0.139
P3	0.76%	-0.76%	0.50	0.63	34%	0.60%	-0.91%
		-1.669					**-2.017**
Market	1.51%		3.27	5.22		1.51%	

This table presents the mean monthly returns Sharpe and Sortino Ratios of consensus portfolios formed on the basis of analyst recommendations and the Black-Litterman Portfolio formed on the basis of relative performance between consensus recommendation groups. The number below the return figures are t-statistics pertaining to the null hypothesis that the associated return is zero. Abnormal returns that are significant at the 10% level have their t-statistics shown in bold. Net performances are calculated assuming a roundtrip transaction cost of 0.47%. The returns are achieved by monthly rebalancing of the portfolios. The consensus recommendations are calculated using all outstanding recommendations. The Black-Litterman Portfolio uses tau = 0.05.

significance. The turnovers of all three consensus portfolios roughly halves as a result of less frequent rebalancing. This causes a substantial reduction in transaction cost. The net market adjusted abnormal returns remain insignificantly different from zero.

Table 5.2 also shows the monthly performance results of consensus portfolios for the period from 31 October 2002 to October 30 2007 achieved through monthly rebalancing. Consensus Recommendation Portfolio 1 & 2 earns average monthly raw returns of 1.57% each, insignificantly outperforming the market by 0.05%. The least favourably recommended Portfolio 3 earns an average of 0.76% per month, and has an abnormal return of –0.76% against the market, significant at the 10% level. For the purpose of comparability, both Black-Litterman Portfolios with daily and monthly rebalancing share the same view matrix estimated by the abnormal returns from Consensus Portfolios using daily rebalancing in the estimation period. The Black-Litterman Portfolio earns an average monthly return of 1.71%. The market adjusted abnormal return for the Black-Litterman Portfolio using monthly rebalancing decreases from a significant 0.35% using daily rebalancing to an insignificant 0.19% under monthly rebalancing. This is accompanied by an increase in net returns after transaction costs due to the substantial reduction in transaction costs as monthly turnover drops from 79% to 22%. The resulting net abnormal return is positive but insignificantly different from zero. In contrast to the loss of significance of the Black-Litterman Portfolio's abnormal return, the market adjusted return for Consensus Portfolio 3 remains significant. Again, monthly turnover declines substantially, from 86% with daily rebalancing to 34% under monthly rebalancing. The above results seem to be consistent with the notion that infrequent rebalancing reduces the abnormal performances captured by our investment strategies. In general, there is a decrease in return and turnover. The abnormal returns net of transaction cost remains statistically insignificant.

We calculate the Sharpe and Sortino ratios to measure the portfolios' return for every unit of volatility and downside risk. The Black-Litterman Portfolio outperforms the market and all individual consensus groups after adjusting for risk, achieving a Sharpe Ratio of 3.50 and a Sortino Ratio of 5.04. This is worse than under daily rebalancing. Portfolio 2 performs best among the consensus groups after adjusting for risk, posting a Sharpe Ratio of 3.41 and a Sortino Ratio of 5.45; this compares to Portfolio 1's 2.18 and 3.50. Both Portfolio 1 and 3 underperforms the market after adjusting for volatility and downside risk. These results also support the hypothesis that infrequent rebalancing reduces the performance of our investment strategy.

5.4 Filtering of Dated Recommendations

In this section, we investigate the effects of using only recently issued recommendations in our consensus calculations on the investment performances. This is done to test whether the performances of trading strategies based on analyst recommendations can be improved by filtering dated recommendations. As Green

(2003) suggests, one of the possible reasons that consensus recommendations perform poorly in some prior studies is because some of the recommendations that enter into the consensus can be fairly stale. If analysts leave their recommendations on stock outstanding for extended periods of time, they may become obsolete. When dated recommendations enter the calculation along with recently issued recommendations they may distort the investment value of the consensus recommendation. Therefore filtering stale recommendations may generate better consensus portfolio performance. On the other hand, a recommendation is not like an earnings forecast, which will change more frequently and suffer from staleness to a larger degree. There could be long standing recommendations that reflect the analyst's view incorporating up to date information. In this case the analyst may not need to update their recommendation and its issuance date could be from many months prior. Furthermore, some researches suggest that not including all recommendations as part of the consensus may make it less informative. Elton et al. (1986) finds consensus analyst recommendations outperform individual analyst recommendations in their predictive ability. Clemen (1989) finds through the review of literature on forecasting that predictive accuracy of forecasts can be substantially improved through the combination of multiple individual forecasts. He also suggests that simple combination methods (like simple averaging) often perform better than more complex combinations.

Table 5.3: Performances of the Black-Litterman Portfolio and Consensus Recommendation Portfolios (using outstanding recommendations within 45 days of issuance)

30 June 1997 to 31 October 2007

Portfolio	Monthly Mean Raw Return	Monthly Mean Market Adjusted Return	Sharpe Ratio	Sortino Ratio	Monthly Turnover	Monthly Return Net of Transaction Cost	Monthly Market Adjusted Return Net of Transaction Cost
P1	1.14%	0.41%	1.08	1.56	205%	0.18%	-0.55%
		0.928					-1.225
P2	0.46%	-0.27%	0.05	0.08	162%	-0.31%	-1.03%
		-1.076					**-4.134**
P3	0.25%	-0.47%	-0.28	-0.36	170%	-0.55%	-1.27%
		-1.202					**-3.228**
Market	0.72%		0.62	0.84		0.72%	

31 October 2002 to 30 October 2007

Portfolio	Monthly Mean Raw Return	Monthly Mean Market Adjusted Return	Sharpe Ratio	Sortino Ratio	Monthly Turnover	Monthly Return Net of Transaction Cost	Monthly Market Adjusted Return Net of Transaction Cost
BL	1.70%	0.19%	3.59	4.95	127%	1.10%	-0.41%
		2.168					**-4.796**
P1	1.57%	0.05%	2.14	3.55	221%	0.53%	-0.99%
		0.130					**-2.497**
P2	1.75%	0.23%	3.24	4.62	159%	1.00%	-0.52%
		1.398					**-3.116**
P3	1.12%	-0.39%	2.02	3.65	156%	0.39%	-1.12%
		-2.000					**-5.736**
Market	1.51%		3.27	5.22		1.51%	

This table presents the mean monthly returns Sharpe and Sortino Ratios of consensus portfolios formed on the basis of analyst recommendations and the Black-Litterman Portfolio formed on the basis of relative performance between consensus recommendation groups. The number below the return figures are t-statistics pertaining to the null hypothesis that the associated return is zero. Abnormal returns that are significant at the 10% level have their t-statistics shown in bold. Net performances are calculated assuming a roundtrip transaction cost of 0.47%. The returns are achieved by daily rebalancing of the portfolios. The consensus recommendations are calculated using outstanding recommendations within 45 days of issuance. The Black-Litterman Portfolio uses tau = 0.05.

To examine these hypotheses associated with trading strategies based on consensus recommendations, we look at the performance of trading strategies based on recent recommendations. The analyst-by-analyst recommendations for all individual updates and revisions are extracted and programmed to form our customized consensus recommendations. This is done by averaging the stock recommendations that has been outstanding for only a certain number of days. We apply two arbitrary cut-off's on outstanding recommendations: 103 days (the median interval between analyst recommendation updates) and a shorter time frame of 45 days. The percentage monthly results earned by these two simulations are presented in Tables 5.3 and 5.4. The Black-Litterman Portfolios' view vectors use relative performances of consensus portfolios with the respective calendar day cut-offs of dated recommendations.

The results seem to send a mix signal as to whether using only recently issued recommendations convey benefits. Table 5.3 shows the monthly performance of consensus group portfolios for the estimation period from 30 June 1997 to 31 October 2002, achieved by using recommendations issued in the recent 45 days. Consensus Recommendation Portfolio 1 earns an average monthly raw return of 1.14%, outperforming the market by 0.41%. This is slightly better than the 1.02% earned by consensus recommendations calculated without filtering of dated recommendations. On the other hand, Portfolio 2 earns an average monthly raw return of 0.46%, and a market adjusted abnormal return of -0.27%, which is worse than the 0.92% earned using consensus recommendations incorporating all outstanding recommendations. The least favourably recommended Portfolio 3 falls by an average of 0.25% per month, and has an abnormal return of –0.47% against the market, which is better than the –0.37% earned using consensus recommendations incorporating all outstanding recommendations. The reported returns thus far are gross of transaction costs. As shown in Table 5.3, the implementation of our filtering of dated recommendations generates significant increases in turnovers. The turnovers of consensus Portfolios 1, 2 & 3 jump from the previous 77%, 37% and 78% to 205%, 162% and 170% respectively. This results in significant increases in transaction cost. The net abnormal returns of both Portfolios 2 & 3 are significantly negative. This is expected, since the calculation of the consensus recommendation involves only the most recent individual recommendations it is likely to change more drastically as new recommendations are issued. This would, in turn, cause stocks to move between consensus groups more frequently.

For the period 31 October 2002 to October 30 2007, Consensus Portfolio 1, with a 45 days recommendation cut-off, earns an average monthly raw return of 1.57%, whereas Portfolio 2 earns an average monthly raw return of 1.75%. The least favourably recommended Portfolio 3 earns an average of 1.12% per month. The Black-Litterman Portfolio earns an average monthly return of 1.70%, which is 0.19% above the market's monthly mean return. It is lower than the result achieved by incorporating all outstanding recommendations, but remains statistically significant. The lower performance could be attributed to the difference in relative performance of consensus portfolios from 30 June 1997 to 31 October 2002 (which makes the view matrix for the period from 31 October 2002 to October 30 2007) and the realized performance in the later period. During the period from 30 June 1997 to 31 October 2002 Portfolio 1 performs very well, whereas Portfolio 2 performs relatively poorly. The reverse was true from 31 October 2002 to October 30 2007. Turnover during this period also increases dramatically. The Black-Litterman Portfolio's monthly turnover increases from 79% without filtering of dated recommendations to 127% with a 45 days cut-off. This causes it to incur a statistically significant negative abnormal return net of transaction cost. The consensus portfolios also experienced substantial increases in turnover and transaction cost, which causes all of them to incur a statistically significant negative net abnormal return.

Table 5.4 shows the monthly performance of consensus group portfolios for the estimation period from 30 June 1997 to 31 October 2002, achieved though using recommendations issued in the recent 103 days. The results are also mixed in their support for both hypotheses. Consensus Recommendation Portfolio 1 earns an average monthly raw return of only 0.64%, underperforming the market by 0.08%. This is worse than the 1.02% earned by consensus recommendations incorporating all outstanding recommendations. On the other hand, Portfolio 2 earns an average monthly raw return of 1.19%, and a market adjusted abnormal return of 0.46%, which is better than the 0.92% earned without he filtering of dated recommendations. The least favourably recommended Portfolio 3 falls by an average of 0.48% per month,

Table 5.4: Performances of the Black-Litterman Portfolio and Consensus Recommendation Portfolios (using outstanding recommendations within 103 days of issuance)

30 June 1997 to 31 October 2007

Portfolio	Monthly Mean Raw Return	Monthly Mean Market Adjusted Return	Sharpe Ratio	Sortino Ratio	Monthly Turnover	Monthly Return Net of Transaction Cost	Monthly Market Adjusted Return Net of Transaction Cost
P1	0.64%	-0.08%	0.33	0.46	145%	-0.04%	-0.76%
		-0.178					**-1.657**
P2	1.19%	0.46%	1.43	2.16	82%	0.80%	0.08%
		2.373					0.392
P3	-0.48%	-1.20%	-1.52	-2.07	136%	-1.12%	-1.84%
		-2.907					**-4.459**
Market	0.72%		0.62	0.84		0.72%	

31 October 2002 to 30 October 2007

Portfolio	Monthly Mean Raw Return	Monthly Mean Market Adjusted Return	Sharpe Ratio	Sortino Ratio	Monthly Turnover	Monthly Return Net of Transaction Cost	Monthly Market Adjusted Return Net of Transaction Cost
BL	1.88%	0.36%	3.18	6.69	221%	0.84%	-0.68%
		1.400					**-2.627**
P1	2.41%	0.90%	3.37	3.46	138%	1.76%	0.25%
		1.939					0.538
P2	1.61%	0.10%	3.30	5.62	144%	0.94%	-0.58%
		0.896					**-5.243**
P3	1.09%	-0.42%	1.64	2.70	106%	0.59%	-0.92%
		-1.862					**-4.043**
Market	1.51%		3.27	5.22		1.51%	

This table presents the mean monthly returns Sharpe and Sortino Ratios of consensus portfolios formed on the basis of analyst recommendations and the Black-Litterman Portfolio formed on the basis of relative performance between consensus recommendation groups. The number below the return figures are t-statistics pertaining to the null hypothesis that the associated return is zero. Abnormal returns that are significant at the 10% level have their t-statistics shown in bold. Net performances are calculated assuming a roundtrip transaction cost of 0.47%. The returns are achieved by daily rebalancing of the portfolios. The consensus recommendations are calculated using outstanding recommendations within 103 days of issuance. The Black-Litterman Portfolio uses tau = 0.05.

more than the 0.37% monthly drop without filtering dated recommendations. The turnovers of consensus Portfolios 1, 2 & 3 roughly doubled from the previous 77%, 37% and 78% to 145%, 82%, and 136% respectively, but were lower than that of the simulation with a 45 days cut-off of recommendations. This is expected, since relaxing the filtering criterion of outstanding recommendations to a longer interval would incorporate a larger number of outstanding recommendations, which would reduce the variance of the consensus and in turn cause stocks to move between consensus groups less frequently. This will likely generate more stable performance and reduce transaction costs.

For the period from 31 October 2002 to October 30 2007, Consensus Recommendation Portfolio 1 earns an average monthly raw return of 2.41%, whereas Portfolio 2 earns an average monthly raw return of 1.61%, both outperforming the market return of 1.51%. The least favourably recommended Portfolio 3 continues to underperform the market, earning an average of 1.09% per month. The Black-Litterman Portfolio earns an average monthly return of 1.88%, which is 0.36% above the market's monthly mean return. It is approximately the same as the result achieved by incorporating all outstanding recommendations. However, it has become statistically insignificant, which is due to an increase in portfolio variance. The performance could be attributed to the consistency in Portfolio 2's outperformance, and the fact that it contains on average 70% of covered stocks. It is overweighted by the Black-Litterman model and performs very well during the complete sample period.

Turnover during this period also increases dramatically. The Black-Litterman Portfolio's monthly turnover increases from 79% without filtering of dated recommendations to 221% with a 103 days cut-off. This causes it to incur a significant negative abnormal return net of transaction costs. The consensus portfolios also experienced similar increases in turnover and transaction costs, which cause Portfolio 2 & 3 to incur a statistically significant negative net abnormal return.

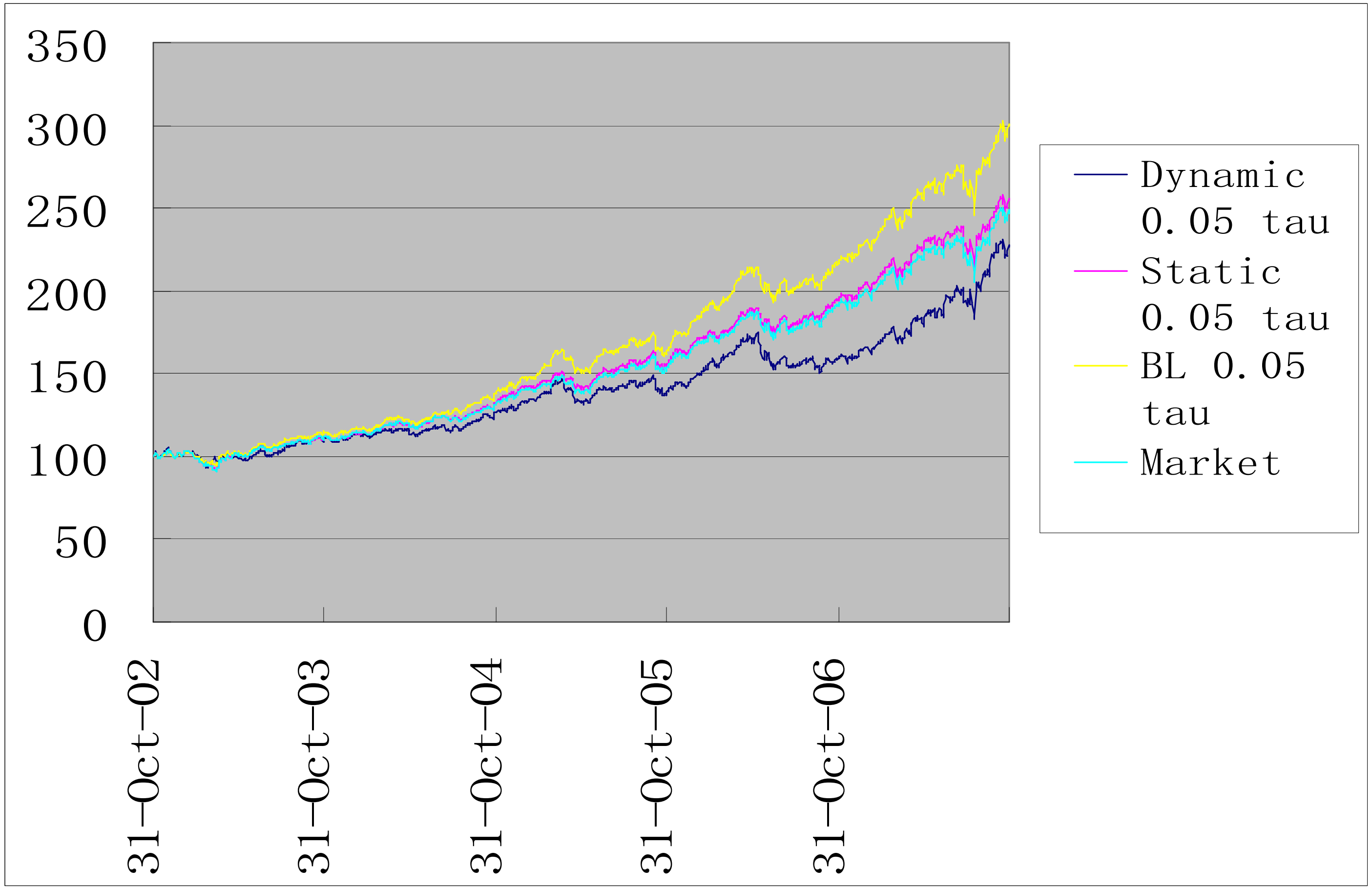
From the results above we can see that the performance of the consensus groups and the Black-Litterman Portfolio are sensitive to the filtering of dated recommendations. Results are mixed as to whether using consensus recommendations formed with recently issued recommendations convey benefits. Performance of consensus portfolios becomes less consistent across time when dated outstanding recommendations are excluded from calculations. Turnovers also increase substantially. Calculation that takes into account all outstanding recommendations tends to generate more consistent consensus portfolio performances, and lower turnover. This is beneficial to the Black-Litterman strategy, since views are expressed in terms of long term relative performance. Outperformance (underperformance) in the estimation period translates to overweight (underweight) in the test period.

5.5 Changing Assumptions of the View Matrix

In the Black-Litterman simulation, the level of consensus portfolio performance relative to the market is assumed to be constant in the long run, while our confidence in the views depends on the short-term volatility of the view portfolio. To see the effect of continuous updating of the view portfolio along with confidence levels or keeping both view and confidence fixed, we run two additional simulations. In the first one, views are updated depending on the recent performances of the consensus portfolios over the past 3 month (i.e. the Q vector of relative performance is continuously updated), whereas in the second one confidence is kept constant (i.e. the Ω matrix is fixed) as the variance of consensus portfolio during the estimation period. Table 5.5 and Figure 9 show the performance of Black-Litterman Portfolios with these different view parameters.

The Black-Litterman Portfolio with its view matrix updated on a daily basis of the consensus portfolios' past 3 month's abnormal return as input performs poorly. It generates a mean monthly return of 1.42%, underperforming the market by 0.10% while generating an extremely high level of turnover of 270% per month. This is due to the fact that the inputs to the Black-Litterman asset allocation model are continuously changing, which generates large amounts of rebalancing trades. This result is expected, since in the long term, consensus portfolios with favourable recommendations would on average outperform the market and consensus portfolios with unfavourable recommendations. The abnormal performance of consensus portfolios may not be robust in the short term, hence updating the return vector of

Figure 9: The Performance of Black-Litterman Portfolios with Different View Matrices and Confidence Assumptions



These performances are based on daily rebalancing at the close, with all recommendations included in the consensus calculation. The Black-Litterman model uses tau = 0.05

Table 5.5: Performances of Variations of the Black-Litterman Portfolio

31 October 2002 to 30 October 2007

Portfolio	Monthly Mean Raw Return	Monthly Mean Market Adjusted Return	Sharpe Ratio	Sortino Ratio	Monthly Turnover	Monthly Return Net of Transaction Cost	Monthly Market Adjusted Return Net of Transaction Cost
BL Dynamic View	1.42%	-0.10%	2.51	3.54	270%	0.15%	-1.37%
		-0.516					**-7.126**
BL Static Confidence	1.58%	0.07%	3.54	5.41	22%	1.48%	-0.04%
		1.915					-0.997
BL 0.1 tau	2.16%	0.65%	4.21	5.63	142%	1.49%	-0.02%
		2.760					-0.087
BL 0.05 tau	1.86%	0.35%	4.03	5.86	79%	1.49%	-0.02%
		2.824					-0.188
BL 0.01 tau	1.61%	0.09%	3.53	5.49	24%	1.49%	-0.02%
		2.652					-0.585

This table presents the mean monthly returns Sharpe and Sortino Ratios of Black-Litterman Portfolios formed on the basis of relative performance between consensus recommendation groups. The number below the return figures are t-statistics pertaining to the null hypothesis that the associated return is zero. Abnormal returns that are significant at the 10% level have their t-statistics shown in bold. Net performances are calculated assuming a roundtrip transaction cost of 0.47%. The returns are achieved by daily rebalancing of the portfolios. The Black-Litterman Portfolio with dynamic view updates both the relative performance between consensus recommendation groups and confidence on the views based on their past three month's performance, whereas both view and confidence stays constant for the Black-Litterman Portfolio with static confidence. All other Black-Litterman Portfolio's in this thesis assumes constant long-term relative performance while updating confidence levels based on variance of their performance.

the view matrix would cause inappropriate positions to be taken based on the short term performance of a consensus group. This is consistent with Figure 9, which show the Black-Litterman Portfolio with updating view vector underperforming the market.

We also run a Black-Litterman Portfolio with constant level of confidence in the views. The variances of the views (instead of being the equal to $P_k \sum P_k'$) are assumed to be the historical variance of the consensus portfolio's abnormal return over the estimation period. It earns a lower rate of monthly return of 1.58% (beating the market by 0.07%) while generating a much lower turnover of only 22% per month. The lower turnover is caused by the static inputs to the Black-Litterman model, which results in less rebalancing trades to occur. The lower return here compared to a Black-Litterman Portfolio with updating confidence levels is due to the fact that the neutral portfolio is tilted to the same extent throughout the sample period, which doesn't take into account changes in market volatility. Updating the confidence has positive effect on the portfolios' gross return, as the portfolios are tilted less aggressively away from the market in uncertain periods of time, and more aggressively towards the views expressed by analyst recommendations in more certain periods of time.

5.6 Bull Market and Bear Market Robustness

Since bull markets predominated during our sample period from 1997 to 2007, doubt may rise as to whether the performance results of the consensus groups and the Black-Litterman portfolio are driven by the upward moving market. That is analysts may be more skilful at stock picking in the rising market, but not a falling market. A robustness check is performed to address this problem, where the estimation and testing periods are separated into bull and bear month. If during a particular month, the market return represented by the S&P/ASX 50 Accumulation Index is positive (negative), it is classified as a bull (bear) month. This is similar to the approach use in Lakonishok, Shleifer and Vishny (1994) who study the performance of glamour and value stocks in bull and bear markets. For 1997 to 2002, 34% of the months are classified as bear markets, while 66% are classified as bull markets. For 2002 to 2007, 23% of the months are classified as bear markets, while 77% are classified as bull markets.

The average monthly raw return and market adjusted returns for bull and bear markets are calculated and reported in Table 6.1. The signs of the market adjusted abnormal returns are robust for daily rebalancing portfolios, but only a few of them are significant. Portfolio 1 and 2, and the Black-Litterman continue to outperform the market, whereas Portfolio 3 consistently underperforms the market. For the simulations ran with monthly portfolio rebalancing, the results are robust for the Black-Litterman Portfolio and Portfolio 3 across both bull markets and bear markets as they continue to generate positive and negative market adjusted returns, respectively. Although Portfolios 1 and 2 do not consistently beat the market in

Table 6.1: Percentage Monthly Return Earned by the Black-Litterman Portfolio and Consensus Recommendation Portfolios for Bull and Bear Market Months (Daily and Monthly Rebalancing)

Daily Rebalancing

97-02	Bull		Bear	
	Raw	Mkt Adjusted	Raw	Mkt Adjusted
P1	2.97%	0.10%	-2.69%	0.68%
		0.230		0.930
P2	3.00%	0.13%	-3.05%	0.32%
		0.676		1.593
P3	1.60%	-1.27%	-4.05%	-0.68%
		-1.372		-0.582

02-07	Bull		Bear	
	Raw	Mkt Adjusted	Raw	Mkt Adjusted
P1	2.72%	0.07%	-2.03%	0.20%
		0.132		0.269
P2	2.74%	0.09%	-2.12%	0.10%
		0.777		0.740
P3	1.83%	-0.82%	-3.72%	-1.50%
		-2.662		-1.519
BL	3.07%	0.41%	-2.09%	0.13%
		2.977		0.504

Monthly Rebalancing

97-02	Bull		Bear	
	Raw	Mkt Adjusted	Raw	Mkt Adjusted
P1	3.44%	0.57%	-3.22%	0.16%
		1.259		0.209
P2	2.83%	-0.04%	-3.04%	0.34%
		-0.229		**1.748**
P3	1.49%	-1.38%	-3.73%	-0.36%
		-1.531		-0.261

02-07	Bull		Bear	
	Raw	Mkt Adjusted	Raw	Mkt Adjusted
P1	2.59%	-0.07%	-1.78%	0.44%
		-0.144		0.649
P2	2.70%	0.05%	-2.12%	0.11%
		0.394		0.731
P3	2.09%	-0.56%	-3.62%	-1.40%
		-1.188		-1.211
BL	2.91%	0.25%	-2.23%	-0.01%
		1.522		-0.025

This table presents the mean monthly returns earned by consensus portfolios formed on the basis of analyst recommendations and the Black-Litterman Portfolio formed on the basis of relative performance between consensus groups, for bull and bear market months. A bull (bear) market month is defined as one where the return of the S&P/ASX 50 Accumulation Index is positive (negative). For the period from 30/6/1997 to 31/10/2002, 66% (34%) of the months are bull (bear) markets, whereas for the period from 31/10/2002 to 30/10/2007, 77% (23%) of the months are bull (bear) markets. The number below the return figures are t-statistics pertaining to the null hypothesis that the associated return is zero. Abnormal returns that are significant at the 10% level have their t-statistics shown in bold. The consensus recommendations are calculated using all outstanding recommendations.

Table 6.2: Percentage Monthly Return Earned by the Black-Litterman Portfolio and Consensus Recommendation Portfolios for Bull and Bear Market Months (with 45 days and 103 days Cut-Off for Outstanding Recommendations)

Recommendations with 45 Days Cut-Off

97-02	Bull		Bear	
	Raw	Mkt Adjusted	Raw	Mkt Adjusted
P1	3.15%	0.28%	-2.70%	0.68%
		0.486		0.926
P2	2.35%	-0.52%	-3.17%	0.21%
		-1.465		0.824
P3	2.77%	-0.10%	-4.56%	-1.18%
		-0.208		**-1.813**

02-07	Bull		Bear	
	Raw	Mkt Adjusted	Raw	Mkt Adjusted
P1	2.60%	-0.05%	-1.84%	0.38%
		-0.102		0.551
P2	2.99%	0.33%	-2.32%	-0.10%
		1.715		-0.338
P3	2.17%	-0.49%	-2.30%	-0.08%
		-1.928		-0.330
BL	2.84%	0.18%	-2.03%	0.19%
		1.859		1.156

Recommendations with 103 Days Cut-Off

97-02	Bull		Bear	
	Raw	Mkt Adjusted	Raw	Mkt Adjusted
P1	2.50%	-0.37%	-2.91%	0.46%
		-0.613		0.654
P2	3.41%	0.54%	-3.05%	0.32%
		1.94		1.50
P3	1.53%	-1.34%	-4.30%	-0.93%
		-2.69		-1.25

02-07	Bull		Bear	
	Raw	Mkt Adjusted	Raw	Mkt Adjusted
P1	3.60%	0.95%	-1.49%	0.73%
		1.859		0.686
P2	2.76%	0.11%	-2.15%	0.07%
		0.817		0.366
P3	2.32%	-0.34%	-2.94%	-0.71%
		-1.283		-1.572
BL	3.08%	0.43%	-2.10%	0.12%
		1.404		0.285

This table presents the mean monthly returns earned by consensus portfolios formed on the basis of analyst recommendations and the Black-Litterman Portfolio formed on the basis of relative performance between consensus groups, for bull and bear market months. A bull (bear) market month is defined as one where the return of the S&P/ASX 50 Accumulation Index is positive (negative). For the period from 30/6/1997 to 31/10/2002, 66% (34%) of the months are bull (bear) markets, whereas for the period from 31/10/2002 to 30/10/2007, 77% (23%) of the months are bull (bear) markets. The returns are achieved by daily rebalancing of the portfolios. The number below the return figures are t-statistics pertaining to the null hypothesis that the associated return is zero. Abnormal returns that are significant at the 10% level have their t-statistics shown in bold. The consensus recommendations are calculated using outstanding recommendations within 45 days (103 days) of issuance.

bull and bear months, they continue to outperform Portfolio 3.

We also look at the performance in bull / bear months of simulations using only recently issued recommendations (see Table 6.2). After excluding recommendations which have been outstanding for more than 45 days consensus Portfolios 1 & 2 do not consistently beat the market in bull and bear months, while on average, they continue to outperform Portfolio 3. The Black-Litterman Portfolio and Portfolio 3 continue to generate positive and negative market adjusted abnormal returns respectively across both bull markets and bear markets. After excluding recommendations which have been outstanding for more than 103 days, , Portfolios 2 & 3 outperform and underperform the index respectively in both bull and bear markets whereas Portfolio 1 outperforms the index in bear markets, but underperforms in bull markets, from 30 June 1997 to 31 October 2002. Portfolios 1 & 2, and the Black-Litterman Portfolio continue to outperform both Portfolio 3 and the market in the period from 31 October 2002 to 30 October 2007.

5.7 Execution Robustness

The robustness of the results is further tests by assuming different execution prices other than the close price. Trades are assumed to have executed at the trading day's VWAP or buyer-initiated and seller-initiated VWAP for buy and sell orders respectively. The results achieved with different execution assumptions are fairly consistent to assuming rebalancing at the close price. Returns achieved by assuming buyer-initiated and seller-initiated VWAP are lower in most cases than returns achieved assuming close price or VWAP execution, because the buyer-initiated and seller-initiated VWAP incorporates, to a certain extent, price impact cost and bid-ask spreads. However, there are a large proportion of days where the buyer-initiated VWAP was lower than the seller-initiated VWAP presumably because buyer-initiated trades occurred at lower intraday prices. The results are reported in Appendix B.

6. Conclusion

Analysts carry out research on listed companies in an attempt to identify discrepancies between the intrinsic value and market price of securities. Stock recommendations are issued with the explicit purpose of improving investment performance by exploiting perceived market mispricing. The purpose of this study is to examine the investment value of analyst recommendations on the Australian equity market. We find that stocks with favourable consensus recommendations ("strong buy" and "buy") on average earns a higher return than the market, whereas stocks with unfavourable recommendations ("strong sell" and "sell") earns a lower return. The relative performances of portfolios constructed on the basis of consensus analyst recommendations are somewhat path depended and unstable in the short term. An investment strategy using the Black-Litterman asset allocation model that overweights (underweights) stocks with favourable (unfavourable) consensus recommendations, in conjunction with daily rebalancing, produced more stable and statistically significant abnormal performance. It outperforms the market in terms of return and risk adjusted performance measures. Its performance is also consistent across bull markets and bear markets and for different execution assumptions. The implementation of our daily rebalancing strategies generates significant turnover and transaction cost. Less frequent rebalancing, in most cases, causes a decrease in both performance and turnover. Filtering of dated recommendations causes an increase in turnover, while creating mixed effects on investment returns. After accounting for a reasonable amount of transaction cost no significant abnormal profit opportunities remain.

The results seem to suggest that the market is semi-strong inefficient, and does not fully respond to analyst recommendations (before transaction cost). Although market inefficiencies exist, they are not readily exploitable for two reasons. Firstly, transaction costs would erode most of the abnormal returns generated by active investment strategies. Secondly, abnormal returns relative to the market are not consistent in the short term. There are months where unfavourably recommended stocks outperformed favourably recommended ones. These reasons allow inefficiencies to persist. However, Barber et al (2001) suggests, despite the lack of positive net returns to the strategies in this study, analyst recommendations should remain valuable to investors who are otherwise considering trading. Investor would be better off overweighting more favourable recommended stocks and underweighting those with less favourable analyst ratings, all other things being equal.

The results of this study are confined to the investment universe and investment strategies under examination and do not rule out the existence of profitable investment opportunities based on analyst recommendations. Whether other investment strategies applying analyst recommendations in other ways, to a different investment universe and/or time period would be able to yield significant net abnormal returns remains an open question, which could be explored by future research.

References

Aitken, M., J. Muthuswamy, and K. Wong (2000) The Impact of Brokers' Recommendations: Australian Evidence. PACAP/FMA conference paper, Melbourne and www.sirca.org.au.

Anand, A., S. Badrinath, S. Chakravarty, and R. Wood (2006) Is It Prudent to Trade Around Analyst Recommendation Changes? An Analysis of Transaction Costs. *Journal of Trading,* (2006) 22-37.

Ball, R., P. Brown and F. Finn, (1978), Published Investment Recommendations and Share Prices: Are there free lunches in security analysis? *JASSA*, 2, 5-10.

Barber, B., R. Lehavy, M. McNichols, and B. Trueman (2001). Can Investors Profit from the Prophets? Security Analyst Recommendations and Stock Returns. *Journal of Finance,* 56, 531−563.

Barber, B., R. Lehavy, M. McNichols, and B. Trueman (2007). Comparing the Stock Recommendation Performance of Investment Banks and Independent Research Firms. *Journal of Financial Economics*, 85, 490−517.

Barber, Brad M., and Terrance Odean (2000). Trading is hazardous to your wealth: The common stock investment performance of individual investors, *Journal of Finance* 55, 773–806.

Benninga, S. (2008) Financial Modelling 3rd Edition, The MIT Press

Black, F., and R. Litterman (1992) Global Portfolio Optimization, *Financial Analysts Journal*, September–October, pp. 28–43.

Blamont, D. and Firoozy, N. (2003) Asset Allocation Model. *Global Markets Research: Fixed Income Research,* Deutsche Bank, July

Boni L. and K. Womack (2002). Wall Street's Credibility Problem: Misaligned Incentives and Dubious Fixes? *Brookings-Wharton Papers on Financial Services: 2002*

Brown and Warner (1980) Measuring Security Price Performance, *Journal of Financial Economics* 8, 205-258

Busse, J., and T. Green (2002) Market Efficiency in Real Time. *Journal of Financial Economics* 65, 415-437.

Choi. J. (2000) The Value Line Enigma: The Sum of Known Parts. *The Journal of Financial and Quantitative Analysis,* Vol. 35, No. 3, pp. 485 -498

Clemen, R. (1989) Combining Forecasts: A Review and Annotated Bibliography. *International Journal of Forecasting*, 5 (1989) 559-583

Cowles, A. (1933) Can Stock Market Forecasters Forecast? *Econometrica* 12 (1933), 309-324

Cowles, A. (1944) Stock Market Forecasting. *Econometrica*, 12, (1944), 206-214.

Dimson, E., P. Marsh and M. Staunton (2003) Global Evidence on the Equity Risk Premium. *Journal of Applied Corporate Finance*, (2003) Vol. 15, 4

Drobetz, W. (2001), How to Avoid The Pitfalls in Portfolio Optimization? Putting the Black-Litterman Approach at Work, *Financial Markets and Portfolio Management* 15, 59-75.

Elton, E., M. Gruber, and S. Grossman, (1986), Discrete Expectational Data and Portfolio Performance. *Journal of Finance*, 41 (3), July, 699-714.

Fabre, J. and M. Snape (2007) Liquidity Surrounding Sell-Side Equity Analyst Recommendation Revisions on the Australian Securities Exchange. *Working Paper* University of Sydney.

Fama, E. (1998). Market Efficiency, Long-term Returns and Behavioural Finance. *Journal of Financial Economics* 49, 283–306.

Finn, F., (1984), .Analysts' Recommendations in Evaluation of the Internal Processes of Managed Investment Funds, *In Contemporary Studies in Economic and Financial Analysis*, 44, Chapter VII, JAI Press Inc.

Green, T. (2003) The Value of Client Access to Analyst Recommendations. The Social Science Research Network.

Grinold, R. and N. Kahn (1999) Active Portfolio Management. 2nd edition. New York: McGraw-Hill.

He, G., and R. Litterman (1999). The Intuition behind BLACK-LITTERMAN Model Portfolios, *Goldman Sachs Investment Management Research.*

I/B/E/S Recommendation Detail History – A Guide to I/B/E/S Recommendations Database

Idzorek, T. (2004) A Step-By-Step Guide to the Black-Litterman Model: Incorporating User Specified Confidence levels", *Working Paper*

Irvine, P. (2003) The Incremental Impact of Analyst Initiation of Coverage. *Journal of Corporate Finance* 9, 431-451

Jaffe, J. and Mahoney, J. (1999) The performance of investment newsletters, *Journal of Financial Economics*, 53, 289-307.

Jegadeesh, N., and W. Kim (2006) Value of Analyst Recommendations: International Evidence, *Journal of Financial Markets* 9 (2006) 274–309

Jegadeesh, N., W. Kim, S. Krische, and C. Lee (2004) Analysing the Analysts: When Do Recommendations Add Value? *Journal of Finance*, 59, 1083–1124.

Lakonishok, J., A. Shleifer and R. Vishny (1994) Contrarian Investment, Extrapolation and Risk. *Journal of Finance*, 49, 1541–1578.

Ledoit and Wolf (2003) Honey, I Shrunk the Sample Covariance Matrix. The Social Science Research Network.

Lin, H., and M. McNichols, (1998) Underwriting Relationships, Analysts' Earnings Forecasts and Investment Recommendations, *Journal of Accounting and Economics* 25, 101– 127.

Li, X. (2005). The Persistence of Relative Performance in Stock Recommendations of Sell-side Financial Analysts, *Journal of Accounting and Economics* 40, 129–152

Markowitz, H.M. (1952) Portfolio Selection. *The Journal of Finance*, March, 77-91.

Michaely, R, and K. Womack, (1999). Conflict of Interest and the Credibility of Underwriter Analyst Recommendations, *Review of Financial Studies* 12, 653–686.

Mikhail, M., B. Walther, and R. Willis (2004). Do Security Analysts Exhibit Persistent Differences in Stock Picking Ability? *Journal of Financial Economics* 74, 67–91

Ramnath, S., Rock S., and Shane, P. (2008) The Financial Analyst Forecasting Literature: A Taxonomy with Suggestions for Further Research. *International Journal of Forecasting* 24 (2008) 34–75.

Roll, R. (1997) A Critique of the Asset Pricing Theory's Tests' Part I: On Past and

Potential Testability of the Theory. *Journal of Financial Economics*. 4:2, 129-176

Schipper (1991) Analysts' Forecasts. *Accounting Horizons;* Dec 1991; 5, 4

Sharpe, W. (1964) Capital Asset Prices: A Theory of Market Equilibrium. *Journal of Finance*, September, 425-442.

Sharpe, W. (1974) Imputing Expected Security Returns from Portfolio Composition. *Journal of Financial and Quantitative Analysis*, June, 463-472.

Standard and Poor's: S&P Australian Indices Methodology. www.standardandpoors.com.au

Stickel, S. (1995) Anatomy of the Performance of Buy and Sell Recommendations. *Financial Analysts Journal* 51, 25–39.

Theil, H. (1978) *Introduction to Econometrics*. New Jersey: Prentice-Hall, Inc.

Womack, K. (1996) Do Brokerage Analysts' Recommendations Have Investment Value? *Journal of Finance* 51, 137–167.

Wong, K., (2002) The Impact of Analysts' Recommendations. Working Paper Sydney University

Appendix A: Table of Annotated References

Security Analyst Recommendation Literature		
Author	**Reference**	**Summary / Findings**
Anand, Badrinath, Chakravarty, & Wood, (2006)	*Journal of Trading,* Fall 2006, 22-37.	The release of analyst recommendations enhances liquidity. Spreads do not change while volume and depth increase.
Ball, Brown & Finn, (1978)	*JASSA*, 2, 5-10.	Abnormal returns are found in the months leading up to the announcement of the recommendations. Smaller returns are recorded in the month of the announcement, while little evidence of abnormal returns is found in the post-recommendation period.
Barber, Lehavy, McNichols, & Trueman, (2001)	*Journal of Finance,* 56, 531−563.	Calendar-time trading strategies that long (short) stocks with the most (least) favourable stock recommendations yields abnormal returns of over 4%.p.a. However, net returns after transaction cost are insignificant.
Barber Lehavy, McNichols, & Trueman, (2002)	The Social Science Research Network.	A re-examination of the investment value of analyst recommendations using calendar-time trading strategy for 2000 and 2001 finds that the least favourably recommended stock outperform the most favourably recommended ones.
Barber, Lehavy, & Trueman, (2007)	*Journal of Financial Economics*, 85, 490−517	The market reaction to independent analysts' buy recommendations exceeds the reaction to investment bank analysts' buy recommendations, suggesting that the market can de-bias the optimism in investment bank analysts' recommendations.
Boni & Womack (2002)	*Brookings-Wharton Papers on Financial Services: 2002*	Existing and potential investment banking relationships influence analyst judgement. Institutional investors are able to de-bias sell-side analysts' research results, to a certain extent with internal research.
Brown (1993)	International Journal of Forecasting 9 (1993) 295-320	This paper provides a summary of the literature on analyst earnings forecasting.
Choi, (2000)	*The Journal of Financial and Quantitative Analysis,* Vol. 35, No. 3, 485 - 498	The investment advice encapsulated in the Value Line Investment Surveys exhibits performance beyond what is predicted by existing models of expected return. However, abnormal profits after transactions costs are insignificant.
Cowles, (1933)	Econometrica 12,	This paper assesses the stock selection and market

	309-324	timing ability of security analysts and finds that on average the recommendations issued by analysts perform poorly against the market.
Cowles, A., (1944)	*Econometrica*, 12, July. October, 206-214.	This paper re-examines the recommendations of 11 of the financial publications and find evidence of more favourable performance compared to Cowles, (1933).
Elton, Gruber & Grossman (1986)	*Journal of Finance*, XLI (3), July, 699-714	Firms that receive buy (sell) recommendations tend to earn higher (lower) abnormal returns. Consensus recommendations generally perform better than individual ones.
Fabre & Snape, (2007)	Working Paper	Analyst recommendation revisions are found to be liquidity enhancing events. The empirical results indicate that bid-ask spreads do not change around revisions, but depths and trading volume increase.
Finn (1984)	*In Contemporary Studies in Economic and Financial Analysis*, 44, Chapter VII, JAI Press Inc.	This paper examines the information content of recommendations produced by the in-house analysts of a financial institution. The price movements of the stocks are consistent with the direction of the recommendations. The most significant evidence of abnormal returns is found in the first month after a recommendation.
Green, (2003)	The Social Science Research Network.	Early access to stock recommendations provides investors with incremental investment value. Abnormal profit after transaction costs is significant. A calendar-time strategy produces annualized returns of over 30%.
Irvine, (2003)	Journal of Corporate Finance 9, 431-451	The market responds more positively to analysts' initiations than to other recommendations. Both price and liquidity of the stock increases.
Jaffe & Mahoney, (1999)	Journal of Financial Economics, 53, 289-307.	Stocks recommended in investment newsletters do not on average outperform the market. The performance of individual investment newsletters exhibits some persistency.
Jegadeesh, & Kim (2006)	*Journal of Financial Markets* 9 (2006) 274–309	Stock prices react significantly to recommendation revisions in all G7 countries except Italy. The largest price reactions around recommendation revisions and the largest post-revision price drifts happen in the US.
Jegadeesh, Kim, Krische, Lee, (2004)	*Journal of Finance*, 59, 1083–1124.	Stocks favourably recommended by the analysts, on average, outperform stocks unfavourably recommended by them. However, there is a bias for analysts from sell-side firms to recommend "glamour" stocks, which may affect investment

		returns.
Li, (2005)	*Journal of Accounting and Economics* 40, 129–152	Analysts with above-median risk-adjusted performance in the estimation period persistently outperform those with below-median performance in the subsequent holdout period.
Lin, & McNichols, (1998)	*Journal of Accounting and Economics* 25, 101–127	Recommendations of underwriter analysts are more optimistic than that of unassociated analysts. Investors respond similarly to favourable recommendations, but more negatively to hold recommendations from underwriter analysts.
Michaely, & Womack, (1999)	*Review of Financial Studies* 12, 653–686	Buy recommendations from underwriter analysts underperform buy recommendations from unassociated analysts, suggesting bias in underwriter analysts' research. The market does not fully recognize the extent of the bias.
Mikhail, Walther, & Willis (2004)	*Journal of Financial Economics* 74, 67–91	Analysts' recommendations exhibit persistency in performance. Excess returns following the revision are positively associated with analysts' prior performance. However, a trading strategy taking long (short) positions in recommendation upgrades (downgrades) conditional on analysts' performance is not sufficiently profitable after transaction cost.
Ramnath, Rock & Shane, (2008)	*International Journal of Forecasting* 24 (2008) 34–75	This paper develops a taxonomy of research examining the role of financial analysts in capital markets, based on the foundation provided by Schipper (1991) and Brown (1993).
Schipper (1991)	*Accounting Horizons;* Dec 1991; 5, 4	This paper provides a summary of the results of prior literature on analyst earnings forecasts, decision process and incentives.
Stickel, (1995)	*Financial Analysts Journal* 51, 25–39	The magnitude of price impact from recommendation changes is positively related to the strength of the recommendation, the magnitude of change, the reputation of the analyst, and the marketing ability of the brokerage. The effect of the analyst recommendations also depends on the information environment, and whether contemporaneous earnings revisions are being released.
Womack, (1996)	*Journal of Finance* 51, 137–167	Large share price reactions are recorded at the time of the recommendations, even though few recommendations coincide with new events or provide previously unavailable information. Post-recommendation stock price drifts are found to last up to one month for upgrades and six months for

		downgrades.
Black-Litterman Model Literature		
Author	**Reference**	**Summary**
Black & Litterman (1992)	*Financial Analysts Journal*, September–October, pp. 28–43	This paper introduces the Black-Litterman Global Optimization Model.
Da & Jagannathan (2005)	*Teaching Note on Black-Litterman Model*	MBA teaching note (Kellogg School of Business) on the excel modelling and implementation of the Black-Litterman Model.
Drobetz (2001)	*Financial Markets and Portfolio Management* Volume 15, PP. 59-75	Provides an intuitive guide and examples to the Black-Litterman Model.
He & Litterman (1999)	*Goldman Sachs Investment Management Research.*	Explains the underlying intuition with the Black-Litterman Model.
Idzorek (2004)	Working Paper	Provides and detailed step-by-step guide to the implementation of the Black-Litterman Model, with a focus of how to incorporate investor views.
Malloch & O'Shea (2008)	Next Financial Research Paper	Explains the basic math and derivation from the mean-variance optimization to the Black-Litterman Model.

Appendix B: Monthly Raw Returns and Market Adjusted Returns of Portfolios Using Different Execution Assumptions

Consensus Portfolios from 30/6/1997 to 31/10/2002

Period	Rebalancing	Execution	Portfolio	Monthly Raw Return	Monthly Market Adjusted Return
Consensus					
1997-2002	Daily	cls	1	1.022%	0.298%
1997-2002	Daily	vwap	1	1.035%	0.013%
1997-2002	Daily	bisi	1	0.956%	0.240%
1997-2002	Daily	cls	2	0.918%	0.194%
1997-2002	Daily	vwap	2	0.935%	-0.087%
1997-2002	Daily	bisi	2	0.897%	0.180%
1997-2002	Daily	cls	3	-0.365%	-1.089%
1997-2002	Daily	vwap	3	-0.447%	-1.468%
1997-2002	Daily	bisi	3	-0.648%	-1.365%
Monthly Rebalancing					
1997-2002	Monthly	cls	1	1.150%	0.426%
1997-2002	Monthly	vwap	1	1.159%	0.138%
1997-2002	Monthly	bisi	1	1.144%	0.428%
1997-2002	Monthly	cls	2	0.814%	0.090%
1997-2002	Monthly	vwap	2	0.806%	-0.216%
1997-2002	Monthly	bisi	2	0.792%	0.076%
1997-2002	Monthly	cls	3	-0.303%	-1.027%
1997-2002	Monthly	vwap	3	-0.222%	-1.244%
1997-2002	Monthly	bisi	3	-0.429%	-1.145%
45 Days Cut-off					
1997-2002	Daily	cls	1	1.138%	0.414%
1997-2002	Daily	vwap	1	1.306%	0.582%
1997-2002	Daily	bisi	1	1.093%	0.376%
1997-2002	Daily	cls	2	0.455%	-0.269%
1997-2002	Daily	vwap	2	0.444%	-0.280%
1997-2002	Daily	bisi	2	0.295%	-0.421%
1997-2002	Daily	cls	3	0.250%	-0.474%
1997-2002	Daily	vwap	3	0.157%	-0.566%
1997-2002	Daily	bisi	3	-0.047%	-0.764%
103 Days Cut-Off					
1997-2002	Daily	cls	1	0.642%	-0.082%
1997-2002	Daily	vwap	1	0.817%	0.093%
1997-2002	Daily	bisi	1	0.629%	-0.087%
1997-2002	Daily	cls	2	1.187%	0.463%
1997-2002	Daily	vwap	2	1.106%	0.382%
1997-2002	Daily	bisi	2	1.056%	0.340%
1997-2002	Daily	cls	3	-0.477%	-1.201%
1997-2002	Daily	vwap	3	-0.485%	-1.209%
1997-2002	Daily	bisi	3	-0.685%	-1.402%

Appendix B: Consensus Portfolios from 31/10/2002 to 30/10/2007

Period	Rebalancing	Execution	Portfolio	Monthly Raw Return	Monthly Market Adjusted Return
Consensus					
2002-2007	Daily	cls	1	1.612%	0.097%
2002-2007	Daily	vwap	1	1.620%	0.132%
2002-2007	Daily	bisi	1	1.614%	0.127%
2002-2007	Daily	cls	2	1.607%	0.092%
2002-2007	Daily	vwap	2	1.556%	0.067%
2002-2007	Daily	bisi	2	1.547%	0.061%
2002-2007	Daily	cls	3	0.535%	-0.980%
2002-2007	Daily	vwap	3	0.570%	-0.919%
2002-2007	Daily	bisi	3	0.486%	-1.001%
Monthly Rebalancing					
2002-2007	Monthly	cls	1	1.568%	0.053%
2002-2007	Monthly	vwap	1	1.525%	0.036%
2002-2007	Monthly	bisi	1	1.501%	0.014%
2002-2007	Monthly	cls	2	1.575%	0.060%
2002-2007	Monthly	vwap	2	1.564%	0.075%
2002-2007	Monthly	bisi	2	1.558%	0.071%
2002-2007	Monthly	cls	3	0.759%	-0.756%
2002-2007	Monthly	vwap	3	0.792%	-0.697%
2002-2007	Monthly	bisi	3	0.752%	-0.735%
45 Days Cut-off					
2002-2007	Daily	cls	1	1.566%	0.051%
2002-2007	Daily	vwap	1	1.501%	0.012%
2002-2007	Daily	bisi	1	1.397%	-0.090%
2002-2007	Daily	cls	2	1.747%	0.232%
2002-2007	Daily	vwap	2	1.803%	0.314%
2002-2007	Daily	bisi	2	1.650%	0.163%
2002-2007	Daily	cls	3	1.124%	-0.391%
2002-2007	Daily	vwap	3	1.038%	-0.450%
2002-2007	Daily	bisi	3	0.942%	-0.545%
103 Days Cut-Off					
2002-2007	Daily	cls	1	2.415%	0.900%
2002-2007	Daily	vwap	1	2.388%	0.899%
2002-2007	Daily	bisi	1	2.379%	0.892%
2002-2007	Daily	cls	2	1.613%	0.098%
2002-2007	Daily	vwap	2	1.584%	0.095%
2002-2007	Daily	bisi	2	1.569%	0.082%
2002-2007	Daily	cls	3	1.090%	-0.425%
2002-2007	Daily	vwap	3	0.926%	-0.563%
2002-2007	Daily	bisi	3	0.936%	-0.551%

Appendix B: Black-Litterman Portfolios

Period	Rebalancing	Execution	Shrinkage	Monthly Raw Return	Monthly Market Adjusted Return
Black-Litterman (default)					
2002-2007	Daily	cls	0.1 tau	2.160%	0.645%
2002-2007	Daily	vwap	0.1 tau	2.150%	0.662%
2002-2007	Daily	bisi	0.1 tau	2.103%	0.616%
2002-2007	Daily	cls	0.01 tau	1.606%	0.092%
2002-2007	Daily	vwap	0.01 tau	1.582%	0.093%
2002-2007	Daily	bisi	0.01 tau	1.576%	0.089%
2002-2007	Daily	cls	0.05 tau	1.862%	0.347%
2002-2007	Daily	vwap	0.05 tau	1.843%	0.354%
2002-2007	Daily	bisi	0.05 tau	1.818%	0.332%
2002-2007	Monthly	cls	0.05 tau	1.709%	0.194%
2002-2007	Monthly	vwap	0.05 tau	1.684%	0.196%
2002-2007	Monthly	bisi	0.05 tau	1.682%	0.196%
Black-Litterman 45 Days Cut-off					
2002-2007	Daily	cls	0.05 tau	1.701%	0.186%
2002-2007	Daily	vwap	0.05 tau	1.710%	0.221%
2002-2007	Daily	bisi	0.05 tau	1.640%	0.153%
Black-Litterman 103 Days Cut-off					
2002-2007	Daily	cls	0.05 tau	1.876%	0.361%
2002-2007	Daily	vwap	0.05 tau	1.781%	0.293%
2002-2007	Daily	bisi	0.05 tau	1.712%	0.225%
Black-Litterman with Dynamic Views					
2002-2007	Daily	cls	0.05 tau	1.416%	-0.099%
2002-2007	Daily	vwap	0.05 tau	1.358%	-0.131%
2002-2007	Daily	bisi	0.05 tau	1.223%	-0.264%
Black-Litterman with Static Confidence					
2002-2007	Daily	cls	0.05 tau	1.583%	0.069%
2002-2007	Daily	vwap	0.05 tau	1.550%	0.061%
2002-2007	Daily	bisi	0.05 tau	1.554%	0.067%