School of Economics and Finance

An Analysis of Australian Mutual Fund Performance and Market Relationships

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

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Abstract

Mutual funds are emerging as an opportunity for investors to automatically diversify their investments in such a way that all their money is pooled and the investment decisions are left to a professional manager. There are various types of mutual funds that generally come with different investment objectives. Consequently, mutual funds have grown to play an important role in financial markets and the price prediction evaluation of mutual funds have performed has evolved into an important topic for investors and academicians consider over the last decade.

Portfolio theory demonstrates that the gains from a diversified portfolio involve different degrees of price co-movement between securities. If domestic equity markets have a long-run tendency to diverge from equilibrium, there are gains to be made from domestic diversification between equity mutual funds and the stock market. According to the rational expectations and the efficient market hypothesis, the expectations of future prices are equal to optimal forecasts using all currently available information. If equilibrium does exist then the market signals would function properly. The implications for rational expectations are that most of the information gleaned from market prices will be known. Then, if the prices of equity mutual funds and stock markets tend to converge, this suggests that the price of one security can be used to predict another.

Understanding the price behaviour and performance of mutual funds would be useful for investors who have a choice of investment. Knowledge of the causes and degree of equity mutual fund volatility is beneficial to policy makers and economic forecasters in predicting the direction of mutual fund prices. However, previous Australian studies have only been limited into testing explicitly of superannuation funds and wholesale funds. These results have lead to a number of interesting and important research questions.

The preliminary objective of this thesis is evaluating the performance of equity mutual funds. It provides guidance to the investors on how they can use performance analysis at the time of investment decision making. The risk adjusted performance of equity mutual funds has been measured through traditional measures such as Sharpe and Treynor ratios, and Jensen's alpha performance measures. The autoregressive conditional heteroskedasticity and generalized autoregressive conditional heteroskedasticity models are constructed to provide information of equity mutual fund return volatility clustering.

The primary objective of this thesis is to examine the lagged relationship between equity mutual funds and the stock market. The interesting finding in this study relates to the degree to which equity mutual fund prices influence stock market prices and to what extent security prices drive mutual fund prices. Therefore, potential price relationships may also exist between the different equity mutual fund categories. This study has important implications for both the stability and the forecasting of stock prices and returns.

There is a need to understand the effects of lagged security prices on equity mutual fund prices through its influence on the stock market and vice versa. The main objective of the research, then, is to investigate the price volatility of the stock market and equity mutual funds by estimating vector auto-regression and vector error correction models to uncover the transmission mechanisms of the specified variables. Long-run price co-movements are detected by employing Johansen cointegration tests, and the short-run price dynamic is analysed by the Granger causality/Block Exogeneity Wald test with variance decompositions and impulse response function and an examination of error correction terms to investigate the speed of the models to reach equilibrium and thus long-term exogeneity.

Analysis of Australian equity mutual funds is not only important for investors and fund managers, but also for academics and policy makers, in examining the implications of investing in domestic equity markets. In this study, the existence and possible causes of the price dynamics are investigated over the period from 2000 to 2010 using daily data. Three study periods are considered, namely the period before the global financial crisis in 2007, the period after it, and the full period. Therefore, the study provides a further examination of mutual fund performance and price linkages by controlling for various equity mutual fund categories that can be useful to investors on which segments of Australian equity mutual funds they should consider investing in for differing economic conditions. The study also offers guidance to investors on which segments of Australian equity mutual fund prices are related to stock market prices and how they can use analysis of the prediction of market prices at the time of investment decision making.

A number of Australian studies have focused on superannuation funds and unit trusts used monthly, annual data and replicate the data over a short-term study period. This dissertation focuses on open-ended equity mutual funds with a long study period using daily data. In many studies, the price linkages in long-run equilibrium estimated using Engle-Granger cointegration and Granger-causality tests are used to measure the short-run price linkages. This study investigates the price relationship between equity mutual funds and the stock market by controlling equity mutual fund categories using a time-series vector error correction model approach including stationarity tests, cointegration tests and Granger-causality and Block exogeneity tests to capture the security price volatility in both short-run and long-run relationships. Therefore, impulse response functions and variance decompositions are generated to explain the response to the price shock between the stock market and equity mutual funds. The unification of various estimation dynamic models of pricing provides a sufficient evidence to support (reject) the hypothesis of this study.

Most of the previous studies test uni-directional causality and only a small number of studies take structural breaks into account. Unlike previous studies, this study provides an analysis of two-way causality between the specified variables and considers tests for dynamic pricing with allowance for structural breaks. This study therefore contributes further with its investigation of the price dynamics in the equity mutual funds, which have not been previously addressed.

The Sharpe, Treynor and Jensen's alpha performance measure results have documented negative performance, indicating that equity mutual fund is below as compared to market portfolio performance over the three study periods. The probable reasons that can be made performance diverge between market portfolio and equity mutual funds are management fees, taxation and timing effects. Risk adjusted performance results of equity mutual funds depict negative risk adjusted returns to investors. The autoregressive conditional heteroskedasticity and generalized autoregressive conditional heteroskedasticity results suggest that the volatility in equity mutual fund returns exhibits a persistence of volatility and mean reverting behaviour, especially for middle and small-cap equity mutual funds. This indicates that historical volatility does add considerable explanatory power to forecasts based on implied volatilities. Therefore, there is evidence of structural shifts in volatility during the post-crisis period. The cause of volatility may be a result of new unanticipated information and trading volume changes that create the change in the expected returns for equity mutual funds.

Returning to the lagged models, the results indicate that the long-run pricing of equity mutual funds are cointegrated with the stock market index during the three study periods. In the short-run, the results indicate that some equity mutual fund categories possess both long-run and short-run exogeneity with the stock market. Therefore, the short-run dynamic indicates short-run Granger causal links running between different equity mutual fund categories. A multivariate vector error correction model, variance decomposition and impulse response function analyses, add further evidence that the stock market index is lower strongly exogenous, indicating that changes in equity mutual fund prices are passed on to stock market index prices so as to maintain an equilibrium.

Thus, there are no existing potential long-run domestic portfolio diversification gains for investors in the sense that there is evidence of a cointegrating of the relationship between equity mutual funds and the stock market index according to portfolio theory. However, the equity mutual funds may offer gains for investors seeking to replicate the movement in the stock market. Based on the rational expectations and the efficient market hypothesis, the expectations of future prices are using the knowledge of the past price behaviour in particular the equity mutual fund category to improve forecasts of prices of other equity mutual fund categories and the stock market index. These results provide more useful guidance in drawing definitive conclusions regarding the rational expectations hypothesis.

The study recommends that the future research should attempt to use panel data and cover a longer study period based on mutual fund holdings. It is important to understand the impact of equity mutual fund holdings on equity mutual fund prices. This will provide valuable knowledge on the extent to which particular shares drive the equity mutual fund prices and lead to understanding more about price interaction between equity mutual funds and the stock market based on the style of diversification.

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CHAPTER 1

Introduction

1.1 Chapter overview

This chapter discusses the foundation of the dissertation. The background of the research problem and the significance of the study are discussed. The overview of the relevant theories and brief description of the methodology are discussed. An overview of the research background is given in the next section. The significance of the study is discussed in Section 1.3. The outline of this dissertation is presented in Section 1.4. This chapter concludes with a summary of the chapter in Section 1.5.

1.2 Research background

One of the most interesting financial phenomena of the 1990s was the explosive global growth in mutual funds. Worldwide investment funds held assets of US$17.8 trillion in 2005, increasing sharply from US$11.4 trillion in 1999. There was a doubling of funds managed in the first quarter 2010 (US$23 trillion). According to the European Fund and Asset Management Association (EFAMA), by the end of the first quarter 2012, the five largest mutual fund market shares were the United States (48.90%), Europe (28.60%), Brazil (5.90%), Australia (5.50%), and Japan (3.70%).

A mutual fund is a special type of company that pools together money from many investors and invests it to purchase various investment vehicles, such as stocks, bonds and money market instruments on behalf of the group, in accordance with a stated set of objectives. There are two types of mutual fund companies — open-end funds and closed-end funds. Both of these funds sell shares to investors and use the money invested to buy securities that match their investment objectives. Open-end funds allow investors to make purchases and to sell their shares throughout the day on the open market. Unlike open-end funds, closed-end funds shares issue new shares only once - at their creation. Investors who wish to invest in closed-end mutual funds must find a buyer on the open market. The price of closed-end fund shares is determined by supply and demand. Thus, the difference between open-end and closed-end funds is the way they handle share sales and redemptions (Pozen and Hamacher 2011).

Therefore, there are other criteria that are commonly used to classify the various types of funds by what is generally referred to as 'type' or 'category'. These include types of securities, clients, management style, market capitalization, and sometimes objectives. In asset class classification, there are three main asset classes of mutual funds: equity funds, bond funds and money-market funds. Equity mutual funds usually have their own unique investment strategies and cater to a broad range of equity securities of various companies, which are publicly tradable in the stock market. Bond funds invest in a mixture of corporate and government bonds at all times. The most sophisticated investors often switch between short-term, intermediate-term and long-term bonds, depending upon the direction of interest rates. Money market funds are generally the safest and most secure of mutual fund investments. They invest in the largest, most stable securities, including Treasury bills (Mobius 2007).

For client classification, there are two types of clients: retail and institutional clients. Most mutual funds are available to both the retail clients (individual investors) and institutional clients (large companies, foundations and etc.). Institutional funds are often categorized as wholesale funds. According to the Investment Company Institute, retail funds are primarily retail products, which gather assets from vast numbers of individuals who have limited balances to invest. Wholesale funds gather assets from a limited number of clients to invest. Retail funds and wholesale funds are distributed differently, operate under different legal and regulatory structures, and have different business risks.

Market capitalization is one of the criteria used to classify stock funds. Australian equity funds are classified according to the size of capitalisation of the companies they invest in. Large- or mid-cap funds invest in larger companies, while small-cap and micro-cap funds look to the smaller and more developing end of the listed company spectrum according to Morningstar Australasia (2012) .

The other mutual fund criterion based on type is investing style: either an active or passive approach. Passive mutual funds are often called index funds. These funds try to mimic a certain index by investing in exactly the same securities and in the same proportion. Apparently, a passive fund mimics an index so the return will be similar to that of the index. Passive mutual funds generally have very low turnover and lower management and trading costs, so they are able to offer a lower-cost alternative that may also be more tax efficient. On the other hand, an active fund aims to beat the market by making investment decisions based on the health of the market. Finding investment opportunities and making trading decisions requires the collective efforts of not only the portfolio manager but also researchers, analysts, and traders. This is primarily why the fees of an actively managed fund are higher than passive mutual funds. This is because the passive funds are only trying to track an index; they do not have the same costs associated with actively managed mutual funds (Williams 1992; Kremnitzer 2012).

There are three kinds of investment objective in stock funds: value, growth and blend. According to Morningstar Australasia, value investing is the intent to find securities of companies that are priced well below their intrinsic value, then buying and holding those securities until their price is in line with their intrinsic value. Growth investing is striving to find the securities of companies that are in the growth stage of their life cycle or are poised to grow at a relatively rapid rate. Blend investing is a mutual fund style that employs a combination of value investing and growth investing.

Mutual funds offer investors the advantages of portfolio diversification and professional management at low investment minimums and transaction costs. Specifically, equity mutual funds are the value that can be added due to the diversification and professional management. Bond and money market mutual funds give an investor the benefits of transactional efficiency through diversification and professional money management, but the tax incentives and regulatory factors have been an important development of bond and money market mutual funds (Klapper et al. 2004).

However, there are some disadvantages to investing in managed funds. If a mutual fund receives any income (interest and/or dividends) resulting from the fund's investments, each of the fund shareholders is liable for income tax on their proportional share of the income, even if the shareholder did not withdraw any money from the mutual fund. Likewise, if the fund sells any securities, each of the fund shareholders may be liable for income tax on their proportional share of the capital gain, even if the shareholder did not withdraw any money from the mutual fund (Pozen and Hamacher 2011). A fund with a high turnover rate is more likely to have a tax consequence than a fund with a low turnover rate (Peterson et al. 2002). Another disadvantage associated with the mutual funds is that the average returns are often below which are amplified due to fund fees (Elton et al. 1993; Golec 1996; Ippolito 1989).

Most of the empirical studies on mutual fund performance and performance persistence have concluded that, on average, mutual funds do not outperform their respective benchmark and past performance of mutual funds can predict future performance (Hendricks et al. 1993; Elton et al. 1996b). As a result, understanding the behaviour of mutual fund prices has been one of the challenging issues and important research questions in financial analyst forecasting literature.

Portfolio theory demonstrates that the gains from a diversified portfolio involve different degrees of price co-movement between securities. The efficiency of the financial market and rational expectations theory give rise to forecasting tests that mirror those adopted when testing the optimality of a forecast in the context of given information set. If domestic equity markets have a long-run tendency to diverge, there exist apparent gains from domestic diversification. On the other hand, the convergence of security prices suggests that one security's price can be used to predict the other.

Past studies provide evidence of performance in mutual funds. Examples of findings are that the fund performance of a sample of U.S. active mutual funds is no better before and after expenses than the passive benchmark (Jensen 1968; Malkiel 1995; Gruber 1996; Carhart 1997). These authors conclude that the fund managers are unable to predict security prices. In the Australian context, most studies have focused on superannuation and wholesale fund performance and the findings are consistent with United States evidence that mutual funds perform at lower levels than the stock market index (Sawicki and Ong 2000; Gallagher 2001; Holmes and Faff 2004). On the other hand, there is evidence that mutual funds beat the market (for example, Hendricks et al. 1993; Goetzmann and Ibbotson 1994; Elton et al. 1996a and Gruber 1996).

Within the literature available on fund price interaction, Allen and MacDonald (1995) used cointegration techniques to investigate international equity mutual funds using Australia as a main part of the study's sample of financial markets. The findings indicate that Australia does not have a long-term equilibrium relationship with the funds of the other 15 countries in the sample. Recent empirical studies show that the price linkages in the equity market are not only international, but also regional. Matallin and Nieto (2002) examine the relationship between mutual funds and the stock market in Spain and conclude that there is no evidence of a long-term equilibrium relationship. Low and Ghazali (2007) examine short- and long-run price linkages using evidence from Malaysia. The findings reveal no evidence of long-run equilibrium between unit trust funds and the local stock market index price. In the short-run, the Granger-causality tests indicate that unit trust funds and the local stock market index have a one-way relationship with market-to-fund causality. However, the study tests only one-way causality on past values of mutual funds and the stock market index. Chu (2010) examines short- and long-run price linkages with evidence from Hong Kong using monthly fund prices for 101 mandatory provident funds. The study finds some funds have both a long- and a short-run relationship.

The preliminary objective of this study is to examine the performance of Australian equity mutual funds. Unlagged models are also constructed to provide information on the behaviour of all variables interacting within a contemporaneous system. The primary objective of this thesis is to examine the lagged relationship between equity mutual funds and the stock market. The study investigates how equity mutual fund categories have been affected both relative to its own prices and relative to those of the stock market.

In terms of the few studies to have examined equity mutual fund performance and price dynamics in Australia, these require closer examination in a number of respects. First, it represents an Australia market where the performances of the equity mutual fund conditional on the state of the economy. The different equity mutual fund categories can differ fundamentally in terms of portfolio objectives. It is thus of crucial interest to investigate whether there are differences in the performance of equity mutual funds across different classifications and the stock market. Second, it also represents an Australia mutual industry on how dynamics of pricing across equity mutual fund categories and the stock market. Third, most of empirical researches are from the perspective of US investors using monthly and annual data, and they leave open the question of whether the equity mutual fund performance in Australia exhibits similar results. Fourth, the equity mutual funds play a vital role in Australia in investment and saving, capturing 40.11% of the mutual fund assets under management in the first quarter 2012, according to EFAMA (2012). Policy-makers mentioned that domestic saving is important as a source of investments to continue to drive long-term economic growth (Pootrakool et al. 2005). Fifth, an increased access to equity markets provides expanded opportunities for investors to diversify their investments, but there is limited of evidence for Australian equity mutual fund that have been investigated.

New evidence from the Australian market allows individual investors to obtain practical and innovative ways to manage and obtain the skill of professional managers in charge of the equity mutual funds. The degree and direction to which equity fund price categories are related to the stock market index are important to fund managers with regard to their investment strategies. The possession of such a short-term and long-term price linkage between equity markets can be helpful to investors and fund managers to predict a security's price. A different trading strategy can be made using dynamic short-term and long-term price predictors across different equity mutual fund classifications and the stock market.

This thesis differs from previous studies in several ways. First, other studies of mutual funds, which use monthly and annual data over short-time periods (for example, McDonald 1974; Mains 1977; Shawky 1982; Cesari and Panetta 2002) and a number of Australian studies, focus on superannuation funds and unit trusts (for example, Praetz 1976; Bird et al. 1983; Robson 1986). This dissertation focuses on open-ended equity mutual funds with a longer study period using daily data.

Second, most recent studies investigate the relationship of mutual fund price volatility by controlling for individual mutual funds (for example, Matallín-Sáez and Nieto 2002; Low and Ghazali 2007). The current study provides a further examination of mutual fund performance and price linkages by controlling for various equity mutual fund categories that can be useful to investors on which segments of the Australian mutual fund they should consider investing. The study therefore provides guidance to investors on which segments of the Australian equity mutual fund prices can be related to stock market price.

Third, the study uses a time-series vector error correction model approach with model based cointegration and Granger-causality tests to capture the security price volatility for both short-run and long-run relationships. In addition, impulse response functions (IRF) and variance decomposition techniques are generated to explain the response to a shock between the stock market prices and equity mutual fund prices. The unification of various estimation dynamic models of pricing provides sufficient evidence to support (reject) the hypothesis of long-run and short-run relationship between the variables. This represents a significant contribution to the literature on estimation in dynamic pricing.

Fourth, other studies test uni-directional causality (for example, Low and Ghazali 2007). Only a small number of studies take structural breaks into account (for example, Ben-Zion et al. 1996; Low and Ghazali 2007; Chu 2010). In contrast, the current study provides an analysis of two-way causality between the specified variables and considers a test for dynamic pricing with allowance for structural breaks.

1.3 Significance of the dissertation

This study is the first to examine cointegration and causality between the prices of open-ended equity mutual funds under the Australian Securities Exchange (ASX) and the benchmark indices designed by the Australian Securities Exchange (S&P/ASX All Ordinaries index). It is believed, from a thorough search of the literature, that no other study has used Johansen cointegration and the Granger-causality tests within the VECM framework to investigate the price linkage between equity mutual funds and market security prices using Australian data.

Variance decomposition and IRF analysis adds further evidence to Johansen cointegration and causality/Block Exogeneity Wald test results. The current study provides insights into the shock of equity mutual fund prices that can be explained by the stock market index price and vice versa. The study contributes further with its investigation of the potential benefits from domestic diversification by using equity mutual funds, which have not been addressed in the causal relationships of equity mutual funds previously.

The study uses extensive empirical analysis and covers three study periods of varying volatility in financial markets. Consequently, this study is able to distinguish between different financial market conditions. The result provides advice to investors on how the equity mutual fund price categories perform in recession and non-recession and of which state of the economic for those investors should consider the investment. It also provides the guidance to investors on how they can apply the analysis of security prices at the time of decision making for investment.

The study uses daily closing prices in the six different categories of open-ended Australian equity mutual funds: large-cap blend funds, large-cap growth funds, large-cap value funds, middle and small-cap blend funds, middle and small-cap growth funds, and middle and small-cap value funds. Together, these categories represent 110 equity mutual funds. The S&P/ASX All Ordinaries index is used as a market benchmark for each equity mutual fund category because this index comprises the largest 500 equity shares by average market capitalisation and covers large, and middle and small capitalisation. The 90 day bank accepted bill rates are used as a proxy for the risk-free rate for the Australian market. Historical daily data on equity mutual fund prices, the stock market index and the risk free rate are obtained from the Morningstar Direct Database for the period 2000 to

2010. The study divides into three periods: a full study period (3rd January 2000 to 31st December 2010), a pre-crisis period (3rd January 2000 to 2nd July 2007), and a post-crisis period (3rd July 2007 to 31st December 2010).

The primary aim of this study is to examine the magnitude of price linkages between the equity mutual funds and the stock market in an optimally lagged model. The preliminary analysis provides evidence relevant to fund performance in unlagged models to see how the data behave contemporaneously.

To determine if data are subject to a potential structural break, the study uses the Quandt-Andrews break point test (Quandt 1988; Andrews 1993). With regard to the assumptions of OLS that distributions of the variables specified are normal, the Jarque-Bera test is applied. The Augmented Dickey-Fuller (ADF) (Dickey and Fuller 1979, 1981) and the Phillips-Perron (PP) (Phillips and Perron 1988) unit root tests are applied to check stationarity of the data.

Regarding the definition of risk, this study accounts the performance using both total risk (standard deviation) and systematic risk (Beta) through traditional measures such as Sharpe and Treynor ratios and Jensen's alpha measures. To examine the time series of prices and returns from equity mutual funds and the stock market the, unlagged models test both the ordinary least squares and the autoregressive conditional heteroskedasticity models (ARCH).

The dynamic relationships are tested using vector autoregression (VAR) and VECM to uncover the transmission mechanisms of the specified variables. Long-run price co-movements are detected by employing Johansen cointegration tests and the short-run price dynamic is analysed by using the Granger-causality and Block Exogeneity Wald test. The variance decompositions and IRF and an examination of error correlation terms

(ECT) are used to investigate the speed of the models to equilibrium and thus long-term exogeneity.

The preliminary results reveal that the performance of equity mutual funds is different from that of the stock market, indicating that equity mutual funds have under-performed over all three study periods. The possible reasons for performance diverges are fund expenses, risk, cash flows, tax efficiency and timing effects. These factors might be significant determinates of after-tax equity mutual fund returns. Financial theory dictates that securities with high systematic risk should have high pre-tax returns. Carhart (1997) provides evidence that the level of fees and expense charged by mutual fund have effect on returns. Peterson et al. (2002) offer evidence that risk, investment style, past pre-tax performance and expenses are important determinants of future after-tax returns. Therefore, ARCH shows evidence of equity mutual fund return volatility clustering, indicating the future returns of equity mutual fund are conditional on the previous information.

Returning to the lagged models, multivariate cointegration results indicate that the long-run pricing of equity mutual funds are cointegrated with the stock market index during the three study periods. In the short-run, the results indicate that some equity mutual fund prices impact the stock market prices. Therefore, there is strong evidence of the price linkage between equity mutual fund categories. Subsequently, the other equity mutual fund categories influence growth equity mutual funds as shown by the Granger-causality/Block Exogeneity Wald test, error correction terms, variance decomposition and IRF analysis.

Results show that domestic equity mutual fund prices (based on fund category) have a statistically significant impact on both long- and short-term stock market index prices. These results provide knowledge to investors and fund managers as to what equity mutual fund categories they should pay attention to when they are making short-term and long-term investment decisions in different market situations. Potentially, this could assist fund managers and investors to improve their trading and diversification strategies, especially during high volatility periods. Therefore, the results of this study help other researchers improve their ongoing research, since market instability may be explained by the absence of, or existence of, cointegration and causality between the variables. The study therefore provides economic policy makers with another point of reference towards forecasting the interaction of price movements in domestic equity markets. A new policy may be implemented based on the results of this study.

1.4 Outline of the dissertation

Chapter 2 provides a broad theoretical and literature review in terms of fund performance and price interaction. Chapter 3 begins with a description of the methodology for the main analysis and provides an outline of cointegration and causality approaches. This Chapter also describes the data. Chapter 4 discusses a specific model for investigating price interaction. The second part of Chapter 4 provides a discussion of the specific research questions, objectives and hypotheses. Chapter 5 contains the preliminary analysis of fund performance and is co-supplemented by a more detailed analysis using the Sharpe and Treynor ratios and Jensen's alpha. The study then considers the data in more detail to test an unlagged model in order to discover basic contemporaneous relationships and to see how the data behave. Chapter 6 moves to the analysis of a dynamic model where optimal lags are introduced. The VECM Johansen cointegration (1998, 1995), Granger-causality and Block Exogeneity Wald test (1969, 1988), variance decomposition and IRF are tested for the six fund categories and stock market index. Chapter 7 discusses the findings of the preliminary analysis of Chapter 5 and the primary analysis of Chapter 6. This Chapter also discusses new evidence demonstrating the uniqueness of the study and its main contributions to the body of knowledge. The policy implications, limitations of the study, future research directions and policy implications are also discussed in this Chapter.

1.5 Concluding remarks

This Chapter has presented a research outline of the study. The research ultimately seeks to enhance the relatively limited amount of literature on Australian mutual funds and stock market relationships. The major contribution is that, after a thorough search of the literature, no other study has been found that uses the Johansen cointegration and the Granger-causality tests within the VECM framework to investigate the price linkage between equity mutual funds and market security prices using purely Australian data, as is done in this study. The study contributes further with its investigation of the potential benefits from domestic diversification by investing in equity mutual funds where causal relationships have not been previously analysed.

There are two parts of the research study. First, the preliminary study is fund performance and contemporaneous relationships in the ARCH model. Second, the primary analysis is a dynamic price modelling using VECM based tests of cointegration and the Granger-causality and Block Exogeneity Wald test. The variance decompositions and IRF are added to the latter analysis and an examination of ECT to investigate the speed of the model movement to equilibrium and thus long-term exogeneity. In respect of the latter analysis, the study focuses on the effects of the lag specification on the test results. Furthermore, the dynamic interaction with daily closing prices of retail equity mutual funds is examined using an eleven-year sample period, and this includes the analysis of sub-periods decided on the basis of structural breaks in the level series data. The results of this study should be part of the texbook of investors and financial planners interested in investing across equity mutual fund categories. In Chapter 2, the theory and previous studies that relate to the study are reviewed.

CHAPTER 2

Theoretical and Literature Review

2.1 Chapter overview

This chapter discusses the particular theory and literature relating to mutual fund performance and the interaction of mutual fund and stock market prices that forms the empirical analysis of this study. This chapter also discusses research gaps and the new contribution to demonstrate the uniqueness of this study and how it adds to the body of knowledge. An overview of Australian mutual funds is also presented. The review of theories relating to mutual funds is discussed in the next section. Section 2.3 deals with the empirical literature in relation to mutual funds. Section 2.4 provides an overview of Australian mutual funds and conclusions are provided in Section 2.5.

2.2 Theory

In this section models of mutual fund performance are discussed. A number of valuation methods have been developed, tested and revised to demonstrate the appropriate tools for analysis used over the past 60 years.

2.2.1 Portfolio theory

Portfolio theory was developed by Markowitz (1952). The portfolio model is based on the assumption that an investor can maximize return and minimize risk by diversification. The portfolio hypotheses deal with the selection of investment assets that have a lower collective risk than a single asset. The notion of diversification is about creating a portfolio that includes multiple investments in order to reduce risk. The hypotheses consider the desirability of maximized expected returns.

Portfolio efficiency can provide an expected rate of return with minimum variance and maximum expected returns. In addition, the portfolio model assumes that the portfolio return can be a weighted combination of returns while the total risk is measured by the standard deviation of returns.

Markowitz (1952) suggests the use of standard deviation as a measure of the total risk of a portfolio. The standard deviation measures the dispersion of returns from a central average value. Moreover, the greater the standard deviation means the higher the fund's volatility (total risk). The standard deviation of the portfolio is expressed as follows:

$$\sigma_{port} = \sqrt{\sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{i=1}^{n} w_i \, w_j Cov_{ij}} \qquad 2.1$$

where, σ_{port} is the standard deviation of the portfolio; w_i is the weight of the individual assets in the portfolio; where weights are determined by the proportion of value in the portfolio; σ_i^2 is the variance of the rate of return for asset i; and Cov_{ij} is the covariance between the rates of return for assets *i* and j, $Cov_{ij} = r_{ij}\sigma_i\sigma_j$. In this study, the standard deviation will be applied to estimate mutual fund total risk.

In portfolio theory the total risk of investment has two components. These are unsystematic risk and systematic risk (Pinches and Vashist 1996). It can be written as:

Total risk	=	Systematic risk + Unsystematic risk
	=	Unavoidable risk + Avoidable risk
	=	Market risk + Firm specific risk

Systematic risk is risk that affects the whole stock market to a greater or lesser extent. This type of risk is also described as market risk, and it cannot be eliminated by diversification (for example, GDP, interest rate and inflation). Unsystematic risk is risk that affects only a particular asset or industry (for example, the company's management). This type of risk is described also as an industry or firm specific risk and it can be reduced or eliminated through diversification.

The concept of diversification is to create a portfolio that includes many individual unrelated assets in order to reduce risk while maintaining a consistent high rate of return. The well-diversified portfolio involves different degrees of price co-movement between securities. A correlation coefficient is a single number that describes the degree of relationship between the securities. The correlation coefficient is always between -1.0 and +1.0. The positive sign indicates the positive relationship and the securities move in the same direction. The negative sign indicates the negative relationship and the movements are in the opposite direction. Perfect positive correlation exists when the correlation coefficient is +1 and -1 is perfect negative correlation (Elton et al. 2007).

With a diversified portfolio investors spread investment across different asset classes, countries and industries, this can reduce the total risk because prices of different securities rise and fall independently. As a result, a price decrease in one security can be offset by a price increase in another security and the more securities in the portfolio, the greater the probability of this offsetting price movement.

The concept of total risk is relevant to the study of managed fund performance. The methodology of portfolio theory can be applied to the study in terms of asset allocation, total risk measurement and expected returns between the equity mutual funds and the stock market. Therefore, portfolio theory is also applied for comparison between equity mutual fund categories. This is because the different fund categories may have different total risk and expected returns.

2.2.2 Capital asset pricing model

The capital asset pricing model (CAPM) builds on modern portfolio theory and asset pricing theory (Treynor 1961; Sharpe 1963, 1964; Lintner 1965; Mossin 1966) . This model provides a pricing relationship for individual securities. The CAPM states that the expected return on assets is equal to a risk-free rate of return plus a premium for risk. The main assumption is that all investors hold a diversified portfolio and investors can measure the level of risk by the Beta coefficient. In order to meet this assumption, the portfolio tends to have a systematic risk or non-diversifiable market related risk that is measured by an asset's Beta. The CAPM can be written as follows:

$$(R_{it} - R_{ft}) = \alpha_{it} + \beta_{it} \left(R_{mt} - R_{ft}\right) + \varepsilon_{it} \qquad 2.2$$

Equation 2.2 is a regression model with an intercept α_{it}; R_{it} is the return on fund i at time t; R_{ft} is the risk free rate at time t; R_{mt} is the return on a stock market at time t; β_{it} is Beta (systematic risk) on fund i at time t and ε_{it} is the random error term on fund i at time t (unsystematic risk).

The Beta coefficient has been regarded as a powerful tool to measure the level of systematic risk for different investments (Reilly and Brown 2006). The Beta coefficient is also used to inform investors about how much systematic risk a particular asset has relative to that of an average asset. Generally, the stock market has a Beta of 1.0. The Beta for an individual stock indicates the expected volatility of the stock, which has a relationship to the volatility of the market's portfolio. By assuming the Beta is equal to 1.0, the security tends to cause the same risk as the stock market. If securities have a Beta smaller than 1.0, it is less volatile (less risky), while securities that have a Beta more than 1.0 indicates a higher risk level (Jones et al. 2007).

Different mutual fund categories may have different systematic and unsystematic risks. In this study, the standard CAPM will be applied to estimate mutual fund Betas based on Equation 2.2.

2.2.3 Efficient market hypothesis

The efficient market hypothesis (EMH) posits that current stock prices reflect all available information (Fama 1970). The hypothesis is that all information is quickly and efficiently incorporated into asset prices at any point in time and profit (abnormal returns) cannot be made from trading information. Therefore, analysis, such as fundamental analysis[1] and technical analysis[2] cannot be used (Bishop et al. 2004). Thus, the term “market efficiency” means security prices are rational and an investor cannot systematically beat the market (Statman 1999). If all the available information is factored into the market price, the market price will reflect the share’s worth or, rather, estimate its value; that is:

$$p_t \cong V_t \equiv \sum_{i=1}^{\infty} \frac{E_t(D_{t+i})}{(1+r)^i} \qquad 2.3$$

where V_t is defined as the share’s fundamental value at time *t*, $E_t(D_{t+i})$ is the expected dividend based on information available at time *t*, r is the appropriate risk adjusted discount rate for the expected dividend stream. *i* is up to infinity since a share is a perpetual instrument (Shiller 2002; Mabhunu 2004).

Another theory related to the EMH is the random walk theory introduced by Bachelier.[3] The random-walk behaviour of daily or monthly stock prices became widely associated with the efficient markets hypothesis that was proposed by Fama (1991) and Fama and French (1993). The degree of efficiency in the market is indicated by the random sequence of the price changes. There are three identified classifications of the EMH depending on the level of available information. There are weak-form efficient, semi-strong-form efficient and strong-form efficient markets.

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[1] Fundamental analysis is used to evaluate investments in securities from characteristics of a security by attempting to measure the intrinsic value.

[2] Technical analysis is the evaluation of securities from the chart using historical price behaviour to predict future movement.

[3] Bachelier (1900). The English translation of the thesis is by A.J. Boness, and Cootner (1964).

Weak-form efficiency is also described by the random walk hypothesis. The current market price fully reflects historical prices and volume information by showing that share prices are independent of each other and unpredictable. The weak-form efficient market supports the theory that prices follow a random walk. The random walk hypothesis suggests that share prices reflect reactions of the market to information being fed into the market completely randomly and uncorrelated to any observable trend. Since the information is coming in randomly there is an absence of predictive price patterns and this means that historical prices and trading volumes cannot be used to predict the future price or gain abnormal returns. Thus, weak-form efficiency and the random walk theory conclude that the size and direction of any future price change are random with respect to the information available at that point in time. It means there is no value in predicting future prices using past prices and past price changes.

With regard to semi-strong-form efficiency, the current market price is assumed to fully reflect historical prices and public information (for example, corporate reports, corporate announcements and information related to corporate dividend policies). Semi-strong-form efficiency concludes that superior returns cannot be made by examining the historical sequence of prices and public information about the security because past prices and any information do not lead to a change in security prices. Tests for semi-strong-form efficiency are mainly concerned with the speed and accuracy of the market reaction to the information publicly available.

In respect to strong-form efficiency, security prices are expected to reflect all relevant information, including historical stock prices, economic fundamentals and private information. Tests for the strong-form efficiency are mainly concerned with finding whether or not any special interest groups (for example, corporate insiders, stock exchange specialists and professional asset managers) can out-guess the current asset price with information not publicly available.

Therefore, the EMH is related closely to rational expectations theory (Muth 1961; Lucas 1978). The theory of rational expectations is based on the assumption that the market is efficient and investor expectations are systematic and that investors use all relevant information in predicting a future price. The current prices in a financial market will be set so that the optimal forecast of a security's price using all available information equals the security's equilibrium price as determined by a statistically adequate model.

With rational expectations, the outcomes that are being forecasted do not differ from the market equilibrium. That means the expected value of a variable is the same as the expected value predicted by the dynamic model. Even though rational expectations equal the optimal forecast, a predication based on it may not always be perfect. If there is a change in the way a variable moves, the way in which expectations of the variable are formed also change.

According the EMH and rational expectation theories, a dynamic model (for example, VAR and VECM) can be used to study the price linkages between the variables. The existence of the cointegration implies the presence of the predictable component by using historical mutual fund prices and stock market prices (Groenewold and Kang 1993; Allen and MacDonald 1995; Rahman and Uddin 2012). In this study, the outcome of dynamic pricing models can be used to predict equity mutual fund prices and stock market prices since expectations of future prices are equal to optimal forecasts using all currently available information.

2.2.4 Performance indicators

The Treynor ratio (Treynor 1965) uses excess returns on the funds while the scales of excess returns on the funds come from the Beta of the fund. The assumption of the Treynor model is that the market is efficient. A greater value of the ratio indicates higher performance. The Treynor Index is expressed as,

$$T_{it} = \frac{\overline{R_{it}} - \overline{R_{ft}}}{\beta_{it}} \quad 2.4$$

where T_{it} is the Treynor measure of fund i at time t; $\overline{R_{it}}$ is an average return of fund i at time t; $\overline{R_{ft}}$ is an average rate of return on a risk-free security over the period studied at time t; β_{it} is the Beta (systematic risk) of fund i at time t.

Sharpe (1966) developed a "reward to variability" ratio, which has become known as the Sharpe ratio. The assumption of this ratio is that the market is inefficient. The Sharpe ratio uses the standard deviation of the fund return and excess return to evaluate reward per unit of risk. The Sharpe ratio indicates that a portfolio with a ratio value of more than one is performing better than the market benchmark. On the other hand, a portfolio with a ratio value less than one is under-performing. The Sharpe ratio is expressed as,

$$S_{it} = \frac{\overline{R_{it}} - \overline{R_{ft}}}{\sigma_{it}} \quad 2.5$$

Where S_{it} is the Sharpe measure of fund i at time t; σ_{it} is the standard deviation of fund i at time t.

Jensen's alpha suggests a different concept of risk. Jensen is concerned only with systematic risk (Beta) for scaling the returns of the portfolio (Jensen 1968). The Jensen technique involves measuring the fund performance based on the value of the constant term α_{it}. The portfolio with an alpha greater than zero is performing better than the market benchmark. Alternatively, positive and statistically significant of alpha indicate the fund beats the market, on a systematic risk adjusted basis. The CAPM can be reformulated under Jensen's alpha to give:

$$(R_{it} - R_{ft}) = \alpha_{it} + \beta_{it}\,(R_{mt} - R_{ft}) + \varepsilon_{it} \quad 2.6$$

Equation 2.5 is a regression model, with an intercept α_{it} which is the risk adjusted excess return of a fund i at time t (Jensen's alpha). $\overline{R_{it}}$ is an average return on fund i at time t; $\overline{R_{ft}}$ is an average rate of return on a risk-free security at time t; R_{mt} is the return on a stock market at time t; β_{it} is the Beta (systematic risk) on fund i at time t. ε_{it} is the random error term for fund i at time t.

If $\alpha_{it} > 0$, this implies that portfolio managers have selective properties, while $\alpha_{it} = 0$ can be expected from a randomly chosen portfolio. If $\alpha_{it} < 0$, this implies the random portfolio choice is inferior to portfolio managers.

Multi-factor asset pricing models have been used in the mutual fund literature to evaluate performance. For example, the eight-portfolio benchmarks of Grinblatt and Titman (1989a, 1989b) consist of a composite of passive portfolios, which are constructed to take into account size (four portfolios), dividend yields (three portfolios) and past returns (one portfolio). The three-factor model of Fama and French (1993) compares a portfolio to three distinct factors: Beta, size of stocks in the portfolio, and book-to-market value. The four factor model of Carhart (1997) is an extension of the Fama-French three-factor model with an added momentum factor.

The Treynor and Sharpe measures have advantages and disadvantages. An advantage is that both approaches provide the excess return of the fund portfolio over the risk-free rate. These two techniques do not contain a benchmark. The difference between the Treynor and Sharpe measures is in the terms of the risk adjustment factor. The Treynor measure provides the excess return in terms of systematic risk (Beta), while the Sharpe measure provides the excess return in terms of total risk (standard deviation). A disadvantage is that whilst these two approaches provide a relative test, they are unable to provide the statistics for testing the difference between the ratio results (Reilly and Brown 2006). Unlike the Sharpe and Treynor measures, the Jensen technique evaluates fund risk adjusted returns with reference to a benchmark. The Treynor ratio and Jensen's alpha techniques are the same in terms of the risk adjustment factor. Both techniques provide the excess return in terms of systematic risk (Beta). However, these two techniques' results may differ in their rankings of the funds being evaluated.

Jobson and Korkie (1981) test the significance of any differences between the Sharpe and Treynor techniques and suggest that the Treynor ratio provides lower power than the Sharpe ratio. Bird et al. (1983) provide the ranking of fund performance according to these three techniques and find that the results of these three techniques are not significantly different. The findings are consistent with Jobson and Korkie and re-emphasize that the Treynor technique obtains a lower power than those results from the Sharpe and Jensen techniques.

The Sharpe and Treynor ratios and Jensen's Alpha are important statistics for measuring risk-adjusted returns, comparing alternative portfolios, and comparing similar investments. Although these measures have limitations in terms of the ranking of the funds evaluated, the approaches are still important tools for investment comparison and analysis.

2.3 Literature review

2.3.1 Review of fund performance

In this section the study discusses of the many studies of mutual fund performance. It begins with Sharpe (1966) and Jensen (1968), who claim that mutual funds have under-performed against the benchmark. Grinblatt and Titman (1989a) find that the fund performance of a sample of US active mutual funds is no better before and after expenses than their passive benchmark, the S&P 500. However, there is some evidence in later studies that mutual funds out-perform the passive benchmark (for example, Hendricks et al. 1993 and Goetzmann and Ibbotson 1994).

Sharpe (1966) introduced the Sharpe ratio to examine fund performance over the period 1964 to 1963 using annual data. The study compared mutual fund performance with the Dow-Jones Industrial Average and finds that only 11 out of 34 mutual funds out-perform the passive benchmark. When expenses are taken into account, the results are generally different and indicate that 19 out of 34 mutual funds show superior performance to the market benchmark.

Jensen (1968) extended the CAPM to evaluate the performance of 115 funds using annual data for the period 1955 to 1964 and 56 funds over a 20 year period from 1945 to 1964. The study finds that there is a positive relationship between mutual fund returns and Beta. The results indicate that mutual funds do not achieve abnormal performance and almost all mutual funds under-perform the market when the S&P 500 is used as a benchmark. There is strong evidence of a high number of funds with negative alphas. This finding supports the strong-form level of market efficiency.

Carlson (1970) recalculated the Jensen and Sharpe results for 82 mutual funds over the period 1948 to 1967. The results contradict both Jensen and Sharpe and find a number of funds with positive alphas. The study suggests that the Sharpe ratio shows statistical significance when mutual funds under-perform the stock market.

McDonald (1973) used Jensen's alpha measure to assess the performance of French mutual funds. Monthly data during the period 1964 to 1969 are analysed. McDonald finds that French mutual fund performed better than their benchmark even after risk adjusted returns.

McDonald (1974) examines the performance of maximum capital gain funds, growth funds, income growth funds, balanced funds and income funds during a ten year period from 1960 to 1969 for 123 mutual funds from the US market using monthly returns. The study finds that 80 out of 123 mutual funds had a Beta less than the stock market index and only 45 out of

123 mutual funds had a total risk less than the local market index. The study concludes that there is a positive relationship between the level of risk and the fund classified according to fund objective. The results indicate that 67 out of 123 mutual funds have a Treynor ratio value greater than the stock market. Therefore, more than half of the sample (54%) out-performs the market portfolio with positive alphas and only 39 mutual funds have a Sharpe ratio value less than the benchmark. The study concludes that aggressive funds performed better than conservative funds.

Ward and Saunders (1976) examine the performance of UK unit trusts from 1964 to 1972 using annual rates of return for 49 unit trusts. The study finds that the performance ranking results of the Sharpe, Treynor, and Jensen models are similar and conclude that UK unit trusts performed worse than the stock market index.

Consistent with the United States, Australian studies find that mutual funds perform at lower levels than the stock market index, even though different techniques and different indices are used. For example, Praetz (1976) analyse the performance of four Australian mutual funds and 12 unit trusts against the Sydney Ordinary Shares Index during the period 1967 to 1971 using Treynor and Sharpe techniques. Investment funds show poor performance during the study period.

Mains (1977) investigates fund performance using the Jensen technique with a sub-sample of 70 funds using monthly returns over the period from 1955 to 1964. The study finds that most funds appear to out-perform the market when expenses are taken into account. This finding contradicts those of Sharpe and Jensen.

Shawky (1982) employs Treynor, Sharpe, and Jensen performance measures to evaluate the performance of US mutual funds. The monthly net asset value is collected over the period from 1973 to 1977. The findings are that there is no difference in performance between the mutual funds and the equally weighted NYSE index. Therefore, there is no significant difference between the three performance measures.

Bird et al. (1983) compare superannuation fund performance from 1973 to 1981 for 380 Australian funds using quarterly rates of returns. Three market indices used: the Statex Actuaries Accumulation index, the 20/30 index[4] and the adjusted Campbell and Cook index. The evaluation techniques included the Sharpe, Jensen, and Treynor models. The study finds that fund and manager performance levels are worse than the market index even though different techniques and different indices are used.

The findings of Robson (1986) using monthly returns, suggest consistency with previous findings that managed funds were not able to generate positive abnormal returns during the period 1969 to 1978. The three major risk-adjusted performance measures, Treynor, Sharpe, and Jensen are used to evaluate the performance of 67 Australian unit trusts and 9 mutual funds. The study uses the Statex Actuaries Accumulation index, Walter index[5] and an equally weighted index comprising all the sample funds as benchmarks. The study finds that income and growth funds appear to out-perform the other fund types. There is some evidence of a negative relationship between fund risk levels and fund performance.

Droms and Walker (1994) present a comprehensive analysis of the relationship between asset size and equity mutual funds over the period from 1971 to 1990. The study employs Treynor, Sharpe and Jensen performance measures to evaluate performance using the annual data for 108 international equity mutual funds and uses the S&P 500 index, the

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[4] The 20/30 index developed by Bird et al. (1983).

[5] The Walter index developed by Terry Walter. The index is a random selection of 50 actively traded industrial shares listed on the Melbourne Stock Exchange (Robson 1986)

EAFE index[6], and the World index comprising all the sample funds as benchmarks. They find that fund size has no significant relationship with fund performance for international equity mutual funds, both before and after risk adjustment. They point out that fund characterises do not affect fund performance, such as portfolio turnover, expense ratios and fund size. However, the arguments of Droms and Walker are countered by Indro et al. (1999).

Carhart (1997) claims that underperformance of active mutual funds is caused by high expenses using a sample of all diversified U.S. equity funds in existence from 1962 to 1993. He finds that the investment costs of expense ratios and transaction costs have a negative impact on performance. He suggests that increases in fund fees cannot build up fund performance while the managed funds are successfully performed by increasing fund size.

Malhotra and Mcleod (1997) investigate the relationship between expense ratio and performance using a regression model for 464 equity funds in 1992 and 468 equity funds in 1993. The study finds that equity funds with a higher expense ratio have lower yields.

Indro et al. (1999) investigate the relationship between fund size and performance for 683 US equity mutual funds using a non-linear model over the period 1993 to 1995. The study argues that the size of fund can affect the active investment strategies. Although the funds have the same expense ratio and turnover, the outcomes of active investment strategies are significantly different. They also document that the marginal return does decrease when a mutual fund exceeds its optimal size. Additionally, they conclude that the large funds are more likely to lead to low marginal returns and diseconomies of scale. The study suggests that smaller funds perform

[6] EAFE index is the stock market index for the major stock markets outside of the United States and Canada.

better than large funds and an asset under management is an important factor effect on fund performance.

Dahlquist et al. (2000) examine the performance of Swedish mutual funds from 1993 to 1997 using weekly returns for 126 equity mutual funds. The results indicate that a small equity fund tends to perform better than large equity funds and conclude that active funds perform better than passive funds. The study shows that there is a negative relationship between performance and fund fees. According to the Jensen performance measure, the evidence is mixed results for different fund categories and overall suggests that there is some evidence that equity funds have out-performed the market.

Sawicki and Ong (2000) examine the performance of 97 Australian wholesale funds using monthly data over the period 1983-1995. They use a conditional market timing model to evaluate the performance. Tests using successive three-year periods indicate that there is little evidence of performance persistent.

Heffernan (2001) examines the performance of eight categories of UK investment trusts for 273 trusts for the period 1994 to 1999. There is no evidence of a relationship between fund fees and fund performance.

Cesari and Panetta (2002) examine the performance of Italian equity mutual funds over the period 1985 to 1995. Data are provided monthly for 82 equity funds using six different benchmarks based on the Milan Stock Exchange indices. According to the Jensen performance measure, the mutual funds do not differ from the market portfolio based on net returns. With gross returns, the mutual funds out-perform the stock market.

Chen et al. (2004) analyse the relationship between fund size and mutual fund returns in the regression framework using US monthly data from 1962 to 1999. The study employs CAPM and the three factor model of Fama and French to evaluate fund performance. They conclude that asset size erodes performance and suggests that the smaller funds can take advantage of their economies of scale.

Faff (2004) evaluates the performance of Australian equity funds during the period 1996 to 1999 using daily data for 24 equity mutual funds. There are four value weighted style indexes produced by the Frank Russel Company, while the ASX All Ordinaries Index is a market portfolio. According to the Fama and French (1993) three factor model, the study finds large-cap equity mutual funds outperformed small-cap equity mutual funds.

Holmes and Faff (2004) examine the selective and timing performance of multi-sector equity managed funds in Australia over the period 1990 to 1999 for 198 trusts. The results show that there is a negative relationship between market timing and fund performance. They also suggest that the volatility timing is negative related to fund performance.

Noulas et al. (2005) evaluate the performance of Greek equity funds during the period 1997 to 2000 using weekly data for 23 equity mutual funds. The study provides the ranking of fund performance according to Treynor, Sharpe, and Jensen techniques, but the study does not contain any tests of the significance of any differences between these three techniques. The evidence shows that the Beta of mutual funds is less than one and is smaller than the market portfolios (general index of the Athens Stock Exchange).

Gallagher and Martin (2005) examine the relationship between the asset size and performance of Australian equity mutual funds over the period 1991 to 2000. They suggest that fund size is not related to fund performance and find that the portfolio performance also does not depend on size of portfolio. This finding is consistent with the empirical evidence in Droms and Walker (1994). However, the arguments of Gallagher and Martin are countered by Chen et al. (2004), Yan (2008) and Ferreira et al. (2013).

Gallagher and Looi (2006) examine the ability of 34 active Australian equity fund managers to earn superior risk-adjust returns using daily data from 1995 to 2001. The study finds that active managed funds outperform the passive benchmark (the S&P/ ASX All Ordinaries Accumulation Index, the S&P/ ASX 200 and 300 Accumulation indices) in terms of their trading ability according to the modified DGTW approach (Daniel et al. 1997). The result shows that manager's stock picking ability is successful in stock ranked 101-105 by market capitalization.

Sipra (2006) shows results consistent with previous studies and concludes that there is a small number of funds (approximately 30%) that beat the Pakistan stock market using Treynor, Sharpe, and Jensen measures. The monthly closing prices for 33 mutual funds over the period 1995 to 2004 are examined. This finding supports the semi-strong-form of the efficient market hypothesis, which suggests there is no potential to gain from abnormal returns with publicly available information.

Sapp and Yan (2008) examine the relationship between fund performance and security concentration of U.S. equity mutual funds over the period 1984 to 2002. Data are provided for 2,278 funds comprising 16,399 fund-years. Regression results for the three-factor and four-factor models show that the number of stock holdings is related with fund performance. They find that funds with large stock holding are more likely to perform well, even after expenses.

Yan (2008) examines the effect of fund size on fund performance of US mutual funds from 1993 to 2002 for 1,024 funds using a cross-sectional regression approach. The study employs CAPM, the three factor model of Fama and French and the four factor model of Carhart to evaluate fund performance and finds that the size of funds has a negative relationship with fund performance, especially funds with less liquid stock holdings and high turnover.

Chen et al. (2010) examine the ability of stock selection skill of 40 active Australian small-cap equity manager on a risk-adjusted basis using both the monthly and daily data from 1991 to 2004. The study finds that active small-cap equity managed funds out-perform the passive benchmark (the S&P/ ASX Small Ordinaries Accumulation Index) before management expenses and tax according to the four-factor model and five-factor model. There is evidence of superior stock selection skills for Australian small-cap equity managers.

Soongswang and Sanohdontree (2011b) evaluate the performance of Thai mutual funds using monthly returns for 138 equity mutual funds during the period 2000 to 2007. The study suggests that mutual funds are able to beat the local stock market index according to Treynor, Sharpe, and Jensen measures. Therefore, there is strong evidence of abnormal returns of the funds.

Glode (2011) studies fund performance with a parsimonious model[7] using data from 3,147 actively managed US equity funds over the period 1980 to 2005. This study considers the effect on the measurement of risk adjusted returns and the state of the economy. The evidence suggests that fund managers with high abnormal returns may be able to charge relatively high fees during economic downturns. Therefore, the evidence shows the equity mutual funds are able to generate returns better when the economy is doing poorly and concludes that the levels of the fund performance depend on the state of the economy. These findings are supported by Moskowitz (2000), Kosowski (2006), and Bello (2009) who study US domestic equity mutual funds with large data-sets. These studies find that equity mutual fund performance is higher during economic downturns.

[7] A parsimonious model is a model with as few parameters as possible for a given quality of model.

Haque (2012) examines the relationship between fund fees and performance for 351 Australian equity mutual funds using Fama and French's (1993) three factor model over the period 1996 to 2010. The study suggests that the expense ratios of Australian blend equity mutual funds are positive related to performance in both recession and non-recessions. Therefore, the expense ratios of Australian growth equity mutual funds are related to the gross alpha in recession. This finding is not consistent with the empirical evidence in Glode (2011)

Ferreira et al. (2013) analyse the effects of fund size on mutual fund performance of 10,568 mutual funds from 19 countries over the period 1999 to 2005. The findings are that asset size is positively and significantly related to fund performance and shows that the large funds experience organizational economies of scale by using CAPM and the Carhart four-factor model to measure fund performance.

Wang and Haque (2013) evaluate the performance of Australian equity funds during the period 2000 to 2010 using daily data. There are four value weighted style indexes produced by the Frank Russel Company, while the S&P/ASX 300 Accumulation Index is the stock market benchmark. According to the statistics of the excess returns per annum, small-cap equity mutual fund is found to outperform large-cap equity mutual funds. The study suggests that large-cap equity mutual funds tend to have negative alphas in both high and low volatility markets. On the other hand, small-cap equity mutual funds show positive alphas in high (low) volatility markets. This finding is not consistent with the empirical evidence in Faff (2004).

In summary, empirical findings about the mutual fund performance are mixed. Based on the existing literature, equity mutual fund performance evaluation needs further investigation.

2.3.2 Review of the security price interaction

Another set of studies provides empirical evidence on the relationship between mutual funds and the macroeconomic variables and evaluates the issues using cointegration and causality tests. These findings are discussed here.

Warther (1995), using monthly data from 1984 to 1993, examines the correlation between aggregate mutual fund cash flows and security returns. Warther finds there is a positive relationship between fund inflows and security returns and concludes that security returns neither lag nor lead mutual fund flows.

Cha (1999) uses various techniques, such as a VAR model and Granger-causality tests to examine the lead–lag relationship between security returns and investment cash flows and finds that equity mutual fund flows do not lead stock price changes.

Alexakis et al. (2005) examine the dynamics between fund flows and stock returns using evidence from Greece. Granger causality (1969) and the standard Engle-Granger two-step ordinary least squares techniques (1987) are employed using a time series of 2,396 daily closing prices from 1994 to 2003. Both causality and cointegration tests suggest most of the fund flows can predict future stock market returns. It is concluded that mutual fund flows lead stock market returns.

Rakowski and Wang (2009) study the relationship between fund returns and daily mutual fund flows using daily data within a VAR framework. They report that past fund flows has a positive relationship with future fund returns. However, they find no relationship between fund flows and future fund returns using monthly data.

Watson and Wickramanayake (2012) study the relationship between aggregate equity fund flows and excess share market returns in Australia use monthly data for the period 1990 to 2009. The results of the Granger causality test show a one-way causal relationship running from share market returns to mutual fund flows and confirm a positive relationship between mutual fund flows and security returns.

Although research into mutual fund prices has a long history, research into the dynamic interaction between security prices and mutual fund prices is sparse.

Bailey and Lim (1992) study the correlations for country funds and US stock market returns. Using daily and weekly returns for 19 country funds, they find evidence of correlations between country fund returns and national market returns. The result is significant, but divergent and far from perfect. It is concluded that the prices of country funds behave more like domestic stocks than the foreign equities in which these funds are invested.

Allen and Macdonald (1995) study international equity diversification, including evidence from Australia over the period 1970 to 1992. Using a time series of 16 country monthly indices, the standard Engle-Granger and Johansen estimations are employed to capture the long-run relationship of the indices. Both Engle-Granger and Johansen estimations suggest that there is no evidence of cointegration between the monthly Australian index and the indices of the other countries (Austria, Belgium, Italy, Japan, Norway, Malaysia, Singapore, Spain, Sweden and USA).

Chang et al. (1995) study the dynamic interaction between closed-end country fund share values and net asset values. Weekly returns of 15 countries are examined over the period 1985 to 1990. The Engle-Granger methodology is used to determine the long-run relationship. They find evidence of a long-run equilibrium relationship between a country fund share value and net asset value for Australia, Canada, Mexico, and most

European countries. However, cointegration does not exist between the two variables in Brazil, Spain, and Asian countries.

Ben-Zion et al. (1996) study the price linkages between country funds and national stock markets (Germany, Japan, and UK) using daily data for the period December 1, 1987 to February 28, 1990. Engle-Granger cointegration and causality tests are applied and no evidence of cointegration between country fund prices and the local market index is found. The causality tests suggest a two-way causal relationship between country funds and the local stock market.

Choi and Lee (1996) study the pricing behaviour of closed-end country funds. They examine fund prices in a cross section format for 21 funds using weekly data. The findings are consistent with Ben-Zion et al. (1996), suggesting that the performance of country funds is sensitive to the local stock market. The evidence shows equilibrium pricing in the national market.

Matallin and Nieto (2002) examine the relationship between mutual funds and the stock market in Spain. Johansen (1988) cointegration tests are applied and show a small number of mutual funds are cointegrated with the local stock market. The study concludes that there is no evidence of a long-term equilibrium relationship. They document that 17.5% of mutual funds have their price levels cointegrated with the stock market index (Ibex 35). The weak evidence of cointegration may be due to market timing and security selection. They find that market instability does not explain the absence of cointegration.

Low and Ghazali (2007) examine short- and long-run price linkages using evidence from Malaysia. A sample of 35 unit trust funds from January 1996 to December 2000 is examined. An Engle-Granger cointegration test is used to identify the long-run relationship between unit trust funds and the stock market index. The findings reveal no evidence of long-run equilibrium between unit trust funds and the stock market. In the short-run, the Granger-causality test indicates that unit trust funds and the local stock market index have a one-way relationship with market-to-fund causality. The results show that 13 out of 35 funds studied have causal links with the stock market. The study suggests that fund managers may respond to changes in the stock market by adjusting portfolio holdings over the short-run. However, the study tests only one-way causality by running a regression of mutual funds on past values of mutual funds and the stock market index.

Chu (2010) examines short and long-run price linkages with evidence from Hong Kong using monthly fund prices for 101 mandatory provident funds from December 1, 2000 to December 31, 2008. Engle-Granger cointegration and Granger causality tests are used to determine the long-run and the short-run relationship between fund prices and stock market prices. The study finds some funds have both a long- and a short-run relationship. The evidence shows that 56.43% of the equity funds in Hong Kong have a one-way short-run relationship with the local stock market index and this runs from the market to mutual funds.

Chu (2011) investigates cointegration and causality between net asset values of equity funds and the local stock market index with evidence from Hong Kong during the period 2001 to 2009. Cointegration tests (using both standard Engle-Granger cointegration and Johansen cointegration) are used to determine the long-run relationship between the variables. Causality tests (using both the standard Granger-causality and the VECM) are used to determine the short-run relationships. The results show that 44.44% of the sampled funds are cointegrated with the local stock market index. The evidence shows that 10 out of 15 equity funds have a one-way short-run relationship with the local stock market index and this runs from the market to the equity funds.

In summary, empirical findings about the relationship between fund prices and security prices are mixed. Based on the existing literature, the relationship between mutual fund prices and share market prices need further investigation.

2.3.3 Identifying research gaps

The review of previous studies suggests a number of research gaps. The performance evaluation shows mixed results for different country funds. Many studies have focused on the US mutual fund industry and cross-country funds while a small number of studies refer to Australian mutual funds. Other studies of mutual fund performance use monthly and annual data, over short-time periods (for example, McDonald 1974; Mains 1977; Shawky 1982; Cesari and Panetta 2002). This study differs from the other Australia studies. The prior studies have focused on the performance of Australian superannuation funds and unit trusts (for example, Praetz 1976; Bird et al. 1983; Robson 1986).

The current study is focused on the performance of open-ended equity mutual funds during the period 2000 to 2010 using daily fund returns. With regard to definitions of risk, this study also accounts for fund performance using both total risk (standard deviation) and systematic risk (Beta) by applying the Sharpe and Treynor ratios as well as Jensen's alpha measures. The study calculates fund performance by controlling for fund categories.

Another set of researchers have examined the dynamic interaction between security returns and mutual fund flows. Only a few studies consider the dynamic relationships between mutual fund prices and stock market prices and mostly based on other country funds. Although previous studies have investigated the interaction between security prices and mutual fund prices, there is no clear evidence for the existence of cointegration and causality between them. Previous studies have used standard Engle-Granger techniques to determine the long-run relationship between variables and standard Granger causality methods to determine the short-run relationships. Therefore, only a small number of studies take structural breaks into account (for example, Ben-Zion et al. 1996; Low and Ghazali 2007; Chu 2010).

There has been a body of research undertaken on equity mutual fund prices and the local stock market price while the mutual fund industry of Australia and other valid approaches to evaluating cointegration and causality have received only scant attention. Unlike other studies, the current study tests for cointegration and causality with structural breaks based on two sub-samples. The study examines the long-term equilibrium relationships and short-term exogeneity using VECM based tests of causality, block exogeneity tests, variance decomposition and IRF. To extend the multivariate cointegration and causality analysis, the study pays attention to both the effect of changes in equity fund prices on the movement of stock market index prices and vice versa. The study contributes further with its investigation of the price dynamic in equity mutual funds, which has not been previously addressed.

2.4 Overview of Australian mutual funds

The regulation of the managed funds industry in Australia is the responsibility of the Australian Securities and Investments Commission. Over 80% of managed funds are invested through superannuation products. Furthermore, superannuation funds are also invested through unit trusts. A unit trust is a managed fund institution that pools funds from a number of investors for the purpose of investing in a particular type or mix of assets. There are two broad types of Australian mutual funds: first, asset funds that invest in single asset classes such as cash management funds, property funds, Australian equity funds, international equity funds, mortgage funds, fixed interest and bond funds; and second, there are mixed asset funds that invest in different types of asset classes such as growth funds, balanced funds, conservative funds and cash funds.

The value of funds under management in Australia has increased at an average annual rate of 11% since late 1991 and had AU$1.7 trillion in funds under management as at 31 December 2011 according to the Australian Bureau of Statistics (2011). This equates to 1.30 times of the gross domestic product and around 1.26 times of domestic equity market capitalisation in the December quarter of 2010. The funds-management market has historically been divided into retail and wholesale segments. The wholesale market is dominated by superannuation funds and other large institutions and represents around 69% of funds under management. Retail funds account for 85% of the entire mutual fund market.

The retail funds under management, multi-sector sources accounted for 41% of funds under management, domestic equity was 19%, international equity was 14%, and cash was 12%. Asset classes, including property and infrastructure, fixed interest, fixed income and others, account for 14% of funds under management in March 2010 according to the Morningstar.

There are 76 mutual fund companies in the retail sector in Australia with assets under management totalling AU$57,209 million. The company with the largest number of products is the Independent Order of Odd Fellows Investments, which offers 1,084 different funds for investment. Additionally, retail equity funds continue to drive growth in the Australian funds management industry, with funds under management of AU$121,834 million. The largest retail equity fund is the Commonwealth and Colonial Group with AU$13,314 million of funds under management followed by the BT Financial Group with AU$12,881 million and Macquarie Bank Group with AU$12,879 million under management.

In total, the growth in assets held by the fund management industry was over AU$500 billion, growing to AU$1,793 billion from 2005 to 2010. Australia’s pension market has grown strongly. As a result, Australia has the fourth largest onshore managed fund market in the world and the largest in the Asia-Pacific region.

2.5 Concluding remarks

The aim of this Chapter is to provide a review of theoretical and empirical research on mutual funds, concentrating on the performance and price linkages. Measuring fund performance has become an important issue for the finance industry since the CAPM was introduced in the 1960s. Many studies have focused on the US mutual fund industry and cross-country funds while a smaller number of studies refer to the Australian market. Consequently, to measure and evaluate the performance of Australian equity mutual funds needs further investigation. Whilst, the empirical evidence has increased recently; there is limited research into the long-term and short-term dynamic interactions between stock prices and mutual fund prices.

In view of past inconclusive results and lack of evidence concerning the relationship between different equity mutual fund price categories, this issue clearly is an important area for further analysis. This dissertation contributes to the literature by offering new insights into Australian mutual funds in order to improve understanding of the Australian equity mutual fund industry. In contrast to the previous studies, the current study investigates the fund pricing behaviour in a structural context using a Johansen maximum likelihood procedure with a VAR framework, Granger causality and Block Exogeneity Wald tests, the variance of the forecast from the VECM and IRF. Chapter 3 presents various methodologies employed in examining fund performance and price linkages between equity mutual funds and the stock market index.

CHAPTER 3

Methodology

3.1 Chapter overview

A description of the performance indicators has been provided in Chapter 2 and the results of that investigation are provided in the preliminary results chapter which also details the use of unlagged data. The study then moves to the examination of optimally lagged data in dynamic models. This chapter addresses and describes multivariate time series models to investigate the price linkages of various equity mutual fund categories and the stock market over the 2000 to 2010 period. Section 3.2 discusses the empirical methodology of the unlagged and lagged relationship between equity mutual fund prices and stock market prices. Section 3.4 provides concluding remarks.

3.2 Methodology

The aim of this study is to examine the price linkages between equity mutual funds and the local stock market based on Australian data. To achieve this, the preliminary analysis examines performance indicators before unlagged relationship are investigated in regression models. The main analysis examines lagged variables in a VECM to test long- and short-run relationships. The analysis related to this dissertation is categorised into pre-crisis, post-crisis, and full study periods. The period from 3rd January 2000 to 2th July 2007 represents the pre-crisis period; the post-crisis period refers to the period from 3rd July 2007 to 31st December 2010; and the study period from 3rd January 2000 to 31st December 2010 represents the full study period.

The two main time series tested are prices of equity mutual funds and the S&P/ASX All Ordinaries index as the local stock market index. Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend, growth, value; middle and small-cap: blend, growth, and value), with LB representing large-cap blend equity mutual funds; LG representing large-cap growth equity mutual funds; LV representing large-cap value equity mutual funds; MSB representing middle and small-cap blend equity mutual funds; MSG represents middle and small-cap growth equity mutual funds; MSV represents middle and small-cap value equity mutual funds.

3.2.1 Structural break tests

A structural break test is required to account for structural changes in the time series. To determine if data are subject to a potential structural break, the study estimates the Quandt-Andrews break point test[8] (Quandt 1988; Andrews 1993) to ascertain the existence of a structural break. The null hypothesis related to the structural change is that there is no structural change in the series, as opposed to the alternative hypothesis that there is a structural change in the series.

3.2.2 Data normality tests

One important assumption of OLS is that the distributions of the variables specified are normal and to test this the Jarque-Bera test is applied. This test has a chi-square distribution with two degrees of freedom (one for skewness and one for kurtosis). The skewness and kurtosis relate to the shape of the distribution. The skewness is a measure of the degree of asymmetry of a distribution; for example, a normal distribution has zero skewness. Kurtosis is a measure of whether the data is peaked or flat relative to a normal distribution (for example, the kurtosis of a normal distribution is equal to three).

[8] Quandt-Andrews test is single break estimator for the unknown break date.

3.2.3 Unit root tests

The unit root test is required to test stationarity of the data. After a preliminary analysis of unlagged data is captured in OLS, lagged models are considered in a VAR and VECM as the main analysis. Initially the data need to be tested for non-stationary with integration testing. The VAR model is designed for use with non-stationary series that are known to be cointegrated (Ben-Zion et al. 1996; Chu 2011). Many of the variables studied in financial economics are non-stationary (Hill et al. 2001; Kirchgässner and Wolters 2008). As a result, it is necessary to test the variables for stationarity in the first differences before proceeding with the cointegration test and the causality test. In this section, the study focuses on the statistical tests to determine if the level series is non-stationary. In non-stationary time series, tests are conducted for unit roots and trend-stationarity. This study focuses on the unit root test for determining non-stationarity at levels in the specified variables and stationarity of first differences in the specified variables and the errors of the first difference relationships.

There are three issues concerning the unit roots and non-stationary time series (Brooks 2008). First, past shocks in stationary time series will gradually die away while shocks in non-stationary time series have infinite and persistent behaviour. Second, when non-stationary time series are estimated by standard regression methods, they can exhibit spurious relationships with a very high explanatory power despite variables being uncorrelated. Third, standard assumptions for stationary time series are not valid for non-stationary time series.

In the case of non-stationarity there can be one or more unit roots in the time series data generated. Unit roots can be eliminated by taking the differences in the series. In other words, when variables are purely non-stationary due to the unit roots, they can be transformed to stationarity by linear transformations of differencing. By definition, a time series which is specified as $I(0)$ means that the time series is stationary. However, the series or variable denoted by $I(d)$ is said to be integrated of order 'd' meaning the series must be differenced 'd' times before becoming stationary.

Among several approaches to test whether the time series contains unit roots are the ADF (Dickey and Fuller 1979, 1981) and the PP (Phillips and Perron 1988) unit root tests. There are three possible forms under the ADF test.

$$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \mu_t \quad 3.1$$

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \mu_t \quad 3.2$$

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \mu_t \quad 3.3$$

where, Δ is the first difference operator; Y_t is the variable tested for stationarity; t is a linear time trend; and μ_t is a covariance stationary random error. The first form (Equation 3.1) is appropriate when generated by a random walk with zero drift and has zero mean (pure random walk). The second form (Equation 3.2) is appropriate when generated by a random walk with zero drift and non-zero mean (random walk with drift). The third form (Equation 3.3) is appropriate if the time series has a non-zero mean and non-zero drift (random walk with drift and deterministic trend); then estimation includes both a constant and a trend term.

The null hypothesis is the existence of the unit root ($\delta = 0$) indicating that the time series is non-stationary, while the alternative hypothesis is that the series is stationary ($\delta < 0$). If the *t*-ratio $\tau = \hat{\delta}/s.e(\hat{\delta})$ does not exceed the critical values of the ADF, then the null hypothesis is accepted, indicating the presence of a unit root and thus the series is considered non-stationary.

However, the ADF approach has been challenged by Perron (1989). He argues that the ADF test for unit roots has low power. When there are structural breaks in the underlying series, the PP test is introduced as more powerful than the ADF test (Glynn et al. 2007). This study employs the PP approach to analyse the stationarity of the data. There are three possible breaks under the PP test.

$$\Delta Y_t = \alpha + \varphi DU_t + \beta t + d(DTB)_t + \rho Y_{t-1} + \sum_{i=1}^{p} b_i \Delta Y_{t-1} + \mu_t \qquad 3.4$$

$$\Delta Y_t = \alpha + \beta t + \theta DT_t + \rho Y_{t-1} + \sum_{i=1}^{p} b_i \Delta Y_{t-1} + \mu_t \qquad 3.5$$

$$\Delta Y_t = \alpha + \varphi DU_t + \beta t + d(DTB)_t + \theta DT_t + \rho Y_{t-1} + \sum_{i=1}^{p} b_i \Delta Y_{t-1} + \mu_t \qquad 3.6$$

where, α is a constant and *t* is time trend $(1,2,3 \ldots, T)$. *TB* is the time of the break and DTB_t equals one if *t* = *TB* + 1 and zero otherwise. DU_t equals one if $t > TB$ and zero otherwise. DT_t represents a change in the slope of the trend function; DT = $t - TB$ or $DT_t = t$ if $t > TB$ and zero otherwise. μ_t is a white noise process.

Each of the three models has a unit root under the null hypothesis and the alternative hypothesis is taken as trend stationary with a break at time TB. If unit root tests reveal stationarity (including a stationary error term of the relationship between the first differenced variables) then, as the level series have been proven non-stationary, tests may then follow for long-term equilibrium (cointegration) and short-term exogeneity (causality). The second stage involves testing whether variables have a long-term stationary equilibrium relationship.

3.2.4 Performance indicators

Returning now to the preliminary analysis of fund performance, the study applied the Treynor ratio (1965), Sharpe ratio (1966), and Jensen's alpha (1968). These equations have been displayed previously in Equations 2.3 – 2.5. Fundamentally, return on a portfolio is as follows:

$$R_{it} = \left[\frac{P_{it} - P_{it-1}}{P_{it-1}}\right] \times 100 \qquad 3.7$$

where, R_{it} is the return of fund i at time t; P_{it} is the price of fund i at time t. Daily returns based on the price of the Australia equity mutual funds for the period are taken and the simple averages of such returns, AR_p, are calculated. Similarly, market returns, R_m, are taken to arrive at the average market return, AR_m.

$$R_m = \left[\frac{ASX_t - ASX_{t-1}}{ASX_{t-1}}\right] \times 100 \qquad 3.8$$

where, R_m is return on the market portfolio using the S&P/ASX All Ordinaries index.

In terms of risk, the study uses the standard deviation (Markowitz 1952) as a measure of the total risk of a portfolio. The standard deviation of the portfolio is expressed in Equation 2.1. In addition, the study examines the extent of Australian equity mutual funds systematic risk (β) by running a linear regression of the excess return of the given portfolio on the excess return of the market portfolio. Fund Beta is measured using the standard CAPM (Sharpe 1964; Lintner 1965) as presented earlier in Equation 2.2.

Another part of the primary analysis considers an unlagged linear regression model of seven time series (logarithmically transformed) in order to examine the contemporaneous relationship between equity mutual fund prices and stock market prices at an introductory level. Two linear regressions are tested: Ordinary Least Square (OLS) and ARCH.

3.2.5 Ordinary least squares

The OLS equations examine a linear regression of the unlagged price series for each fund category based on single market models as follows:

$$\ln(F_t) = \alpha_t + \beta_{it}\ln(ASX_t) + \varepsilon_t \qquad 3.9$$

where, $\ln(ASX_t)$ is the natural logarithm of S&P/ASX All Ordinaries index at time t; $\ln(F_t)$ is the natural logarithm of Australian equity mutual funds at time t; α_t and β_t are the regression coefficients at time t, ε_t is the error term of the regression at time t.

3.2.6 Autoregressive conditional heteroskedasticity

Recently, the behaviour of speculative price series has attracted the attention of researchers. Among the most common techniques to estimate volatility is ARCH by Engle (1982) and the generalised ARCH (GARCH) model of Bollerslev (1986). The temporal concentration of volatility is referred to as volatility clustering. The implication of volatility clustering is that the volatility shock today will influence the expectation of volatility in the future (Higgs 2009). According to Engle (1982), the ARCH model is more appropriate when conditional heteroskedasticity[9] in the errors is evident. The main concept of the ARCH model is that it allows for inequality in the variance of the residuals. Heteroscedasticity can be present because the variance is changing over time. The ARCH model is considered using the default option, with the order of ARCH = 1 (one lag of the squared errors), GARCH = 1 (one lag of the conditional variance) and Threshold = 0, which is associated with the TGARCH (1,1,0) model. The mean equation of the natural logarithms of the return series is as follows:

$$\ln(F) = c_1 + c_2 \ln(F) + e \qquad 3.10$$

where, F is equity mutual fund return at time t, C is constant and e is residual. The variance equation of the natural logarithms of the return series is as follows:

$$H_t = c_3 + c_4 H_{t-1} + c_5 \mathrm{e}_{t-1}^2 \qquad 3.11$$

The residual derived from the mean equation (3.10) is used in making the variance equation (3.11).

where, H_t is vaiance of the residual derived from equation (3.11). This represents the current day's volatility of equity mutual fund returns (F). C_3 is constant, C_4 is coefficient of H_{t-1} (GARCH term) and C_5 is coefficient of

[9] This study elects to use ARCH when heteroscedasticity of an unknown form is identified by White tests.

e_{t-1}^2(ARCH term) and indicates volatility clustering. H_{t-1} is previous day's volatility of equity mutual fund returns (F). e_{t-1}^2 is previous period's squared residual derived from equation (3.10). It represents the previous day's equity mutual fund return information about volatility. The sum of the ARCH-GARCH coefficients indicates the extent to which a volatility shock is persistent over time. If $C_4 + C_5 = 1$, a current shock persists indefinitely in conditioning the future variance. If $C_4 + C_5 > 1$, then the response function of volatility increases with time. If $C_4 + C_5 < 1$, this means that shocks decay with time (Dash 2007).

Two steps are necessary to prove the consistency of the OLS and ARCH estimators: the goodness-of-fit of the estimated model to the data and residual tests.

First, the two measures used to consider the quality of the estimated linear model: the coefficient of determination and the adjusted determination coefficient. The coefficient of determination (often called the R-square value) is a measure of the quality of the estimated linear model. When R^2 is equal to one it is an indication that the regression line perfectly fits the data. Another measure, the adjusted determination coefficient, often called adjusted R-square ($\bar{R}^2$) is also a measure of the closeness of fit in the linear model, especially when other variables are added.

Second, the study examines the heteroskedasticity and serial correlation on the OLS and ARCH estimators. White's test[10] (1980) is a test for heteroskedasticity under the null hypothesis of homoscedasticity[11]. Furthermore, the Durbin-Watson test (1950) is used in the presence of serial correlation. If the errors of level series regressions are serially correlated, it

[10] The White Test is used to determine whether a residual variance of a variable in a regression model is constant.

[11] Homoscedasticity is defined as equal variances in the error terms.

means that the OLS results are spurious. The study moves to investigate log differences and this usually removes the problem of serial correlation.

The main analysis is to investigate the price dynamic between equity mutual funds and the stock market in both the short run and the long run. The cointegration test is used to identify the long-run relationships, while causality tests examine the short-run relationships. This section discusses the concept of cointegration with the VAR model and a restricted VAR known as the VECM.

3.2.7 Vector autoregression model

Generally, econometric models in a structural approach use economic theory to describe the relationship between the variables of interest. The resulting model is then estimated and used to test the relevance of theory to the empirical issues. Normally, economic theory is not rich enough to provide a specific model to capture the dynamic relationship between variables. In addition, estimation and inference are complicated because of the endogeneity of variables that may appear on both left and right sides of the models. To resolve these problems, alternative, non-structural approaches to modelling the relationships are used.

The VAR, as framed by Sims (1980a), suggests that the model can be used in forecasting interrelated time series and in analysing the dynamic impact of random disturbances of the system on variables, with all variables in the model assumed endogenous.

Consider the simple bivariate VAR with two dependent variables y_t and z_t in a condition of stationarity:

$$y_t = b_{10} - b_{12}y_t + \gamma_{11}y_{t-1} + \gamma_{12}z_{t-1} + \varepsilon_{yt} \qquad 3.12$$

$$z_t = b_{20} - b_{21}y_t + \gamma_{21}y_{t-1} + \gamma_{22}z_{t-1} + \varepsilon_{zt} \qquad 3.13$$

where, ε_{yt} and ε_{zt} are white noise and they are uncorrelated, $t = 1,2,3, \ldots, T$. Therefore, Equations 3.12 and 3.13 are written in matrix form as,

$$\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \begin{pmatrix} y_t \\ z_t \end{pmatrix} = \begin{pmatrix} b_{10} \\ b_{20} \end{pmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{pmatrix} y_t \\ z_t \end{pmatrix} + \begin{pmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{pmatrix}$$

It can also be written in the structure of VAR (SVAR) as,

$$BX_t = B_0 + CX_{t-1} + \varepsilon_t \qquad 3.14$$

where,

$$\mathbf{B} = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}, \boldsymbol{X_t} = \begin{pmatrix} y_t \\ z_t \end{pmatrix}, \mathbf{B_0} = \begin{pmatrix} b_{10} \\ b_{20} \end{pmatrix}, \mathbf{C} = \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix}, and\ \varepsilon_t = \begin{pmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{pmatrix}$$

Stand

and VAR can be re-written by modifying Equation 3.12 as

$$X_t = B^{-1}B_0 + B^{-1}CX_{t-1} + B^{-1}\varepsilon_t \qquad 3.15$$

or

$$X_t = G + HX_{t-1} + K \qquad 3.16$$

where,

$$G = B^{-1}B_0, H = B^{-1}C, K = B^{-1}\varepsilon_t, and\ B^{-1} = \frac{1}{1 - B_{21}} \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix}$$

Alternatively

$$G = \begin{bmatrix} \frac{b_{10}}{1 - b_{21}b_{12}} - \frac{b_{12}b_{20}}{1 - b_{21}b_{12}} \\ \frac{-b_{21}b_{10}}{1 - b_{21}b_{12}} + \frac{b_{20}}{1 - b_{21}b_{12}} \end{bmatrix}$$

$$H = \begin{bmatrix} \frac{\gamma_{11}}{1 - b_{21}b_{12}} - \frac{b_{12}\gamma_{21}}{1 - b_{21}b_{12}} & \frac{\gamma_{12}}{1 - b_{21}b_{12}} - \frac{b_{12}\gamma_{21}}{1 - b_{21}b_{12}} \\ \frac{-b_{21}\gamma_{11}}{1 - b_{21}b_{12}} + \frac{\gamma_{21}}{1 - b_{21}b_{12}} & \frac{-b_{21}\gamma_{11}}{1 - b_{21}b_{12}} + \frac{\gamma_{22}}{1 - b_{21}b_{12}} \end{bmatrix}$$

or

$$H = \begin{bmatrix} \frac{\gamma_{11} - b_{12}\gamma_{21}}{1 - b_{21}b_{12}} & \frac{\gamma_{12} - b_{12}\gamma_{21}}{1 - b_{21}b_{12}} \\ \frac{-b_{21}\gamma_{11} + \gamma_{21}}{1 - b_{21}b_{12}} & \frac{-b_{21}\gamma_{11} + \gamma_{22}}{1 - b_{21}b_{12}} \end{bmatrix}$$

$$K = \begin{pmatrix} \dfrac{\varepsilon_{yt} - b_{12}\varepsilon_{zt}}{1 - b_{21}b_{12}} \\ \dfrac{-b_{21}\varepsilon_{yt} - \varepsilon_{zt}}{1 - b_{21}b_{12}} \end{pmatrix}$$

or

$$\begin{pmatrix} e_{1t} \\ e_{2t} \end{pmatrix} = \frac{1}{1 - b_{21}b_{12}} \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} \begin{pmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{pmatrix}$$

Since the error terms are composites of two shocks ε_{yt} and ε_{zt}, and $\varepsilon_t = B^{-1}\varepsilon_t$, the e_{1t} and e_{2t} can be written in the equivalent form as,

$$e_{1t} = \frac{\varepsilon_{yt} - b_{12}\varepsilon_{zt}}{(1 - b_{12}b_{21})} \qquad 3.17$$

$$e_{2t} = \frac{-b_{21}\varepsilon_{yt} + \varepsilon_{yt}}{(1 - b_{12}b_{21})} \qquad 3.18$$

Additionally, if non-stationarity and cointegration are found between the variables, the VECM is the appropriate tool to examine the issue of causation rather than the VAR.

This study employs the Johansen and Juselius (1990) approach to investigate the long-run relationship between equity fund price and the local stock market price. Hall (1991), suggests obtaining the best Johansen estimation results by using the minimum test statistic VAR length. To carry out this cointegration test, a vector autoregressive process first estimates the variables that supposedly can be cointegrated. To be specific, the VAR model of order p is written as follows:

$$Y_t = A_0 + \sum_{i=1}^{p} A_i Y_{t-i} + \varepsilon_t \qquad 3.19$$

where, A_0 is an $(n\ x\ 1)$ vector of constants, Y_t is an $(n\ x\ 1)$ vector of non-stationary $I(1)$ variables, p is the number of lags of variables in the system, A_i is an $(n\ x\ n)$ matrix of coefficients and ε_t is the error term of the regression at time t.

The VAR model is presented in terms of a logarithmic price series based on Equation 3.19, which reduces to the following:

$$Y_t = \alpha \sum_{i=1}^{p} Y_{t-i} + \varepsilon_t \qquad 3.20$$
$$Y = \{ASX, LB, LG, LV, MSB, MSG, MSV\}$$

To explore the relationship between equity mutual funds and the S&P/ASX All Ordinaries index the model is specified as follows:

$$\ln(ASX_t) = \alpha_t + \beta_{1t}\ln(LB_t) + \beta_{2t}\ln(LG_t) + \beta_{3t}\ln(LV_t) + \beta_{4t}\ln(MSB_t) + \beta_{5t}\ln(MSG_t) + \beta_{6t}\ln(MSV_t) + \varepsilon_t \qquad 3.21$$

The study undertakes a VAR lag order selection process using the model selection criteria to find the most parsimonious model. Endogenous variables are ASX, LB, LG, LV, MSB, MSG and MSV. The lag-length selection is discussed in the next section.

3.2.8 Lag-length selection

Johansen (1991) suggests that the VAR lag order selection has a proper inference effect on cointegrating vectors and rank. Identifying the appropriate lag structure is important because various criteria can be chosen for different lag structures. For example, if the lag-length is too large, the estimates are unbiased, but inefficient, while if it is too small, the estimates are biased, but have a smaller variance.

Information criteria are used to test for autoregressive lag lengths and five criteria are considered in all procedures. The five different criteria in specifying the lag lengths commonly used in research are: the Akaike Information Criterion (AIC) (Akaike 1973), Schwarz information criterion (SIC) (Schwarz 1978), Hannan-Quinn Criterion (HQ) (Hannan and Quinn 1978), Final Prediction Error (FPE) (Akaike 1969), and Bayesian Information Criterion (BIC).

According to Ozcicek and McMillin (1999), the study shows that the results based on the AIC are generally much closer to the true impulse response function[12] than other criteria used for the long-lag models. They also suggest the other criteria specified in lag length models are almost always worse than that being forecast by the AIC. Ivanov and Kilian (2005) find that AIC has the best performance of VAR models with a sample size between 60 and 600 degrees of freedom. However, they suggest that the SIC and HQ slightly out-perform the AIC when using monthly data with the sample size equal to 120.

In this study, five different bivariate lag models are considered as each lag selection criterion is able to generate responses that can mimic the true impulse response function. A lag length based on the selection criteria and estimates of the VAR model is appropriately chosen.

3.2.9 Cointegration tests

If level series are shown to be non-stationary and differences are stationary including stationary errors of the first difference relationships, the processes are integrated and non-stationary and cointegration tests can be applied. The concept of cointegration was introduced by Granger (1981, 1986) and further developed by Engle and Granger (1987). Cointegration is an appropriate method for analysing a linear relationship between non-stationary variables. If these variables are cointegrated, or do not drift away from each other, they are said to have a long-run equilibrium relationship; however, an absence of cointegration indicates that there is no long-run relationship between the variables. Cointegration suggests a strong relationship between the endogenous and exogenous variables. It suggests rational expectations apply, where the model can be used as a prediction

[12] Impulse responses trace out the responsiveness of the dependent variables in the VAR to shocks to each of the variables (Brooks 2008).

model and it also suggests market informational efficiency on an optimal lag, discovered through the examination of information criteria.

According to Engle and Granger (1987), as previously mentioned, two time series are said to be cointegrated when a linear combination of the two is stationary, even though each variable is non-stationary in their level forms $I(0)$. In other words, cointegration exists if two or more time series with the same order, d and with the error term of the linear regression between the two time series stationary at their level form $I(0)$. For example, an (n x 1) vector of $I(1)$ $\boldsymbol{Y_t} = (y_{1t}, y_{2t}, \dots\dots..y_{nt})'$ is said to be cointegrated if there exists (n x 1) vector of $\boldsymbol{\beta} = (\beta_1, \beta_2, \dots\dots.., \beta_n)'$ such that $\boldsymbol{\beta' Y_t} = \beta_1 y_{1t} + \beta_2 y_{2t} + \cdots + \beta_n y_{nt} \sim I(0)$. The cointegrating vector is commonly normalised so that the first element is unity, that is, $\boldsymbol{\beta} = (1, -\beta_2, \dots\dots.., -\beta_n)'$. There are $r(0 \leq r < n)$ possible cointegrating vectors β_r where, $\boldsymbol{\beta_r' Y_t} \sim I(0)$.

According to Verbeek (2000), the existence of the cointegrating vector $\boldsymbol{\beta}$ can be interpreted as a presence of the long-run relationship. For instance, in a bivariate case, y_{1t} and y_{2t} must have a long-run component that is automatically cancelled out to produce $\varepsilon_t = y_{1t} - \beta_2 y_{2t} \sim I(0)$. Suppose the long-run equilibrium of y_{1t} and y_{2t} is $y_{1t} = \alpha_0 + \beta_2 y_{2t}$. Then, the 'equilibrium error' is $(\varepsilon_t - \alpha_0) \sim I(0)$ and is expected to be zero. The presence of the cointegrating vector, $\varepsilon_t \sim I(0)$, also means that $(\varepsilon_t - \alpha_0) \sim I(0)$.

In other words, the equilibrium error is stationary, consequently creating equilibrium in the system. In contrast, the absence of the cointegrating vector results in a non-stationary nature of the equilibrium error. As a result, the equilibrium error wanders widely and the relationship $y_{1t} = \alpha_0 + \beta_2 y_{2t}$ could not be seen as long-run equilibrium or having a long-run relationship. Thus, if a time series is stationary, the deviation or the distance from the long-run equilibrium's mean values will be temporary and the time series will eventually return to its long-run zero mean values. On the other hand, if the time series is non-stationary, any shock as shown by the long-run mean value, has a permanent effect.

The Johansen and Juselius (1990) approach suggests two cointegration test statistics; the trace statistic and the maximum eigenvalue statistic. The trace test and maximum eigenvalue test for cointegration under the Johansen and Juselius approach is denoted as,

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n} ln\left(1-\widehat{\lambda_i}\right) \qquad 3.22$$

$$\lambda_{max}(r, r+1) = -Tln\left(1-\widehat{\lambda_{r+1}}\right) \qquad 3.23$$

where, r is the number of cointegrating vectors under the null hypothesis, T is the sample size and $\widehat{\lambda_i}$ is the i^{th} largest cross correlation. The trace test is a joint test where the null hypothesis has a number of cointegrating vectors that is less than or equal to r against the alternative hypothesis that has a number of cointegrating vectors more than r. In contrast, the maximum eigenvalue test's null hypothesis is that the number of cointegrating vectors is r against the alternative that it has $r+1$ cointegration relations.

The Johansen and Juselius (1990) approach also provides critical values that are useful for maximum likelihood test statistics. If the test statistic is greater than the critical values in Johansen's suggested tables, the null hypothesis is rejected and there are r cointegrating vectors in favour of the alternative whereby there are more than $r+1$ for λ_{trace} and more than r for λ_{max}.

There are three interpretations of the Johansen test results. First, if rank Π is r and it is found to be $0 < r < n$, then the X variables are cointegrated, and there exists r cointegrating vectors. Second, if rank Π is 0, then there are no combinations of the X variables that are stationary. As such, there is no long-run relationship since ΔX_t does not depend on ΔX_{t-1}, but depends only on ΔX_{t-j}. Hence there are no cointegrating vectors. Third, if rank Π is full, n, then all elements in X are stationary.

Obtaining estimates of the cointegration relationship are the first steps in constructing a complete model. A short-run component of the model is also equally important as it gives short-run adjustment behaviour of the variables.

3.2.10 Vector error correction models

If the variables in the vector $\boldsymbol{Y_t}$ are integrated of order, say one, $I(1)$, and are cointegrated, the cointegration restriction cannot be applied to the VAR of Equation 3.20. According to Engle and Granger (1987), the individual variables driven by permanent shocks are cointegrated, if and only if, there exists a vector error correction in the time series data. Consequently, the VAR in Equation 3.20 cannot be estimated directly as it contains $n\, I(1)$ variables. Therefore, with this restriction applied, the equation is reformulated into a VECM. However, the VECM is a VAR and it is specified in levels series. The VECM are used after differences according to the lag. Variables in the model are entered into the equation with their first difference and the error correction terms (ECT) are added to the model. The VECM representation of Equation 3.20, following the Johansen and Juselius (1990) approach, is written as follows:

$$\Delta X_t = A_0 + \sum_{i=1}^{p} \Gamma_i \Delta X_{t-i} + \Pi X_{t-1} + \varepsilon_t \qquad 3.24$$

and,

$$\Pi = \sum_{i=1}^{p} A_i - I \text{ and } \Gamma_i = -\sum_{j=i+1}^{p} A_j \qquad 3.25$$

where, the coefficient matrix $\boldsymbol{\Pi}$ is reduced rank $r < n$, then defined as the product of two matrices, $\boldsymbol{\alpha}$ and $\boldsymbol{\beta'}$, of dimension $(n\, x\, r)$ and $(r\, x\, n)$, respectively, $\boldsymbol{\Pi} = \boldsymbol{\alpha\beta'}$, and $\boldsymbol{\beta' X_t}$ is stationary. r is the number of linear combinations of the elements in $\boldsymbol{X_t}$ that are affected only by transitory shocks. The matrix $\boldsymbol{\beta}$ is the cointegrating matrix of r cointegration vectors,

$\boldsymbol{\beta_1}, \boldsymbol{\beta_2}, \dots \boldsymbol{\beta_r}$. The $\boldsymbol{\beta}$ vectors represent estimates of the long-run relationship between the variables in the system. The mean reverting weighted sums of cointegration vectors are represented by ECTs, $\boldsymbol{\beta' X_{t-i}}$. The matrix of error correction coefficients $\boldsymbol{\alpha}$ represents the speed at which the variables adjust to their equilibrium values. $\boldsymbol{\Gamma_i}$ is an $(n\ x\ n)$ matrix of unknown parameters $(i = 1{,}2, \dots, k)$, Δ is the difference operator.

It can be seen that given r, the maximum likelihood estimator of $\boldsymbol{\beta}$ is defined as a combination of $\boldsymbol{X_{t-1}}$ that yields the r largest cross correlations of ΔX_t with X_{t-1} after the correction of lagged differences and deterministic variables are presented. Moreover, the VECM is also presented in a form of a change in dependent variables being a function of the explanatory variables. The ECT can be expressed as,

$$\Delta X_t = A_0 + \sum_{i=1}^{p} \Gamma_i \Delta X_{t-i} + \delta ECT_{t-1} + \varepsilon_t \qquad 3.26$$

where, ECT is an error correction term. The ECT is derived from the cointegration vectors and δ records the response of the dependent variable in each period t. Therefore, the initial relationship for X_t, after the cointegration vector has been normalised, can be expressed as,

$$X_t = A_1 X_{t-1} + A_2 X_{t-2} + \cdots + A_i X_{t-i} \qquad 3.27$$

Then, the ECT can be expressed as,

$$ECT_t = X_t + A_1 X_{t-1} + A_2 X_{t-2} + \cdots + A_i X_{t-i} \qquad 3.28$$

Thus, the Johansen and Juselius (1990) approach provides maximum likelihood estimates for Equation 3.24 and this approach takes into account the matrix $\boldsymbol{\Pi}$. On the right-hand side of Equation 3.24 shows that it is stationary only if the components of $\boldsymbol{\Pi X_{t-p}}$ are stationary. In this case, X variables containing $I(1)$ on the left-hand side of the equation are stationary.

The study undertakes further analysis to investigate the short-run dynamics from a long-run equilibrium, so the Johansen's cointegration with the VECM framework is employed. The structure of the cointegration vector is assumed to be the system of a VECM with a constant and linear deterministic trend. The VECM for the Johansen's cointegration test is as follows:

$$\Delta ASX_t = \mu_t + \sum_{k=1}^{r} \alpha_{1,k}\, ECT_{k,t-1} + \sum_{\pi=1}^{p} \gamma_{1,s}\, \Delta ASX_{t-s} + \sum_{s=1}^{p} \gamma_{2,s}\, \Delta LB_{t-s} + \sum_{s=1}^{p} \gamma_{3,s}\, \Delta LG_{t-s} + \sum_{s=1}^{p} \gamma_{4,s}\, \Delta LV_{t-s} + \sum_{s=1}^{p} \gamma_{5,s}\, \Delta MSB_{t-s} + \sum_{s=1}^{p} \gamma_{6,s}\, \Delta MSG_{t-s} + \sum_{s=1}^{p} \gamma_{7,s}\, \Delta MSV_{t-s} + \varepsilon_t \quad 3.29$$

where, μ_t is the intercept and $\gamma_1, \ldots, \gamma_7$ are coefficients. Δ is the first difference operator; α is providing the information on the speed of adjustment coefficient to long-run equilibrium, and *ECT* is an error correction term derived from the long-term cointegrating relationship. The optimal number of lagged difference terms is to be included *(p)*.

The ECT captures the strength of the relationship between equity mutual fund prices and the local stock market index. If bivariate cointegration exists and combines with the strong explanatory power of ECT, it can be concluded that the variables of interest have similar trends in variability and they have a long-term equilibrium relationship. Therefore, the ECT signifies the speed of adjustment of price differences to its long-run equilibrium level, which contains the long-term information that it is derived from the long-term cointegrating relationships known as long-run causality (Masih and Masih 1996; Ratanapakorn and Sharma 2007).

3.2.11 Causality tests

If cointegration exists, exogeneity tests are then applied based on the VECM. Although a relationship between the two variables does exist, it does not mean that one variable causes another. In terms of the econometrics, causality refers to the ability of one variable containing useful information to predict and therefore influence the value of another variable based on linear least squares (Diebold 2007). To explain the causality test, the Granger (1969) definition of the proof of causality is that if variable X_t can be predicted with greater accuracy by using past values of the Y_t variable when all other terms or factors remain unchanged, it simply says that Y_t causes X_t. Therefore, the variables Y_t and X_t can affect each other with distributed lags (past period). Causality test reveals which variable is exogenous and which variables are endogenous.

Engle and Granger (1987), find that a causal relationship exists in at least one direction if two individual variables are cointegrated. The VAR model can be constructed in terms of time series at level form, $I(1)$. It also can be constructed in terms of the first difference of the variable, $I(0)$, with the addition of an ECT to capture the dynamic short-run response. However, if the data are not cointegrated ($I(1)$), the causality test can be derived from transforming the data into stationarity. There are three different approaches to explain the Granger causality test through the VAR technique.

First, Granger causality tests of individual variables for their cointegration at $I(1)$. The test involves estimating the following pair of regressions:

$$X_t = \alpha + \sum_{i=1}^{m} \beta_i X_{t-i} + \sum_{j=1}^{n} \gamma_j Y_{t-j} + \mu_t \qquad 3.30$$

$$Y_t = a + \sum_{i=1}^{q} b_i Y_{t-i} + \sum_{j=1}^{r} c_j X_{t-j} + u_t \qquad 3.31$$

where, μ_t and u_t are zero mean and the lag-lengths are m, n, q and r.

The hypothesis is tested based on Equation 3.30, Y Granger-causes X if:

H_0: $\gamma_1 = \gamma_2 = \gamma_3 = \cdots = \gamma_n = 0$ is rejected against the alternative
H_1: at least one $\gamma_j \neq 0, j = 1,2, \dots, n$.

The hypothesis is tested based on Equation 3.31, X Granger-causes Y if:

H_0: $c_1 = c_2 = c_3 = \cdots = c_r = 0$ is rejected against the alternative
H_1: at least one $c_j \neq 0, j = 1,2, \dots, r$.

Second, Granger causality tests of individual variables for their cointegration at $I(0)$. In this case, Granger (1969) suggested the estimation of the following VAR model including an error correction mechanism term known as restricted VAR.

$$\Delta X_t = \alpha + \sum_{i=1}^{m} \beta_i \Delta X_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta Y_{t-j} + \delta ECM_{t-1} + \mu_t \quad 3.32$$

$$\Delta Y_t = a + \sum_{i=1}^{q} b_i \Delta Y_{t-i} + \sum_{j=1}^{r} c_j \Delta X_{t-j} + dECM_{t-1} + u_t \quad 3.33$$

The hypothesis is tested based on Equation 3.32, ΔY Granger causes ΔX if:

H_0: $\gamma_1 = \gamma_2 = \gamma_3 = \cdots = \gamma_n = 0$ is rejected against the alternative
H_1: at least one $\gamma_j \neq 0, j = 1,2, \dots, n, or\ \delta \neq 0$.

The hypothesis is tested based on Equation 3.33, ΔX Granger causes ΔY if:

H_0: $c_1 = c_2 = c_3 = \cdots = c_r = 0$ is rejected against the alternative
H_1: at least one $c_j \neq 0, j = 1,2, \dots, r, or\ \delta \neq 0$.

Third, Granger causality tests of individual variables for their non-cointegration at $I(1)$. To carry out the causality test, a model is estimated requiring transformations to derive stationarity. The VAR models are shown in such as Equations 3.32 and 3.33 above, but both are without the error correction mechanism term. Thus, it can be formulated in a VAR model as follows:

$$\Delta X_t = \alpha + \sum_{i=1}^{m} \beta_i \Delta X_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta Y_{t-j} + \mu_t \quad 3.34$$

$$\Delta Y_t = a + \sum_{i=1}^{q} b_i \Delta Y_{t-i} + \sum_{j=1}^{r} c_j \Delta X_{t-j} + u_t \quad 3.35$$

The hypothesis is tested based on Equation 3.34, ΔY Granger-causes ΔX if:

H_0: $\gamma_1 = \gamma_2 = \gamma_3 = \cdots = \gamma_n = 0$ is rejected against the alternative
H_1: at least one $\gamma_j \neq 0, j = 1,2, \dots, n, or\ \delta \neq 0$.

The hypothesis is tested based on Equation 3.35, ΔX Granger-causes ΔY if:

H_0: $c_1 = c_2 = c_3 = \cdots c_r = 0$ is rejected against the alternative
H_1: at least one $c_j \neq 0, j = 1,2, \dots, r, or\ \delta \neq 0.$

As a result, there are four different cases according to the explanation of the Granger causality test through the technique of VECM. First, uni-directional causality is from Y to X if the lagged Y terms in Equations 3.30, 3.32, and 3.34 are statistically different from zero as a group, and the lagged X terms in Equations 3.31, 3.33, and 3.35 are not statistically different from zero. Second, uni-directional causality is from X to Y if the lagged X terms in Equations 3.31, 3.33, and 3.35 are statistically different from zero as a group, and the lagged Y terms in Equations 3.30, 3.32, and 3.34 are not statistically different from zero. Third, bi-directional causality is suggested when the sets of Y and X terms are statistically different from zero in both regressions. Fourth, variables being independent from each other is suggested when both sets of Y and X terms are not statistically significant in either of the regressions.

The Granger causality test involves the following procedure. The illustration of each step with $X_t - Y_t$. First, regress current X_t on all lagged X terms, but not including the lagged Y variables in the regression as,

$$X_t = \alpha + \sum_{i=1}^{m} \beta_i X_{t-i} + \mu_t \qquad 3.36$$

Then, obtain the residual sum of squares of this regression (restricted model), RSS_R. Second, regress current X_t on all lagged X terms and include the lagged Y variables in the regression as,

$$X_t = \alpha + \sum_{i=1}^{m} \beta_i X_{t-i} + \sum_{j=1}^{n} \gamma_j Y_{t-j} + \mu_t \qquad 3.37$$

Next, obtain the RSS of this regression (unrestricted model), RSS_U. Third, set the null and the alternative hypotheses as,

H_0: $\gamma_1 = \gamma_2 = \gamma_3 = \cdots = \gamma_n = 0$
H_1: at least one $\gamma_j \neq 0, j = 1,2, \ldots, n$.

Fourth, the null hypothesis is tested using a standard F-test. If the computed F-value exceeds the critical F-value for the chosen level of significance, then the null hypothesis can be rejected by saying that Y Granger-causes X.

3.2.12 Cholesky orders

Brooks (2008) mentions that the ordering of the variables is important to calculate for the IRF and variance decomposition when there is a contemporaneous correlation between the residuals. The Cholesky decomposition is used to define the ordering of variables in this study. The first variables will be selected so that it has a high potential immediate impact to all other variables. This is followed by an analysis of the ECTs which are ranked according to their magnitude and the significance of the variables.

3.2.13 Variance decomposition

The variance decomposition is a useful tool to examine the causal relationship between the variables. Variance decomposition analyses the impact on the explanatory power of the dynamic structure of the VAR when a one standard deviation shock is applied to the endogenous variable. The result of variance decomposition shows the proportion of the variance of the endogenous variable caused by the exogenous variables after each shock. Therefore, it shows how much of the *n*-step-ahead forecast error variance of its own series shock is explained by the error variance of the series in a VECM system. In practice, the variance decompositions should converge when *n* increases. Hence, the variance decomposition will present the impact of such shocks for several periods in the future (Enders 2004; Brooks 2008).

3.2.14 Impulse response functions

The IRF is a dynamic system when its output is presented with a brief input signal or a so-called impulse. In general, an impulse response refers to the reaction of any dynamic system in response to some external change. In other words, the impulse offers a test of the response a dependent variable in the VAR system has towards a shock in an error term. Therefore, IRF analysis based on a VAR allows for an examination of the responses to shocks that are known as "cross effects" between variables of interest. Hence, it is seen that the impulse response function represents the impact of such shocks for several periods in the future. The IRF is also employed for understanding and characterizing the price dynamics inherent in the specified variables (Enders 2004; Brooks 2008).

In conclusion, there are three main steps involved in testing the subject of interest for the current study. The first step, the unit root tests based on the ADF and the PP, are examined to find the presence of stationarity in the data series. The long-run relationship utilizing the Johansen maximum likelihood approach is investigated in the second step. At this stage, if the variables are found to be cointegrated, then the second step, the VECM based on the VAR approach is utilised to confirm the long-run relationships. Then the Granger causality test, the variance decomposition and IRF analyses are performed to examine short- and long-term exogeneity.

3.3 Concluding remarks

This chapter discusses the methodology used in the study. As part of the preliminary analysis for equity fund performance, three major risk adjusted performance measures (the Treynor ratio, Sharpe ratio and Jensen alpha) are utilised to estimate the performance of Australian equity funds. Then basic contemporaneous market models are tested. The multiple regressions of returns based on ARCH models are calculated and investigated. The analysis of dynamic pricing models for equity mutual funds and the stock market index is investigated as the main analysis. The study applies the Quandt-Andrews test to identity structural breaks in the data. The unit root tests applied are based on the AFD the PP tests to detect the presence of unit roots at levels, differences of the variables and in the error terms of the first difference relationships. Johansen cointegration with VECM is employed to investigate the long-run equilibrium relationships. VECM Granger-causality with variance decomposition and IRF are estimated if cointegration exists. The data and hypotheses adopted in the study are discussed in the next chapter.

CHAPTER 4

Data and hypothesis introduction

4.1 Chapter overview

A description of the methodology and model specified is presented in Chapter 3. This chapter discusses the patterns of variable behaviour during the study period and tests the data structural break. It also discusses the hypotheses in relation to theory coupled with past evidence of performance, and the price linkages. Section 4.2 discusses the sample of Australian mutual funds employed in the study. Section 4.3 provides an introduction to the hypotheses and the chapter conclusion is made in Section 4.4.

4.2 Data

The data employed in this study are daily closing prices of open-ended equity mutual funds traded on the Australian Stock Exchange. Historical data on daily closing prices are obtained from the Morningstar Direct Database for six categories open-ended Australian equity mutual funds being: large-cap blend funds, large-cap growth funds, large-cap value funds, middle and small-cap blend funds, middle and small-cap growth funds, and middle and small-cap value funds.

The 90 day bank accepted bill rates are used as a proxy for the risk-free rate for the Australian market because the Australian Commonwealth Government did not issue T-notes over the period 2003 to 2008. The study chooses the S&P/ASX All Ordinaries index as the "local market price" (market benchmark) because this index comprises the 500 equity shares by average market capitalisation. It covers large capitalisation, and middle and small capitalisation. Thus, the S&P/ASX All Ordinaries index potentially provides a better experimental foundation for the cointegration and causality testing between equity mutual fund prices and the local stock market prices.

The stock market price index (S&P/ASX All Ordinaries index) and risk free rate are obtained from the Morningstar Direct based on daily data.

The sample period is from January 3, 2000 to December 31, 2010. This time period is chosen because it encompasses both 2007 global financial crisis and non-crisis period. The financial crisis, the housing bubble and sub-prime crisis in the USA in 2007 caused a recession across the world particularly in 2008 to 2009. Therefore, the world market decline has had an economic impact on worldwide mutual fund assets according to EFAMA (2012). The use of equity mutual fund prices to represent time variation is producing new insights into using dynamic models in the Australian financial market. Hence, the eleven-year period of the study is long enough to cover historically high and low closing prices for Australian investment management mutual funds (Treynor and Mazuy 1966).

The study excludes all equity mutual funds that could not be confidently described as international equity mutual funds, institutional funds and also excluded are those funds with incomplete data. Therefore, this study removes speciality equity mutual funds, such as equity Australian other funds, equity Australian real estate funds, and Australian large-cap geared equity mutual funds.

4.2.1 Description of variables

The data employed in this study consist of daily closing prices for six equity mutual fund categories and stock market indices. The description of variables used in this study is given in Table 4.1.

Table 4.1 Definitions of the variables

Variable	Definitions
S&P/ASX All Ordinaries index (ASX)	The S&P/ASX All Ordinaries Index represents the 500 largest companies in the Australian equities market.
Australian equity mutual funds	Equity Australia funds invest almost exclusively in Australian companies.
Large-cap (L)	Stocks in the top 70% of the capitalisation of the equities market are defined as large-cap.
Middle and small-cap (MS)	Stocks in the bottom 30% of the capitalisation of the Australian equities market are defined as middle and small-cap.
Large-cap blend equity mutual funds (LB)	Equity Australian funds invest primarily in large Australian companies both growth and value stocks.
Large-cap growth equity mutual funds (LG)	Equity Australia funds invest in large Australian companies that are projected to grow faster than other large-cap stocks in the Australian market.
Large-cap value equity mutual funds (LV)	Equity Australia funds invest primarily in large Australian companies that is less expensive and/or may be growing more slowly than other large-cap companies.
Middle and small-cap blend equity mutual funds (MSB)	Equity Australia funds invest primarily in small to mid-sized Australian companies both growth and value stocks.
Middle and small-cap growth equity mutual funds (MSG)	Equity Australia funds invest primarily in small to mid-sized Australian companies that are projected to grow faster than other capitalisation stocks in the Australian market.
Middle and small-cap value equity mutual funds (MSV)	Equity Australia funds invest primarily in small to mid-sized Australian companies that is less expensive and/or may be growing more slowly than other capitalisation companies.

The study consists of 110 equity mutual funds. Funds launched prior to January 1, 2000 provide a maximum of 2,870 daily observations. The numbers of the equity mutual fund samples based on categories are summarised in Table 4.2.

Table 4.2 Equity mutual funds

Australian equity fund types	Number of funds	Percentage
Large-cap blend funds	53	48
Large-cap growth funds	22	20
Large-cap value funds	13	12
Middle and Small-cap blend funds	6	5
Middle and Small-cap growth funds	14	13
Middle and Small-cap value funds	2	2
All equity mutual funds	110	100

Table 4.2 shows that the numbers of equity mutual fund percentages are much lower for all fund categories, except for large-cap blend equity mutual funds. The large-cap blend equity mutual funds have the greatest representation in the sample because of the high number of individual equity mutual funds in this category.

4.2.2 Pattern of variable behaviour

This section presents an overview of the dataset for daily closing prices over a period of 11 years from 2000 to 2010. The x-axis represents units of time and the y-axis represents the prices in Australian dollars. Figure 4.1 displays the Australian Stock Exchange index of daily closing prices and Figure 4.2 shows the same information for Australian equity mutual funds.

Figure 4.1 shows the daily stock market index price for four of the major stock market indices in the Australian stock market – the S&P/ASX 100 index, the S&P/ASX 200 index, the S&P/ASX 300 index and the S&P/ASX All Ordinaries index between the years 2000 and 2010. It can be seen that the pattern of the stock price index is generally similar for all major stock indices. The stock price index presents an upward trend from 2000 to 2007. All the stock market indices reach a peak in November 2007. They drop early in the third quarter of 2007 until the first quarter 2009. Signs of recovery have taken place since then until the end of the study period.

Figure 4.1 Stock market indices, daily closing prices

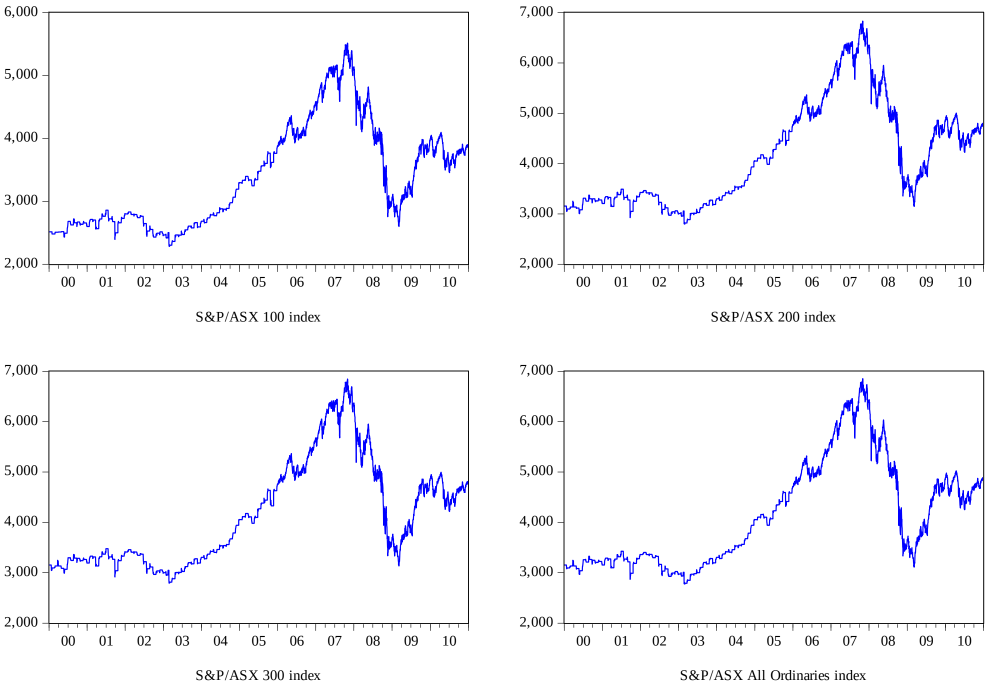


Figure 4.2 Equity mutual fund, daily closing prices

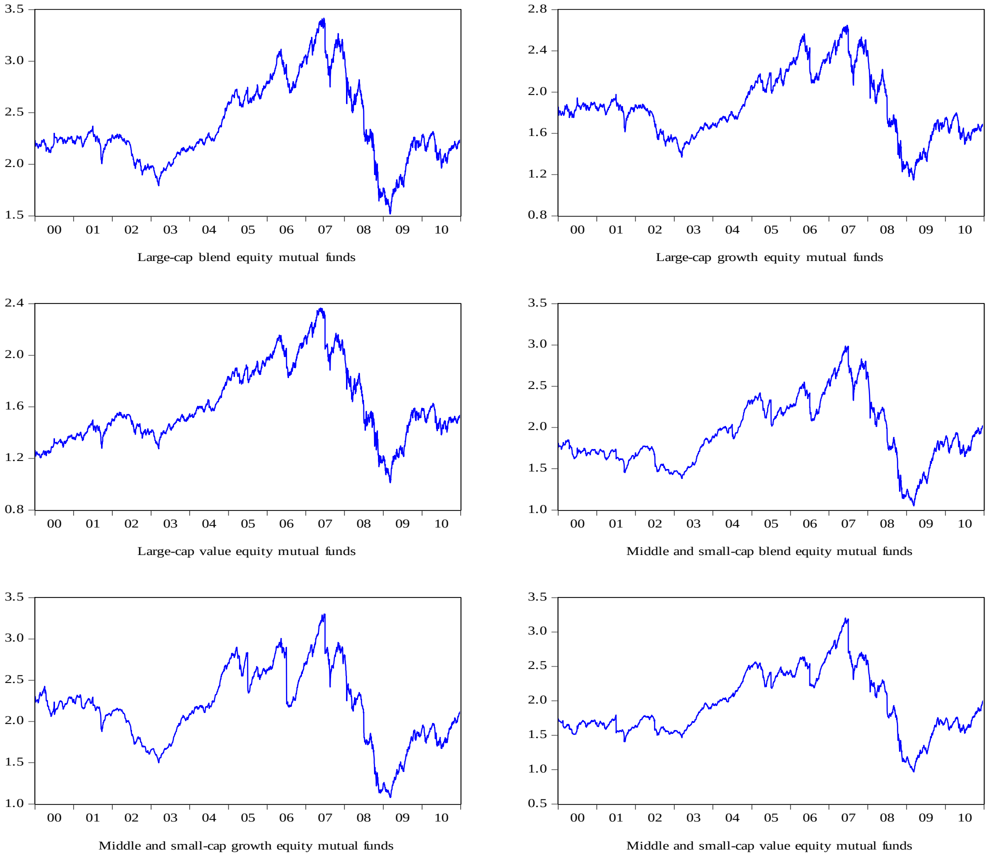


Figure 4.2 shows the mutual fund prices for six of the main equity managed funds (large-cap blend funds, large-cap growth funds, large-cap value funds, middle and small-cap blend funds, middle and small-cap growth funds, and middle and small-cap value funds). Figure 4.2 shows the prices have an upward trend during the pre-crisis period. There is a dramatic growth in prices during the period between 2000 and early 2007. However, after peaking in June 2007, the prices start to decline rapidly from early in the third quarter of 2007 until March 2009. Since then there has been a slight increase in prices through the rest of the study period. According to Figure 4.2, it is clear that daily price patterns show the effects of the global financial crisis.

Figures 4.1 and 4.2 show that the price patterns both the stock market indices and equity mutual funds is similar during the study periods. They reach high points in 2007 before the down-turn to the end of the first quarter of 2009. The data exhibit the possibility of structural breaks at certain times. As a result, a structural break test is required to account for structural changes in the time series.

4.2.3 Structural breaks

The Quandt-Andrews test (Quandt 1988; Andrews 1993) is performed to ascertain an indication of a structural break. The null hypothesis related to the structural change is that there is no structural change in the series against the alternative hypothesis that there is a structural change in the series. The results of testing structural breaks are reported in Table 4.3.

Table 4.3 The results of structural change

Number of breaks compared	**Statistic**	***p*-Value**
2,582 2,296 2,008	*F*-statistic (July/03/2007)	2614.298

According to the Quandt-Andrews test, the null hypothesis is rejected and the alternative hypothesis is accepted at the 1% level of significance. The indications are that a structural break exists around observation number 1,956 (which corresponds to 2 July 2007). On the basis of this finding, considering the turmoil in both the national and international financial markets as a result of the global crisis in March 2007, the study is divided into three periods of time. First, the pre-crisis period includes 1,956 observations and it runs from 3rd January 2000 to 2nd July 2007. Second, the post-crisis extends from 3rd July 2007 to 31st December 2010 encompassing 914 observations. Third, the full period from 3rd January 2000 to 31st December 2010, includes 2,870 observations.

4.3 Hypotheses

The purpose of the study is initially to investigate fund performance and unlagged relationships and then, in a dynamic model, to understand the possible causes of equity mutual fund prices which may affect stock market security prices in the short- and long-run relationships. The explanations for fund performance, sensitivity and pricing between funds are important. It helps investors and fund managers understand that equity mutual fund prices may have robust power in predicting the stock market price. To achieve the purpose of this study, preliminary analyses are employed to find support or otherwise for the primary findings and the hypotheses are based on underlying theory coupled with past evidence.

Past evidence shows that active mutual funds do not out-perform appropriate benchmarks using different measurements, such as the Sharpe, Treynor and Jensen measures. Jensen (1968) and Sipra (2006) find support for the semi-strong-form of the efficient market hypothesis, which suggests there is no potential to gain abnormal returns with publicly available information and it can thus be concluded that mutual fund managers have no access to private information. However, some contradictory studies emerge. Carlson (1970) and Cesari and Panetta (2002) show that mutual funds perform better than their benchmark even after risk adjusted returns. Past evidence of mutual fund performance leads the current study to conclude that results are inconclusive concerning the performance between equity mutual funds and the local stock market. The hypothesis relating to equity mutual fund performance is made between the all equity mutual funds and the stock market benchmark as follows:

Hypothesis 1: The performance of equity mutual funds is not different from that of the stock market.

According to Engle (2004), the ARCH model is a useful model to explain the volatility of the specified variables. Farman and Khan (2011) study the relationship of past volatility in current stock returns of mutual funds and the stock market in Pakistan using monthly data. The study finds that there is no co-movement between closed-ended mutual fund returns and stock market returns. Nafees et al. (2013) study the level of risk in the returns of mutual funds in Pakistan using daily data from 2006 to 2011 with ARCH and GARCH models. They find the presence of volatility clustering for open-ended mutual funds. Therefore, the level of volatility is close to one meaning that volatility is quite persistent. Thus, empirical findings about mutual fund return volatility clustering are limited. Based on the existing literature, equity mutual fund return volatility clustering evaluation needs further investigation. The hypothesis relating to the examination of equity mutual fund return volatility clustering as follows:

Hypothesis 2: There is no evidence of equity mutual fund return volatility clustering.

Despite an extensive literature on mutual funds, there are few studies that focus on the price linkages between equity funds and their own local stock market index. Even when doing so, the evidence leads the study to conclude that there is mixed results in terms of the relationship between equity mutual fund prices and stock market prices. Ben-Zion et al. (1996) study the price linkages between country funds and national stock markets (Germany, Japan, and UK) and no evidence of cointegration between country fund prices and the local market index is found. The causality tests suggest a two-way causal relationship between country funds and the local stock market. Matallin and Nieto (2002) examine the relationship between mutual funds and the stock market in Spain and find a small number of mutual funds are cointegrated with the local stock market. Chu (2010) examines short- and long-run price linkages with evidence from Hong Kong and some funds have both a long- and a short-run relationship.

To extend the multivariate cointegration and causality analysis, the present study pays attention to the effect of changes in equity fund prices on the movement of stock market index prices and vice versa. The proposed hypotheses are based on the theoretical prediction and past evidence related to the price dynamic between equity mutual funds and the stock market in Australia as follows:

Hypothesis 3: There is no long-term equilibrium relationship between the equity managed fund prices and the stock market index price.

Hypothesis 4: There is no short-term exogenous relationship between the equity managed fund prices and the stock market index price.

The study also deals with the interaction between equity mutual fund categories. The proposed hypothesis is related to the price dynamic between equity mutual fund categories as follows:

Hypothesis 5: There is no short-term Granger-causal relationship between the equity managed fund categories.

4.4 Concluding remarks

Daily time series data are used in exploring the relationship between the variables over the period 2000 to 2010. The variables in this study are composed of the six equity mutual fund categories and the stock market index (S&P/ASX All Ordinaries index). The equity mutual funds employed in this study consist of 110 equity mutual funds. When applying the Quandt-Andrews single structural break test, the study finds one structural break for every time series. Consequently, the study divides into three periods: a full study period (3rd January 2000 to 31st December 2010), a pre-crisis period (3rd January 2000 to 2nd July 2007), and a post-crisis period (3rd July 2007 to 31st December 2010).

The central purpose of this study is to examine the price linkages between equity mutual funds and the local stock market based on Australian data. The hypotheses are introduced in relation to the underlying theory coupled with past evidence of mutual fund performance and price linkages. In the following chapter, to achieve the purpose of the study, the mutual fund performance and the contemporaneous relationships between the specified variables are investigated as the preliminary analyses to support or otherwise the primary findings.

CHAPTER 5

Preliminary analysis and Findings

5.1 Chapter overview

One of the aims of this study is to evaluate the performance of equity mutual funds and the local stock market. The analysis in this chapter mainly concerns fund performance and linear regression analysis of possible determinants of the relationship between the variables using OLS and ARCH- GARCH models. This chapter also discusses the basic statistics of the sample. The study performs risk adjusted and non-risk adjusted performance measures utilizing average daily data of equity mutual fund returns using Sharpe and Treynor ratios, and Jensen’s alpha measurements. The highlights of the performance of equity mutual funds and the local stock market are discussed in the next section, followed by testing the contemporaneous relationships between the specified variables in Section 5.3. The conclusions are provided in Section 5.4.

5.2 Performance analysis

The performance analysis is discussed in this section. First, the study evaluates the risks and returns of equity mutual funds and the stock market index. Second, the study examines the risk adjusted performance by calculating the Sharpe and Treynor ratios and Jensen’s alpha performance measures for equity mutual funds against the stock market portfolio. The S&P/ASX All Ordinaries index has been chosen as an appropriate benchmark for measuring fund performance, where the S&P/ASX All Ordinaries index represents the 500 largest companies listed on the Australian Stock Exchange.

With regard to the performance of managed funds four distinct views emerge: 1) The portfolio theory of Markowitz (1952) helps fund managers and investors design a portfolio with the maximum return for the minimum level of risk; 2) The CAPM and its derivations (for example,Treynor 1961; Sharpe 1963, 1964; Lintner 1965; Mossin 1966) help fund managers and investors calculate investment risk and expected return based on the notion that individual investments contain systematic risk and unsystematic risk; 3) Past evidence of fund performance leads the study to conclude that it is hard for fund managers to consistently out-perform the relevant benchmark and the risk level of different funds is a significant factor (for example, Jensen 1968; Malkiel 1995; Gruber 1996; Carhart 1997). They find that the fund performance of a sample of U.S. active mutual funds is no better before and after expenses than their passive benchmark, for example the S&P 500. They conclude that the fund managers are unable to predict security prices; 4) According to the literature, fund performance can be attributed to both market timing ability and security selection ability (for example, Treynor and Mazuy 1966; Coggin et al. 1993). They find no evidence of timing ability for mutual fund managers.

The present study attempts to determine the timing for any diminished performance by calculating the Sharpe and Treynor ratios and Jensen's alpha performance measures during the three study periods. This study tests the null hypothesis (H_{01}) and the alternative hypothesis (H_{A1}) relating to equity managed fund performance stated as follows:

Hypothesis (H_{01}): The performance of equity mutual funds is not different from that of the stock market.

Hypothesis (H_{A1}): The performance of equity mutual funds is different from that of the stock market.

5.2.1 Evaluating returns and measuring risk

This section shows the results of average daily risk and return of equity mutual funds and the local stock market index and is shown in Table 5.1.

Table 5.1 The results of risk and return

Variables	Mean return	Standard deviation	Beta
Panel 1: From 3rd January 2000 to 2nd July 2007			
ASX	0.047390	0.739645	1.000000
LB	0.016507	0.509305	0.311585
LG	0.010563	0.687827	0.414705
LV	0.022510	0.658125	0.374202
MSB	0.019282	0.687631	0.245159
MSG	0.006190	0.950626	0.236862
MSV	0.018723	0.882828	0.245111
Panel 2: From 3rd July 2007 to 31st December 2010			
Variables	**Mean return**	**Standard deviation**	**Beta**
ASX	-0.023096	1.465966	1.000000
LB	-0.045668	1.212513	0.792574
LG	-0.048274	1.353441	0.884872
LV	-0.041562	1.335613	0.854668
MSB	-0.040627	1.217742	0.724437
MSG	-0.038259	1.221275	0.698765
MSV	-0.038133	1.138093	0.619392
Panel 3: From 3rd January 2000 to 31st December 2010			
Variables	**Mean return**	**Standard deviation**	**Beta**
ASX	0.024934	1.028561	1.000000
LB	-0.003300	0.803484	0.623251
LG	-0.008181	0.951956	0.719220
LV	-0.002098	0.929442	0.685494
MSB	0.000196	0.891624	0.555753
MSG	-0.007970	1.044476	0.536004
MSV	0.000610	0.971616	0.487751

Note: ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

Risk and return results during the pre-crisis period: Panel 1 of Table 5.1 focuses on return and the risk of equity mutual funds and the stock market in the pre-crisis period. The results show that the mean of the equity mutual fund average daily return is positive. They also show that all equity mutual funds have lower average daily returns than the benchmark. The overall market risks (Beta) of equity mutual funds are also lower than the stock market on average and less than one. Therefore, the average standard deviation of all equity mutual funds is lower than the average for the local stock market index, with the exception of the middle and small-cap growth and value equity mutual funds. It can be stated that equity mutual funds use asset allocation to diversify their portfolio and they have selected less risky securities than the stock market during the post-crisis period. The middle and small-cap equity mutual funds have lower systematic risk than large-cap equity mutual funds. It can be seen that large-cap equity mutual funds have taken on more risky securities than the middle and small-cap equity mutual funds over the pre-crisis period according to the Beta.

Risk and return results during the post-crisis period: Panel 2 of Table 5.1 focuses on return and the risk of equity mutual funds and the stock market in the post-crisis period. The results suggest that all equity mutual fund categories and the stock market index have negative average daily returns. The global financial crisis appears to have had an effect on the Australian stock market, resulting in its overall poor performance. Therefore, the results show that the systematic risk of equity mutual funds is lower than the market in all fund groups, while the total risks of equity managed funds, on average, are lower when comparison is made to the stock market portfolio. It can be stated that equity mutual funds use asset allocation to diversify their portfolio and they have selected less risky securities during the post-crisis period.

Risk and return results during the full-study period: Panel 3 of Table 5.1 focuses on return and the risk of equity mutual funds and the stock market in the full period. The results show that the mean of the equity mutual funds average daily return is mostly negative. The highest average daily return (0.00061%) is with middle and small-cap value funds. When these statistics are compared with the returns of the local stock market index is that the equity mutual funds average daily returns are lower. In general finds that both systematic and unsystematic risks for equity mutual funds, on average, are less than the market portfolio. It can be stated that the equity mutual funds exhibited lower returns and took on less risky secritites over the whole period of the study.

In summary, the S&P/ASX All Ordinaries index and domestic equity mutual funds show positive returns for the pre-crisis period, while the post-crisis period the returns are negative. Consequently, it indicates negative returns for large-cap equity mutual funds and middle and small-cap growth equity mutual funds for the whole period of the study. Australian equity mutual funds have lower systematic risk than the stock market according to the Beta during the three study periods. It is apparent that Australian equity mutual funds seem to diversify into less risky securities than the stock market portfolio. The findings are consistent with the risk and return maxim. The results imply that lower levels of risk are associated with low expected returns (Noulas et al. 2005).

5.2.2 Evaluating equity mutual fund performances

This section discusses further the results of the fund performance evaluations and the results are presented in Table 5.2. The hypothesis tests are made between all equity mutual funds and the benchmark. Therefore, the study did not report the *t*-statistic for each and every sub-category of equity mutual funds.

Evidence from performance analysis during the pre-crisis period: The results support the rejection of the null hypothesis and acceptance of the alternative hypothesis at the 5% significance level according to the Treynor and Jensen approaches. The equity mutual fund performance, as indicated by the Sharpe ratio, rejects the null hypothesis and accepts the alternative hypothesis at the 1% level of significance. Table 5.2 Panel 1, shows that the equity mutual fund performances are different in comparison to the stock market during the pre-crisis period, indicating the equity mutual funds have performed poorly during economic expansions.

Table 5.2 The results of fund performances

Panel 1: From 3rd January 2000 to 2nd July 2007			
Variables	**Sharpe ratio**	**Treynor ratio**	**Jensen's alpha**
ASX	0.044354	0.032806	N/A
LB	0.003776	0.006172	-0.008299
LG	-0.005846	-0.009696	-0.017625
LV	0.012043	0.021181	-0.004350
MSB	0.006832	0.019163	-0.003345
MSG	-0.008830	-0.035438	-0.016164
MSV	0.004688	0.016886	-0.003902
All funds	0.002111	0.003045	-0.008948
t-statistic	-13.07059*	-3.304551**	-3.416341**
Panel 2: From 3rd July 2007 to 31st December 2010			
Variables	**Sharpe ratio**	**Treynor ratio**	**Jensen's alpha**
ASX	-0.025381	-0.037207	N/A
LB	-0.049302	-0.075424	-0.030289
LG	-0.046094	-0.070502	-0.029462
LV	-0.041683	-0.065140	-0.023873
MSB	-0.044950	-0.075559	-0.027784
MSG	-0.042881	-0.074947	-0.026371
MSV	-0.045905	-0.084347	-0.029199
All funds	-0.045136	-0.074320	-0.027830
t-statistic	-18.05682*	-14.28342*	-28.61651*
Panel 3: From 3rd January 2000 to 31st December 2010			
Variables	**Sharpe ratio**	**Treynor ratio**	**Jensen's alpha**
ASX	0.010208	0.010500	N/A
LB	-0.022071	-0.028454	-0.024279
LG	-0.023756	-0.031444	-0.030167
LV	-0.013272	-0.017996	-0.019534
MSB	-0.015969	-0.025619	-0.020073
MSG	-0.021450	-0.041798	-0.028032
MSV	-0.014228	-0.028342	-0.018945
All funds	-0.018458	-0.028942	-0.023505
t-statistic	-15.61849*	-12.42670*	-12.06755*

Note: * and ** denote that the null hypothesis can be rejected at the 1% and 5% significance levels, respectively. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

Evidence from performance analysis during the post-crisis period: The results support the rejection of the null hypothesis and acceptance of the alternative hypothesis at the 1% significance level and the results show a similarity between the three performance measures. It can be seen from Table 5.2 Panel 2 that the causes and consequences of the global financial crisis have resulted in an overall poor performance during the period from 3rd July 2007 to 31st December 2010. Hence, the study concludes that the equity mutual fund performance differs from the stock market during the post-crisis period indicating that equity mutual funds perform poorly during recessions or periods of economic down-turn.

Evidence from performance analysis during the full study period: The results support the rejection of the null hypothesis and acceptance of the alternative hypothesis at the 1% significance level and the results show a similarity between the three performance measures. Panel 3 of Table 5.2 provides evidence of the consequences of risk adjustment and the performance of the equity mutual funds in the full study period. The study observes that the average daily ratios for all fund categories are lower than the relevant benchmark. Hence, the study concludes that equity mutual funds have performed poorly in relation to the stock market during the period from 2000 to 2010.

In summary, the results from the performance measures reveal that domestic equity mutual funds under-performed the market portfolio during the pre-recession and recession periods and these results are reflected over the full period. In turn, from past evidence, Sharpe (1966), Jensen (1968), Elton et al. (2004), and Fama and French (2010) are supported. The middle and small-cap equity mutual funds out-perform the large-cap equity mutual funds during the three study periods. This is in line with previous studies including Indro et al (1999), Chen et al. (2004), and Bello (2009). They find that fund size is negatively related to fund performance. They demonstrate that the large capitalization equity mutual funds under-perform smaller capitalization equity mutual funds. The findings of the high number of funds with negative alphas supports the efficient market hypothesis, which suggests there is no potential to gain abnormal returns with publicly available information.

5.3 Unlagged models

The preliminary analysis now moves to regression models to explain further the contemporaneous relationship between the variables. The study carries out preliminary tests for the unlagged model in order to examine the relationship between equity mutual fund prices and stock market prices. Two linear regressions are tested, OLS and ARCH. In terms of the OLS, the evaluation of the relationship between the equity mutual fund prices and the stock market index prices are described based on the sample periods.

5.3.1 Data normality tests

One of the assumptions of OLS is that the variables in the model are normally distributed. Consequently, descriptive analyses are conducted to check whether daily data are normally distributed. Under the null hypothesis the price series is a normal distribution against the alternative hypothesis that the price series is not a normal distribution.

Table 5.3 The normality tests

Panel 1: From 3rd January 2000 to 2nd July 2007							
Variables	**ASX**	**LB**	**LG**	**LV**	**MSB**	**MSG**	**MSV**
Skewness	0.9308	0.4783	0.3066	0.4714	0.3707	-0.1492	0.4094
Kurtosis	2.6144	2.0133	2.4338	2.0754	2.1684	2.57159	1.8682
Jarque-Bera	2.9456	153.93	56.777	142.13	101.162	22.2119	159.02
(Probability)	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
Panel 2: From 3rd July 2007 to 31st December 2010							
Variables	**ASX**	**LB**	**LG**	**LV**	**MSB**	**MSG**	**MSV**
Skewness	-0.0545	0.2208	0.2401	0.05158	-0.1768	-0.111	-0.152
Kurtosis	2.40429	2.3456	2.3403	2.53914	2.44429	2.3903	2.3081
Jarque-Bera	13.9675	23.734	25.358	8.49393	16.5234	16.042	21.771
(Probability)	0.000**	0.000**	0.000**	0.014**	0.000**	0.000**	0.000**
Panel 3: From 3rd January 2000 to 31st December 2010							
Variables	**ASX**	**LB**	**LG**	**LV**	**MSB**	**MSG**	**MSV**
Skewness	0.4124	0.2952	-0.012	0.3144	-0.0387	-0.5993	-0.060
Kurtosis	1.9179	2.6190	2.6602	2.3554	2.7186	3.2593	2.6297
Jarque-Bera	221.37	59.040	13.869	96.962	10.1829	179.853	18.109
(Probability)	0.000**	0.000**	0.001**	0.000**	0.006**	0.000**	0.000**

Note: ** denotes that the null hypothesis can be rejected at the 5% significance level. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

Table 5.3 shows that the Jarque-Bera test statistic supports rejection of normality of all variables at the 5% significance level, which is consistent with the findings of the other studies. Fama (1965) and Campbell et al. (1997) show that the distribution of daily U.S. stock indices (Dow Jones and NYSE indices) depart from normality, so that normality is rejected for the majority of the previous studies. The lack of normality in each period may imply autocorrelation and heteroskedasticity problems due to the time dependence in the conditional variance. However, the assumption of normal distributions is made when considering the OLS model. Pesaran and Pesaran (2009), suggest that a normality assumption is not generally relevant with larger samples.

5.3.2 Ordinary least squares

This section shows the basic statistical measures and how successful the model is in explaining the variation of the data, based on the assumptions of OLS regression, as far as the testing of the heteroskedasticity and serial correlation in the errors are concerned. The results of the OLS estimators for basic market models are presented in Table 5.4 based on the level price series.

Table 5.4 Market model based on prices, OLS

Funds	**Coefficient (ASX)**	***t*-statistic**	**R-squared**	**Adjusted *R*-squared**	**Durbin-Watson statistic**
LB	0.510436	60.52016*	0.560843	0.560690	0.002197
LG	0.450681	43.90968*	0.402009	0.401801	0.002570
LV	0.563908	63.79766*	0.586633	0.586489	0.003042
MSB	0.638769	57.86670*	0.538651	0.538490	0.002308
MSG	0.441788	28.84822*	0.224911	0.224641	0.001838
MSV	0.644888	46.43116*	0.429123	0.428924	0.002109

Note: * denotes the 1% significance level. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

Table 5.4 shows the low value of the Durbin-Watson statistic. This indicates problems with serial correlation in the error terms. The study therefore undertakes further analysis to estimate the OLS regression based on the return series.

Table 5.5 Market model based on returns, OLS

Funds	Coefficient (ASX)	*t*-statistic	Adjusted *R*-squared	Durbin-Watson statistic	Hetero. *F*-Statistic
LB	0.623164	70.83373*	0.636245	2.013829	436.4908
LG	0.719144	66.09368*	0.603614	1.957334	184.9410
LV	0.685414	62.32351*	0.575188	2.009445	86.14117
MSB	0.555579	44.70563*	0.410555	1.856524	65.23172
MSG	0.535814	33.25946*	0.278162	1.875750	2.093435
MSV	0.487570	32.26698 *	0.266150	1.928275	2.782839

Note: * denotes the 1% significance level. Hetero denotes heteroscedasticity. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

Table 5.5 shows that the equity mutual funds have a positive relationship with the S&P/ASX All Ordinaries index at the 1% level. The results show the high value of the Durbin-Watson statistic. This indicates no problems with serial correlation in the error terms. However, there is a problem with heteroscedasticity in the model according to the *F*-Statistics of the White tests.

Thus, using basic market models of level series prices based on OLS produces spurious results due to serial correlation of the error terms. However, converting the price series to return series under the OLS removes the problems of serial correlation, the White tests show heteroscedasticity in the error terms. Therefore, the basic market models are re-specified into an ARCH- GARCH specification with both mean and variance equations investigated.

5.3.3 Autoregressive conditionally heteroscedasticity

In this section the study analyses the time variation in volatility in equity mutual funds from 2000 to 2010. The study examines if there has been an increase (decrease) in volatility persistence in equity mutual fund returns on account of the global financial crisis that apparently causes the shifts in volatility. Table 5.6 presents the results based on the ARCH (1,0) and ARCH-GARCH models using the default option, with the order of ARCH = 1 (one lag of the squared errors), GARCH = 1 (one lag of the conditional variance) and Threshold = 0, which is associated with the TGARCH (1,1,0) model. Hypotheses relating to the examination of equity mutual fund return volatility clustering are as follows:

Hypothesis (H_{02}): There is no evidence of equity mutual fund return volatility clustering.

Hypothesis (H_{A2}): There is evidence of equity mutual fund return volatility clustering.

Table 5.6 Return volatility clustering.

Panel 1: From 3rd January 2000 to 2nd July 2007						
Funds	**ARCH (1,0) *t*-statistic**	**ARCH Coefficient**	**GARCH Coefficient**	**Hetero. *F*-statistic**	**Durbin-Watson statistic**	**Adjusted *R*-squared (Ranking)**
LB	3.213035*	0.306834*	0.644867*	0.062751	1.845672	0.202296 (1)
LG	6.423104*	0.230721*	0.709196*	0.054707	1.770375	0.196757 (2)
LV	4.425980*	0.307324*	0.720037*	0.168771	1.732656	0.151064 (3)
MSB	4.792852*	0.991990*	0.417652*	0.123250	1.801126	0.060233 (4)
MSG	3.242222*	1.966491*	0.261203*	0.001889	1.691945	0.026275 (6)
MSV	3.028764*	1.682711*	0.355665*	0.105762	1.743338	0.029513 (5)
Panel 2: From 3rd July 2007 to 31st December 20100						
Funds	**ARCH (1,0) *t*-statistic**	**ARCH Coefficient**	**GARCH Coefficient**	**Hetero. *F*-statistic**	**Durbin-Watson statistic**	**Adjusted *R*-squared (Ranking)**
LB	4.474454*	0.129037*	0.860638*	0.001178	1.918824	0.916636 (1)
LG	3.431726*	0.119965*	0.860351*	0.005383	2.129754	0.913984 (2)
LV	3.575755*	0.112796*	0.878506*	0.018515	1.919408	0.879543 (3)
MSB	3.391718*	0.180828*	0.783397*	0.668922	1.887679	0.757706 (4)
MSG	3.628699*	0.364922*	0.640442*	0.041795	1.841713	0.694776 (5)
MSV	3.375318*	0.290224*	0.640134*	0.027047	1.806517	0.630091 (6)
Panel 3: From 3rd January 2000 to 31st December 2010						
Funds	**ARCH (1,0) *t*-statistic**	**ARCH Coefficient**	**GARCH Coefficient**	**Hetero. *F*-statistic**	**Durbin-Watson statistic**	**Adjusted *R*-squared (Ranking)**
LB	10.53499*	0.220111*	0.788943*	0.240401	2.035837	0.625778 (1)
LG	5.374563*	0.156093*	0.840109*	0.025013	2.006620	0.584511 (2)
LV	3.188459*	0.208057*	0.810609*	0.855310	1.998964	0.573403 (3)
MSB	3.975977*	0.622296*	0.531346*	0.017936	1.872472	0.400261 (4)
MSG	3.498906*	1.098097*	0.522077*	0.000108	1.819969	0.256764 (6)
MSV	3.251550*	1.1950204*	0.427040*	0.033462	1.917868	0.263413 (5)

Note: * denotes the 1% significance level. Hetero denotes heteroscedasticity. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

Evidence for the ARCH model during the pre-crisis period: The results support the rejection of the null hypothesis and acceptance of the alternative hypothesis at the 1% significance level and the results show a similarity between the six equity mutual fund categories. This means volatility clustering exists. This indicates that the previous day's equity mutual fund return information can influence today's mutual fund return volatility.

Table 5.6 Panel 1, shows the level of volatility is determined from the coefficients of variance equation. The ARCH and GARCH coefficients are statistically significant at the 1% level. With the low summation of the ARCH and GARCH coefficients for large-cap blend and growth equity mutual funds, this implies that the impact of volatility on these equity mutual fund returns, despite being positive, shows the shock is a non-persistent; that is, new information in the equity mutual fund market die quickly. The degree of persistence is greater than that for other equity mutual fund categories, exhibiting a permanent impact, indicating a daily return exceeding the normal or mean level of volatility leads to an increase in conditional volatility, which does not die down. Thus, the previous information can be used to capture the volatility in returns on equity mutual funds. Therefore, a positive return change is associated with further positive change.

Evidence for the ARCH model during the post-crisis period: The results support the rejection of the null hypothesis and acceptance of the alternative hypothesis at the 1% significance level, and the results show a similarity between the six equity mutual fund price categories. This indicates that the previous information cannot be neglected in forecasting future equity mutual fund returns.

Table 5.6 Panel 2 shows that the ARCH and GARCH coefficients are statistically significant at the 1% level. The sums of the coefficients for the ARCH and GARCH effects are close to one for large-cap equity mutual funds indicating that volatility shock is persistent over time. This means the previous information can be used to capture the volatility in the returns of large-cap equity mutual funds. Further, the sum of the ARCH and GARCH coefficients for middle and small-cap blend and value equity mutual funds is less than one, implies that the effect of shocks on equity mutual fund return to these equity mutual funds exhibits a non-permanent impact and will decrease in conditional volatility in future periods. The sums of the ARCH and GARCH coefficients are: middle and small-cap blend equity mutual fund –0.96; middle and small-cap value equity mutual fund –0.93. The degree of persistence is equal to one for middle and small-cap growth equity mutual fund, indicating that the shock of the stock returns in the middle and small-cap growth equity mutual fund is persists.

Evidence for the ARCH model during the full period: The results support the rejection of the null hypothesis and acceptance of the alternative hypothesis at the 1% significance level and the results show a similarity between the six equity mutual fund categories. This indicates that future equity mutual fund returns are conditional on the previous information. Therefore, previous day's equity mutual fund return volatility has a positive influence on today's mutual fund return volatility.

Table 5.6 Panel 3, shows in all cases the ARCH and GARCH effects are statistically significant at the 1% level. Further, the sum of the ARCH and GARCH coefficients for middle and small-cap equity mutual fund is greater than one. The sums of the ARCH and GARCH coefficients for the middle and small-cap blend equity mutual fund –1.15; middle and small-cap growth equity mutual fund –1.62; middle and small-cap equity mutual fund –1.62. This implies that the lagged volatility shocks in the stock equity mutual fund returns to these equity mutual funds have a permanent impact. There is evidence that the sum of the ARCH and GARCH coefficients is equal to one in the large-cap equity mutual fund, which indicates the volatility persists.

An important feature of volatility that emerges from the above analysis is that equity mutual fund returns in Australia reveal high volatility persistence during the three study periods. The post-crisis period shows some fall in the persistent character of the equity mutual fund return volatility, but the magnitude of the fall is small and persistence continues to remain high, even in the full study period. Thus, there is evidence of volatility clustering indicating the previous information can be used to capture the volatility in equity mutual fund returns. The finding across equity mutual funds is that volatility shocks are highly persistent for middle and small-cap growth equity mutual funds.

The results show that the Durbin-Watson statistic is higher than 1.5 for the three study periods, showing no problem of serial correlation in the error terms of the relationship. According to the *F*-statistic, the results lead to rejection of the alternative hypothesis and acceptance of the null hypothesis, homoscedasticity of the residual, at the 1% significance level. The results indicate that there is no heteroscedasticity left in the models. Therefore, the results of the ARCH-GARCH models generating high adjusted *R*-squared values, suggest that these models, have high predictive power in explaining the equity mutual fund return volatility clustering during the post-crisis period followed by full study and pre-crisis periods.

Using basic market regression models of the return series under the ARCH-GARCH removes the problems of serial correlation and controls for heteroscedasticity in the error terms. The evidence shows that volatility clustering does exist. These results allow the study to move on to further investigate the relationships of a lagged model in the main analysis to investigate the short-term dynamic and long-term equilibrium relationships

5.4 Concluding remarks

An equity mutual fund is an asset traded in Australia that serves as an indirect investment vehicle for direct portfolio investment in the Australian stock market. It is useful to see how equity mutual funds have performed in the past 11 years. The performance between the equity mutual funds and the stock market portfolio can then be compared with various performance indicators, including Sharpe and Treynor ratios, and Jensen's alpha. This chapter has focused on testing the alternative hypotheses revealing that the performance of equity mutual funds is different from that of the stock market, with the sample divided into three study periods. The results from the performance measures reveal that domestic equity mutual funds under-performed compared to the market portfolio during the pre-recession and recession periods, and these results are reflected over the full period.

The results show the Beta (systematic risk) and standard deviation (total risk) of equity mutual fund returns are lower than the stock market portfolio. This demonstrates that the equity mutual funds hold less risky securities than the stock market portfolio. The results for Sharpe and Treynor ratios, and Jensen's alpha, show the equity mutual funds have suspect risk adjusted returns that are different from the stock market during the three study periods, implying poor performance. The findings of the high number of funds with negative alphas supports the efficient market hypothesis, which suggests there is no potential to gain abnormal returns with publicly available information.

The ARCH-GARCH model is an unbiased and efficient model. The results reveal that there is evidence of volatility in equity mutual fund returns. This means that previous information can be used to capture the volatility in returns of equity mutual funds. As far as the equity mutual fund category is concerned, the middle and small-cap equity mutual funds demonstrate higher volatile than large-cap equity mutual fund.

Thus, the findings of the preliminary analysis in relation to performance and return volatility of equity mutual funds are helpful as support or otherwise for the main hypotheses of this study. Therefore, the study is undertaking further analysis of dynamic and optimally lagged models to explain both short- and long-term relationships between the variables, as discussed in Chapter 6.

CHAPTER 6

Primary findings

6.1 Chapter overview

The primary objective of this study is to examine the dynamic price linkages between equity mutual funds and the local stock market based on Australian data. The Johansen cointegration tests within a VECM framework are used to identify the long-run relationships, while VECM based Granger-causality tests examine the short-run causality and exogeneity. The longer term exogeneity is indicated by the results of variance decomposition and IRF analysis. The estimation procedures are described in the next section. Regarding the stationarity of variables, unit root tests are performed and the results are reported in Section 6.3. Section 6.4 and Section 6.5 provide a specific lagged endogenous model based on the VAR and VECM. Section 6.6 discusses the number of cointegrating relationships using different models. Section 6.7 and Section 6.8 show the analysis of a dynamic relationship between equity managed funds and stock market prices. Section 6.9 and Section 6.10 examine how the prices of those equity mutual funds affect each other and also stock market index prices in the long run. Section 6.11 shows the model to be used for estimation and forecasting the stock market index price. This chapter concludes with a summary in Section 6.12.

6.2 Estimation procedures

All variables are transformed into natural logarithms because, over time prices, are skewed, so a lognormal distribution better reflects the reality of the prices (Harrington 1987). Unit root tests are performed to find the order of integration. The VAR and its stability are tested and optimal lag orders are selected. If the variables are integrated of the same order then the Johansen test for cointegration is used to test the long-run equilibrium relationship between the variables. If the series are cointegrated, the VECM is estimated using the optimal lag found in the VAR to investigate the transmission mechanism with ECT between the variables and cointegration is retested. Granger-causality tests are compiled with variance decomposition and IRF analyses are completed when cointegration is present in the VECM.

6.3 Unit root testing

The seminal paper by Granger and Newbold (1974) shows that the problem of spurious regressions exists in those regressions containing non-stationary variables. According to the EMH, the stock prices will reflect all publicly available information (Fama 1970). Then, testing the presence or absence of a unit root among variables can be interpreted as testing of weak-form market efficiency (Groenewold and Kang 1993; Allen and MacDonald 1995; Rahman and Uddin 2012). Therefore, the VAR model is designed for use with non-stationary series that are known to be cointegrated (Ben-Zion et al. 1996; Chu 2011). As a result, it is necessary to test the variables for stationarity before proceeding with the analysis of the VAR model and ADF and PP tests are used for unit roots in level series and first differences.

The PP is a better test when there is evidence of structural breaks in the data (Glynn et al. 2007). The test results are reported in Table 6.1. The null hypothesis is that all series variables are non-stationary against the alternative hypothesis that all series variables are stationary. This study tests hypothesis related to non-stationarity of a data series for pre-crisis, post-crisis and full study periods:

The results of the test for the pre-crisis period from 3rd January 2000 to 2nd July 2007 are presented in Table 6.1 Panel 1. In the case of level series, the results fail to reject the null hypothesis that all level series variables are non-stationary and the results show a similarity between two unit root tests, the ADF and the PP tests.

Table 6.1 Unit root tests

Variables	Augmented Dickey-Fuller test		Phillips Perron test	
Panel 1: From 3rd January 2000 to 2nd July 2007				
	Level	**1stDifference**	**Level**	**1stDifference**
ASX	1.134750	-45.78891*	1.408315	-45.93989*
LB	0.422931	-21.96185*	0.177925	-40.91667*
LG	-0.600658	-39.31748*	-0.641123	-39.72961*
LV	-0.822836	-39.14550*	-0.861816	-39.38524*
MSB	-0.004961	-26.84101*	-0.145689	-41.08861*
MSG	-0.966916	-36.79130*	-1.075575	-38.14385*
MSV	-0.349019	-39.01572*	-0.459913	-39.75938*
Panel 2: From 3rd July 2007 to 31st December 2010				
Variables	**Augmented Dickey-Fuller test**		**Phillips Perron test**	
	Level	**1stDifference**	**Level**	**1stDifference**
ASX	-1.663599	-30.66931*	-1.642412	-30.68648*
LB	-1.716936	-30.75498*	-1.711906	-30.76182*
LG	-1.722455	-29.56758*	-1.735712	-29.57617*
LV	-1.739606	-29.86523*	-1.739606	-29.86528*
MSB	-1.641769	-26.44554*	-1.645066	-27.18027*
MSG	-1.595281	-17.40401*	-1.571535	-26.47536*
MSV	-1.607619	-16.93248*	-1.610722	-25.77530*
Panel 3: From 3rd January 2000 to 31st December 2010				
Variables	**Augmented Dickey-Fuller test**		**Phillips Perron test**	
	Level	**1stDifference**	**Level**	**1stDifference**
ASX	-1.220832	-54.73263*	-1.168543	-54.80739*
LB	-1.308768	-53.06314*	-1.356428	-53.08767*
LG	-1.432706	-51.49540*	-1.537991	-51.52866*
LV	-1.679143	-52.94867*	-1.677301	-52.94570*
MSB	-1.351568	-32.92696*	-1.549254	-49.88143*
MSG	-1.469481	-32.98333*	-1.614483	-48.96579*
MSV	-1.256379	-34.01349*	-1.448174	-50.52148*

Note: Panel 1: the critical values for the ADF and the PP test statistic with intercept at the 0.01 level are -3.433, -2.862 and -2.567, respectively. Panel 2: the critical values for the ADF and the PP test statistic with intercept at the 0.01, 0.05 and 0.10 levels are -3.437, -2.864 and -2.568, respectively. Panel 3: the critical values for the ADF and the PP test statistic with intercept at the 0.01, 0.05 and 0.10 levels are -3.432, -2.862 and -2.567, respectively. * indicates significance at the 1% level. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

There are indications that the logarithmic closing prices are non-stationary as the *t*-statistic critical values are greater than the ADF and the PP critical values. The study then applies the same test to their first differences. The results show a rejection of the null hypothesis and an acceptance of the alternative hypothesis in that all level series variables are stationary at the 1% level of significance and results show a similarity between the ADF and the PP tests. It can be seen that the *t*-statistics critical value have smaller values than the ADF and the PP critical values. Thus, each price series is found to be stationary at the first differences ($I(1)$).

Table 6.1 Panel 2, shows the test results for the unit root test during the post-crisis period from 3rd July 2007 to 31st December 2010. In the case of level series, the results fail to reject the null hypothesis that all level series variables are non-stationary and the results show a similarity between the two unit root tests. There are indications that the logarithmic closing prices are non-stationary as the *t*-statistic critical values are greater than the ADF and the PP critical values. The study then applies the same test to their first differences. The results show a rejection of the null hypothesis and an acceptance of the alternative hypothesis in all differenced variables are stationary at the 1% level of significance and results show a similarity between the ADF and the PP tests. It can be seen that the *t*-statistics critical values have smaller values than the ADF and the PP critical values. Thus, each price series is found to be stationary at the first differences ($I(1)$).

The results of the unit root test are shown for the entire period of the study from 3rd January 2000 to 31st December 2010 in Table 6.1 Panel 3. In the case of level series, the results fail to reject the null hypothesis in that all level series variables are non-stationary and the results show a similarity between the two unit root tests. There are indications that the logarithmic closing prices are non-stationary as the *t*-statistic critical values are greater than the ADF and the PP critical values. The study then applies the same test to their first differences. The results show a rejection of the null hypothesis and an acceptance of the alternative hypothesis that differenced series variables are stationary at the 1% level of significance and results show a similarity between the ADF and the PP tests. It can be seen that the *t*-statistics critical value have smaller values than the ADF and the PP critical values. Thus, each price series is found to be stationary at the first differences ($I(1)$).

Based on the ADF and the PP results, the level series of price variables are non-stationary and the log return series of the variables are stationary data and do not contain a unit root. According to the Engel-Granger residual approach (1987), the estimation of a long-run relationship by OLS is needed if the series is cointegrated and then the residuals of the linear combination are $I(0)$. The estimated residual sequence from Equation 4.3 is denoted ε_{it}. These deviations (the residual sequence) are stationary at level $I(0)$ with a constant. The study then applies the unit root test to the residuals of the linear combination. The presence of a unit root in the residuals indicates that the residual term is non-stationary and leads to the rejection of cointegration (Escudero 2000). The results of the deterministic components unit root test for the three equations are presented in Table 6.2.

Table 6.2 Unit root tests of deterministic components, OLS

Panel 1: From 3rd January 2000 to 2nd July 2007		
Residual series	**Augmented Dickey-Fuller test 1st Difference**	**Phillips Perron test 1st Difference**
$\varepsilon_{2,t}$	-48.00078*	-50.75265*
Panel 2: From 3rd July 2007 to 31st December 2010		
Residual series	**Augmented Dickey-Fuller test 1st Difference**	**Phillips Perron test 1st Difference**
$\varepsilon_{3,t}$	-24.27148*	-34.30981*
Panel 3: Form 3rd January 2000 to 31st December 2010		
Residual series	**Augmented Dickey-Fuller test 1st Difference**	**Phillips Perron test 1st Difference**
$\varepsilon_{1,t}$	-56.52605*	-59.83060*

Note: Panel 1: the critical values for the ADF and the PP test statistic with intercept at the 0.01, 0.05 and 0.10 levels are -3.433, -2.862 and -2.567, respectively. Panel 2: the critical values for the ADF and the PP test statistic with intercept at the 0.01, 0.05 and 0.10 levels are -3.437, -2.864 and -2.568, respectively. Panel 3: the critical values for the ADF and the PP test statistic with intercept at the 0.01, 0.05 and 0.10 levels are -3.432, -2.862 and -2.567, respectively. * indicates significance at the 1% level.

The results show a rejection of the null hypothesis and an acceptance of the alternative hypothesis in that all residuals of the linear combination of log differences are stationary during the three study periods at the 1% level of significance. The results of the ADF and the PP tests are not fundamentally different, as presented in Table 6.2. The results show that the error terms of the first differenced relationships are stationary. This means that the series examined are integrated non-stationary processes. Additionally, a test based on Kwiatkowski et al. (1992) reveals similar evidence. The robustness of these deviations allow the analysis to proceed to the next step of testing cointegration in a lagged multivariate equation using the Johansen and Juselius approach (1990).

The relationships of the level series are captured in a VAR model. Cointegration is implied if the series have similar stochastic trends and together achieve the equilibrium or stability in the long-term (Ben-Zion et al. 1996; Chu 2010).

6.4 Vector autoregression model

Since the time series of equity mutual fund prices and the stock market index price are $I(1)$, there exists the possibility of a long-run equilibrium relationship between them. The study employs a specific VAR estimated to apply a specific lagged endogenous multivariate model. Endogenous variables are log(S&P/ASX All Ordinaries index), log(Large Blend funds), log(Large Growth funds), log(Large Value funds), log(Middle and Small Blend funds), log(Middle and Small Growth funds) and log(Middle and Small Value funds). The default of the lag interval of the endogenous variables used is one to two and it is later reported that this is the optimal lag based on lag length information criteria. Table 6.3 shows the *R*-squared and adjusted *R*-squared results based on VAR models.

In the cases of S&P/ASX All ordinaries index models, the results show that there are large *R*-squared values of up to 0.999 and it can be concluded that the VAR models over the three study periods are a good fit for estimating the S&P/ASX All ordinaries index price. In the cases of the index and the fund models, the results show that there are large adjusted *R*-squared values up to 0.999 and it can be concluded that the VAR models over the three study periods are a good fit for estimating the index values and equity mutual fund prices.

Table 6.3 The results of the VAR

Panel 1: From 3rd January 2000 to 2nd July 2007							
Exogenous	**ASX**	**LB**	**LG**	**LV**	**MSB**	**MSG**	**MSV**
R-squared	0.999	0.999	0.998	0.999	0.999	0.997	0.998
Adjusted *R*-squared	0.999	0.999	0.998	0.999	0.999	0.997	0.998
Panel 2: From 3rd July 2007 to 31st December 2010							
Exogenous	**ASX**	**LB**	**LG**	**LV**	**MSB**	**MSG**	**MSV**
R-squared	0.994	0.996	0.995	0.995	0.998	0.998	0.998
Adjusted *R*-squared	0.994	0.996	0.995	0.994	0.998	0.998	0.998
Panel 3: From 3rd January 2000 to 31st December 2010							
Exogenous	**ASX**	**LB**	**LG**	**LV**	**MSB**	**MSG**	**MSV**
R-squared	0.998	0.998	0.997	0.997	0.998	0.998	0.998
Adjusted *R*-squared	0.998	0.998	0.997	0.997	0.998	0.998	0.998

Note: ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

The stability of the VAR models is tested. Table 6.4 shows the VAR stability condition check results. These results show that none of the roots are outside the unit circle during the three study periods, which indicates that these VAR models satisfy the stability condition check.

Three different information criteria are used for model selection in order to determine the appropriate lag–length of the VAR models along with the Likelihood Ratio (LR), Wald test for lag exclusion and the Final prediction error (FPE): The information criteria are Akaike information criterion (AIC), Schwarz Information criterion (SC) and Hannan-Quinn criterion (HQ). In order to ensure that the results do not lose important information by restricting the lag length, the study performs a VAR lag exclusion Wald test as well. Five alternative VAR $(p),\ p = 1,2,3,4,5,$ models are estimated for each of the sample periods. The endogenous variables are S&P/ASX All Ordinaries and Australian equity mutual funds. The exogenous variable is constant (C).

Table 6.4 The results of the VAR stability

Panel 1: From 3rd January 2000 to 2nd July 2007	
Root	**Modulus**
0.998926	0.998926
0.997804	0.997804
0.993563 - 0.000965i	0.993563
0.993563 + 0.000965i	0.993563
0.982263	0.982263
0.971995	0.971995
0.918421	0.918421
0.167718	0.167718
-0.061123 - 0.113146i	0.128600
-0.061123 + 0.113146i	0.128600
-0.009970 - 0.102380i	0.102864
-0.009970 + 0.102380i	0.102864
-0.082561	0.082561
-0.011414	0.011414
Panel 2: From 3rd July 2007 to 31st December 2010	
Root	**Modulus**
0.996412 - 0.007496i	0.996440
0.996412 + 0.007496i	0.996440
0.988329 - 0.007438i	0.988357
0.988329 + 0.007438i	0.988357
0.953659	0.953659
0.934500 - 0.027734i	0.934911
0.934500 + 0.027734i	0.934911
0.192848	0.192848
-0.185525	0.185525
-0.141877 - 0.101923i	0.174692
-0.141877 + 0.101923i	0.174692
0.067050 - 0.092236i	0.114031
0.067050 + 0.092236i	0.114031
-0.060947	0.060947
Panel 3: From 3rd January 2000 to 31st December 2010	
Root	**Modulus**
0.998525	0.998525
0.998385 - 0.001906i	0.998387
0.998385 + 0.001906i	0.998387
0.995694	0.995694
0.991353	0.991353
0.981767	0.981767
0.956784	0.956784
0.147317	0.147317
-0.092549 - 0.051354i	0.105842
-0.092549 + 0.051354i	0.105842
-0.011712 - 0.087613i	0.088392
-0.011712 + 0.087613i	0.088392
-0.046686	0.046686
0.000150	0.000150

A comparison of the results for the alternative lag selection criteria and a VAR lag exclusion Wald test are presented in Table 6.5.

Table 6.5 VAR lag order selection criteria

Panel 1: From 3rd January 2000 to 2nd July 2007					
Lag	**FPE**	**AIC**	**SC**	**HQ**	**Wald test**
0	2.23e-20	-25.38584	-25.36583	-25.37848	0.00000
1	4.83e-34	-56.84727	-56.68722*	-56.78843	12286.64
2	4.38e-34	-56.94469	-56.64460	-56.83436*	156.9066*
3	4.29e-34*	-56.96568*	-56.52554	-56.80386	118.9028
4	4.33e-34	-56.95643	-56.37624	-56.74313	49.01159
5	4.41e-34	-56.93782	-56.21759	-56.67303	60.85405
Panel 2: From 3rd July 2007 to 31st December 2010					
Lag	**FPE**	**AIC**	**SC**	**HQ**	**Wald test**
0	1.15e-22	-30.65195	-30.61505	-30.63787	0.00000
1	8.36e-34	-56.29941	-56.00422*	-56.18673	6606.257
2	6.82e-34	-56.50328	-55.94981	-56.29201*	132.6236*
3	6.82e-34	-56.50321	-55.69145	-56.19334	66.05251
4	6.77e-34	-56.51006	-55.44002	-56.10160	89.17779
5	6.75e-34*	-56.51403*	-55.18570	-56.00698	100.0868
Panel 3: From 3rd January 2000 to 31st December 2010					
Lag	**FPE**	**AIC**	**SC**	**HQ**	**Wald test**
0	8.01e-19	-21.80330	-21.78874	-21.79805	0.00000
1	1.65e-33	-55.61926	-55.50276*	-55.57726	18833.02
2	1.52e-33	-55.70387	-55.48543	-55.62512*	130.1239*
3	1.49e-33*	-55.72346*	-55.40308	-55.60795	80.58974
4	1.49e-33	-55.71833	-55.29601	-55.56606	61.26294
5	1.50e-33	-55.71756	-55.19330	-55.52854	95.11535

Note: * indicates lag order selected by the criterion

During the pre-crisis period, as shown in Panel 1 of Table 6.5 from 3rd January 2000 to 2nd July 2007, the FPE and the AIC indicate that the optimal number of lags to be included in the VAR is $p = 3$. While the SC selects one lag, the HQ indicates a lag length of two, as does the Wald test.

Results of lag order selection for the post-crisis period from 3rd July 2007 to 31st December 2010, suggest that the lag length of VAR is $p = 5$ according to FPE and AIC. The SC finds one lag as the appropriate lag length, while the VAR lag exclusion Wald and HQ tests indicate that two lags are significant for the system.

The results of the sample period from 3rd January 2000 to 31st December 2010 in Panel 3 of Table 6.5 show that the FPE and the AIC statistics suggest a VAR of lag order three. In contrast, both the HQ and the Wald test statistics suggest the use of two lags. The SC suggests a VAR of lag order one.

By selecting lag length criteria, the statistical results in Table 6.5 show that lags of order two are sufficient based on that suggested by the VAR lag exclusion Wald test and HQ statistics. Hence, the study selects the optimal lag with the lag interval one to two for cointegration and causality tests based on the VECMs. This decision is justified based on the interaction of these variables in a relatively efficient Australian stock market (Groenewold and Kang 1993).

6.5 Cointegration

As the VECM specification only applies to cointegrated series, it is necessary to run the Johansen cointegration test prior to the VECM specification. Testing for the presence of cointegration among the variables involves the use of the maximum likelihood method according to Johansen (1988) based on a VAR. Both trace and maximum eigenvalue statistics are based on five alternative assumptions, which are: 1) the model does not allow for any deterministic components in the data; 2) the model does not allow for any linear trends in the data, but allows for constants in the cointegration equations; 3) the model allows for linear trends in the data, but no trends in the cointegration equations; 4) the model allows both constants and linear trends in the cointegration equations; 5) the model allows for non-linear trends and this is the least restrictive model on deterministic components. Table 6.6 summarises the results for both Trace and Maximum eigenvalue statistics based on all five assumptions.

In the case of the pre-crisis period, Table 6.6, Panel 1 shows that in four of the five cointegration relationships tested there are two cointegrating vectors at the 1% significance level using the critical value for Trace and Maximum eigenvalue statistics. In the case of the post-crisis period (see Panel 2), the results show that in three of the five cases there are two cointegrating vectors using the critical value for the trace statistic at the 1% significance level.

Table 6.6 The number of cointegrating relations by model

Panel 1: From 3rd January 2000 to 2nd July 2007					
Data Trend	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace Max-eigenvalue	1 1	2 2	2 2	2 2	2 2
Panel 2: From 3rd July 2007 to 31st December 2010					
Data Trend	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace Max-eigenvalue	1 1	1 1	2 1	2 1	2 1
Panel 3: From 3rd January 2000 to 31st December 2010					
Data Trend	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace Max-eigenvalue	1 1	1 1	1 1	1 1	1 1

Note: The critical values used for the test are defined by Mackinnon (1999) at the 1% significance level.

In the case of the full study period (see Panel 3), the results show that for every cointegration relationship tested, there is one cointegrating vector using the critical value for the Trace and Maximum eigenvalue statistics at the 1% significance level. Thus, the results strongly suggest that there is an equilibrium long-run relationship between the stock market index prices and equity mutual fund prices.

6.6 Vector error correction model

The ECT of the VECM indicates exogeneity and the speed of adjustment of the model to long-term equilibrium. The study considers the first cointegration vector in deriving the VECM as the test results are highly significant. Table 6.7 shows the ECT estimates of the variables with lag specification one to two as evidence of cointegration for the pre-crisis, post-crisis and full study periods (see Panels 1 to 3). The complete results are reported in Appendix A in Tables A1 to A3.

Table 6.7 The results of ECT

Panel 1: From 3rd January 2000 to 2nd July 2007							
Exogenous	ΔASX	ΔLB	ΔLG	ΔLV	ΔMSB	ΔMSG	ΔMSV
Error correction term	-0.048967	0.006894	0.000988	0.003551	-0.002682	-0.019873	-0.004085
	(0.00768)	(0.00549)	(0.00738)	(0.00704)	(0.00725)	(0.00955)	(0.00918)
	[-6.37969]*	[1.25490]	[0.13389]	[0.50408]	[-0.36969]	[-2.0799]**	[-0.44513]
Adjusted *R*-squared	0.026{3}	0.018{4}	0.014{5}	0.009{7}	0.036{1}	0.032{2}	0.009{6}
Panel 2: From 3rd July 2007 to 31st December 2010							
Exogenous	ΔASX	ΔLB	ΔLG	ΔLV	ΔMSB	ΔMSG	ΔMSV
Error correction term	-0.043247	-0.019146	-0.045576	-0.036240	0.010225	-0.009530	0.017569
	(0.02275)	(0.01874)	(0.02089)	(0.02073)	(0.01857)	(0.01843)	(0.01712)
	[-1.90123]	[-1.02173]	[-2.182]**	[-1.74858]	[0.55073]	[-0.51700]	[1.02604]
Adjusted *R*-squared	0.006{7}	0.014{4}	0.013{5}	0.007{6}	0.034{3}	0.040{2}	0.051{1}
Panel 3: From 3rd January 2000 to 31st December 2010							
Exogenous	ΔASX	ΔLB	ΔLG	ΔLV	ΔMSB	ΔMSG	ΔMSV
Error correction term	-0.001579	0.000130	-0.004409	-0.003473	-0.001229	-0.002451	-0.001222
	(0.00192)	(0.00151)	(0.00178)	(0.00174)	(0.00165)	(0.00187)	(0.00177)
	[-0.82452]	[0.08596]	[-2.475]**	[-1.991]**	[-0.74647]	[-1.31118]	[-0.69032]
Adjusted *R*-squared	0.004{7}	0.013{4}	0.010{5}	0.005{6}	0.029{1}	0.027{2}	0.018{3}

Note: * and ** denote the 1% and 5% significance levels, respectively. Δ denotes the difference operator, standard errors in ( ), *t*-statistics in [ ] and ranking in { }. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

The results of the estimated ECTs for the pre-crisis period are presented in Panel 1 of Table 6.7. The ECT value has a significant negative effect on the stock market index at the 1% level, when the S&P/ASX All ordinaries index is treated endogenously. The significance of the ECT value confirms the existence of a long-run equilibrium relationship between the stock market index and equity mutual funds. An ECT of -0.0489 implies that the feedback into the short-run dynamic process from the previous periods is 4.89%.

The ECT value has a significant effect on the middle and small-cap growth equity mutual funds at the 5% level, when this variable is treated endogenously. This indicates that the other equity mutual fund price categories and the stock market index price do contribute to changes in the middle and small-cap growth equity mutual fund prices in the long-run. An ECT of -0.0198 implies that the feedback into the short-run dynamic process from the previous period is 1.98%.

The results of the ECT values for the joint significance of equity mutual funds lagged endogenous variables show it is not a significant adjusted effect to long-run equilibrium relationships for large-cap equity mutual funds, middle and small-cap blend and value equity mutual funds (see Appendix A in Table A1). This indicates that none of the variables contribute to changes in the large-cap equity mutual fund prices and middle and small-cap blend and value equity mutual fund prices in the long run. Therefore, the middle and small-blend equity mutual fund suggests the strong explanatory power of the models according to the adjusted *R*-squared values.

The results of the estimated ECTs for the post-crisis period are presented in Panel 2, Table 6.7. The ECT value has no significant effect when the S&P/ASX All ordinaries index is treated endogenously. The results suggest that, in the long-run the six equity mutual funds do not contribute significantly to changes in the stock market index prices during the post-financial-crisis period. An ECT of -0.043 implies that the feedback into the short-run dynamic process from the previous period is 4.3%.

The ECT value has a significant effect on the large-cap growth equity mutual funds at the 5% level, when this variable is treated endogenously (see Appendix A in Table A2). This indicates that the other equity mutual fund price categories and the stock market index price do contribute to changes in the large-cap growth equity mutual fund prices in the long run. An ECT of -0.045 implies that the feedback into the short-run dynamic process from the previous period is 4.5%.

The results of the ECT values for the joint significance of equity mutual funds lagged endogenous variables is not a significant adjusted effect on long-run equilibrium for large-cap blend and value equity mutual funds and middle and small-cap equity mutual funds, when these five variables are treated endogenously (see Appendix A in Table A2). This indicates that none of the variables contribute significantly to changes in the large-cap blend and value equity mutual fund prices and middle and small-cap equity mutual fund prices in the long run. Therefore, the middle and small-cap value equity mutual fund suggests a strong explanatory power by the models according to the adjusted *R*-squared values.

The results of the estimated ECTs for the full study period are presented in Panel 3, Table 6.7. The ECT value has no significant effect on the stock market index price, when that is treated endogenously. The results suggest that, in the long-run the six equity mutual funds do not contribute significantly to changes in the stock market prices during the full study period. An ECT of -0.0015 implies that the feedback into the short-run dynamic process from the previous period is very slow.

The ECT value has a significant effect on the large-cap growth and value equity mutual funds at the 5% level, when these two variables are treated endogenously (see Appendix A in Table A3). The results indicate that the other equity mutual fund price categories and the stock market index price contribute to changes in the large-cap growth and value equity mutual fund prices in the long-run at the 5% level of significance. An ECT of -0.004 implies that the feedback of large-cap growth equity mutual funds into the short-run dynamic process from the previous period is 0.4%. An ECT of -

0.003 implies that the feedback of large-cap value equity mutual funds into the short-run dynamic process from the previous period is 0.3%.

The results of the ECT values for the joint significance of equity mutual funds lagged endogenous variables do not show a significant adjusted effect of a long-run equilibrium relationship for large-cap blend equity mutual funds and middle and small-cap equity mutual funds (see Appendix A in Table A3). This indicates that none of the variables contribute significantly to any change in the large-cap blend equity mutual fund prices and middle and small-cap equity mutual fund prices in the long run. Therefore, the large-cap equity mutual fund suggests a strong explanatory power by the models according to the adjusted *R*-squared values.

It can be seen that some models have a significantly higher ECT value and explanatory power (adjusted *R*-squared values) than the S&P/ASX All Ordinaries index model (for example, the middle and small-growth equity mutual funds models). However, this study is interested in causal relationships with the specified model.

6.7 Johansen cointegration

Johansen's cointegration tests within the VECM framework are used to identify a long-run equilibrium relationship between variables. The null hypothesis (H_{03}) and the alternative hypothesis (H_{A3}) for pre-crisis, post-crisis and full study periods are stated as follows:

Hypothesis (H_{03}): There is no long-term equilibrium relationship between the equity managed fund prices and the stock market index price.

Hypothesis (H_{A3}): There is a long-term equilibrium relationship between the equity managed fund prices and the stock market index price.

Testing for the presence of cointegration between the variables involves the use of the maximum likelihood method from Johansen (1988). Accordingly, Trace tests under the null hypothesis of r cointegrating relations against k cointegrating relations, where k is the number of endogenous variables, for $r = 0,1, \dots, k$ are undertaken. The Maximum eigenvalue tests under the null hypothesis of r cointegrating relations against the alternative of $r + 1$ cointegrating relations are also carried out.

The study estimates the model under the assumption of linear trends in the data, but no trends in the cointegration equations using lag intervals one to two because the variables have an upward trend (Allen and MacDonald 1995). The results for both Trace and Maximum eigenvalue statistics are reported in Table 6.8.

Table 6.8 Johansen cointegration

Panel 1: From 3rd January 2000 to 2nd July 2007			
Null	Alternative	Trace Statistic	99% Critical value
$r = 0$	$r \geq 1$	208.9915*	135.9732
$r \leq 1$	$r \geq 2$	124.6009*	104.9615
$r \leq 2$	$r \geq 3$	65.29041	77.81884
Null	Alternative	Max-Eigen Statistic	99% Critical value
$r = 0$	$r = 1$	84.39061*	52.30821
$r \leq 1$	$r = 2$	59.31049*	45.86900
$r \leq 2$	$r = 3$	31.52060	39.37013
Panel 2: From 3rd July 2007 to 31st December 2010			
Null	Alternative	Trace Statistic	99% Critical value
$r = 0$	$r \geq 1$	183.5202*	135.9732
$r \leq 1$	$r \geq 2$	110.3540*	104.9615
$r \leq 2$	$r \geq 3$	71.44885	77.81884
Null	Alternative	Max-Eigen Statistic	99% Critical value
$r = 0$	$r = 1$	73.16625*	52.30821
$r \leq 1$	$r = 2$	38.90513	45.86900
$r \leq 2$	$r = 3$	19.93624	39.37013
Panel 3: From 3rd January 2000 to 31st December 2010			
Null	Alternative	Trace Statistic	99% Critical value
$r = 0$	$r \geq 1$	157.0011*	135.9732
$r \leq 1$	$r \geq 2$	76.46706	104.9615
$r \leq 2$	$r \geq 3$	50.76179	77.81884
Null	Alternative	Max-Eigen Statistic	99% Critical value
$r = 0$	$r = 1$	80.53403*	52.30821
$r \leq 1$	$r = 2$	25.70527	45.86900
$r \leq 2$	$r = 3$	23.13774	39.37013

Note: * denote that the null hypothesis of no cointegration can be rejected at the 1% significance level. The critical values used for the test are defined by Mackinnon (1999).

It can be seen that the Trace and the Maximum eigenvalue tests perform similarly in the bivariate case when the first hypothesis $(r = 0)$ is tested. However, the Trace and the Maximum eigenvalue tests perform quite differently in other cases. At this point, the Trace test results are preferable for the current study (Lüutkepohl et al. 2001).

Panel 1 of Table 6.8: With the inclusion of the Trace statistic and the Maximum eigenvalue statistic, the findings lead to the rejection of the null hypothesis (H_{03}) and acceptance of the alternative hypothesis (H_{A3}) that there is a long-term equilibrium relationship between the equity managed fund prices and the stock market index price at the 1% level of significance. The Trace tests show that the null hypothesis of $r = 0$ against the alternative $r \geq 1$, can be rejected at the 1% level of significance as the Trace statistic (208.99) is greater than the 135.97 critical value. Also, the null hypothesis of $r \leq 1$ against the alternative $r = 2$ can be rejected at the 1% level of significance as the Trace statistic (124.60) is greater than the 104.96 critical value. However, the null hypothesis of $r \leq 2$ against the alternative $r = 3$, cannot be rejected at the 99% critical value level as the Trace statistic (65.29) is smaller than the 77.81 critical value. This suggests that there is a cointegration rank of two according to the Trace test.

As for the Maximum eigenvalue tests, the test statistic (84.39) is greater than the 99% critical value of 52.30. This indicates that the null hypothesis of $r = 0$ can be rejected at the 1% level of significance. Similarly, the null hypothesis of $r \leq 1$ against the alternative $r = 2$ can be rejected at the 1% level of significance as the test statistic (59.31) is greater than the critical value of 45.86. However, the null hypothesis of $r \leq 2$ against the alternative $r = 3$ cannot be rejected at the 1% level of significance, as the Maximum eigenvalue statistic (31.52) is smaller than the 99% critical value of 39.37. This indicates that there exist two-cointegrating vectors at the 1% level of significance.

Hence, the results of both the Trace and the Maximum eigenvalue tests suggest that there are two cointegrating vectors at the 1% level of significance for the pre-crisis period. This means that there is a long-run equilibrium relationship between the S&P/ASX All Ordinaries index price and Australian equity mutual fund prices.

Panel 2 of Table 6.8 deals with the second study period: With the inclusion of the Trace statistic and Maximum eigenvalue statistic, the findings lead to the rejection of the null hypothesis (H_{03}) and acceptance of the alternative hypothesis (H_{A3}) that there is a long-term equilibrium relationship between the equity managed fund prices and the stock market index price at the 1% level of significance. The results show that the Trace test statistic (183.52) has a greater value than the 99% critical value of 135.97; in this regard, it indicates that the null hypothesis of $r = 0$ can be rejected at the 1% level of significance. Testing for the null hypothesis of $r \leq 1$ against the alternative of $r = 2$, the value of the Trace test statistic (110.35) is greater than the 99% critical value of 104.96. However, the null hypothesis of $r \leq 2$ against the alternative $r = 3$ cannot be rejected at the 1% level of significance. The test shows that the Trace statistic's value (71.44) is smaller than 77.81 (99% critical value). Thus, this suggests that there is a cointegration rank of two according to the Trace test.

The Maximum eigenvalue tests show that the null hypothesis of $r = 0$ can be rejected at the 1% level of significance. The value of the test statistic (73.16) is greater than the 99% critical value of 52.30. The null hypothesis of $r \leq 1$ against the alternative hypothesis of $r = 2$, however, cannot be rejected at the 1% level of significance, as the value of the test statistic (38.90) is smaller than 45.86 (99% critical value). The Maximum eigenvalue suggests that one cointegration vector exists at the 1% level of significance. The Trace test has results that are superior in power to the Maximum eigenvalue tests when a comparison is made between them.

Therefore, the Trace test statistic of the final result is chosen for the current study.

According to the Trace test, there are two cointegrating vectors at the 1% level of significance for the post-crisis period. This means that there is a long-run equilibrium relationship between the S&P/ASX All Ordinaries index price and Australian equity mutual fund prices.

Panel 3 of Table 6.8 deals with the full period: With the inclusion of the Trace and Maximum eigenvalue statistics, the findings lead to the rejection of the null hypothesis (H_{03}) and acceptance of the alternative hypothesis (H_{A3}) that there is no long-term equilibrium relationship between the equity managed fund prices and the stock market index price at the 1% level of significance. The test shows that the Trace statistic (157.00) is greater than the 99 % critical value of 135.97. The null hypothesis of $r = 0$ can be rejected at the 1% level of significance. However, the null hypothesis of $r \leq 1$ fail to be rejected at the 1% level of significance, since the Trace statistic (76.46) is smaller than 104.96. This suggests that there is a cointegration rank of one according to the Trace test.

Similarly, the Maximum eigenvalue tests show that the null hypothesis of $r = 0$ against the alternative of one cointegrating vector ($r = 1$) can be rejected at the 1% level of significance. The result shows that the Maximum eigenvalue statistic (80.53) is greater than the 99% critical value of 52.30. On the other hand, the null hypothesis of $r \leq 1$ against the alternative $r = 2$ fails to be rejected at the 1% level of significance, since the Maximum eigenvalue statistic (25.70) is smaller than 45.86. This indicates that there is at least one cointegrating vector.

Thus, both Trace and the Maximum eigenvalue tests suggest that there is a unique cointegrating vector at the 1% level of significance over the entire period of the study. This means that there are long-run equilibrium relationships between the S&P/ASX All Ordinaries index price and Australian equity mutual fund prices.

The results obtained from the Johansen approach show strong support for rational expectation theory during the three study periods, suggesting prices converge in the long-run between these seven series. There is a linear combination between equity mutual fund prices and the stock market index price that forces these variables into a long-run equilibrium relationship. The next section discusses the short-run causality (exogeneity).

6.8 Granger causality

After establishing that the variables are cointegrated, the next question concerns the nature of the short-run relationship between the Australian stock market index and Australian equity mutual funds. In order to investigate this, VECM based Granger-causality tests along with variance decomposition and impulse response analyses are conducted.

Granger (1988) suggests that, if the ECT in the cointegration vector is a representation of the data, then Granger-causality must exist in at least one direction. Based on the VECM results, the study performs Granger-causality tests between equity mutual fund prices and the stock benchmark index price. Previous studies have tested bi-directional causality (for example, Ben-Zion et al. 1996). Other studies have tested uni-directional causality (for example, Low and Ghazali 2007). This study provides an analysis of two-way causality between the variables and tests (1) whether equity mutual fund prices Granger cause the stock index price, (2) whether the stock market index price Granger causes equity mutual fund prices and (3) whether each equity mutual fund category Granger causes other equity mutual fund categories.

The study uses Block Exogeneity Wald tests with a chi-square statistic to indicate the existence of Granger-causality when all variables interact in one system. This technique tests for the joint significance of all equity mutual funds variables. The null hypothesis (H_{04}) and the alternative hypothesis (H_{A4}) relate to the price dynamic in a short-run relationship between equity mutual funds and the stock market in Australia and are stated as follows.

Hypothesis (H_{04}): There is no short-term exogenous relationship between equity managed fund prices and the stock market index price.

Hypothesis (H_{A4}): There is a short-term exogenous relationship between equity managed fund prices and the stock market index price.

The technique also tests for exogeneity between each equity mutual fund variable within the specified model. The null hypothesis (H_{05}) and the alternative hypothesis (H_{A5}) concern the short-run relationship between equity mutual fund categories and are stated as follows:

Hypothesis (H_{05}): There is no short-term Granger-causal relationship between the equity managed fund price categories.

Hypothesis (H_{A5}): There is a short-term Granger-causal relationship between the equity managed fund price categories.

Table 6.9 reports the results of the short-run relationships between the specified variables. The table summarises the Granger-causality test results during the pre-crisis period. The findings fail to reject the null hypothesis (H_{04}) of no short-run exogenous relationship between equity managed fund prices and the stock market index prices. The Granger-causality results show that the S&P/ASX All Ordinaries index prices do not Granger cause equity mutual fund prices, while the equity mutual fund prices, with some exceptions do not Granger cause the S&P/ASX All Ordinaries index prices.

Granger causality between the stock market index and the large-cap blend and value of equity mutual funds is one-way (equity mutual funds to stock market) at the 5% level of significance. The large-cap growth and middle and small-cap value of equity mutual fund prices do Granger cause changes to the S&P/ASX All Ordinaries index price at the 10% significance level.

Table 6.9 Multivariate causality, pre-crisis period

Dependent variable: Δ(ASX)				**Dependent variable: Δ(MSB)**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Δ(LB)	3.632	2	0.163	Δ(ASX)	4.587	2	0.101
Δ(LG)	0.357	2	0.836	Δ(LB)	22.327	2	0.000*
Δ(LV)	2.011	2	0.366	Δ(LG)	2.274	2	0.321
Δ(MSB)	4.033	2	0.133	Δ(LV)	5.220	2	0.074***
Δ(MSG)	1.449	2	0.485	Δ(MSG)	7.964	2	0.019**
Δ(MSV)	0.278	2	0.870	Δ(MSV)	5.481	2	0.065***
All	15.447	12	0.218	All	63.517	12	0.000*
Dependent variable: Δ(LB)				**Dependent variable: Δ(MSG)**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Δ(ASX)	6.586	2	0.037**	Δ(ASX)	2.277	2	0.320
Δ(LG)	3.392	2	0.183	Δ(LB)	35.125	2	0.000*
Δ(LV)	11.604	2	0.003*	Δ(LG)	5.092	2	0.078***
Δ(MSB)	2.362	2	0.307	Δ(LV)	5.397	2	0.067***
Δ(MSG)	0.453	2	0.797	Δ(MSB)	10.433	2	0.005*
Δ(MSV)	3.900	2	0.142	Δ(MSV)	4.621	2	0.099***
All	44.283	12	0.000*	All	57.380	12	0.000*
Dependent variable: Δ(LG)				**Dependent variable: Δ(MSV)**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Δ(ASX)	4.720	2	0.094***	Δ(ASX)	5.090	2	0.079***
Δ(LB)	11.943	2	0.003*	Δ(LB)	15.401	2	0.001*
Δ(LV)	6.758	2	0.034**	Δ(LG)	0.089	2	0.956
Δ(MSB)	2.151	2	0.341	Δ(LV)	4.637	2	0.098***
Δ(MSG)	0.028	2	0.986	Δ(MSB)	10.178	2	0.006*
Δ(MSV)	6.027	2	0.049**	Δ(MSG)	1.448	2	0.485
All	32.640	12	0.001*	All	31.225	12	0.002*
Dependent variable: Δ(LV)							
Excluded	Chi-sq	df	Prob.				
Δ(ASX)	7.821	2	0.020**				
Δ(LB)	11.233	2	0.004*				
Δ(LG)	6.380	2	0.041**				
Δ(MSB)	1.490	2	0.475				
Δ(MSG)	3.350	2	0.187				
Δ(MSV)	2.421	2	0.298				
All	29.781	12	0.003*				

Note: *, ** and *** represent a rejection of the hypotheses of non-causality at the 1%, 5% and 10% significance levels, respectively. ASX represents the S&P/ASX All Ordinaries index and LB represents the large-cap blend equity mutual funds. LG represents the large-cap growth equity mutual funds and LV represents the large-cap value equity mutual funds. MSB represents the middle and small-cap blend equity mutual funds, MSG represents the middle and small–cap growth equity mutual funds and MSV represents the middle and small-cap equity value funds. Δ denotes the difference operator.

With the inclusion of the VECM based Granger-causality tests for equity mutual funds within the specified model, the findings reject the null hypothesis (H_{05}) and accept the alternative hypothesis (H_{A5}) that there is a short-run Granger causal relationship between equity managed fund categories at the 1% level of significance.

There are four pairs of bi-directional price causality among the equity mutual fund categories within the specified model. First, a causal link exists between the large-cap blend equity mutual funds and the large-cap value equity mutual funds. The second pair is the large-cap growth equity mutual funds and the large-cap value equity mutual funds. The third pair is the middle and small-cap blend equity mutual funds and the middle and small-cap growth equity mutual funds. The last pair is the middle and small-cap blend equity mutual funds and the middle and small-cap value equity mutual funds.

The study finds one-way Granger-causality between the large-cap growth and blend equity mutual funds at the 1% level of significance running from the growth equity mutual fund to the blend equity mutual fund. Results show that the large-cap growth equity mutual fund prices Granger cause the middle and small-cap value equity mutual fund prices at the 5% significance level.

Another one-way causal direction is from the middle and small-cap blend equity mutual fund prices to the large-cap blend equity mutual fund prices at the 1% level of significance. The result suggests that the middle and small-cap blend equity mutual fund prices Granger cause the large-cap value equity mutual fund prices at the 10% level of significance. The results show Granger-causality runs from the middle and small-cap growth equity mutual fund prices to the large-cap blend equity mutual fund prices at the 1% level of significance. The middle and small-cap growth equity mutual fund prices Granger cause the large-cap growth and value equity mutual fund prices at the 10% significance level. Another one-way causal direction is from the middle and small-cap growth equity mutual fund prices to the middle and small-cap value equity mutual fund prices at the 10% level of significance.

The findings suggest that changes in the middle and small-cap value equity mutual fund prices Granger cause the change in the large-cap blend and value equity mutual funds at the 1% and 10% significance levels respectively.

In summary, there is bi-directional Granger-causality between the large-cap equity mutual funds in the short-run suggesting the large-cap blend equity mutual fund prices contribute more than the large-cap growth equity mutual fund prices to changes in the large-cap value equity mutual fund prices. The results also show bi-directional Granger-causality along the middle and small-cap equity mutual funds in the short-run, suggesting the middle and small-cap growth equity mutual fund prices contribute more than the middle and small-cap value mutual fund prices to changes in the middle and small-cap blend equity mutual fund price. The results indicate the large-cap value equity mutual fund prices contribute more than other large-cap mutual fund prices to changes in the S&P/ASX All Ordinaries price. This further suggest the middle and small-cap equity mutual fund prices contribute more than the other large-cap mutual fund prices to changes in the large-cap blend equity mutual fund prices.

Table 6.10 summarises the Granger-causality test during the post-crisis period. With the inclusion of the tests for the joint significance of all equity mutual funds, the findings indicate the rejection of the null hypothesis (H_{04}) and acceptance of the alternative hypothesis (H_{A4}) concerning the short-run dynamic relationship between the equity managed fund prices and the stock market index prices at the 5% level of significance. The results show that the S&P/ASX All Ordinaries index prices do not Granger cause equity mutual fund prices, with some exceptions and equity mutual fund prices, with some exceptions do not Granger cause the S&P/ASX All Ordinaries index prices.

Table 6.10 Multivariate causality, post-crisis period

Dependent variable: Δ(ASX)				**Dependent variable: Δ(MSB)**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Δ(LB)	1.848	2	0.397	Δ(ASX)	5.975	2	0.050**
Δ(LG)	3.801	2	0.150	Δ(LB)	1.923	2	0.382
Δ(LV)	5.075	2	0.079***	Δ(LG)	5.478	2	0.065***
Δ(MSB)	4.294	2	0.117	Δ(LV)	2.997	2	0.224
Δ(MSG)	3.344	2	0.188	Δ(MSG)	4.655	2	0.098***
Δ(MSV)	4.979	2	0.083***	Δ(MSV)	7.934	2	0.019**
All	23.253	12	0.026**	All	24.106	12	0.020**
Dependent variable: Δ(LB)				**Dependent variable: Δ(MSG)**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Δ(ASX)	0.342	2	0.843	Δ(ASX)	4.226	2	0.121
Δ(LG)	6.317	2	0.043**	Δ(LB)	1.918	2	0.383
Δ(LV)	5.915	2	0.052***	Δ(LG)	6.777	2	0.034**
Δ(MSB)	3.777	2	0.151	Δ(LV)	1.003	2	0.606
Δ(MSG)	3.757	2	0.153	Δ(MSB)	2.663	2	0.264
Δ(MSV)	3.513	2	0.173	Δ(MSV)	7.279	2	0.026**
All	22.056	12	0.037**	All	19.717	12	0.072***
Dependent variable: Δ(LG)				**Dependent variable: Δ(MSV)**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Δ(ASX)	1.390	2	0.499	Δ(ASX)	4.616	2	0.100***
Δ(LB)	1.011	2	0.603	Δ(LB)	1.974	2	0.373
Δ(LV)	3.435	2	0.180	Δ(LG)	5.373	2	0.068***
Δ(MSB)	4.414	2	0.110	Δ(LV)	1.423	2	0.491
Δ(MSG)	3.734	2	0.155	Δ(MSB)	3.823	2	0.148
Δ(MSV)	7.442	2	0.024**	Δ(MSG)	3.963	2	0.138
All	25.807	12	0.011**	All	14.196	12	0.2883
Dependent variable: Δ(LV)							
Excluded	Chi-sq	df	Prob.				
Δ(ASX)	1.800	2	0.407				
Δ(LB)	0.931	2	0.628				
Δ(LG)	8.139	2	0.017**				
Δ(MSB)	2.819	2	0.244				
Δ(MSG)	2.905	2	0.234				
Δ(MSV)	3.368	2	0.186				
All	24.331	12	0.018**				

Note: *, ** and *** represent a rejection of the hypotheses of non-causality at the 1%, 5% and 10% significance levels, respectively. ASX represents the S&P/ASX All Ordinaries index and LB represents the large-cap blend equity mutual funds. LG represents the large-cap growth equity mutual funds and LV represents the large-cap value equity mutual funds. MSB represents the middle and small-cap blend equity mutual funds, MSG represents the middle and small–cap growth equity mutual funds and MSV represents the middle and small-cap equity value funds. Δ denotes the difference operator.

There is one bi-directional price causal link existing between the S&P/ASX All Ordinaries index and the middle and small-cap value equity mutual funds. The results indicate that the S&P/ASX All Ordinaries index prices do Granger cause changes in large-cap value equity managed fund prices in the short-run at the 10% significance level. The study finds a one-way causal relationship between the S&P/ASX All Ordinaries index and the middle and small-cap blend equity mutual funds at the 5% level of significance, which runs from the middle and small-cap blend equity mutual fund prices to the stock market index prices.

With the inclusion of the tests for the joint significance of all equity mutual funds, the findings reject the null hypothesis (H_{05}) and accept the alternative hypothesis (H_{A5}) for the short-run Granger causal relationship between the equity managed fund price categories at the 5% and 10% levels of significance.

No bi-directional price causal link exists between the equity mutual fund price categories. The study finds that the price of the large-cap blend equity mutual funds Granger cause the large-cap growth equity mutual fund prices at the 5% level of significance. The large-cap blend equity mutual fund price Granger cause the large-cap value equity mutual fund prices at the 10% significance level. There is a one-way causal relationship running from the large-cap growth equity mutual fund prices to the middle and small-cap value equity mutual fund prices at the 5% level of significance. The results suggest that the large-cap value equity mutual fund prices Granger cause the large-cap growth equity mutual fund prices at the 5% level of significance.

The results show one-way causality running from the middle and small-cap blend equity mutual fund prices to the large-cap growth equity mutual fund prices at the 10% level of significance. A causal link exists between the middle and small-cap blend equity mutual fund prices and the other middle and small-cap equity mutual fund price categories as it runs from the middle and small-cap blend equity mutual fund prices to the middle and small-cap growth and value equity mutual fund prices at the 10% and 5% significance levels respectively. The middle and small-cap growth equity mutual fund prices Granger cause the large-cap growth equity mutual fund prices at the 5% significance level. The middle and small-cap growth equity mutual fund prices Granger cause the middle and small-cap value equity mutual fund prices at the 5% significance level.

In summary, the results indicate bi-directional causality between the middle and small-cap value equity mutual fund prices and the S&P/ASX All Ordinaries index price suggesting the S&P/ASX All Ordinaries index price contributes much to change in the middle and small-cap value equity mutual fund prices. There is also evidence that the S&P/ASX All Ordinaries index price Granger causes the large-cap value equity mutual fund prices. The results suggest that middle and small-cap blend equity mutual fund prices contribute much to change in the S&P/ASX All Ordinaries index price. The result indicates that the large-cap value equity mutual fund prices contribute much to change in the large-cap growth equity mutual fund prices.

Table 6.11 summarises the Granger-causality test during the post-crisis period. With the inclusion of the tests for the joint significance of all equity mutual funds, the findings indicate the rejection of the null hypothesis (H_{04}) and acceptance of the alternative hypothesis (H_{A4}) concerning the short-run dynamic relationship between the equity managed fund prices and the stock market index prices at the 5% level of significance. The results show that the S&P/ASX All Ordinaries index prices do not Granger cause equity mutual fund prices, with some exceptions and equity mutual fund prices do not Granger cause the S&P/ASX All Ordinaries index prices.

The study finds a one-way causal relationship between the S&P/ASX All Ordinaries index and the large-cap value equity mutual funds at the 5% level of significance, which runs from the stock market index prices to large-cap value equity mutual funds. With the inclusion of the tests for the joint significance of all equity mutual funds, the findings reject the null hypothesis (H_{05}) and accept the alternative hypothesis (H_{A5}) for the short-run Granger causal relationship between the equity managed fund price categories at the 1% and 5% levels of significance.

Table 6.11 Multivariate causality, full study period

Dependent variable: Δ(ASX)				**Dependent variable: Δ(MSB)**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Δ(LB)	3.708	2	0.157	Δ(ASX)	0.397	2	0.820
Δ(LG)	2.933	2	0.231	Δ(LB)	9.499	2	0.009*
Δ(LV)	6.632	2	0.036**	Δ(LG)	0.321	2	0.852
Δ(MSB)	3.553	2	0.169	Δ(LV)	8.854	2	0.012**
Δ(MSG)	0.212	2	0.899	Δ(MSG)	9.211	2	0.010**
Δ(MSV)	2.242	2	0.326	Δ(MSV)	5.491	2	0.064
All	24.646	12	0.017**	All	44.195	12	0.000*
Dependent variable: Δ(LB)				**Dependent variable: Δ(MSG)**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Δ(ASX)	3.012	2	0.222	Δ(ASX)	0.338	2	0.845
Δ(LG)	1.706	2	0.426	Δ(LB)	10.522	2	0.005*
Δ(LV)	21.935	2	0.000*	Δ(LG)	0.267	2	0.875
Δ(MSB)	5.111	2	0.078***	Δ(LV)	6.543	2	0.038**
Δ(MSG)	2.288	2	0.319	Δ(MSB)	9.419	2	0.009*
Δ(MSV)	7.072	2	0.029**	Δ(MSV)	6.329	2	0.042**
All	50.963	12	0.000*	All	36.587	12	0.000*
Dependent variable: Δ(LG)				**Dependent variable: Δ(MSV)**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Δ(ASX)	0.940	2	0.625	Δ(ASX)	0.303	2	0.860
Δ(LB)	3.056	2	0.217	Δ(LB)	10.202	2	0.006*
Δ(LV)	12.393	2	0.002*	Δ(LG)	1.817	2	0.403
Δ(MSB)	3.058	2	0.217	Δ(LV)	8.424	2	0.015**
Δ(MSG)	1.808	2	0.405	Δ(MSB)	8.920	2	0.012**
Δ(MSV)	8.241	2	0.016**	Δ(MSG)	3.969	2	0.138
All	34.266	12	0.001*	All	29.775	12	0.003*
Dependent variable: Δ(LV)							
Excluded	Chi-sq	df	Prob.				
Δ(ASX)	1.815	2	0.404				
Δ(LB)	5.214	2	0.074***				
Δ(LG)	0.971	2	0.615				
Δ(MSB)	3.792	2	0.150				
Δ(MSG)	2.693	2	0.260				
Δ(MSV)	3.103	2	0.212				
All	24.838	12	0.016**				

Note: *, ** and *** represent a rejection of the hypotheses of non-causality at the 1%, 5% and 10% significance levels, respectively. ASX represents the S&P/ASX All Ordinaries index and LB represents the large-cap blend equity mutual funds. LG represents the large-cap growth equity mutual funds and LV represents the large-cap value equity mutual funds. MSB represents the middle and small-cap blend equity mutual funds, MSG represents the middle and small–cap growth equity mutual funds and MSV represents the middle and small-cap equity value funds. Δ denotes the difference operator.

There are five pairs of bi-directional price causality among the equity mutual fund categories within the specified model. First, a causal link exists between the large-cap blend equity mutual funds and the large-cap value equity mutual funds. The second pair is the large-cap blend equity mutual funds and the middle and small-cap blend equity mutual funds. The third pair is the large-cap blend equity mutual funds and the middle and small-cap value equity mutual funds. The fourth pair is the middle and small-cap blend equity mutual funds and middle and small-cap growth equity mutual funds. The last pair is the middle and small-cap blend equity mutual funds and middle and small-cap value equity mutual funds.

The study finds one-way Granger-causality between the large-cap growth and value equity mutual fund prices at the 1% level of significance running from the large-cap growth equity mutual fund prices to the large-cap value equity mutual fund prices. Results show that the large-cap growth equity mutual fund prices Granger cause the middle and small value equity mutual fund prices at the 5% level of significance.

Another one-way causal direction is from the middle and small-cap blend equity mutual fund prices to the large-cap value equity mutual fund prices at the 5% level of significance. The results suggest that the middle and small-cap growth equity mutual fund prices Granger cause the large-cap blend equity mutual fund prices at the 1% level of significance. The results show Granger-causality runs from the middle and small-cap growth equity mutual fund prices to both the large-cap value equity mutual fund prices and the middle and small-cap value equity mutual fund prices at the 5% significance level. The finding suggests that changes in the middle and small-cap value equity mutual fund prices Granger cause the change in the large-cap value equity mutual fund prices at the 5% level of significance.

In summary, the results show bi-directional Granger-causality along the equity mutual funds in the short-run, suggesting the middle and small-cap value equity mutual fund prices contribute more than the middle and small-cap blend equity mutual funds to changes in the large-cap blend equity mutual fund prices. The results also indicate bi-directional causality between the large-cap blend and value equity mutual funds suggesting the large-cap blend equity mutual fund prices contribute much to change in the large-cap value equity mutual fund prices. The results show bi-directional Granger-causality along the middle and small-cap equity mutual funds in the short-run, suggesting the middle and small-cap growth equity mutual fund prices contribute more than the middle and small-cap value equity mutual fund prices to changes in the middle and small-cap blend equity mutual fund price. The results suggest that the middle and small-cap blend equity mutual fund prices contribute more than the other middle and small-cap equity mutual fund prices to changes in the large-cap value equity mutual fund prices.

6.9 Variance decompositions

Variance decomposition is employed to determine the relative quantitative importance of shocks to the variables in the VECM system. A one standard deviation shock is imparted to the endogenous variable and the effects of that shock are observed in the exogenous variables, which include the shocked endogenous variable. The variance decomposition measures the contribution of each innovation at different moments using a 30 days window forecast error variance of the dependent variables. To obtain the variance decomposition of price linkages, the Cholesky decomposition is used. The study's use of Cholesky decomposition starts with the S&P/ASX All Ordinaries index and is followed by an analysis of the significance of the ECTs, which are ranked according to the magnitude and significance of the variables. Variance decomposition is calculated for the estimated VECM and is given by percentages in Tables 6.12 to 6.14 for the pre-crisis, post-crisis and full study periods.

Table 6.12 reports the forecast error variance decomposition for the Australian stock market index and equity mutual funds during the pre-crisis period. The results demonstrate that the S&P/ASX All Ordinaries index has a relatively less strength of exogeneity among the interacting variables.

Table 6.12 Variance decompositions, pre-crisis period

Ordering for Cholesky: ASX, MSG, LB, LV, MSV, MSB and LG Sample: 3rd January 2000 to 2nd July 2007								
VDC of	**Days**	**Percentage of forecast error variance explained by innovation in:**						
		Δ ASX	**Δ LB**	**Δ LG**	**Δ LV**	**ΔMSB**	**ΔMSG**	**ΔMSV**
ASX	1	100.000	0.000	0.000	0.000	0.000	0.000	0.000
	15	93.572	4.120	0.051	0.306	0.193	1.333	0.426
	30	70.408	20.091	0.643	1.408	0.286	5.063	2.100
LB	1	16.097	48.059	0.000	0.000	0.000	35.844	0.000
	15	16.058	38.608	0.726	1.843	0.027	42.228	0.510
	30	16.985	34.277	1.190	2.357	0.049	43.669	1.473
LG	1	14.432	27.993	9.504	3.765	0.026	44.233	0.047
	15	10.790	23.968	9.049	6.272	0.034	49.574	0.312
	30	10.669	23.620	8.106	5.735	0.162	50.901	0.808
LV	1	13.532	24.758	0.000	17.226	0.000	44.484	0.000
	15	10.919	23.354	0.175	22.515	0.013	42.887	0.137
	30	11.631	22.590	0.111	22.514	0.036	42.803	0.315
MSB	1	5.946	4.542	0.000	0.030	30.865	55.345	3.273
	15	3.672	3.061	0.257	0.315	23.262	63.370	6.064
	30	3.393	3.569	0.218	0.366	18.676	63.568	10.21
MSG	1	2.907	0.000	0.000	0.000	0.000	97.093	0.000
	15	0.976	0.179	0.183	0.563	0.101	96.361	1.636
	30	0.602	0.617	0.118	0.428	0.172	94.289	3.773
MSV	1	3.480	2.868	0.000	1.680	0.000	60.066	31.906
	15	1.734	2.861	0.004	3.085	0.372	58.710	33.234
	30	1.676	3.623	0.020	3.125	0.362	56.363	34.830

Note: VDC represent the variance decomposition. Δ denotes the difference operator. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

This indicates that almost 70.40% of the S&P/ASX All Ordinaries index variance is explained by its own shock after 30 days. Movements in the S&P/ASX All Ordinaries index prices do not explain the forecast error variances of any other equity mutual funds, except for the large-cap blend equity mutual funds (20.09%), while the large-cap equity mutual funds prices can explain a sizable portion of the S&P/ASX All Ordinaries index price after 30 days. These categories are the large-cap blend equity mutual funds (16.98%), the large-cap growth equity mutual funds (10.66%), and the large-cap value equity mutual funds (11.63%).

The results of variance decomposition also indicate that the middle and small-cap growth equity mutual funds have relatively lower strength of exogeneity in comparison to other equity mutual funds variables. The result show 94.28% of middle and small-cap growth equity mutual funds' variance is explained by its own shock after 30 days. Movements in the middle and small-cap growth equity mutual funds do not explain forecast error variances of any other equity mutual funds, while the other equity mutual fund categories can explain a sizable portion of the middle and small-cap growth equity mutual fund prices after 30 days. These categories are the large-cap blend equity mutual funds (43.66%), the large-cap growth equity mutual funds (50.90%), the large-cap value equity mutual funds (42.80%), the middle and small blend equity mutual funds (63.56%), and the middle and small value equity mutual funds (56.36%).

Table 6.13 reports the forecast error variance decompositions for the Australian stock market index and equity mutual funds during the post-crisis period. The result of variance decomposition demonstrates that the S&P/ASX All Ordinaries index has a relatively lower strength of exogeneity in relation to the equity mutual funds variables. Approximately 83.78% of the S&P/ASX All Ordinaries index's variances can be explained by its own shock after 30 days. Movements in the S&P/ASX All Ordinaries index prices do not explain the forecast error variances of any other equity mutual funds, except for the large-cap blend equity mutual funds (5.56%), the middle and small-cap growth equity mutual funds (5.68%), and the middle and small-cap value equity mutual funds (3.19%).

While the equity mutual fund prices can explain a sizable portion of the S&P/ASX All Ordinaries index price after 30 days. These categories are the large-cap blend equity mutual funds (70.12%), the large-cap growth equity mutual funds (74.57%), the large-cap value equity mutual funds (68.04%), the middle and small blend equity mutual funds (70.39%), the middle and small growth equity mutual funds (61.55%), and the middle and small value equity mutual funds (64.75%).

Table 6.13 Variance decompositions, post-crisis period

Ordering for Cholesky: ASX, LG, LV, MSV, LB, MSB and MSG
Sample: 3rd July 2007 to 31st December 2010

VDC of	Days	Percentage of forecast error variance explained by innovation in:						
		Δ ASX	Δ LB	Δ LG	Δ LV	ΔMSB	ΔMSG	ΔMSV
ASX	1	100.000	0.000	0.000	0.000	0.000	0.000	0.000
	15	94.058	2.313	0.056	0.749	0.006	1.369	1.448
	30	83.786	5.562	0.617	1.140	0.018	5.683	3.194
LB	1	92.073	3.561	3.929	0.435	0.000	0.000	0.002
	15	80.835	8.791	4.083	3.501	0.004	1.525	1.260
	30	70.128	12.675	5.390	4.430	0.006	5.153	2.219
LG	1	92.411	0.000	7.589	0.000	0.000	0.000	0.000
	15	86.030	3.845	6.098	1.902	0.013	1.228	0.884
	30	74.575	8.760	7.267	3.393	0.010	4.568	1.426
LV	1	87.972	0.000	3.889	8.139	0.000	0.000	0.000
	15	77.256	2.909	2.457	15.209	0.177	1.131	0.861
	30	68.045	6.518	2.875	16.283	0.354	4.145	1.780
MSB	1	78.084	0.014	1.686	0.181	7.963	0.000	12.072
	15	77.613	0.352	0.674	0.242	3.694	2.569	14.856
	30	70.393	1.036	0.935	0.841	3.051	8.635	15.109
MSG	1	73.310	0.082	6.532	0.399	1.717	6.216	11.744
	15	70.424	0.904	3.538	0.177	0.933	9.559	14.464
	30	61.550	1.789	4.041	0.689	1.087	16.426	14.418
MSV	1	66.954	0.000	6.460	0.003	0.000	0.000	26.582
	15	70.806	0.387	2.393	0.283	0.186	2.129	23.815
	30	64.757	1.139	2.017	0.459	0.214	7.985	23.429

Note: VDC represent the variance decomposition. Δ denotes the difference operator. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

The results of variance decompositions suggest that the large-cap growth equity mutual funds have relatively lower strength of exogeneity in comparison to the equity mutual funds. The result shows 7.26% of the large-cap growth equity mutual funds' variance can be explained by its own shock after 30 days. Movements in the large-cap growth equity mutual funds do not explain the forecast error variances of any other equity mutual funds, except for the large-cap blend equity mutual funds (8.76%), the large-cap value equity mutual funds (3.39%), and the middle and small growth equity mutual funds (4.56%). The other equity mutual fund categories on the other hand seem to increase gradually, resulting in a sizable portion of the large-cap growth equity mutual fund prices after 30 days. These categories are the large-cap blend equity mutual funds (5.39%), the large-cap value equity mutual funds (2.88%), the middle and small growth equity mutual funds (4.04%), and the middle and small value equity mutual funds (2.02%).

Table 6.14 reports the forecast error variance decomposition for the Australian stock market index and the equity mutual funds during the full study period.

Table 6.14 Variance decompositions, full study period

Ordering for Cholesky: ASX, LG, LV, MSG MSB, MSV, and LB Sample: 3rd January 2000 to 31st December 2010								
VDC of	**Days**	**Percentage of forecast error variance explained by innovation in:**						
		Δ ASX	**Δ LB**	**Δ LG**	**Δ LV**	**ΔMSB**	**ΔMSG**	**ΔMSV**
ASX	1	100.000	0.000	0.000	0.000	0.000	0.000	0.000
	15	99.067	0.140	0.223	0.159	0.025	0.004	0.384
	30	98.944	0.262	0.196	0.189	0.020	0.007	0.382
LB	1	61.790	7.272	30.102	0.835	0.000	0.000	0.000
	15	56.236	5.737	35.293	2.158	0.078	0.039	0.459
	30	55.944	5.797	35.459	2.194	0.084	0.043	0.478
LG	1	57.631	0.000	42.369	0.000	0.000	0.000	0.000
	15	53.371	0.453	45.260	0.372	0.075	0.068	0.401
	30	52.445	1.389	45.042	0.547	0.115	0.126	0.336
LV	1	55.500	0.000	34.093	10.407	0.000	0.000	0.000
	15	50.553	0.289	35.343	13.661	0.029	0.007	0.118
	30	49.398	0.882	34.713	14.855	0.047	0.019	0.086
MSB	1	41.554	0.615	25.065	0.113	20.510	0.000	12.142
	15	40.787	0.575	28.409	0.317	14.067	0.422	15.423
	30	40.413	0.895	28.342	0.373	13.879	0.497	15.602
MSG	1	29.770	0.013	35.404	0.171	2.956	17.692	13.994
	15	30.352	0.058	35.020	0.426	2.886	14.579	16.679
	30	29.691	0.232	34.631	0.524	2.846	15.262	16.814
MSV	1	27.181	0.000	31.400	1.496	0.000	0.000	39.923
	15	30.701	0.199	30.889	2.227	0.109	0.024	35.851
	30	30.600	0.308	30.790	2.326	0.104	0.030	35.840

Note: VDC represent the variance decomposition. Δ denotes the difference operator. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

The result of variance decomposition demonstrates that the S&P/ASX All Ordinaries index has relatively less strength of exogeneity in relation to the equity mutual funds variables. Approximately 98.94% of the S&P/ASX All Ordinaries index's variances can be explained by its own shock after 30 days. Movements in the S&P/ASX All Ordinaries index prices do not explain the forecast error variances of any other equity mutual funds, while the equity mutual fund prices can explain a sizable portion of the S&P/ASX All Ordinaries index price after 30 days. These categories are the large-cap blend equity mutual funds (55.94%), the large-cap growth equity mutual funds (52.44%), the large-cap value equity mutual funds (49.39%), the middle and small blend equity mutual funds (40.41%), the middle and small growth equity mutual funds (29.69%), and the middle and small value equity mutual funds (30.60%).

The result of variance decompositions also indicates that the large-cap value equity mutual funds have relatively lower strength of exogeneity in comparison to other equity mutual funds variables. The result shows 14.86% of the large-cap value equity mutual funds' variance is explained by its own shock after 30 days. Movements in large-cap value equity mutual funds do not explain forecast error variances of any other equity mutual funds, whereas the other equity mutual fund categories seem to increase gradually resulting in a sizable portion of the large-cap value equity mutual fund prices after 30 days. These categories are the large-cap blend equity mutual funds (2.19%), the large-cap growth equity mutual funds (0.55%), the middle and small blend equity mutual funds (0.37%), the middle and small growth equity mutual funds (0.52%), and the middle and small value equity mutual funds (2.33%).

In summary, the results of the variance decompositions are related to the results of Granger-causality tests during the three study periods. The results indicate that the six equity mutual fund categories are exogenous in the stock market VECM, but the major exogenous force is the shocked endogenous stock market variable. In the first sub-period, the relative strength of exogeneity lies with the shocked share price index followed by large-cap blend equity mutual funds in that order over 30 days. In the second sub-period, the relative strength of exogeneity lies with the shocked share price index, followed by middle and small-cap growth equity mutual funds in that order over 30 days. In the full period, the relative strength of exogeneity lies with the shocked share price index, followed by large-cap blend equity mutual funds in that order over 30 days. Therefore, the results of ECTs also support the results of the variance decomposition in that the latter also indicates the speed of the model towards equilibrium. The forecast error variance decomposition finds that there is evidence of the contribution of the variables in the system changing dramatically after 30 days.

6.10 Impulse response functions

The IRF is employed to investigate the transmission mechanism between equity mutual fund and the stock market. The IRF traces the responses of other specified variables to a one standard deviation shock to the specified endogenous stock market variable. The persistence of a shock indicates how fast the price system returns to equilibrium. To obtain the IRF of price linkages the Cholesky decomposition is considered. The study using Cholesky decomposition starts with the S&P/ASX All Ordinaries index and is followed by an analysis of the significance of the ECTs which are ranked according to the magnitude and significance of the variables at 95% confidence intervals.

The IRF is reported for a horizon of 10 days and is followed by the magnitude and significance of the VAR lag order selection criteria and Granger causality analysis. Additionally, the results reveal these do not change after 10 days. The scale of the vertical axis is the percentage of variation in the price. The horizontal axis represents the number of days after the shock to the endogenous variable. In order to illustrate the movement of the model towards equilibrium after the shock to the share index endogenous variable during the pre-crisis period in Appendix B in Figures B1 to B7.

Figure B1 reports the response of the S&P/ASX All Ordinaries index prices to its own shocks and equity mutual fund price shocks. The results suggest that the S&P/ASX All Ordinaries index prices have a negative response to its own shocks and large-cap growth equity mutual fund price shocks. While, the S&P/ASX All Ordinaries index prices have a positive response to other equity mutual fund categories shocks.

The results show that the S&P/ASX All Ordinaries index prices are significantly affected by large-cap blend equity mutual fund price shocks at a three-day lag. The shock of large-cap value equity mutual funds and middle and small-cap blend and value equity mutual funds have a significant effect on future S&P/ASX All Ordinaries index prices with a lag of four and five days. The results suggest that the response of the S&P/ASX All Ordinaries index prices to middle and small-cap growth equity mutual fund price shocks is a significant effect at a two-day lag. While the middle and small-cap value equity mutual fund price shocks have a significant effect on the S&P/ASX All Ordinaries index future prices with a lag of four days.

Figures B2 to B7 show that the responses of equity mutual fund prices to the S&P/ASX All Ordinaries index price shocks have followed the same pattern as the S&P/ASX All Ordinaries index is affected by its own shocks. Equity mutual fund prices have a negative response to the S&P/ASX All Ordinaries index price shocks. The evidence shows that the S&P/ASX All Ordinaries index price shocks have a significant effect on future middle and small-cap growth equity mutual fund prices with a lag of eight days.

The IRF is reported for a horizon of 10 days during the post-crisis period in Appendix C in Figures C1 to C7.

Figure C1 reports the response of the S&P/ASX All Ordinaries index to a one standard deviation shock of itself and equity mutual funds. The results suggest that the S&P/ASX All Ordinaries index prices have a negative response to its own shocks and equity mutual fund price shocks, with the exception of the large-cap and middle and small-cap value equity mutual funds with a positive response. The results show that the shock of large-cap blend equity mutual fund prices and middle and small-cap growth equity mutual fund prices have a significant effect on the S&P/ASX All Ordinaries index prices with a lag of six and seven days. Moreover, the shock of large-cap value equity mutual fund prices have a significant effect on S&P/ASX All Ordinaries index prices with a lag of five and six days.

Figures C2 to C7 show that large-cap growth equity mutual fund prices and middle and small-cap equity mutual fund prices have a positive response to the S&P/ASX All Ordinaries index price shocks. While, the large-cap blend and value equity mutual fund prices have a negative response to the S&P/ASX All Ordinaries index shock prices. Therefore, the pattern of responses to price shocks between equity mutual funds and the S&P/ASX All Ordinaries index is similar, indicating that the prices move towards stability two days after the shock.

The IRF is reported for a horizon of 10 days during the full study period in Appendix D in Figures D1 to D7.

Figure D1 reports the response of S&P/ASX All Ordinaries index prices to a one standard deviation shock to itself and equity mutual fund prices. The results suggest that the S&P/ASX All Ordinaries index price has a negative effect to its own shocks and large-cap blend equity mutual fund price shocks, while it has a positive response to other equity mutual fund categories shocks. A shock of large-cap value equity mutual fund prices have a significant effect on S&P/ASX All Ordinaries index from one- and three-day lags. Shocks to middle and small-cap blend and growth equity mutual fund prices have a significant effect on S&P/ASX All Ordinaries index prices at a one-day lag into the future.

Figures D2 to figure D7 show that large-cap growth equity mutual fund prices and middle and small-cap equity mutual fund prices have a positive response to the S&P/ASX All Ordinaries index price shocks. While, the large-cap blend and value equity mutual fund prices have a negative response to an S&P/ASX All Ordinaries index price shock. Therefore, the pattern of responses to price shocks between equity mutual funds and the S&P/ASX All Ordinaries index is similar, indicating that the prices move towards stability two days after the shock.

In summary, the IRFs findings are consistent with Johansen cointegration results indicating that the S&P/ASX All Ordinaries index is substantially affected by equity mutual fund price shocks, as reflecting the cointegrated nature of all the variables. The results of IRFs confirm the findings of the Granger-causality tests indicating that there exists a price association between the equity mutual fund categories for the future periods according to the shock response pattern. The results, consistent with the variance decomposition analysis, indicate that the S&P/ASX All Ordinaries index is strongly endogenous.

6.11 Normalised cointegration coefficients

The results of the Johansen cointegration tests show that the specified variables have long-run equilibrium relationships for the three study periods. The study considers the first cointegration vector in deriving the VECM as the test results are highly significant. The first equation reports a normalised equation from the cointegration analysis that expresses a long-run relationship between the Australian stock market index price and all independent variables. Table 6.15 shows the normalised cointegration coefficients and leads to the confirmation of the final parameters in the cointegration equations for the S&P/ASX All Ordinaries index price relationships with the various funds.

Table 6.15 Normalised cointegration coefficients

Panel 1: From 3rd January 2000 to 2nd July 2007			
Cointegrating vector	Coefficient	Standard errors	*t*-statistic
ΔLB_{t-1}	-2.195023	(0.22533)	[-9.74116]*
ΔLG_{t-1}	0.305937	(0.20296)	[1.50737]
ΔLV_{t-1}	0.184483	(0.07147)	[2.58118]*
ΔMSB_{t-1}	-0.052992	(0.10875)	[-0.48730]
ΔMSG_{t-1}	0.612333	(0.07296)	[8.39246]*
ΔMSV_{t-1}	-0.277604	(0.09797)	[-2.83348]*
Constant	-6.876368		
Panel 2: From 3rd July 2007 to 31st December 2010			
Cointegrating vector	Coefficient	Standard errors	*t*-statistic
ΔLB_{t-1}	-2.406809	(0.37407)	[-6.43406]*
ΔLG_{t-1}	1.200976	(0.31118)	[3.85939]*
ΔLV_{t-1}	0.272303	(0.15193)	[1.79228]
ΔMSB_{t-1}	-0.891780	(0.20918)	[-4.26325]*
ΔMSG_{t-1}	0.714336	(0.15403)	[4.63751]*
ΔMSV_{t-1}	0.059239	(0.10096)	[0.58676]
Constant	-7.234615		
Panel 3: From 3rd January 2000 to 31st December 2010			
Cointegrating vector	Coefficient	Standard errors	*t*-statistic
ΔLB_{t-1}	-11.93750	(1.06073)	[-11.2540]*
ΔLG_{t-1}	8.601943	(0.96359)	[8.92694]*
ΔLV_{t-1}	1.221058	(0.31360)	[3.89369]*
ΔMSB_{t-1}	0.692074	(0.40899)	[1.69214]
ΔMSG_{t-1}	-0.815825	(0.36778)	[-2.21824]**
ΔMSV_{t-1}	0.752265	(0.28823)	[2.60993]*
Constant	-4.283162		

Note: * and ** denote the 1% and 5% significance levels, respectively. Δ denotes the difference operator. ASX represents the Australian stock market index (S&P/ASX All ordinaries index). Australian equity mutual fund prices are divided into six equity mutual fund categories (large-cap: blend (LB), growth (LG), value (LV), and middle and small-cap: blend (MSB), growth (MSG), and value (MSV)).

Normalising for the S&P/ASX All Ordinaries index, as presented in Panel 1 of Table 6.15, suggests the following results. The large-cap blend equity mutual fund prices have a highly significant positive effect on the S&P/ASX All Ordinaries index price at the 1% level. There will be a 2.19% increase in the S&P/ASX All Ordinaries index price if the large-cap blend equity mutual fund price increases of 1%. In addition, the large-cap growth equity mutual fund prices have a negative relationship with the S&P/ASX All Ordinaries index price, but this is not significant. The results show a 1% increase in the large-cap growth equity mutual fund prices will lead to a 0.30% decrease in the S&P/ASX All Ordinaries index price.

Further, the large-cap value equity mutual fund prices have a negative effect on the S&P/ASX All Ordinaries index price at the 1% level of significance. Thus, a 1% change in the large-cap value equity mutual fund prices will cause the S&P/ASX All Ordinaries index price to decrease by 0.18%.

The coefficient of the middle and small-cap blend equity mutual fund prices has a positive relationship with the S&P/ASX All Ordinaries index price, but is not significant. On average, a 1% increase in the middle and small-cap blend equity mutual fund prices will result in an increase in the S&P/ASX All Ordinaries index price of 0.05%. Therefore, the result shows that the middle and small-cap growth equity mutual fund prices have a significant negative relationship with the S&P/ASX All Ordinaries index price at the 1% level. This indicates that an increase in the middle and small-cap growth equity mutual fund prices of 1% will lead to a decrease in the long-term S&P/ASX All Ordinaries index price of 0.61%. The middle and small-cap value equity mutual fund prices show a statistically significant positive relationship with the S&P/ASX All Ordinaries index price at the 1% level. The results show that an increase in the middle and small-cap value equity mutual fund prices of 1% will lead to an increase in the S&P/ASX All Ordinaries index price of 0.27%.

In summary, the evidence shows that increases in the large-cap blend equity mutual fund prices of middle and small-cap value equity mutual fund prices results in a positive effect with an increase in the S&P/ASX All Ordinaries index price. However, the large-cap value equity mutual fund prices or the middle and small-cap growth equity mutual fund prices will have a negative effect on the S&P/ASX All Ordinaries price.

Normalising for the S&P/ASX All Ordinaries index for the second study period, as presented in Panel 2 of Table 6.15 suggests the following results. The large-cap blend equity mutual fund prices have a highly significant positive effect on the S&P/ASX All Ordinaries index price at the 1% level. There will be a 2.40% increase in the S&P/ASX All Ordinaries index price when the large-cap blend equity mutual fund prices increase by 1%. In addition, the large-cap growth equity mutual fund prices have a negative and statistically significant effect on the S&P/ASX All Ordinaries index price at the 1% level. The result shows that a 1% increase in the large-cap growth equity mutual fund prices will lead to a 1.20% decrease in the S&P/ASX All Ordinaries index price. Further, an increase in the large-cap value equity mutual fund prices has a negative and not significant effect on the S&P/ASX All Ordinaries index price. Thus, a 1% rise in the large-cap value equity mutual fund prices will cause the S&P/ASX All Ordinaries index price to decrease by 0.27%.

The coefficient of the middle and small-cap blend equity mutual fund prices have a positive and highly significant effect on the S&P/ASX All Ordinaries index price at the 1% level. On average, a 1% increase in the middle and small-cap blend equity mutual fund prices will result in an increase in the S&P/ASX All Ordinaries index price of 0.89%. The results also show that the middle and small-cap growth equity mutual fund prices have a statistically significant and negative relationship with the S&P/ASX All Ordinaries index price at the 1% level. This indicates that an increase in the middle and small-cap growth equity mutual fund prices of 1% will lead to a decrease in the long-term S&P/ASX All Ordinaries index price of 0.71%. The middle and small-cap value equity mutual fund price shows a negative relationship with the S&P/ASX All Ordinaries index price, but this is not significant. The result shows that an increase in the middle and small-cap value equity mutual fund prices of 1% will lead to a decrease in the S&P/ASX All Ordinaries index price of 0.05%.

In summary, the evidence shows that an increase in the blend equity mutual funds has a positive effect on share prices and results in an increase in the S&P/ASX All Ordinaries index price. However, an increase in the value and growth of equity mutual funds has a negative effect on the S&P/ASX All Ordinaries index price.

Normalising for the S&P/ASX All Ordinaries index for the full study period, as presented in Panel 3 of Table 6.15 suggests the following results. The large-cap blend equity mutual fund prices have a highly significant positive effect on the S&P/ASX All Ordinaries index price at the 1% level. There will be an 11.93% increase in the S&P/ASX All Ordinaries index price when the large-cap blend equity mutual fund prices increase by 1%. In addition, the large-cap growth equity mutual fund prices have a negative effect and are statistically significant at the 1% level. The results show that a 1% increase in the large-cap growth equity mutual fund prices will lead to an 8.60% decrease in the S&P/ASX All Ordinaries index price. Further, large-cap value equity mutual fund prices are negatively related to the S&P/ASX All Ordinaries index price and statistically significant at the 1% level. Thus, a 1% rise in the large-cap value equity mutual fund prices will cause the S&P/ASX All Ordinaries index price to decrease by 1.22%.

The coefficient of the middle and small-cap blend equity mutual fund prices is negative and insignificant on the S&P/ASX All Ordinaries index price. On average, a 1% increase in the middle and small-cap blend equity mutual fund price will result in a decrease in the S&P/ASX All Ordinaries index price by 0.69%. Further, the results show that the middle and small-cap growth equity mutual fund prices have a significant positive relationship with the S&P/ASX All Ordinaries index price at the 5% level. This indicates that an increase in the middle and small-cap growth equity mutual fund prices of 1% will lead to an increase in the long-term S&P/ASX All Ordinaries index price of 0.81%. The middle and small-cap value equity mutual fund prices show a statistically significant negative relationship with the S&P/ASX All Ordinaries index price at the 1% level. The result shows that an increase in the middle and small-cap value equity mutual fund prices of 1% will lead to a decrease in the S&P/ASX All Ordinaries index price of 0.75%. In sum, there is evidence showing that an increase in both the large-cap blend and the middle and small-cap growth equity mutual fund prices has a positive effect on the increase in the share price of the firm and ultimately results in an increase in the S&P/ASX All Ordinaries index price. However, an increase in the large-cap growth and value of equity mutual funds, and the middle and small-cap blend and value equity mutual fund prices, results in a negative effect on the S&P/ASX All Ordinaries index price.

6.12 Concluding remarks

The central aim of this study is to investigate long-run and short-run relationships between six equity mutual funds and the stock market index price in the Australian Stock Exchange. All the time series used in this analysis are found to be non-stationary at the levels while stationary at the first differences. Johansen cointegration suggests that there is a long-run equilibrium relationship between the equity mutual funds and the stock market index during the three study periods. The results of ECTs confirm the findings of Johansen cointegration. The VECM analysis shows that the speed of price adjustment to long-term equilibrium is significant for the S&P/ASX All Ordinaries index and middle and small-cap growth equity mutual funds during the pre-crisis period, while for large-cap growth equity mutual funds during the post-crisis period. Therefore, the large-cap growth and value equity mutual funds have a high speed of price adjustment from the short-run to the long-run.

According to the short-term dynamics, VECM based Granger-causality and Block Exogeneity Wald tests and variance decomposition analysis suggest that in a model where all specified variables interact, the S&P/ASX All Ordinaries index is significant endogenous variable in the pre-crisis period according to ECT value. The study finds that the responses of the equity mutual funds to a one standard deviation innovation to the S&P/ASX All Ordinaries index follow the same pattern as the responses of the S&P/ASX All Ordinaries index to itself. The results of IRFs confirm the findings of the Johansen cointegration, Granger-causality and ECTs which indicate that there exists a close association between the stock market price and the price of equity mutual funds for future periods.

The findings are discussed in relation to support or otherwise for the hypotheses and support or otherwise of underlying theory coupled with past evidence in Chapter 7.

CHAPTER 7

Conclusions

7.1 Chapter overview

The aim of this study is to examine the price linkages between equity mutual funds and the local stock market based on Australian data over three study periods. The methodology and data are discussed in relation to achieving the aim of this study. This chapter also summarises the preliminary and main findings and discusses how past equity mutual fund prices are important in explaining the stock market index prices. This chapter also discusses new evidence to demonstrate the uniqueness of the study and how it adds to the body of knowledge. The limitations of the study, future research directions and policy implications are also discussed.

7.2 Thesis summary

Equity mutual funds were created as an indirect alternative to direct portfolio investment in the stock market. There has been rapid global growth in mutual funds since the 1990s in Asian and Pacific countries. Australia holds the highest level of mutual fund assets at USD 1.1 trillion, which accounts for 4.2% of worldwide investment fund assets in 2009. Therefore, Australia held the second highest level of mutual equity fund assets at USD 0.3 trillion (with Japan the highest) at the end of the second quarter of 2009. Over a 20-year period from 1989 there has been strong growth in the value of funds under management in Australia and the managed fund market is forecast to grow significantly to AUD 7 trillion by 2028 according to Deloitte Actuaries and Consultants (2009).

Modern portfolio theory demonstrates that investors gain benefit from diversification when the portfolio encompasses an imperfect correlation of securities. An understanding of the price movements between stock and equity mutual funds is important for investors, fund managers and policy makers as part of national equity diversification for Australian investors. The efficiency of the financial market and rational expectations theory give rise to forecasting tests that mirror those adopted when testing the optimality of a forecast in the context of given information set. If cointegration exists between stock market prices and equity mutual fund prices, this suggests that one of the variables can be used to predict the other. Accordingly VAR and VECM models can be used to study the price linkages between the variables (Juselius 2010).

A thorough review of the literature suggests that different methods have been used in the mutual fund literature to evaluate fund performance and leads this study to conclude that there are mixed results for fund performance. This thesis is different from the previous studies that mostly used United States data. Previous studies of mutual funds, which used monthly and annual data, replicate the data and consider short-time study periods (for example, McDonald 1974; Mains 1977; Shawky 1982; Cesari and Panetta 2002). A number of Australian studies have focused on superannuation funds and unit trusts (for example, Praetz 1976; Bird et al. 1983; Robson 1986).

The current study is focused on the performance of open-ended equity mutual funds during the period 2000 to 2010 using daily fund returns. With regard to definitions of risk, this study accounts for performance using both the total risk (standard deviation) and the systematic risk (Beta) by applying the Sharpe and Treynor ratios and Jensen's alpha measures to investigate performance. Further, the study calculates fund performance by controlling for fund categories.

Another set of researchers have examined the dynamic interaction between security returns and mutual fund flows (for example, Warther 1995; Cha 1999; Alexakis et al. 2005; Rakowski and Wang 2009). Previous studies suggest long-run equilibrium relationships between the country funds, but there are only a few studies that examine the price dynamic interaction between the local stock market and equity mutual funds (for example,Ben-Zion et al. 1996; Choi and Lee 1996; Low and Ghazali 2007; Chu 2010). Most previous studies use the standard Engle-Granger cointegration methodology to determine the long-run relationships and the standard Granger-causality techniques to determine the short-run relationships between the variables. Therefore, previous studies test only uni-directional causality (for example, Low and Ghazali 2007) and only a small number of studies take structural breaks into account (for example, Ben-Zion et al. 1996; Low and Ghazali 2007; Chu 2010). Based on a thorough search of the literature it appears that there is a paucity of research on equity mutual fund prices and local stock market prices in Australia. Other approaches (for example, VECM, IRF and variance decomposition) have received scant attention.

As mentioned, the investigation of price interaction in this study differs from existing studies. Previous studies do not take structural breaks into account. This study examines the relationships over a long study period and takes into consideration a turbulent financial market. The short-run causal links between equity mutual fund price categories have not been examined previously in a time series framework. The current study investigates uni- and bi-directional causal relationships between the specified variables. As mentioned, previous studies do not take equity mutual fund categories into account.

Thus, the study examines the issue of price interaction from the perspective of Australian investors who have diversified with the local stock market indices, but desire to augment their investment with equity managed funds from major equity mutual fund categories. With this objective, the study uses an econometric approach of time series cointegration and causality to determine the existing short-run and the long-run relationships. The methodology in this study is different from that used by previous studies. To capture the possible time variation in relationships between variables, the study employs the structural VAR model (Sims 1980b). Therefore, the study estimates a VECM with the Johansen and Juselius (1990) approach to capture the long-run relationships. The study utilises the VECM Granger Block Exogeneity Wald test (1969), variance decomposition and IRF analysis to capture the short-run relationships. By combining these techniques the study can analyse the interactions of both long-run and short-run relationships between the variables with reliable results.

The data consists of daily closing prices for 110 equity mutual funds as divided into six equity mutual fund categories (large-cap blend, large-cap growth, large-cap value, middle and small-cap blend, middle and small-cap growth, and middle and small-cap value) and one diversified stock market portfolio as proxied by the S&P/ASX All Ordinaries index. This study covers the 11 year period from 2000 to 2010 and identifies market structural changes coinciding with the beginnings of the global financial crisis in the middle of 2007. Thus, this study breaks the sample at 2 July 2007 with a pre-crisis period, which includes 1,956 observations running from 3rd January 2000 to 2nd July 2007. A post-crisis period runs from 3rd July 2007 to 31st December 2010 encompassing 914 observations. The full study period includes 2,870 observations and runs from 3rd January 2000 to 31st December 2010.

The preliminary analysis is to determine the time of the turning point for any diminished performance by calculating the Sharpe and Treynor ratios and Jensen's alpha performance measure for equity mutual funds against the stock market portfolio (S&P/ASX All Ordinaries index) during the three study periods. As discussed in the review of the literature regarding the performance of managed funds, five distinct views emerge. 1) The portfolio theory of Markowitz (1952) helps fund managers and investors design a portfolio with the maximum return for the minimum level of risk. 2) The capital asset pricing model (Treynor 1961; Sharpe 1963, 1964; Lintner

1965; Mossin 1966) helps fund managers and investors to calculate investment risk and expected return based on the idea that individual investment contains two types of risk (systematic risk and unsystematic risk). 3) Past evidence of fund performance leads the study to conclude that it is hard for fund managers to consistently out-perform the relevant benchmark and the risk level of different funds is a significant factor (Jensen 1968; Malkiel 1995; Gruber 1996; Carhart 1997). 4) Fund performance can be attributed to both market timing ability and security selection ability (Grinblatt and Titman 1989a, 1993; Grinblatt et al. 1995; Daniel et al. 1997; Wermers 1997). 5) With regard to the relationship between performance and mutual fund size, empirical findings provide mixed evidence, (for example, Grinblatt and Titman 1989a; Indro et al. 1999; Gallagher and Martin 2005; Matallín-Sáez 2011). Therefore, given that the evaluation of fund performance is an exclusive issue, this study tests hypotheses relating to equity managed fund performance in Australia for the pre-crisis, post-crisis, and full study periods and the hypotheses are stated as follows:

Hypothesis (H_{01}): The performance of equity mutual funds is not different from that of the stock market.

Hypothesis (H_{A1}): The performance of equity mutual funds is different from that of the stock market.

The evidence from performance analysis during the pre-crisis period: With the inclusion of the performance indicators, the results reject the null hypothesis (H_{01}) and accept the alternative hypothesis (H_{A1}), that the performance of equity mutual funds is different from that of the stock market during the pre-crisis period at the 5% significance level according to the Treynor and Jensen approaches. The equity mutual fund performance, as indicated by the Sharpe ratio, rejects the null hypothesis (H_{01}) and accepts the alternative hypothesis (H_{A1}) in that the performance of equity mutual funds is different from that of the stock market during the pre-crisis period at the 1% level of significance.

The evidence from performance analysis during the post-crisis period: With the inclusion of the performance indicators, the results reject the null hypothesis (H_{01}) and accept the alternative hypothesis (H_{A1}) that the performance of equity mutual funds is different from that of the stock market during the post-crisis period at the 1% significance level and the results show a similarity between the three performance measures: the Sharpe and Treynor ratios and Jensen's alpha.

The evidence from performance analysis during the full study period: With the inclusion of the performance indicators the results reject the null hypothesis (H_{01}) and accept the alternative hypothesis (H_{A1}), that the performance of equity mutual funds is different from that of the stock market during the full study period at the 1% significance level. Results show a similarity between the three performance measures: the Sharpe and Treynor ratios and Jensen's alpha.

The rejection of the null hypothesis is supported by previous studies and finance theory in this field. For example, Treynor (1965), Sharpe (1966), Jensen (1968), Cumby and Glen (1990), Carhart (1997) and Brown et al. (2001). McDonald (1974) examines U.S. mutual funds using Sharpe and Treynor ratios and the Jensen's alpha; Ward and Saunders (1976) and Firth (1977) analyse U.K. mutual funds; Dahlquist et al. (2000) analyse Swedish mutual funds using Jensen's alpha. Fama and French (2010) and Ferreira et al. (2013) examine cross country funds using a four factor model. Previous studies show evidence of an absence of superior selection ability and fund managers are unable to predict security prices well enough to beat the market. Therefore, the rejection of the null hypothesis is also supported by previous studies in this field using the risk adjustment of the Sharpe, Treynor and Jensen approaches. For example, Praetz (1976) analyses the performance of four Australian mutual funds and 12 unit trusts against the Sydney Ordinary Shares Index using Treynor and Sharpe techniques. The results show that investment funds performed worse than the stock market index. Sawicki and Ong (2000) examine Australian mutual funds using Jensen's alpha. Sheikh and Noreen (2012) analyse U.K. mutual funds using Jensen's approach. Their findings suggest that the fund managers do not out-perform the market and also lack market timing abilities. Wang and Haque (2013) evaluate the performance of Australian equity funds during the period 2000 to 2010 using daily data. The study suggests that large-cap equity mutual funds have negative alphas in both high and low volatility markets. Although different benchmarks and data-sets have been used in these studies, they provide generally similar results.

The portfolio theory of Markowitz (1952) and the capital asset pricing model (Treynor 1961; Sharpe 1963, 1964; Lintner 1965; Mossin 1966), underlines the EMH. Portfolio theory assumes that the portfolio return can be a weighted combination of the assets' returns, while the total risk (unsystematic) is measured by the standard deviation of its return. The concept of portfolio theory is used to reduce unsystematic risk while the capital asset pricing model reflects the linear relationship between the rate of risk and the rate of return and designates the systematic risk as Beta. The Beta of the market is 1.0. A Beta for an equity mutual fund portfolio of less than 1.0 indicates the fund portfolio has less volatility than the market. The rejection of the null hypothesis is also supported by the EMH that the investment managers are unable to select the undervalued stocks and forecast the market movements to create portfolios with positive abnormal returns (Jensen 1968; Fama 1970).

The results show the Beta and standard deviation of equity mutual fund returns are lower than the stock market portfolio during the three study periods. This demonstrates equity mutual funds hold less risky securities than an average stock market portfolio over the last 11 years (see Panels 1 to 3 in Table 5.1).

The results for Jensen's alpha are a negative alpha value, suggesting that equity mutual funds have not performed well. The Treynor measure indicates that the beta value of equity mutual funds is less than one, meaning a defensive strategy had been adopted. This means equity mutual funds do not generate returns in excess of the stock market using performance measures based on total risk (Sharpe ratio) and market risk (Treynor ratio). The results for Sharpe and Treynor ratios, and Jensen's alpha, show equity mutual funds' risk adjusted returns are different from the stock market during the three study periods, implying poor performance (see Panels 1 to 3 in Table 5.2). The probable reasons that can be made for this performance diverge between market portfolio and equity mutual funds are management fees, fund size, taxation, and timing effects.

With regard to the relationship between performance and expense ratio, empirical findings provide mixed evidence. Carhart (1997) claims that underperformance of active mutual funds is caused by high expenses. Malhotra and Mcleod (1997) find that equity funds with a higher expense ratio have lower yields. Heffernan (2001) examines the performance of eight categories of UK investment trusts, suggesting no evidence of a relationship between fund fees and fund performance. Holmes and Faff (2004) examine the selective and timing performance of mulit-sector equity managed funds in Australia. The results show that there is a negative relationship between market timing and fund performance. They suggest that the volatility timing is negative related to fund performance. Haque (2012) examines the relationship between fund fees and performance for Australian equity mutual funds. The study suggests that the expense ratios of Australian blend equity mutual funds are positive related to performance in both recessions and non-recessions.

With regard to the relationship between performance and mutual fund size, empirical findings provide mixed evidence. Grinblatt and Titman (1989a) report evidence of performance in a sample data set of US funds for the period 1975 to 1984. They find that the negative performance may be due to the fund size. Indro et al. (1999) and Annaert et al. (2003) find a positive relationship between fund performance and fund size, while Gallagher and Martin (2005) argue that there is no evidence to support the relationship between fund size and fund performance.

The current study revisits this argument with a different method and a larger data-set. Comparing classification results between a large-cap and middle and small-cap equity mutual funds is the focus of this study. The comparison results show evidence of size effects in equity mutual fund performance levels, suggesting middle and small-cap equity mutual funds generally out-perform large-cap equity mutual funds. The evidence also shows that the value portfolios out-performed the growth portfolios. This finding is consistent with Arshanapalli and Nelson (2007) who study the performance of value investing and small-cap investing under bull and bear markets. They suggest that the small-cap equities perform better than large-cap equities and the value portfolios out-performed the growth portfolios during the recession periods.

Another part of the preliminary analysis results is now discussed in relation to unlagged and lagged models. Since the semi-strong form of the EMH for the Australian share market has been investigated (Groenewold and Kang 1993), it is necessary to carry out preliminary tests for the unlagged model in order to examine the contemporaneous relationship between equity mutual fund prices and stock market prices. Two linear regressions are applied (OLS and ARCH). In terms of the OLS, the evaluation of the relationship between equity mutual fund prices and stock market index prices is based on market models.

The evidence of the OLS approach based on prices: The results show that equity mutual fund prices are highly significant at the 1% level. The coefficients of the equity mutual fund prices have a positive relationship with the S&P/ASX All Ordinaries index price during the study period. The results show that large-cap blend equity mutual funds have a highly positive relationship with the S&P/ASX All Ordinaries index followed by the large-cap value equity mutual funds and middle and small-cap blend equity mutual funds.

The evidence of the OLS approach based on returns: The results show that equity mutual fund returns are highly significant at the 1% level. The coefficients of the equity mutual fund returns have a positive relationship with the S&P/ASX All Ordinaries index returns during each study period. The results show that the large-cap equity mutual fund returns have the strongest positive relationship with the S&P/ASX All Ordinaries index followed by the middle and small-cap equity mutual fund returns.

The overall OLS regressions based on returns have a good fit over the three study periods as measured by the adjusted *R*-squared value. The results indicate that up to 63.62% of the market model can be explained by the equity mutual fund variables when considering all study periods. This means the model fits the data well and equity mutual fund returns have a statistically significant impact on predicting local stock market index returns. The OLS models, whilst they do not exhibit evidence of serial correlation in the errors (according to the DW test statistics. See Table 5.5) the models are not considered to be the most appropriate due to the problem of heteroscedasticity.

Volatility as a measure of risk is important in financial decisions in such situations. Another purpose for preliminary analysis is to examine the volatility of equity mutual fund returns and related stylized facts using ARCH models. It is recalled in the current study that White tests (see Table

5.5) show that the errors of the OLS models are heteroskedastic. Engle (1982, 2004) suggests that the ARCH model is more appropriate for conditional heteroscedasticity to explain the volatility dynamic of the specified variables. Two commonly used symmetric volatility models, ARCH and GARCH, are estimated when there is heteroskedasticity of an unknown form in the models (Engle 1982, 2004; Bollerslev 1986). This study tests hypotheses relating to the return volatility of equity mutual funds for the pre-crisis, post-crisis and full study periods, and the hypotheses are stated as follows:

Hypothesis (H_{02}): There is no evidence of equity mutual fund return volatility clustering.

Hypothesis (H_{A2}): There is evidence of equity mutual fund return volatility clustering.

The evidence of the ARCH (1,0): The results support the rejection of the null hypothesis (H_{02}) and acceptance of the alternative hypothesis (H_{A2}) at the 1% significance level. The results show a similarity among the six equity mutual fund categories during three study periods. This means that, for the returns of equity mutual funds, there is volatile clustering, indicating the previous information can capture the volatility in future returns of equity mutual fund. Therefore, the level of volatility is determined from the coefficients of variance equation.

The evidence of the variance equation: The pre-crisis period provides results of ARCH and GARCH, effects which are significant at the 1% level. The degree of volatility persistence is greater than one for large-cap value equity mutual funds and middle and small-cap equity mutual funds, indicating that the impact of past equity mutual fund return shocks on the conditional variance of the equity mutual fund return is a permanent effect, and will increase in future periods. With the low summation of the ARCH and GARCH coefficients for large-cap blend and growth equity mutual funds, this implies that the lagged volatility shocks in equity mutual fund returns to these equity mutual funds are transitory rather than permanent (see Panel 1 in Table 5.6).

The post-crisis period provides results of ARCH and GARCH effects, which are significant at the 1% level. In case of large-cap equity mutual funds and middle and small-cap equity mutual funds, the impact of past equity mutual fund return shocks on the conditional variance of the equity mutual fund return is persistent over time. The degree of volatility persistence is less than one for small-cap blend and value equity mutual funds, indicating declining volatility and risk convergence (see Panel 2 in Table 5.6).

The full study period provides results of the ARCH and GARCH effects with significance at the 1% level. In the case of large-cap equity mutual funds, the sum of ARCH and GARCH residuals turned out to be one, indicating a current shock persists indefinitely in conditioning the future variance. The sums of the coefficients for the ARCH and GARCH effects are greater than one, indicating the impact of past equity mutual fund return shocks on the conditional variance of equity mutual fund returns is a persistent and permanent effect for future periods for middle and small-cap equity mutual funds (see Panel 3 in Table 5.6).

The findings of this study are supported by Nafees et al. (2013) who study the level of risk in the returns of mutual funds in Pakistan using daily data from 2006 to 2011 with ARCH and GARCH models. They find the presence of volatility clustering for open-ended mutual funds. Therefore, the level of volatility is close to one, meaning that volatility is quite persistent. They conclude that the market portfolio and closed-ended mutual funds are more risky than the open-ended mutual fund index. On the other hand, Farman and Khan (2011) study the past volatility of closed-ended mutual funds for Pakistan, taking the monthly returns from 2002 to 2008. Results show that the ARCH (six) and GARCH (one) coefficients are insignificant and that these coefficients are not close to one when combined together, meaning that volatility is not persistent.

The current study revisits this argument with daily data and open-ended equity mutual funds. The results indicate that all expected parameters are significant. There is evidence of long memory volatility in equity mutual fund returns. In most cases, the ARCH and GARCH coefficients are greater than one when combined, indicating any shock of equity mutual fund returns leads to a permanent change in all the future values of the current day's volatility of equity mutual fund return.

In general, the findings across equity mutual fund categories reveal that volatility shock is highly persistent for middle and small-cap growth equity mutual funds. As far as risk analysis determined through standard deviation of daily returns is concerned, middle and small-cap equity mutual funds are more risky than large-cap equity mutual funds. Therefore, there is evidence of structural shifts in return volatility as a consequence of global financial crisis. With respect to return volatility, the probable reasons are that new unanticipated information and trading volume changes may have an influence on equity mutual fund return volatility (Nnenna 2012).

In summary, the unlagged models deal with returns. This study has investigated whether or not there are contemporaneous relationships between the variables of interest. The findings of the preliminary analysis are helpful as support or otherwise for the main hypotheses of this study. The study undertakes further analysis to investigate the price relationship between equity mutual funds and the stock market within the VECM framework. A VECM is a restricted VAR that is designed for use with non-stationary series that are known to be cointegrated. The unit root tests are necessary to verify that each variable is stationary in first differences including the errors of the first differenced relationships.

As discussed in the review of the literature, two distinct views emerge. 1) The EMH holds that stock prices will reflect all publicly available information (Fama 1970). Tests of the presence or absence of a unit root between the variables can be interpreted as tests of weak-form efficiency (for example, Allen and MacDonald 1995; Rahman and Uddin 2012). 2) The VAR model is designed for use with non-stationary series that are known to be cointegrated (Ben-Zion et al. 1996; Chu 2011). As a result, it is necessary to test the variables for stationarity before proceeding with the cointegration test and the causality tests based in the VECM. The study performs the unit root test based on the ADF and the PP tests to test for the presence of unit roots in both price levels and the first difference of the variables. The ADF tests perform well when serial correlation is present in level series relationships, while the PP tests are a better test in the case of structural breaks (Glynn et al. 2007). The null hypothesis is that all series variables are non-stationary against the alternative hypothesis that all series variables are stationary and this includes in the latter case the errors of the first differenced relationships.

With the inclusion of the unit root tests, the results of the price level series fail to reject the null hypothesis in that all members of the time series are non-stationary during the three study periods and the results show a similarity between two unit root tests, including the ADF and the PP tests. The study then applies the same test to their first differences. The results show a rejection of the null hypothesis and an acceptance of the alternative hypothesis in that all members of the time series are stationary during the three study periods at the 1% level of significance and the results show a similarity between two unit root tests, including the ADF and the PP tests. The acceptance of the alternative hypothesis is supported by previous studies in this field: For example, Abeysekera (2001), Rakowski and Wang (2009) and Chu (2010). These studies conclude that the log return series of the stock markets are stationary data series and do not contain a unit root.

The results show that in case of level series, the *t*-statistics critical values are greater than the ADF and the PP critical values. According to these findings, the null hypothesis cannot be rejected, as variables are non-stationary at levels. However, the null hypothesis of a unit root is rejected at the first differences. This means all the series will be stationary at the first differences using both the ADF and the PP unit root tests. That is, all variables are integrated of the same order $I(1)$. The results of the unit root tests suggest that the Australian equity market is not a weak-form efficient market as the data series are stationary at the first differences (Rahman and Uddin 2012).

The study then applies the unit root test to the residuals of the linear combinations. The results show a rejection of the null hypothesis and an acceptance of the alternative hypothesis in that all residuals of the linear combinations are stationary during the three study periods at the 1% level of significance. Results also show a similarity between the two unit root tests. The acceptance of the alternative hypothesis is supported by the residual based tests of Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990).

The results show that a stationary linear combination of the non-stationary variables is found during the three study periods since the *t*-statistics values are smaller than the ADF and the PP critical values. According to these findings, the null hypothesis can be rejected indicating that all the residuals are stationary at levels. This allows the study to confirm that the variables of interest are integrated non-stationary processes and can be modelled by a VAR with VAR based tests of cointegration and exogeneity applied. The study therefore applies Johansen's cointegration and Granger-causality tests to capture the relationship between price series as discussed in the next section.

The study undertakes further analysis to investigate the price linkages in the long-run relationship between equity mutual funds and the stock market index. Johansen's cointegration tests within the VECM framework are used to identify a long-run relationship between the variables. In order to investigate the short-run relationship following VECM Granger-causality, the ECT and variance decompositions and IRF are also investigated.

The Johansen cointegration tests are sensitive to lag specification (Thornton and Batten 1985; Ozcicek and McMillin 1999; Scott Hacker and Hatemi-J 2008), so the VAR lag order selection criteria are used to select the number of lags required in the cointegration test. The maximum lag-length begins with five lags and proceeds down to the appropriate lag by examining the AIC, SC and HQ information criteria. In order to ensure that the results do not lose important information by restricting the lag-length, the study also performs a VAR lag exclusion Wald test. In this study the VAR lag exclusion Wald test and the HQ test suggest that the value p indicates that the optimal lag is two days and that this is the appropriate specification of the lag order of the VAR model. Then, the Johansen procedure is used for cointegration testing by considering the following statistics: the Trace statistic and Maximum eigenvalue statistic. The Johansen test is performed under the assumption of a constant and a linear deterministic trend.

As discussed in the review of the literature regarding the fund price relationship, five distinct views emerge. First, the efficiency of the financial market and rational expectations theory give rise to forecasting tests that mirror those adopted when testing the optimality of a forecast in the context of given information set. If cointegration exists between stock market prices and equity mutual fund prices, this suggests that one of the variables can be used to predict the other (Allen and MacDonald 1995; Rahman and Uddin 2012).

Second, few researchers examine the lagged relationship between equity managed funds and the stock market price. Even when doing so, the evidence leads the studies to conclude that there are mixed results for these relationships (for example, Matallín-Sáez and Nieto 2002; Low and Ghazali 2007; Chu 2010).

Third, regarding the financial crisis, there is some evidence that mutual funds tend to perform well when the economy is in a downturn (for example, Moskowitz 2000; Kosowski et al. 2006). There is evidence of a relationship between financial crisis and investment strategies (Bartram and Bodnar 2009; Bello 2009). Bartram and Bodnar, find evidence of correlation between stock markets and investment styles during a non-crisis period. This study suggests a significant correlation increase during a crisis period. Empirical studies indicate that the style of investing based on fund size is one of the keys to successful portfolio management and leads to superior performance (for example, Sharpe 1992; Chen et al. 2004; Chow et al. 2008). Although previous studies have examined the dynamics of price between managed funds and the stock market, they do not consider how their prices are related to each other under market instability (for example, Ben-Zion et al. 1996; Chu 2010).

Four, Matallín-Sáez (2011) points out that fund performance does not Granger cause fund size and fund size also does not Granger cause fund performance. Although previous studies have examined the price dynamics between managed funds and the stock market, they do not consider the price dynamic interaction between equity mutual fund categories (for example, Matallín-Sáez and Nieto 2002; Low and Ghazali 2007; Chu 2010).

Fifth, most previous studies examine fund price in the context of a cross section of country funds (for example, Bailey and Lim 1992; Chang et al. 1995; Choi and Lee 1996).

This current study investigates the price interaction that differs from existing studies. Other studies test uni-directional causality, (for example, Low and Ghazali 2007). The current study provides a two-way direction of the dynamic relationship between the variables. The study examines the relationship between equity mutual fund's price and the stock market prices in an expanded study period and taking into consideration the turbulence of the financial market. The causal links between the equity mutual fund price categories are examined. The new sample period and new country selected (Australia) are investigated comprehensively. The analysis consists of determining whether the stock market index is cointegrated with the equity mutual funds by controlling equity mutual fund categories. The study makes new contributions to the related literature by studying the price relationships including the period of the recent global financial crisis.

The null hypothesis (H_{03}) and the alternative hypothesis (H_{A3}) relating to a long-run equilibrium relationship between equity mutual funds and the stock market in Australia for the pre-crisis, post-crisis, and full study periods are stated as follows:

Hypothesis (H_{03}): There is no long-term equilibrium relationship between equity managed fund prices and the stock market index price.

Hypothesis (H_{A3}): There is a long-term equilibrium relationship between equity managed fund prices and the stock market index price.

The study uses Block Exogeneity Wald tests with a chi-square statistic to indicate the existence of Granger-causality when all variables interact in one system. This technique tests for the joint significance of all equity mutual funds variables. The null hypothesis (H_{04}) and the alternative hypothesis (H_{A4}) relate to the price relationship in the short-run between equity mutual funds and the stock market in Australia and these hypotheses are stated as follows:

Hypothesis (H_{04}): There is no short-term exogenous relationship between equity managed fund prices and the stock market index price.

Hypothesis (H_{A4}): There is a short-term exogenous relationship between equity managed fund prices and the stock market index price.

Evidence for the pre-crisis period: With the inclusion of the Trace statistic and Maximum eigenvalue statistic, the findings reject the null hypothesis (H_{03}) and accept the alternative hypothesis (H_{A3}) that there is a long-term equilibrium relationship between the equity managed fund prices and the stock market index prices at the 1% level of significance. With the inclusion of the VECM Granger-causality tests for the joint significance of all equity mutual funds variables, the findings fail to reject the null hypothesis (H_{04}) that there is no short-run exogenous relationship between the equity managed fund prices and the stock market index prices.

Evidence for the post-crisis period: With the inclusion of the Trace statistic and Maximum eigenvalue statistic, the findings reject the null hypothesis (H_{03}) and accept the alternative hypothesis (H_{A3}) that there is a long-term equilibrium relationship between the equity managed fund prices and the stock market index price at the 1% level of significance. With the inclusion of the VECM Granger-causality tests for the joint significance of all equity mutual funds variables, the findings reject the null hypothesis (H_{04}) and accept the alternative hypothesis (H_{A4}) concerning the short-run dynamic relationship between the equity managed fund prices and the stock market index prices at the 5% level of significance.

Evidence for the full study period: With the inclusion of the Trace statistic and Maximum eigenvalue statistic, the findings reject the null hypothesis (H_{03}) and accept the alternative hypothesis (H_{A3}) that there is a long-term equilibrium relationship between the equity managed fund prices and the stock market index price at the 1% level of significance. With the inclusion of the VECM Granger-causality tests for the joint significance of all equity mutual funds variables, the findings reject the null hypothesis (H_{04}) and accept the alternative hypothesis (H_{A4}) concerning the short-run dynamic relationship between the equity managed fund prices and the stock market index prices at the 5% level of significance.

The acceptance of the alternative hypothesis H_{A3} supports the rational expectations theory and previous studies in this field. For example, Matallin and Nieto (2002) find a number of Spanish mutual funds cointegrated with the Spanish stock market index (The Ibex 35) where 11 out of 63 funds studied were cointegrated with the local stock market with structural breaks throughout the study period. Matallin and Nieto mention that the security selection and market timing abilities of fund managers have a massive impact and lead to the existence or absence of cointegration between mutual fund prices and the local market index price. Chu (2010) finds evidence of cointegration between the equity mutual funds and the local stock market index using the Hong Kong stock market. A figure of 45.61% of the sample of equity mutual funds has long-run price relationships with the local stock market index during the non-crisis period. Chu (2011) finds that 44.44% of the equity mutual funds are cointegrated with the Hong Kong stock market index. However, Ben-Zion et al. (1996), and Low and Ghazali (2007) contradict these studies and, in their research, find no evidence of a long-run relationship during the non-crisis period.

The acceptance of the alternative hypothesis H_{A4} supports previous studies in this field. For example, Low and Ghazali (2007) and Chu (2010) find weak evidence of a one-way market-to-fund causality and conclude that changes in prices of equity mutual funds do not Granger cause changes in the stock market prices. Low and Ghazali (2007) find that 13 out of 35 funds studied have causal links with the stock market. Chu (2010) finds 56.43% of the sample of equity mutual funds have causal links with the local stock market index during a non-crisis period. Chu (2011) shows that 10 out of 15 equity funds have a one-way short-run relationship with the local stock market index and this runs from market to equity funds. However, Ben-Zion et al. (1996) find mutual funds have a significant two-way causal relationship with the local market.

The contradictory findings between the results of cointegration could partially be due to the use of different research methods and data-sets. For example, Ben-Zion et al. (1996) examine three country funds traded on the New York Stock Exchange (Germany, Japan and UK funds), while Low and Ghazali (2007), and Chu (2010) examine Asian stock markets. Matallin and Nieto (2002) and Chu (2011) use Johansen (1988) cointegration tests to measure the long-run price linkages, while other studies use Engle and Granger's cointegration.

The results of this current study show the cointegrating vectors between equity managed fund prices and the S&P/ASX All Ordinaries index prices during the three study periods. This indicates the existence of rational expectations in the Australian equity market, suggesting prices converge in the long-run between these seven series. The results of the Granger-causality tests show that some of the equity mutual funds are responding to the past changes in the stock market index price in the short-run. This implies that some equity mutual fund categories engage in passive stock selection and market timing to construct their portfolios with an objective to beat the market.

The results of the preliminary analysis also confirm the findings of cointegration tests that equity mutual fund managers engage in passive investment strategies, as equity mutual fund portfolio's Beta are less than one thus indicating that equity mutual fund' portfolios are less volatile than the stock market portfolio during the pre-crisis period. Additionally, the existence of cointegration between the price series confirms the findings of unit root tests that the Australian market is not a weak-form efficient market (Rahman and Uddin 2012). The evidence of cointegration implies the possibility of profiting from arbitrage because it is possible to partially forecast the future stock market index prices by using the prices provided by the equity mutual funds.

The results of cointegration and causality tests during the pre-crisis period: The Johansen cointegration results indicate the existence of two cointegrating vectors showing the stock market index prices (S&P/ASX All Ordinaries index) are cointegrated with the equity mutual fund prices (see Panel 1 in Table 6.8). This means the existence of long-run co-movement between stock market prices, large-cap blend equity mutual fund prices, large-cap growth equity mutual fund prices, large-cap value equity mutual fund prices, middle and small-cap blend equity mutual fund prices, middle and small-cap growth equity mutual fund prices and middle and small-cap value equity mutual fund prices. The study finds that the S&P/ASX All Ordinaries index prices have a highly significant and positive long-term relationship with both the large-cap blend equity mutual funds and the middle and small-cap value equity mutual funds at the 1% level. Also, the S&P/ASX All Ordinaries index prices have a negative long-term relationship with the large-cap value equity mutual funds and the middle and small-cap growth equity mutual funds at the 1% level of significance (see Panel 1 in Table 6.15).

Granger-causality results suggest the S&P/ASX All Ordinaries index prices are determined by the large-cap equity mutual fund prices and the middle and small-cap value equity mutual fund prices. The results further indicate the large-cap value equity mutual fund prices contribute more than other equity mutual fund prices to changes in the S&P/ASX All Ordinaries price followed by large-cap blend equity mutual fund prices (see Table 6.9).

The results of ECT confirm the findings of the Granger-causality tests, the S&P/ASX All Ordinaries index prices are determined by the changes in the large-cap blend equity mutual fund past prices at the 5% level of significance (see Appendix A in Table A1). The ECT shows that the speed of an adjustment for the stock market index prices from short-run to long-run equilibrium is relatively quick and is significant at the 1% level. This indicates that if the S&P/ASX All Ordinaries index prices are too high in the short term, they will decrease by 4.89% per time period to eliminate the discrepancy caused by their own shocks and equity mutual fund price shocks (see Panel 1 in Table 6.7).

The results of variance decomposition support the results of Granger-causality tests, indicating the S&P/ASX All Ordinaries index has a relatively lower strength of exogeneity in relation to equity mutual fund variables because 70.40% of the S&P/ASX All Ordinaries index’s variance is explained by its own shock after 30 days (see Table 6.12). Movements in the S&P/ASX All Ordinaries index prices do not explain forecast error variances of any equity mutual fund prices, except the large-cap blend equity mutual funds (20.09%).

On the other hand, the large-cap equity mutual fund prices can explain a sizable portion of the S&P/ASX All Ordinaries index prices after 30 days (these are the large-cap blend equity mutual funds –16.98%, large-cap growth equity mutual funds –10.66%, and large-cap value equity mutual funds –11.63%). Hence, the stock market index prices tend to be dominated by large-cap equity mutual funds in the short-term relationships.

Considering the responses of the S&P/ASX All Ordinaries index prices to equity mutual fund price shocks, the evidence suggests that the S&P/ASX All Ordinaries index price is affected negatively by its own shock and large-cap growth equity mutual fund price shocks. The S&P/ASX All Ordinaries index price is affected positively by large-cap blend and value equity mutual fund price shocks and middle and small-cap equity mutual fund price shocks (see Appendix B in Figure B1).

The response of equity mutual fund prices to the S&P/ASX All Ordinaries index price shock follows a similar pattern as the S&P/ASX All Ordinaries index is affected by its own shocks (see Appendix B in Figures B1 to B7). Equity mutual fund prices have a negative response to the S&P/ASX All Ordinaries index price shocks. The evidence shows that the S&P/ASX All Ordinaries index price shocks have a significant effect on future middle and small-cap growth equity mutual fund prices with a lag of eight days (see Appendix B in Figure B6).

The results of IRF support the results of Granger-causality tests, indicating that in the short-run the S&P/ASX All Ordinaries index prices are determined by the large-cap blend equity mutual fund price shocks on a three-day lag. The value equity mutual fund price shocks have a significant effect on the S&P/ASX All Ordinaries index prices with a lag of four and five days. The stock market index price shocks have a permanent effect on the large-cap equity mutual funds and middle and small-cap blend and value equity mutual funds, although these effects are not significant. The stock market index price shock has a non-permanent effect on the middle and small-cap growth equity mutual funds (see Appendix B in Figure B1).

Thus, the results of the IRF are consistent with the results of Granger causality, ECTs and variance decomposition, indicating that past equity mutual fund prices have an effect on the stock market index future prices. This confirms the findings of the Johansen cointegration, which indicates a close association between the stock market price and the price of equity mutual funds for future periods. As discussed above, the results indicate that the S&P/ASX All Ordinaries index is the endogenous variable over the pre-crisis period (according to the variance decomposition test. See Table 6.12).

The results of cointegration and causality tests during the post-crisis period: The Johansen cointegration results indicate the existence of two cointegrating vectors, which shows stock market index prices (S&P/ASX

All Ordinaries index) are cointegrated with the equity mutual fund prices (see Panel 2 in Table 6.8). This means the existence of long-run co-movement between stock market prices, large-cap blend equity mutual fund prices, large-cap growth equity mutual fund prices, large-cap value equity mutual fund prices, middle and small-cap blend equity mutual fund prices, middle and small-cap growth equity mutual fund prices and middle and small-cap value equity mutual fund prices. The study finds that the S&P/ASX All Ordinaries index prices have a highly significant and positive long-term relationship with the blend equity mutual fund prices at the 1% level. There is a statistically significant negative long-run relationship between the S&P/ASX All Ordinaries index prices and the growth equity mutual fund prices at the 1% level (see Panel 2 in Table 6.15).

Granger-causality results show there is a bi-directional causal relationship between the middle and small-cap value equity mutual fund prices and the S&P/ASX All Ordinaries index prices at the 10% level of significance. The results indicate the stock market index prices do contribute much to changes in middle and small-cap value equity mutual fund prices. The study finds that the S&P/ASX All Ordinaries index prices have an influence on the large-cap value equity mutual fund prices in the short-run. Furthermore, the S&P/ASX All Ordinaries index prices are determined by the middle and small-cap blend equity mutual fund prices in the short-run at the 5% significance level (see Table 6.10).

The results of ECT confirm the findings of the Granger-causality tests, the S&P/ASX All Ordinaries index prices are determined by the changes in the middle and small-cap blend equity mutual fund past prices at the 5% level of significance (see Appendix A in Table A2). The ECT shows that the speed of an adjustment of the stock market index prices from short-run to long-run equilibrium is slow. This indicates that if the S&P/ASX All Ordinaries index prices are too high in the short term, they will decrease by

4.32% per time period to eliminate the discrepancy caused by their own shocks and equity mutual fund price shocks (see Panel 2 in Table 6.7).

The results of variance decomposition support the results of Granger-causality tests, indicating the S&P/ASX All Ordinaries index has a relatively lower strength of exogeneity in relation to equity mutual fund variables because 83.78% of the S&P/ASX All Ordinaries index's variance is explained by its own shock after 30 days (see Table 6.13). Movements in the S&P/ASX All Ordinaries index prices do not explain forecast error variances of any equity mutual fund prices except the large-cap blend equity mutual funds (5.56%), middle and small-cap growth equity mutual funds (5.68%) and middle and small-cap value equity mutual funds (3.19%).

On the other hand, the equity mutual fund prices can explain a sizable portion of S&P/ASX All Ordinaries index prices after 30 days (these are the large-cap blend equity mutual funds –70.12%, large-cap growth equity mutual funds –74.57%, large-cap value equity mutual funds –68.04%, middle and small blend equity mutual funds –70.39%, middle and small growth equity mutual funds –61.55% and middle and small value equity mutual funds –64.75%).

Considering the responses of the S&P/ASX All Ordinaries index prices to equity mutual fund price shocks, the evidence suggests that the S&P/ASX All Ordinaries index price is affected negatively by its own shocks, the blend equity mutual fund price shocks and the growth equity mutual fund price shocks. The S&P/ASX All Ordinaries index price is affected positively by the value equity mutual fund price shocks. The stock market index price shocks a have a temporary effect on equity mutual funds (see Appendix C in Figure C1).

The response of equity mutual fund prices to the S&P/ASX All Ordinaries index price shock follows a similar pattern, indicating that the past equity mutual fund prices have a transitory effect on the stock market index future prices during the post-crisis period. Large-cap growth equity mutual fund prices and middle and small-cap equity mutual fund prices have a positive response to the S&P/ASX All Ordinaries index price shocks (see Appendix C in Figures C3 and C5 to C7). While, the large-cap blend and value equity mutual fund prices have a negative response to an S&P/ASX All Ordinaries index price shock (see Appendix C in Figures C2 and C4).

Thus, the ECT results confirm the findings of the Granger-causality tests, indicating that in the short-run the S&P/ASX All Ordinaries index prices are determined by the changes in the middle and small-cap blend equity mutual fund prices both in the long-run and short-run relationships (see Appendix A in Table A2 and Table 6.10). This supports the findings of the Johansen cointegration, which indicates a close association between the stock market price and the price of equity mutual funds for future periods. As discussed above, the results indicate that the S&P/ASX All Ordinaries index is the endogenous variable over the post-crisis period (according to the variance decomposition test. See Table 6.13).

The results of cointegration and causality test during the full study period: The Johansen cointegration results indicate the existence of one cointegrating vector showing the stock market index prices (S&P/ASX All Ordinaries index) are cointegrated with the equity mutual fund prices (see Panel 3 in Table 6.8). This means the existence of long-run co-movement between stock market prices, large-cap blend equity mutual fund prices, large-cap growth equity mutual fund prices, large-cap value equity mutual fund prices, middle and small-cap blend equity mutual fund prices, middle and small-cap growth equity mutual fund prices, and middle and small-cap value equity mutual fund prices. The study finds that the S&P/ASX All Ordinaries index prices have positive long-run relationships with large-cap blend equity mutual fund prices and middle and small-cap growth equity mutual fund prices at the 1% and 5% levels of significance respectively. The S&P/ASX All Ordinaries index prices have negative long-run relationships with large-cap growth equity mutual fund prices and the value equity mutual fund prices at the 1% level of significance (see Panel 3 in Table 6.15).

Granger-causality results show the large-cap value equity mutual fund prices are determined by the S&P/ASX All Ordinaries index prices at the 5% significance level (see Table 6.11).

The results of ECT confirm the findings of the Granger-causality tests, the S&P/ASX All Ordinaries index prices are determined by the changes in the large-cap value equity mutual past prices at the 5% level of significance (see Appendix A in Table A3). The ECT shows that the speed of an adjustment for the stock market index prices from short-run to long-run equilibrium is slow (see Panel 3 in Table6.7). This indicates that if the S&P/ASX All Ordinaries index prices are too high in the short term, they will decrease by 0.157% per period to eliminate the discrepancy caused by their own shocks and equity mutual fund price shocks.

The results of variance decomposition support the results of Granger-causality tests, indicating the S&P/ASX All Ordinaries index has a relatively lower strength of exogeneity in relation to equity mutual fund variables because 98.94% of the S&P/ASX All Ordinaries index's variance is explained by its own shock after 30 days (see Table 6.14). Movements in the S&P/ASX All Ordinaries index prices do not explain forecast error variances of any equity mutual fund prices.

On the other hand, the equity mutual fund prices can explain a sizable portion of the S&P/ASX All Ordinaries index prices after 30 days (these are the large-cap blend equity mutual funds –55.94%, large-cap growth equity mutual funds –52.44%, large-cap value equity mutual funds –49.39%, middle and small blend equity mutual funds –40.41%, middle and small growth equity mutual funds –29.69%, and middle and small value equity mutual funds –30.60%).

Considering the responses of the S&P/ASX All Ordinaries index prices to equity mutual fund price shocks, the evidence suggests that the S&P/ASX All Ordinaries index price is affected negatively by its own shocks and the large-cap blend equity mutual fund price shocks. The S&P/ASX All Ordinaries index price is affected positively by large-cap growth and value equity mutual fund price shocks and middle and small-cap equity mutual fund price shocks. The shock of large-cap value equity mutual fund prices has a significant effect on S&P/ASX All Ordinaries index from one- and three-day lags. The IRF results indicate that the past equity mutual fund prices have a permanent effect on the stock market index future prices during the full study period (see Appendix D in Figure D1).

The response of equity mutual fund prices to the S&P/ASX All Ordinaries index price shock follows a similar pattern. Large-cap growth equity mutual fund prices and middle and small-cap equity mutual fund prices have a positive response to the S&P/ASX All Ordinaries index price shocks (see Appendix D in Figures D3 and D5 to D7). While, the large-cap blend and value equity mutual fund prices have a negative response to a S&P/ASX All Ordinaries index price shock (see Appendix D in Figures D2 and D4).

Thus, the ECT results confirm the findings of the Granger-causality tests, indicating a close association between the stock market prices and the large-cap value equity mutual fund prices both in the long-run and short-run relationships (see Appendix A in Table A3 and Table 6.11). The results indicate that the S&P/ASX All Ordinaries index is the endogenous variable during the post-crisis period (according to the variance decomposition test. See Table 6.14).

In summary, the evidence from estimations using the Johansen and Juselius approach and VECM, suggest that a long-run relationship between the specified variables exists. The results of the ARCH model are closely supported by the primary findings. The results of a multiple regression of returns based on ARCH indicate that six equity mutual fund categories are relatively exogenous in relation to stock market returns according to the various *R*-squared and adjusted *R*-squared values (see Table 5.7) during the post-crisis period and the full study period. The evidence from Granger-causality tests, variance decompositions and IRFs, suggest that a short-run relationship between the specified variables exists. Thus, the evidences indicate the existence of price association between the stock market index and the equity mutual fund for future periods both in the long-run and short-run relationships. The results indicate that the S&P/ASX All Ordinaries index is the endogenous variable over the three study periods.

As mentioned earlier, there is a growing body of theoretical and empirical literature on the equity mutual fund industry. However, the causal links between the equity mutual fund price categories have not been examined in a time series framework for the Australian financial market. An analysis of price linkages between the equity mutual funds based on funds' categories is a constraint in the Australian mutual fund. This study undertakes further analysis to investigate the price linkages in the short-run relationship between six equity mutual fund categories, and makes new contributions to the related literature by showing price linkages between them in the short-run, both before and after the recent financial crisis.

The study also uses Block Exogeneity Wald tests with a chi-square statistic to indicate the existence of Granger-causality between each equity mutual fund variable within the specified model. The null hypothesis (H_{05}) and the alternative hypothesis (H_{A5}) concern the short-run relationship between equity mutual fund categories and are stated as follows:

Hypothesis (H_{05}): There is no short-term Granger-causal relationship between the equity managed fund price categories.

Hypothesis (H_{A5}): There is a short-term Granger-causal relationship between the equity managed fund price categories.

The price linkages between six equity mutual fund categories: evidence from a causality analysis for the pre-crisis period: With the inclusion of the VECM based Granger-causality tests for equity mutual funds within the specified model, the findings reject the null hypothesis (H_{05}) and accept the alternative hypothesis (H_{A5}) that there is a short-run Granger-causal relationship between equity managed fund categories at the 1% level of significance.

The price linkages between six equity mutual fund categories: evidence from a causality analysis for the post-crisis period: With the inclusion of the tests for the joint significance of all equity mutual funds, the findings reject the null hypothesis (H_{05}) and accept the alternative hypothesis (H_{A5}) for the short-run Granger-causal relationship between the equity managed fund price categories at the 5% and 10% levels of significance.

The price linkages between six equity mutual fund categories: evidence from a causality analysis for the full study period: With the inclusion of the tests for the joint significance of all equity mutual funds, the findings reject the null hypothesis (H_{05}) and accept the alternative hypothesis (H_{A5}) for the short-run Granger-causal relationship between the equity managed fund price categories at the 1% and 5% levels of significance.

The acceptance of the alternative hypothesis H_{A5} is supported by previous studies relating to fund size. A large number of studies suggest that a portfolio's asset-class allocation is related to the size of the fund, (for example, Gruber 1996; Indro et al. 1999; Beckers and Vanughan 2001; Berk and Green 2004; Karlsson and Persson 2005; Chow et al. 2008; Yap and Pierce 2008; Cremers and Petajisto 2009; Ferreira et al. 2013). These suggestions are helpful in explaining the existence of causality between the equity mutual fund categories.

Gruber (1996), Berk and Green (2004) and Chen et al. (2004) find that smaller size funds incur lower organization costs and are more flexible in rotating portfolios. Cremers and Petajisto (2009) suggest that large-cap equity mutual funds attempt to purchase securities that have large market capitalisation with a large number of securities in the portfolio, and tend to be unable to capture active investment opportunities, such as low administration costs and market prices impact (Indro et al. 1999; Chen et al. 2004). Although larger funds have more capital to invest, their portfolio management is less successful because of a less concentrated portfolio position. Hence, large-cap equity mutual funds seem to require more time in negotiations and execution of moves in and out of investment positions. In contrast, middle and small-cap equity mutual funds attempt to purchase securities having low market capitalization, concentrating on a few groups of marketable securities. Gruber (1996), Berk and Green (2004) and Cremers and Petajisto (2009) find that middle and small-cap equity mutual funds may not near a point of marketing a comparative advantage dealing with economies of scale.

The results of the Granger-causality test between the equity managed fund categories during the pre-crisis period: The results of the VECM Granger-causality tests treating large-cap equity mutual funds as an endogenous variable indicate that the large-cap blend equity mutual fund prices contribute more than the large-cap growth mutual fund prices to changes in the large-cap value equity mutual fund prices. The study finds that, in the short-run, the large-cap blend equity mutual fund prices are determined by large-cap growth equity mutual fund prices. The middle and small-cap value equity mutual fund prices are determined by large-cap growth equity mutual fund prices (see Table 6.9).

The results of VECM Granger-causality tests treat middle and small-cap mutual funds as endogenous variables. The study finds that the middle and small-cap growth equity mutual fund prices contribute more than the middle and small-cap value mutual fund prices to changes in the middle and small-cap blend equity mutual fund prices (see Table 6.9).

The ECT value has a significant effect on the middle and small-cap growth equity mutual funds at the 5% level, when this variable is treated endogenously (see Appendix A in Table A1). The results of ECTs and the variance decomposition analysis (see Table 6.12) support the results of the Granger-causality tests, indicating that the middle and small-cap growth equity mutual funds have a relatively lower strength of exogeneity in relation to other equity mutual fund variables. This indicates that if the middle and small-cap growth equity mutual fund prices are too high in the short term, they will decrease by 1.99% per period to eliminate the discrepancy caused by their own shocks and other equity mutual fund price shocks, especially middle and small-cap blend equity mutual funds.

In summary, the study finds that the middle and small-cap equity mutual fund prices have an influence on the large-cap equity mutual fund prices in the short-run. The evidence shows that the equity mutual fund prices are affected positively by its own shocks (see Appendix B in Figures B2 to B7).

The results of the Granger-causality test between the equity managed fund categories during the post-crisis period: The results of the VECM Granger-causality tests treating large-cap equity mutual funds as an endogenous variable indicate that, in the short-run, the large-cap growth equity mutual fund prices are determined by large-cap blend and value equity mutual fund prices. The evidence shows that the large-cap value equity mutual fund prices have an influence on the middle and small-cap value equity mutual fund prices in the short-run relationship (see Table 6.10). Furthermore, the results of variance decomposition support the results of Granger-causality tests, indicating the large-cap growth equity mutual funds have a relatively lower strength of exogeneity in relation to other large-cap equity mutual funds (see Table 6.13).

The results of VECM Granger-causality tests treat middle and small-cap mutual funds as an endogenous variable, indicating that the price of middle and small-cap blend and growth equity mutual funds have an effect on the middle and small-cap value equity mutual fund prices. The evidence also shows that the middle and small-cap blend and growth equity mutual fund prices have an influence on the large-cap growth equity mutual fund prices in the short run (see Table 6.10).

The ECT value has a significant effect on the large-cap growth equity mutual funds at the 5% level, when this variable is treated endogenously (see Appendix A in Table A2). The results of ECTs and the variance decomposition analysis confirm the results of Granger-causality tests, indicating that the large-cap growth equity mutual funds have a relatively lower strength of exogeneity in relation to other equity mutual fund variables. This indicates that if the large-cap growth equity mutual fund prices are too high in the short term, they will decrease by 4.56% per period to eliminate the discrepancy caused by their own shocks and other equity mutual fund price shocks, especially in middle and small-cap value equity mutual funds.

In summary, the equity mutual fund prices are affected negatively by its own shocks (see Appendix C in Figures C2, C3 and C5 to C7), with the exception of the large-cap value equity mutual funds where it is positive (see Appendix C in Figure C4). There is evidence of the equity mutual fund prices positive effect on each other based on market capitalization, especially the value equity mutual funds. The results of variance decomposition and Granger-causality tests, indicating the large-cap growth equity mutual funds are the endogenous variables.

The results of the Granger-causality test between the equity managed fund categories during the full study period: The results of the VECM Granger-causality tests treating large-cap mutual funds as an endogenous variables indicate that the large-cap blend equity mutual fund prices contribute much to change in the large-cap value equity mutual fund prices.

The large-cap blend equity mutual fund prices are determined by middle and small-cap value equity mutual fund prices. The study finds that the large-cap growth equity mutual fund prices have an influence on the value equity mutual fund prices in the short run (see Table 6.11).

The results of VECM Granger-causality tests treating middle and small-cap mutual funds as endogenous variables indicate that the middle and small-cap growth equity mutual fund prices contribute more than the middle and small-cap value equity mutual fund prices to changes in the middle and small-cap blend equity mutual fund prices. Moreover, the middle and small-cap growth equity mutual fund prices have an influence on the large-cap blend equity mutual fund prices. The study finds that the value equity mutual fund prices are determined by middle and small-cap growth equity mutual fund prices (see Table 6.11).

The ECT value shows a significant effect on the large-cap growth and value equity mutual funds at the 5% level, when these two variables are treated endogenously (see Appendix A in Table A3). Combining results of ECTs, variance decomposition and Granger-causality tests indicates that the large-cap value equity mutual funds have a relatively lower strength of exogeneity in relation to other equity mutual fund variables. This indicates that if the large-cap value equity mutual fund prices are too high in the short term, they will decrease by 0.34% per period to eliminate the discrepancy caused by their own shocks and other equity mutual fund price shocks.

In summary, the equity mutual fund prices are affected positively by their own shocks (see Appendix D in Figures D3 to D7), with the exception of the large-cap blend equity mutual funds where it is negative (see Appendix D in Figure D2). Evidence shows that the middle and small-cap equity mutual fund prices have an influence on the large-cap equity mutual fund prices in the short run. The results of the ECTs indicate that there exists a price association between the equity mutual fund categories for the future periods. The results of variance decomposition and Granger-causality tests indicate that the large-cap value equity mutual funds are the endogenous variables (see Tables 6.11 and 6.14).

The results of this study support those of previous studies, such as Ben-Zion et al., (1996), Matallin and Nieto (2002), Low and Ghazali (2007) and Chu (2010, 2011) who study price linkages between mutual funds and local stock markets. The study concludes that some equity mutual fund categories fail to design their portfolios to beat the stock market. There is minimal evidence of benefit from domestic diversification. However, the evidence of cointegration implies the possibility of profiting from arbitrage because it is possible to partially forecast the stock market index price by using the prices provided by the equity mutual funds. Based on rational expectations and the EMH, the expectations of future prices using knowledge of past price behaviour in a particular equity mutual fund category will improve forecasts of prices of other equity mutual fund categories and the stock market index. The main contributions of this study are discussed in the next section.

7.3 Contributions to knowledge

This section highlights the research contributions made by this study. This study is believed to be the first to examine the cointegration and causality between the prices of equity mutual funds under the Australian securities exchange and the benchmark indices designed by the Australian securities exchange (S&P/ASX All Ordinaries index) over periods of pre-crisis and post crisis. This study also makes new contributions to the related literature by showing the price linkages between the equity mutual fund categories in the short-run. Another contribution of this study is that it is believed from a thorough search of literature that no other study has used the Johansen cointegration and the Granger-causality tests within a VAR and a VECM framework to investigate these relationships.

The study uses extensive empirical analysis and covers three study periods of varying volatilities in the financial market. Consequently, this study is able to distinguish between different financial market conditions. Potentially this will help other researchers to improve their ongoing research, since market instability may be explained by the absence or existence of cointegration and causality along the variables. Furthermore, this study will help other researchers investigate the price of equity mutual fund interaction with security prices in the stock market as well as within varying equity mutual fund capitalisations and categories.

The study contributes further by its examination of the relationships between the stock market index price and equity mutual fund prices. Specifically, this study contributes by its investigation of the potential benefits from domestic diversification by investing in equity mutual funds, which have not been addressed in the causal relationships of equity mutual funds previously. The results of this study have the potential to improve investors' portfolio diversification using cointegration and causality techniques for both long- and short-term investments.

The variance decomposition and IRF analysis add further evidence to Johansen cointegration and Granger Block Exogeneity Wald test results. The current study provides insights into the percentage of the forecast error variance and the price shock response of the equity mutual fund that can be explained by the stock market index and vice versa. Potentially this could assist fund managers improve their trading and diversification strategies, especially during a high volatility period. Moreover, the study provides economic policy makers with another point of reference towards forecasting the interaction of price movements in domestic equity markets, hence implementing an appropriate policy action. The policy implications are discussed in the next section.

7.4 Policy implications

A mutual fund open to a limited range of investors who undertake a wide range of investments and trading activities other than the traditional forms of investments is defined as an equity mutual fund. Every equity mutual fund usually comprises of its own unique investment strategies and caters to a broad range of equity securities of various companies which are publicly tradable in the stock market. Consequently, the evaluation of the investment performance and price interaction of managed portfolios in particular have evolved into important topics in the mutual fund industry as well as in academic research.

The preliminary empirical part of this study offers the investor and fund managers a detailed analysis of the performance of equity mutual funds in Australia in terms of how equity mutual funds performed during the pre-crisis and post-crisis periods. For the findings in this research, the performance of equity mutual funds is negative in both recession and non-recessions, which is worse than average of the market portfolio performance. The defensive strategy has been adopted for equity mutual funds. The study finds that middle and small-cap equity mutual fund performance is better compared to the large-cap equity mutual fund. The middle and small-cap equity mutual funds are also more volatile than large-cap equity mutual funds. Therefore, the middle and small-cap equity mutual funds offer a great investment for investors who are interested in investing in equity mutual funds.

The main empirical findings of this study clearly encourage policy makers and investors to pay attention to equity mutual funds when making long-term and short-term investment decisions. The evidence clearly shows that domestic equity mutual fund prices based on fund category have a statistically significant impact on both long- and short-term stock market index prices. There is also evidence that stock market index prices can be forecasted by using the price information of the other equity mutual fund categories over recessionary and non-recessionary periods, especially the value equity mutual funds. Furthermore, the evidence shows that any movements in the S&P/ASX All Ordinaries index price cannot be used to predict the movement of equity mutual funds during non-recessionary periods. These results assist investors and policy makers to beware of the effects of economic conditions when predicting the security prices.

A new investment plan could be implied based on the results of this study, which suggests that the movements of equity mutual fund prices can be forecasted by using the price information of the other equity mutual fund categories. This result is especially strong with same market capitalisation or investment objective. Although the results are important, this study has some limitations, as discussed in the next section.

7.5 Research limitations

To contain the scope of the current study, only open-ended equity mutual funds traded on the Australian securities exchange have been included. Other types of equity mutual funds are excluded, including international equity mutual funds, institutional funds, special equity mutual funds, such as Australian equity real estate funds and Australian large-cap geared equity mutual funds. The study investigates equity mutual funds that existed in the 11 years up to 31st December 2010. The results may have an upward bias because of the study's scope of considering only those equity mutual funds that survived for the eleven-year study period.

Another limitation is that the study could not access the list and percentage of shares held by the equity mutual funds. As a result, investigation of price linkages of equity mutual fund based on portfolio holdings is not possible. However, the results of cointegration and causality are not significantly affected by the existence of dual-listed stocks (that is, stocks listed both in the large-cap equity mutual funds and middle and small-cap equity mutual funds). The study focuses on the price behaviour of the S&P/ASX All

Ordinaries index and equity mutual funds without including the effects of other variables, such as fund flow, management fees, taxation and timing effects, because there is incomplete information. The study does not research why investors choose to invest in equity mutual funds rather than the stock market and vice versa. Hence, this study does not proffer a view on investor behaviour.

The study also examines price linkages of equity mutual funds based on investment objectives of the sample as a whole. Consequently, caution should be exercised when interpreting the results for an individual fund. More extensive analysis of individual fund portfolios and their range of assets must be carried out to present conclusions applicable to those individual funds. Hence, the current study has certain limitations to be taken into account for the future research discussed in the next section.

7.6 Future research

In reflecting on the results and limitations, the study observed several worthy research topics. These topics would foster further research towards expanding the findings on the price linkage of equity mutual funds in Australia. Four particular directions for future research in this area will now be suggested.

First, future research on the price linkage of mutual funds should concentrate on survivorship bias. With respect to the non-surviving funds, the sufficiency of the future model constructs could be analysed by survival analysis methods, such as those employed by the Kaplan Meier (1958) estimator (non-parametric) and the Cox (1972) regression model (semi-parametric).

Second, future research should be extended to cover special equity mutual fund types, such as the Australian real estate equity mutual funds. This research can be used to extend the existing set of samples. In addition, this study recommends that future research can be based on the approach used in this study.

Third, the study recommends that future research focus on the list of shares actually held by equity mutual funds, if there is a possibility to access the proportion of the equity mutual fund holding. It is also important to understand the impact of equity mutual fund holding on equity mutual fund prices. It would provide valuable knowledge on the extent to which particular shares drive the equity mutual fund prices and this could lead to a greater understanding of price interaction based on style diversification.

And finally, the study also recommends that future research should focus on the other factors that can affect fund performance, such as fund flow, management fees, taxation and timing effects in cases where there is complete information.

7.7 Concluding remarks

This study investigates performance, contemporaneous and dynamic relationships of equity mutual funds and the stock market index, in an Australian context, using time series data from 2000 to 2010 such as the S&P/ASX All Ordinaries index and Australian equity mutual funds (large-cap; blend, growth and value, and middle and small-cap; blend, growth, and value). The equity mutual fund results estimated through three performance measures of risk adjusted performance are negative, which means that equity mutual fund performance is worse as compared to market portfolio performance. Furthermore, the results of this study are consistent with previous studies using the same technique.

According to ARCH-GARCH, the evidence shows that there is evidence of long memory volatility in equity mutual fund returns. This indicates that previous information cannot be neglected in forecasting the future equity mutual fund returns, especially for middle and small-cap equity mutual funds.

When unit root tests of the data are considered, the results of the ADF and the PP test statistics indicate each of the series is non-stationary when the variables are defined in levels, while the results of the first differences suggest all interest variables are stationary. Therefore, all residuals of the linear combination of first differences are stationary during the three study periods.

The VECM Johansen cointegration test is used to test for the existence of a long-run statistical equilibrium among the variables. The evidence shows that the S&P/ASX All Ordinaries index prices are cointegrated with a set of these equity mutual fund variables. The existence of cointegration between the S&P/ASX All Ordinaries index and equity mutual funds supports the rational expectations theory coupled with previous studies in this field and also demonstrates that in the long-run their prices will be highly correlated. Investors are not likely to achieve large benefits by diversifying between these two financial instruments in the long-run. However, investors have the potential for arbitrage gains between equity mutual funds and the stock market index, as their prices have been shown to have been dependent on each other.

In the short-run, the Granger Block Exogeneity Wald test, ECT analysis, variance decomposition and IRF are conducted to establish the existence of causality among the variables. There is mixed evidence of causal relations between equity mutual funds and the benchmark index. The Granger-causality tests show some evidence of a one-way relationship from equity mutual fund- to- stock market. The result of variance decomposition and the IRF support the results of Granger-causality tests. That is, S&P/ASX All Ordinaries index possesses relatively lower strength of exogeneity in relation to other variables. This implies the stock market index price would correct itself in the direction of the equity mutual fund prices, especially the large-cap equity mutual funds.

There is evidence of a short-run Granger-causality between equity mutual fund categories. The pre-crisis period results indicate changes in the middle and small-cap growth equity mutual fund prices are determined by changes in the other equity mutual fund prices. In the post-crisis period, the large-cap growth equity mutual funds are highly affected by other equity mutual fund prices. The large-cap value equity mutual funds are highly affected by other equity mutual fund prices during the full study period.

The results of the variance decomposition support the results of Granger-causality tests and ECT models. The results indicate that six equity mutual fund categories have relatively greater strength of exogeneity in relation to stock market returns. The pattern of responses to price shocks between equity mutual funds and the S&P/ASX All Ordinaries index are similar, indicating that the response dynamics commence from two days after the shocks and move to long-term price stability. The results of IRF lend support to the findings of the Johansen cointegration results and indicate that there exists a close association between the stock market prices and the prices of equity mutual fund for future periods.

Despite the limitations this research has achieved its main objectives. The preliminary findings support the primary findings; underlying rational expectation theory coupled with past evidence in this field is supported by the results of the study. The results suggest that any movements in equity mutual fund prices can be used to predict the movement of the S&P/ASX All Ordinaries index price. Therefore, the results indicate that equity mutual fund prices can also be forecasted by using the price information of the other equity mutual fund categories. Thus, investing in particular equity mutual fund category offers an attractive option for investors wanting their portfolios to replicate the behaviour of the Australian stock market. The evidence of causality and cointegration imply the possibility of profiting from arbitrage, because investors may gain insights into the future prices of the stock market index and equity mutual funds by observing the price movements in one of the equity mutual fund categories.

Appendix A

Table A.1 Vector error correction model, pre-crisis period

Exogenous	ΔASX	ΔLB	ΔLG	ΔLV	ΔMSB	ΔMSG	ΔMSV
Error correction term	-0.048967	0.006894	0.000988	0.003551	-0.002682	-0.019873	-0.004085
	(0.00768)	(0.00549)	(0.00738)	(0.00704)	(0.00725)	(0.00955)	(0.00918)
	[-6.37969]*	[1.25490]	[0.13389]	[0.50408]	[-0.36969]	[-2.0799]**	[-0.44513]
ΔASX_{t-1}	-0.033360	-0.031870	-0.043060	-0.058808	-0.035161	-0.032278	-0.050920
	(0.02501)	(0.01790)	(0.02405)	(0.02296)	(0.02364)	(0.03114)	(0.02991)
	[-1.33365]	[-1.78012]	[-1.79008]	[-2.5617]**	[-1.48740]	[-1.03664]	[-1.70258]
ΔASX_{t-2}	-0.027742	-0.022686	-0.029464	-0.027287	-0.031335	-0.028754	-0.045371
	(0.02499)	(0.01789)	(0.02403)	(0.02293)	(0.02362)	(0.03111)	(0.02988)
	[-1.11015]	[-1.26839]	[-1.22611]	[-1.18981]	[-1.32688]	[-0.92438]	[-1.51856]
ΔLB_{t-1}	-0.151632	-0.211309	-0.263850	-0.239606	-0.373341	-0.623553	-0.336751
	(0.08524)	(0.06101)	(0.08197)	(0.07823)	(0.08055)	(0.10611)	(0.10191)
	[-1.77888]	[-3.46367]*	[-3.21889]*	[-3.06296]*	[-4.63471]*	[-5.87674]*	[-3.30426]*
ΔLB_{t-2}	0.061762	0.099100	0.090805	0.094163	0.070068	0.073751	0.197518
	(0.08543)	(0.06114)	(0.08215)	(0.07840)	(0.08073)	(0.10634)	(0.10214)
	[0.72295]	[1.62080]	[1.10534]	[1.20105]	[0.86790]	[0.69353]	[1.93378]
ΔLG_{t-1}	-0.015606	0.110949	0.104492	0.167730	0.120506	0.229331	0.025922
	(0.07809)	(0.05589)	(0.07509)	(0.07167)	(0.07380)	(0.09721)	(0.09337)
	[-0.19985]	[1.98511]	[1.39147]	[2.3404]**	[1.63292]	[2.3592]**	[0.27764]
ΔLG_{t-2}	-0.023176	0.059568	0.099025	0.088081	0.026102	0.018438	-0.010555
	(0.07739)	(0.05539)	(0.07442)	(0.07103)	(0.07314)	(0.09634)	(0.09253)
	[-0.29945]	[1.07541]	[1.33056]	[1.24013]	[0.35689]	[0.19139]	[-0.11407]
ΔLV_{t-1}	0.094883	0.141074	0.143938	0.074831	0.160516	0.210607	0.186712
	(0.07756)	(0.05551)	(0.07459)	(0.07118)	(0.07330)	(0.09655)	(0.09273)
	[1.22332]	[2.5413]**	[1.92983]	[1.05128]	[2.1899]**	[2.1814]**	[2.0134]**
ΔLV_{t-2}	0.024191	-0.117028	-0.119840	-0.152521	-0.016601	-0.053412	-0.057463
	(0.07593)	(0.05435)	(0.07302)	(0.06969)	(0.07176)	(0.09452)	(0.09079)
	[0.31858]	[-2.1534]**	[-1.64118]	[-2.1887]**	[-0.23134]	[-0.56508]	[-0.63294]
ΔMSB_{t-1}	0.075623	-0.021077	-0.025968	-0.002378	0.029138	0.131157	0.149130
	(0.04344)	(0.03109)	(0.04177)	(0.03986)	(0.04105)	(0.05407)	(0.05194)
	[1.74094]	[-0.67794]	[-0.62168]	[-0.05964]	[0.70982]	[2.4256]**	[2.87145]*
ΔMSB_{t-2}	0.052630	-0.039831	-0.055961	-0.048496	-0.102752	-0.110094	-0.066766
	(0.04355)	(0.03117)	(0.04188)	(0.03997)	(0.04115)	(0.05421)	(0.05207)
	[1.20853]	[-1.27794]	[-1.33630]	[-1.21344]	[-2.4968]**	[-2.0310]**	[-1.28231]
ΔMSG_{t-1}	0.006861	-0.017816	-0.002513	-0.059859	0.050470	-0.044816	-0.034635
	(0.03558)	(0.02546)	(0.03421)	(0.03265)	(0.03362)	(0.04429)	(0.04254)
	[0.19282]	[-0.69962]	[-0.07344]	[-1.83322]	[1.50106]	[-1.01190]	[-0.81418]
ΔMSG_{t-2}	-0.041268	0.001422	0.005114	-0.005551	0.083177	0.111110	0.035410
	(0.03553)	(0.02543)	(0.03417)	(0.03261)	(0.03358)	(0.04423)	(0.04248)
	[-1.16149]	[0.05593]	[0.14968]	[-0.17025]	[2.4773]**	[2.5123]**	[0.83357]
ΔMSV_{t-1}	-0.002200	0.037756	0.083485	0.040194	0.018604	0.099194	-0.020253
	(0.03613)	(0.02586)	(0.03474)	(0.03316)	(0.03414)	(0.04497)	(0.04320)
	[-0.06089]	[1.46012]	[2.4029]**	[1.21223]	[0.54490]	[2.2056]**	[-0.46886]
ΔMSV_{t-2}	0.020119	0.042423	0.026450	0.035424	0.080295	0.006522	-0.028936
	(0.03594)	(0.02572)	(0.03456)	(0.03299)	(0.03397)	(0.04474)	(0.04297)
	[0.55973]	[1.64910]	[0.76524]	[1.07392]	[2.3639]**	[0.14578]	[-0.67333]
Constant	0.000333	0.000186	0.000151	0.000302	0.000203	0.000103	0.000243
	(0.00016)	(0.00011)	(0.00015)	(0.00015)	(0.00015)	(0.00020)	(0.00019)
	[2.0803]**	[1.62255]	[0.97785]	[2.0589]**	[1.34195]	[0.51849]	[1.26920]
Adj. R-squared	0.026{3}	0.018{4}	0.014{5}	0.009{7}	0.036{1}	0.032{2}	0.009{6}

Note: * and ** denote the 1% and 5% significance levels, respectively. Δ denotes the difference operator, standard errors in ( ), *t*-statistics in [ ] and ranking in { }.

Table A.2 Vector error correction model, post-crisis period

Exogenous	ΔASX	ΔLB	ΔLG	ΔLV	ΔMSB	ΔMSG	ΔMSV
Error correction term	-0.043247	-0.019146	-0.045576	-0.036240	0.010225	-0.009530	0.017569
	(0.02275)	(0.01874)	(0.02089)	(0.02073)	(0.01857)	(0.01843)	(0.01712)
	[-1.90123]	[-1.02173]	[-2.182]**	[-1.74858]	[0.55073]	[-0.51700]	[1.02604]
ΔASX_{t-1}	0.143992	0.074703	0.210392	0.128759	0.298041	0.300270	0.283058
	(0.13756)	(0.11332)	(0.12630)	(0.12534)	(0.11228)	(0.11148)	(0.10355)
	[1.04674]	[0.65920]	[1.66579]	[1.02731]	[2.65448]*	[2.69354]*	[2.7335]*
ΔASX_{t-2}	0.093700	0.083109	0.119802	0.187502	0.176053	0.128811	0.160647
	(0.13570)	(0.11179)	(0.12460)	(0.12364)	(0.11076)	(0.10997)	(0.10215)
	[0.69047]	[0.74340]	[0.96152]	[1.51647]	[1.58946]	[1.17129]	[1.57262]
ΔLB_{t-1}	-0.101719	-0.083147	0.099514	0.001600	0.013019	0.128557	0.033238
	(0.21469)	(0.17686)	(0.19712)	(0.19561)	(0.17523)	(0.17398)	(0.16161)
	[-0.47380]	[-0.47012]	[0.50485]	[0.00818]	[0.07430]	[0.73891]	[0.20567]
ΔLB_{t-2}	0.226623	0.118922	0.159570	0.135137	0.219871	0.161783	0.205635
	(0.20554)	(0.16932)	(0.18871)	(0.18727)	(0.16776)	(0.16656)	(0.15472)
	[1.10259]	[0.70234]	[0.84557]	[0.72162]	[1.31063]	[0.97130]	[1.32909]
ΔLG_{t-1}	-0.392743	-0.417916	-0.575916	-0.516224	-0.365676	-0.412934	-0.284968
	(0.20853)	(0.17179)	(0.19146)	(0.19000)	(0.17020)	(0.16899)	(0.15697)
	[-1.88338]	[-2.433]**	[-3.00798]*	[-2.71700]*	[-2.14846]	[-2.444]**	[-1.81540]
ΔLG_{t-2}	-0.186262	-0.151121	-0.194888	-0.256560	-0.170201	-0.158061	-0.247906
	(0.20643)	(0.17006)	(0.18954)	(0.18809)	(0.16849)	(0.16729)	(0.15539)
	[-0.90228]	[-0.88862]	[-1.02823]	[-1.36404]	[-1.01014]	[-0.94482]	[-1.59533]
ΔLV_{t-1}	0.186398	0.268324	0.187148	0.237332	0.035239	0.018159	0.042090
	(0.13164)	(0.10845)	(0.12087)	(0.11994)	(0.10745)	(0.10668)	(0.09909)
	[1.41595]	[2.474]**	[1.54839]	[1.97873]	[0.32797]	[0.17022]	[0.42475]
ΔLV_{t-2}	-0.145361	-0.076256	-0.100221	-0.101780	-0.177394	-0.137964	-0.104957
	(0.13277)	(0.10938)	(0.12191)	(0.12097)	(0.10837)	(0.10760)	(0.09995)
	[-1.09480]	[-0.69716]	[-0.82211]	[-0.84134]	[-1.63692]	[-1.28221]	[-1.05013]
ΔMSB_{t-1}	-0.029262	-0.084732	-0.144055	-0.010178	-0.213211	-0.086559	-0.127817
	(0.15614)	(0.12863)	(0.14336)	(0.14226)	(0.12744)	(0.12653)	(0.11753)
	[-0.18741]	[-0.65874]	[-1.00487]	[-0.07154]	[-1.67303]	[-0.68409]	[-1.08750]
ΔMSB_{t-2}	-0.333986	-0.257130	-0.253186	-0.275863	-0.284492	-0.159802	-0.166391
	(0.15552)	(0.12812)	(0.14279)	(0.14170)	(0.12693)	(0.12603)	(0.11707)
	[-2.148]**	[-2.007]**	[-1.77316]	[-1.94687]	[-2.241]**	[-1.26798]	[-1.42135]
ΔMSG_{t-1}	-0.044207	0.057458	-0.013008	0.016294	0.059773	-0.075344	-0.052689
	(0.15673)	(0.12911)	(0.14390)	(0.14280)	(0.12792)	(0.12701)	(0.11798)
	[-0.28207]	[0.44502]	[-0.09040]	[0.11411]	[0.46727]	[-0.59323]	[-0.44661]
ΔMSG_{t-2}	0.295918	0.255474	0.270849	0.271510	0.274652	0.263644	0.227616
	(0.15598)	(0.12850)	(0.14321)	(0.14212)	(0.12731)	(0.12640)	(0.11741)
	[1.89718]	[1.988]**	[1.89126]	[1.91049]	[2.157]**	[2.086]**	[1.93860]
ΔMSV_{t-1}	0.274901	0.226234	0.338067	0.186295	0.303439	0.305837	0.256806
	(0.14568)	(0.12001)	(0.13376)	(0.13273)	(0.11890)	(0.11806)	(0.10966)
	[1.88701]	[1.88508]	[2.527]**	[1.40354]	[2.552]**	[2.5905]*	[2.342]**
ΔMSV_{t-2}	0.071208	0.032434	0.047081	0.050740	0.059206	0.019251	0.061627
	(0.14628)	(0.12051)	(0.13431)	(0.13328)	(0.11940)	(0.11855)	(0.11012)
	[0.48678]	[0.26914]	[0.35053]	[0.38069]	[0.49587]	[0.16240]	[0.55966]
Constant	-0.000278	-0.000371	-0.000360	-0.000347	-0.000279	-0.000234	-0.000247
	(0.00048)	(0.00040)	(0.00044)	(0.00044)	(0.00039)	(0.00039)	(0.00036)
	[-0.57557]	[-0.93076]	[-0.81115]	[-0.78726]	[-0.70796]	[-0.59806]	[-0.67954]
Adj. R-squared	0.006{7}	0.014{4}	0.013{5}	0.007{6}	0.034{3}	0.040{2}	0.051{1}

Note: * and ** denote the 1% and 5% significance levels, respectively. Δ denotes the difference operator, standard errors in ( ), *t*-statistics in [ ] and ranking in { }.

Table A.3 Vector error correction model, full study period

Exogenous	ΔASX	ΔLB	ΔLG	ΔLV	ΔMSB	ΔMSG	ΔMSV
Error correction term	-0.001579	0.000130	-0.004409	-0.003473	-0.001229	-0.002451	-0.001222
	(0.00192)	(0.00151)	(0.00178)	(0.00174)	(0.00165)	(0.00187)	(0.00177)
	[-0.82452]	[0.08596]	[-2.475]**	[-1.991]**	[-0.74647]	[-1.31118]	[-0.69032]
ΔASX_{t-1}	-0.042896	-0.038113	-0.021240	-0.038231	0.014932	0.016548	0.015576
	(0.03125)	(0.02460)	(0.02906)	(0.02846)	(0.02686)	(0.03050)	(0.02887)
	[-1.37247]	[-1.54938]	[-0.73089]	[-1.34356]	[0.55584]	[0.54260]	[0.53945]
ΔASX_{t-2}	-0.053573	-0.019333	-0.018551	-0.002969	-0.007908	-0.006278	-0.003054
	(0.03118)	(0.02454)	(0.02899)	(0.02839)	(0.02680)	(0.03042)	(0.02880)
	[-1.71827]	[-0.78783]	[-0.63991]	[-0.10461]	[-0.29509]	[-0.20636]	[-0.10603]
ΔLB_{t-1}	-0.072676	-0.175357	-0.105780	-0.140808	-0.178550	-0.240150	-0.092088
	(0.08950)	(0.07044)	(0.08321)	(0.08148)	(0.07692)	(0.08733)	(0.08268)
	[-0.81204]	[-2.4894]**	[-1.27117]	[-1.72807]	[-2.3211]**	[-2.7499]*	[-1.11377]
ΔLB_{t-2}	0.147539	0.093941	0.088476	0.106567	0.136886	0.125186	0.235958
	(0.08901)	(0.07006)	(0.08277)	(0.08104)	(0.07651)	(0.08686)	(0.08223)
	[1.65747]	[1.34086]	[1.06899]	[1.31495]	[1.78916]	[1.44126]	[2.86933]*
ΔLG_{t-1}	-0.138610	-0.079166	-0.107525	-0.068962	-0.002927	0.041301	-0.083480
	(0.08229)	(0.06477)	(0.07651)	(0.07492)	(0.07073)	(0.08030)	(0.07602)
	[-1.68441]	[-1.22231]	[-1.40531]	[-0.92046]	[-0.04139]	[0.51434]	[-1.09809]
ΔLG_{t-2}	0.017403	0.025095	0.057619	0.022233	0.039443	-0.001514	-0.063555
	(0.08166)	(0.06427)	(0.07592)	(0.07434)	(0.07018)	(0.07968)	(0.07544)
	[0.21313]	[0.39047]	[0.75891]	[0.29906]	[0.56200]	[-0.01900]	[-0.84250]
ΔLV_{t-1}	0.149019	0.232614	0.195577	0.187831	0.125519	0.137316	0.160995
	(0.06868)	(0.05405)	(0.06386)	(0.06253)	(0.05903)	(0.06701)	(0.06345)
	[2.1698]**	[4.30346]*	[3.06282]*	[3.00405]*	[2.1264]**	[2.0491]**	[2.5375]**
ΔLV_{t-2}	-0.091909	-0.094951	-0.106513	-0.124693	-0.119804	-0.099437	-0.085853
	(0.06830)	(0.05376)	(0.06351)	(0.06218)	(0.05871)	(0.06665)	(0.06310)
	[-1.34564]	[-1.76628]	[-1.67720]	[-2.0052]**	[-2.0408]**	[-1.49199]	[-1.36061]
ΔMSB_{t-1}	0.082864	-0.013644	-0.009773	0.041558	0.016872	0.124886	0.132018
	(0.05158)	(0.04060)	(0.04796)	(0.04696)	(0.04433)	(0.05033)	(0.04765)
	[1.60655]	[-0.33611]	[-0.20378]	[0.88497]	[0.38058]	[2.4814]**	[2.77057]*
ΔMSB_{t-2}	-0.046412	-0.091523	-0.083849	-0.079240	-0.120297	-0.084194	-0.046044
	(0.05167)	(0.04067)	(0.04804)	(0.04704)	(0.04441)	(0.05042)	(0.04773)
	[-0.89824]	[-2.2505]**	[-1.74530]	[-1.68442]	[-2.70874]*	[-1.66988]	[-0.96459]
ΔMSG_{t-1}	-0.014407	0.001978	-0.008775	-0.047264	0.056669	-0.060901	-0.047186
	(0.04555)	(0.03585)	(0.04236)	(0.04147)	(0.03915)	(0.04445)	(0.04208)
	[-0.31627]	[0.05518]	[-0.20718]	[-1.13960]	[1.44735]	[-1.37008]	[-1.12123]
ΔMSG_{t-2}	0.014248	0.054182	0.055533	0.045710	0.107907	0.130411	0.065995
	(0.04553)	(0.03583)	(0.04233)	(0.04145)	(0.03913)	(0.04443)	(0.04206)
	[0.31293]	[1.51198]	[1.31179]	[1.10271]	[2.75742]*	[2.93537]*	[1.56898]
ΔMSV_{t-1}	0.051605	0.082559	0.114098	0.061778	0.058086	0.107959	0.024718
	(0.04429)	(0.03486)	(0.04118)	(0.04032)	(0.03806)	(0.04321)	(0.04091)
	[1.16528]	[2.3686]**	[2.77093]*	[1.53220]	[1.52602]	[2.4983]**	[0.60417]
ΔMSV_{t-2}	0.043478	0.045108	0.035045	0.037263	0.069721	0.016746	0.007446
	(0.04425)	(0.03483)	(0.04114)	(0.04029)	(0.03803)	(0.04318)	(0.04088)
	[0.98257]	[1.29519]	[0.85178]	[0.92493]	[1.83318]	[0.38783]	[0.18215]
Constant	0.000151	2.56E-06	-2.94E-05	7.09E-05	4.79E-05	-3.31E-05	3.79E-05
	(0.00019)	(0.00015)	(0.00018)	(0.00017)	(0.00016)	(0.00018)	(0.00017)
	[0.79846]	[0.01719]	[-0.16710]	[0.41211]	[0.29473]	[-0.17966]	[0.21732]
Adj. R-squared	0.004{7}	0.013{4}	0.010{6}	0.005{1}	0.029{1}	0.027{2}	0.018{3}

Note: * and ** denote the 1% and 5% significance levels, respectively. Δ denotes the difference operator, standard errors in ( ), *t*-statistics in [ ] and ranking in { }.

Appendix B

Figure B.1 Response to Cholesky one S.D. Innovations–response of S&P/ASX All Ordinaries index, the pre-crisis period.

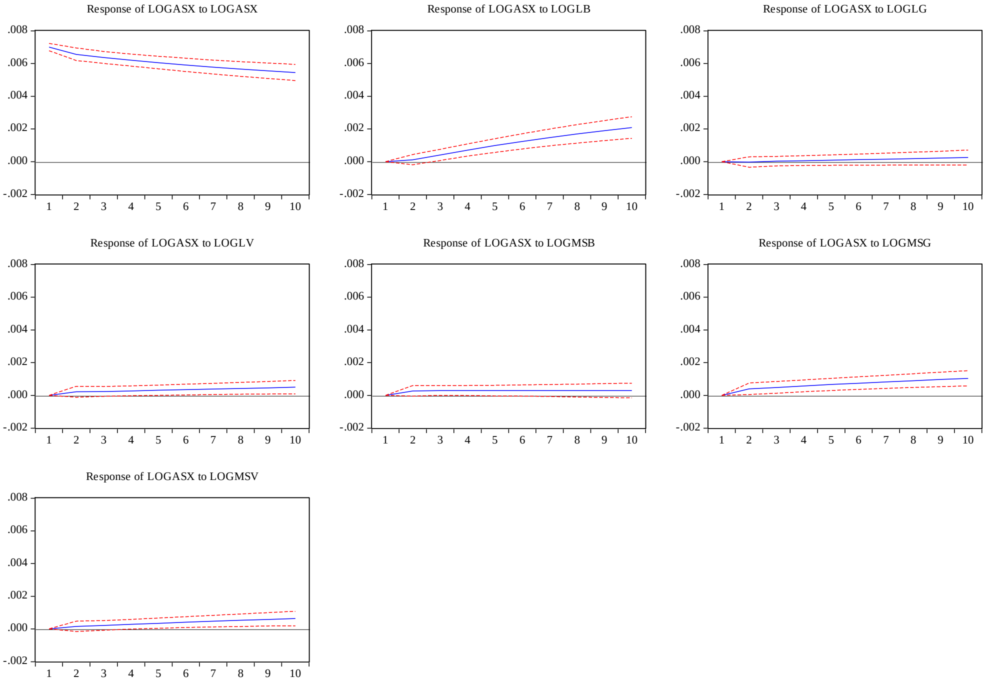


Figure B.2 Response to Cholesky one S.D. Innovations–response of large-cap blend equity mutual funds, the pre-crisis period.

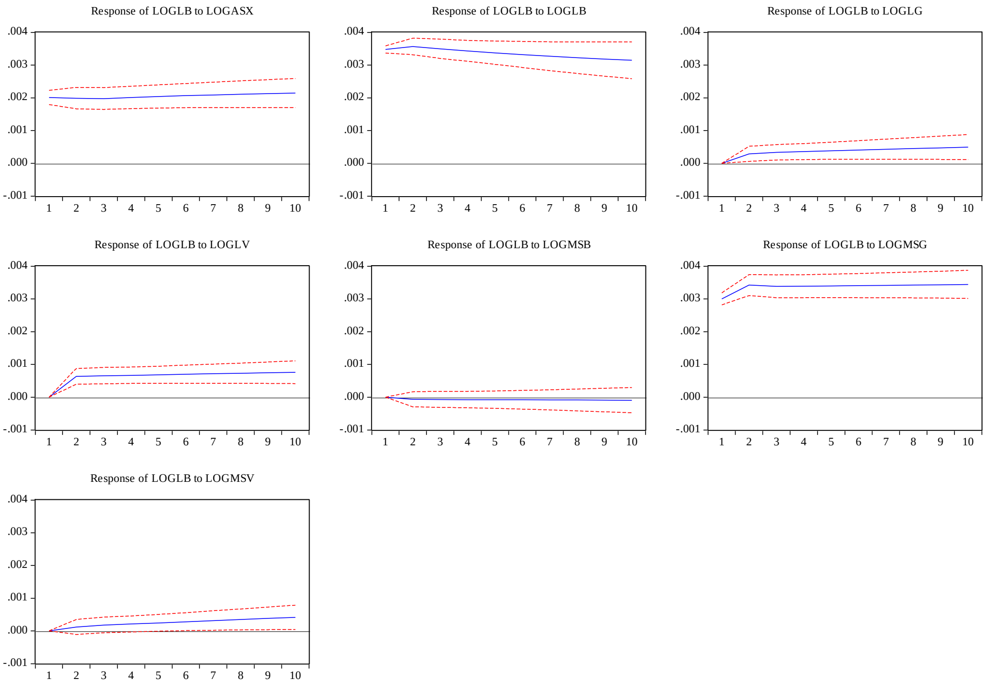


Figure B.3 Response to Cholesky one S.D. Innovations–response of large-cap growth equity mutual funds, the pre-crisis period.

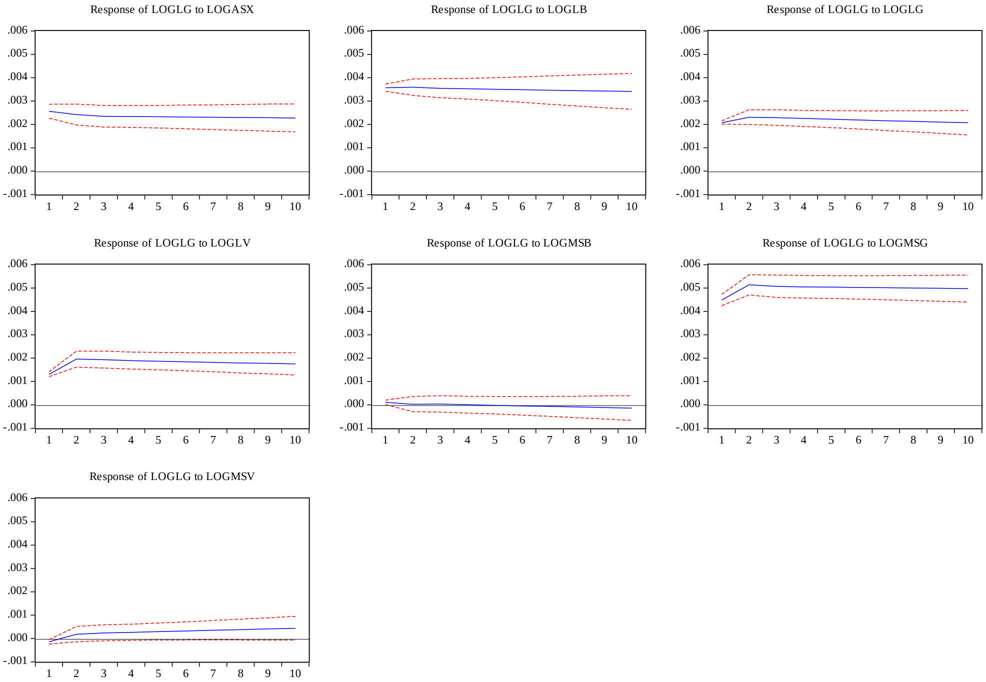


Figure B.4 Response to Cholesky one S.D. Innovations–response of large-cap value equity mutual funds, the pre-crisis period.

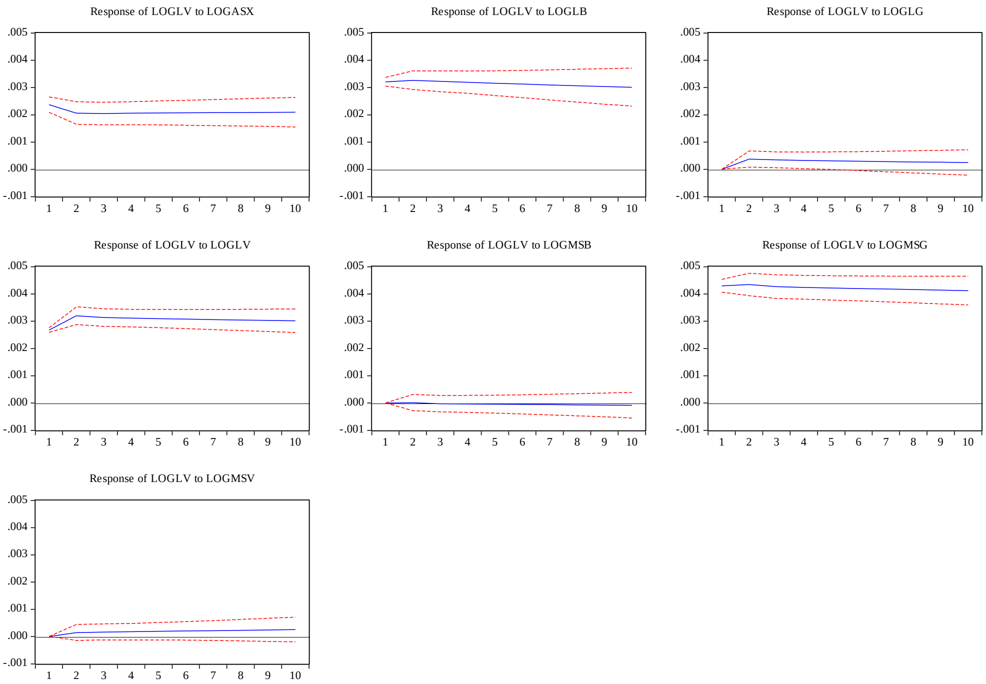


Figure B.5 Response to Cholesky one S.D. Innovations–response of middle and small-cap blend equity mutual funds, the pre-crisis period.

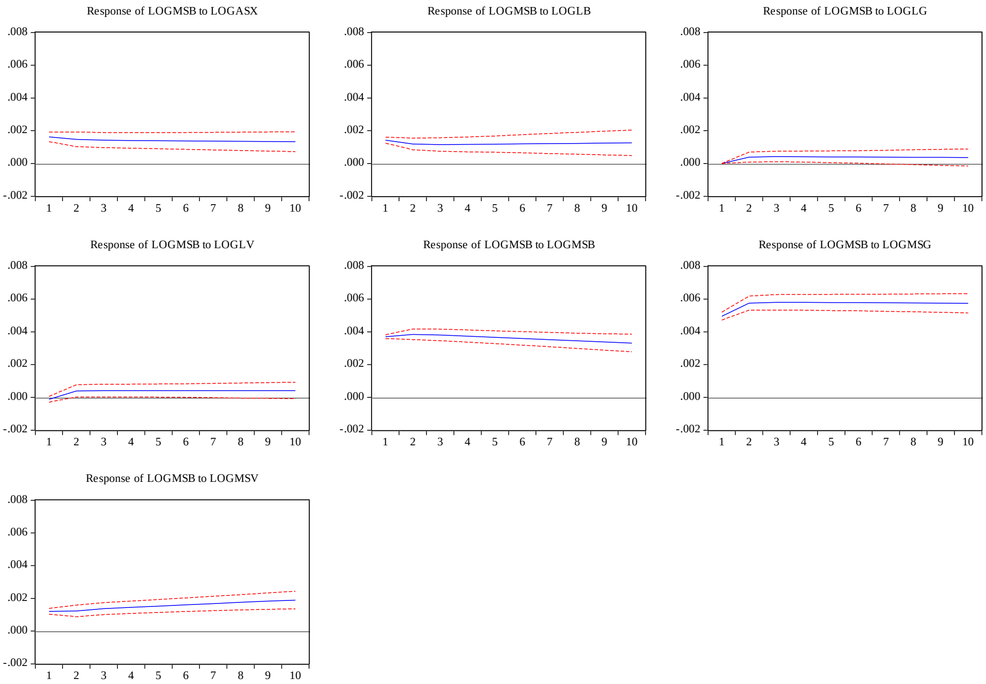


Figure B.6 Response to Cholesky one S.D. Innovations–response of middle and small-cap growth equity mutual funds, the pre-crisis period.

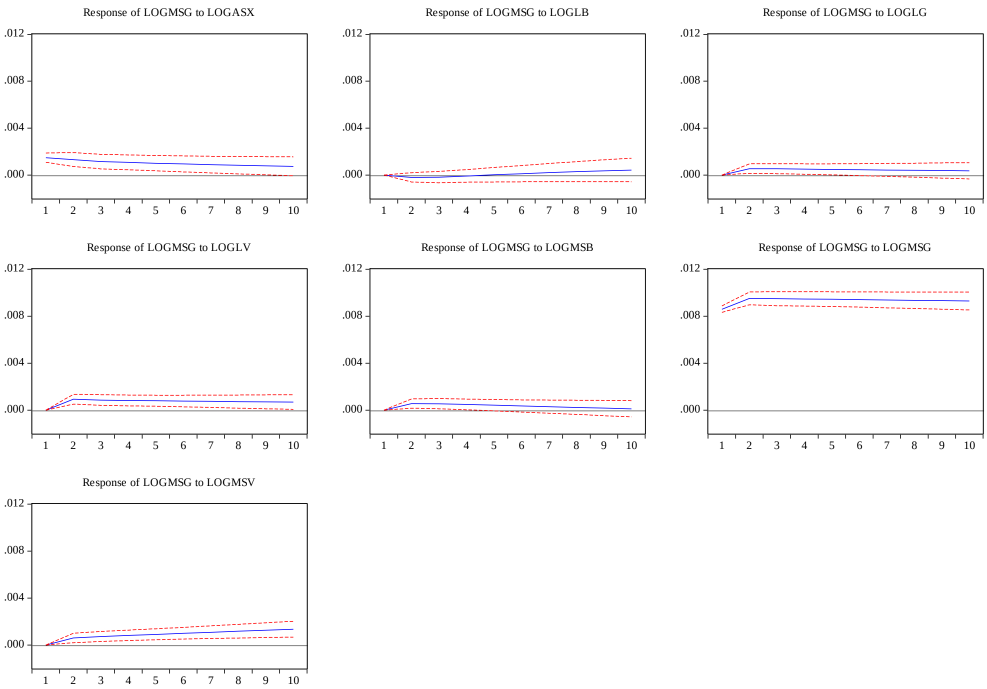
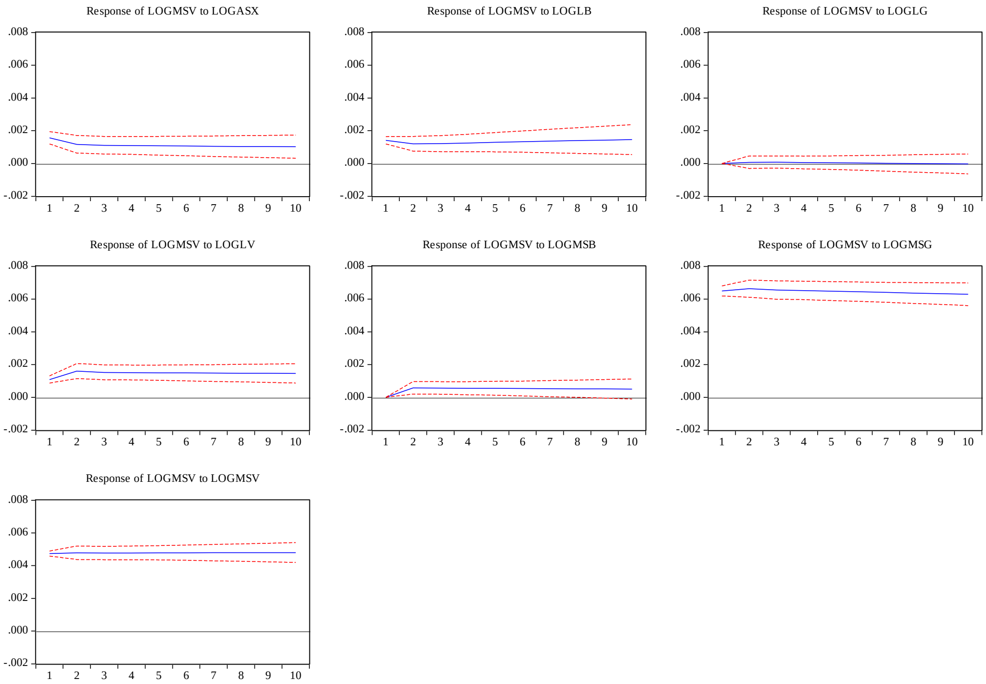


Figure B.7 Response to Cholesky one S.D. Innovations–response of middle and small-cap value equity mutual funds, the pre-crisis period.



Appendix C

Figure C.1 Response to Cholesky one S.D. Innovations–response of S&P/ASX All Ordinaries index, the post-crisis period.

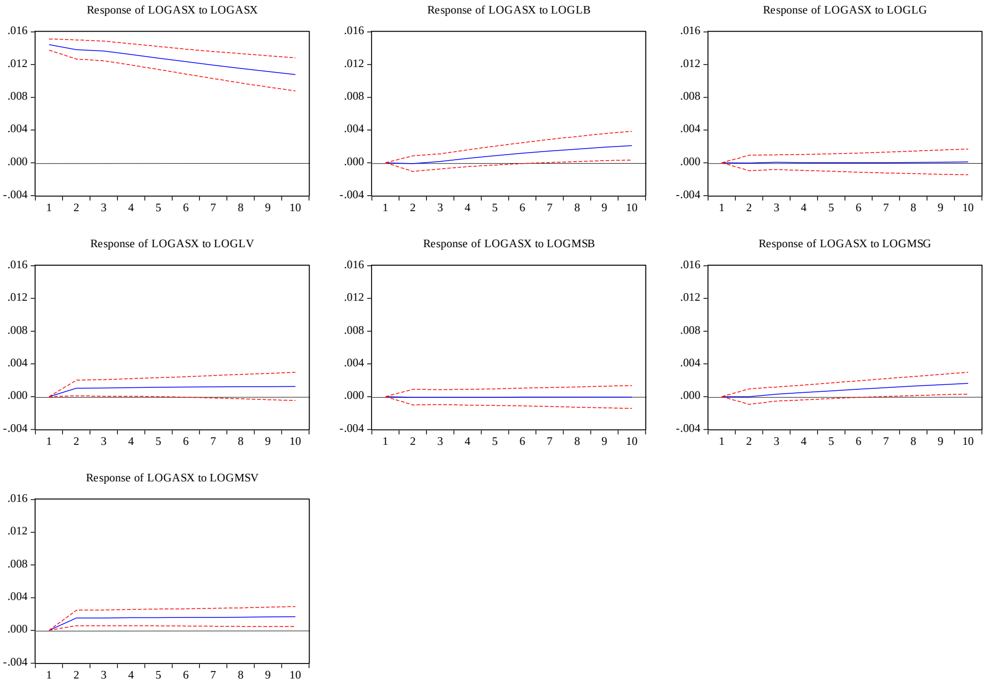


Figure C.2 Response to Cholesky one S.D. Innovation– response of large-cap blend equity mutual funds, the post-crisis period.

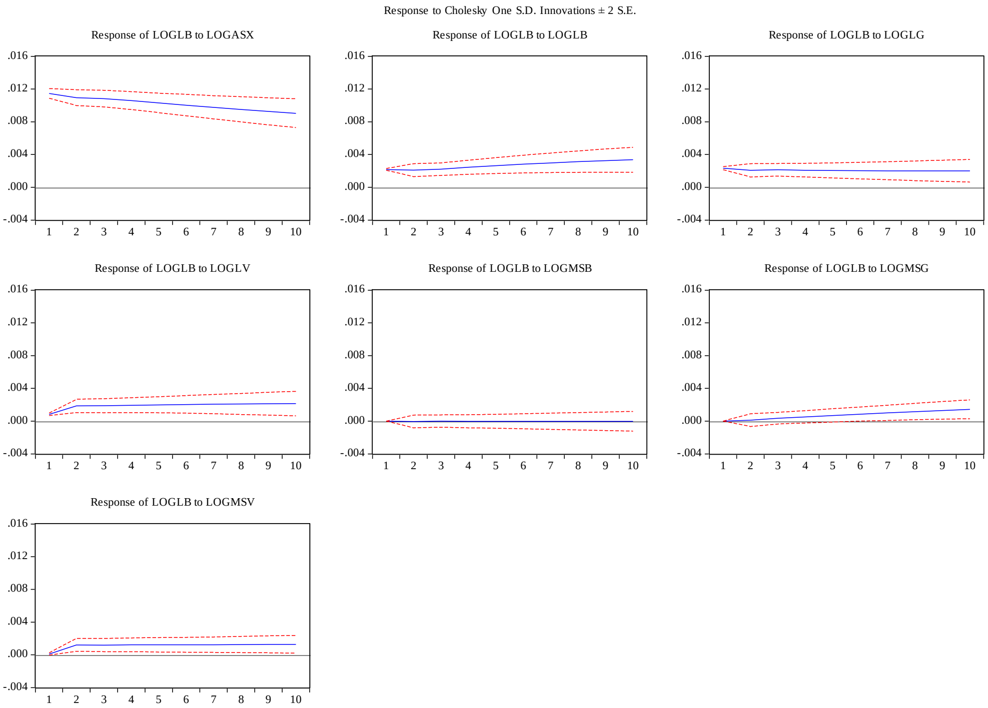


Figure C.3 Response to Cholesky one S.D. Innovations–response of large-cap growth equity mutual funds, the post-crisis period.

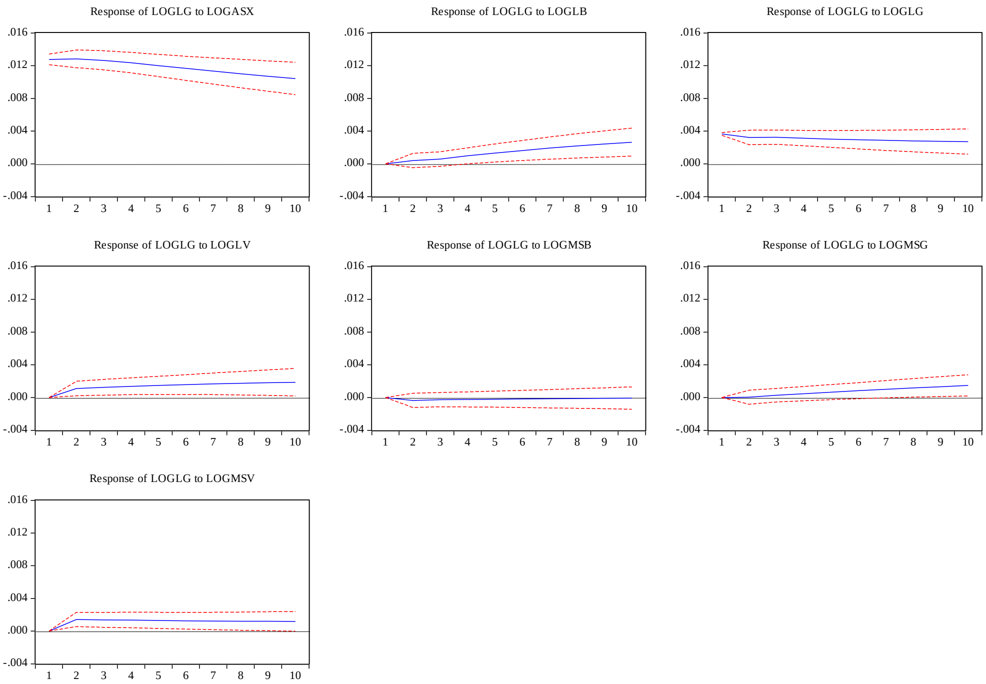


Figure C.4 Response to Cholesky one S.D. Innovations–response of large-cap value equity mutual funds, the post-crisis period.

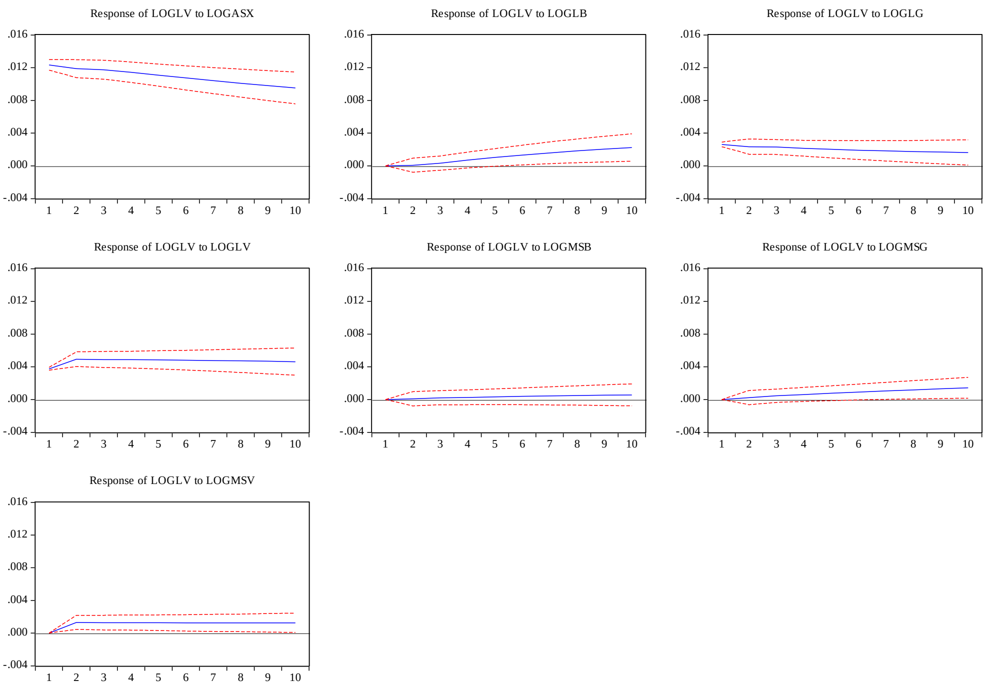


Figure C.5 Response to Cholesky one S.D. Innovations–response of middle and small-cap blend equity mutual funds, the post-crisis period.

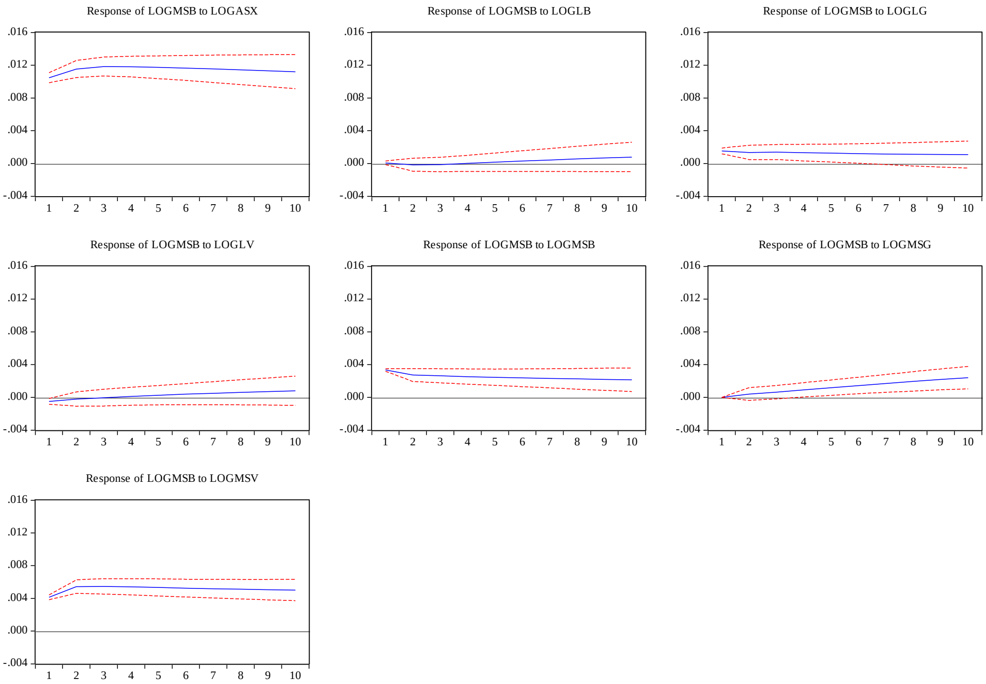


Figure C.6 Response to Cholesky one S.D. Innovations–response of middle and small-cap growth equity mutual funds, the post-crisis period.

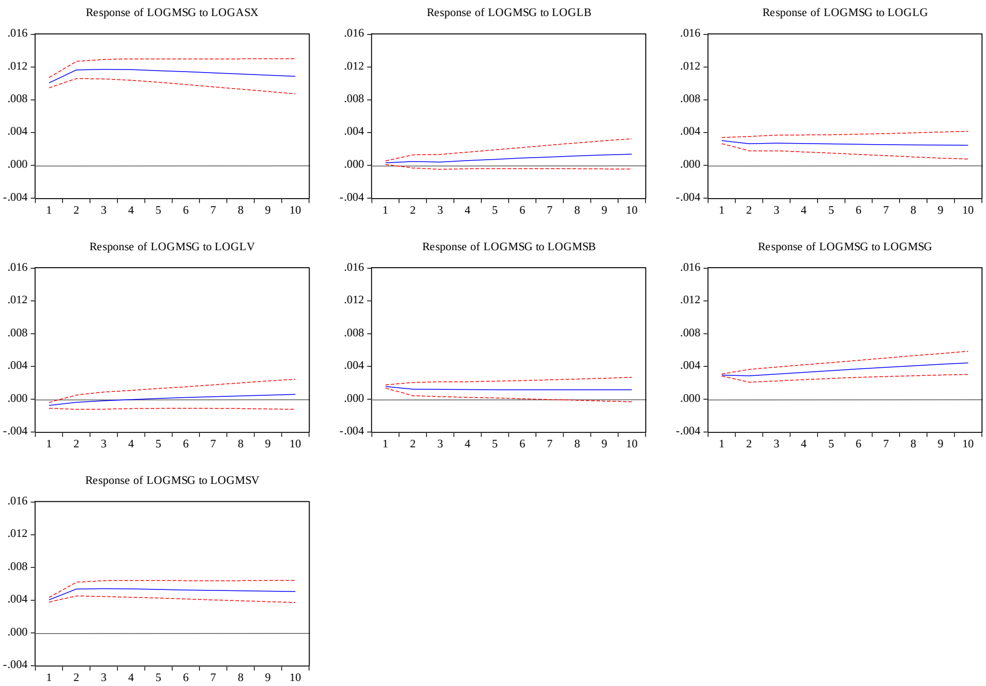
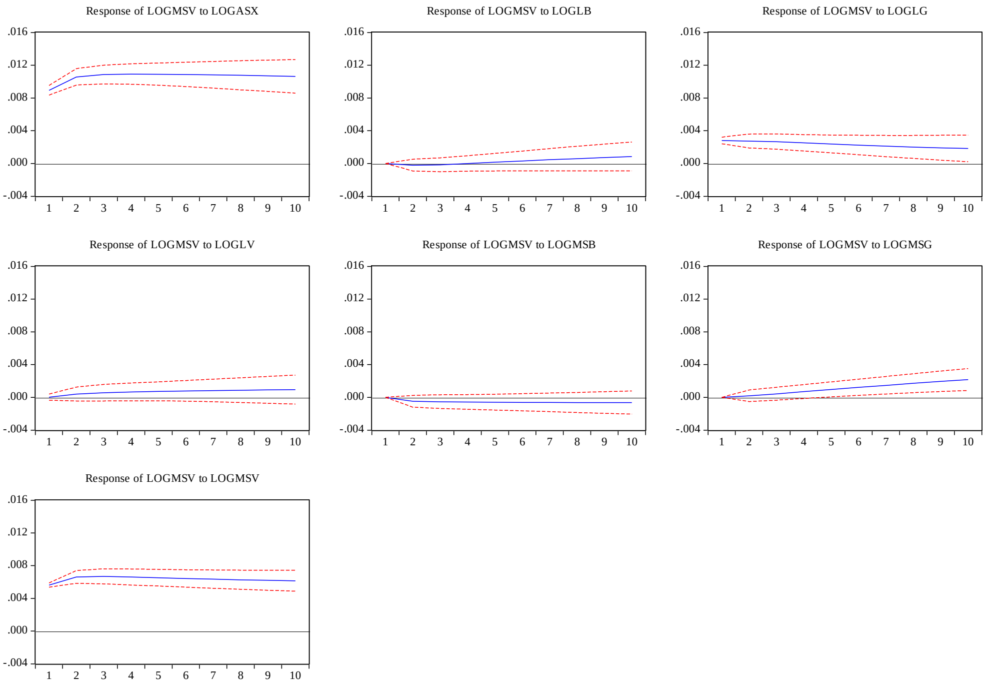


Figure C.7 Response to Cholesky one S.D. Innovations–response of middle and small-cap value equity mutual funds, the post-crisis period.



Appendix D

Figure D.1 Response to Cholesky one S.D. Innovations–response of S&P/ASX All Ordinaries index, the full study period.

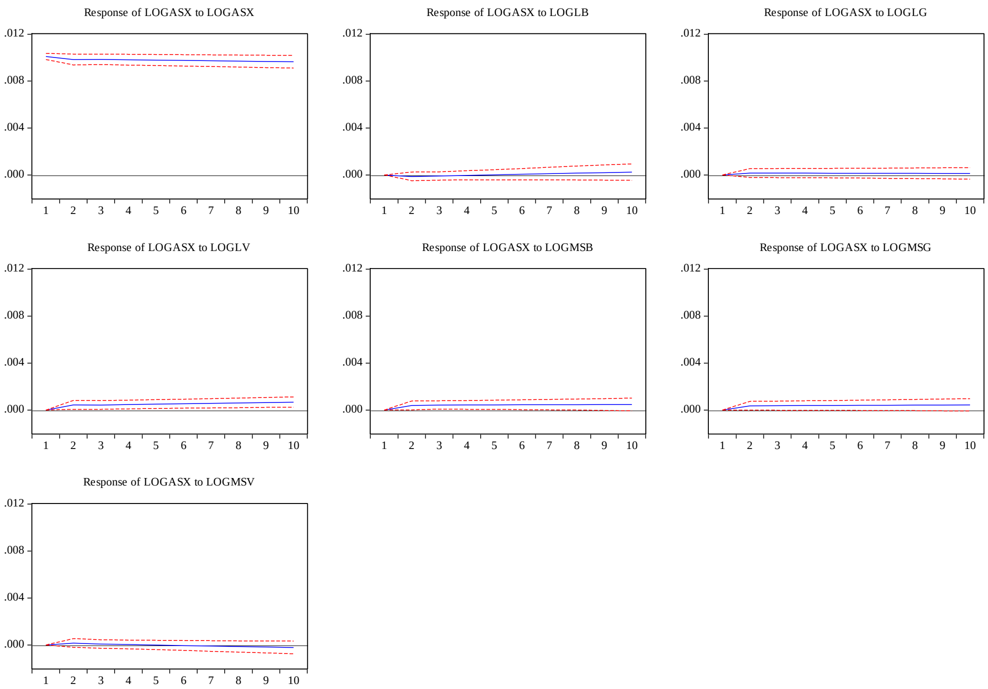


Figure D.2 Response to Cholesky one S.D. Innovations– response of large-cap blend equity mutual funds, the full study period.

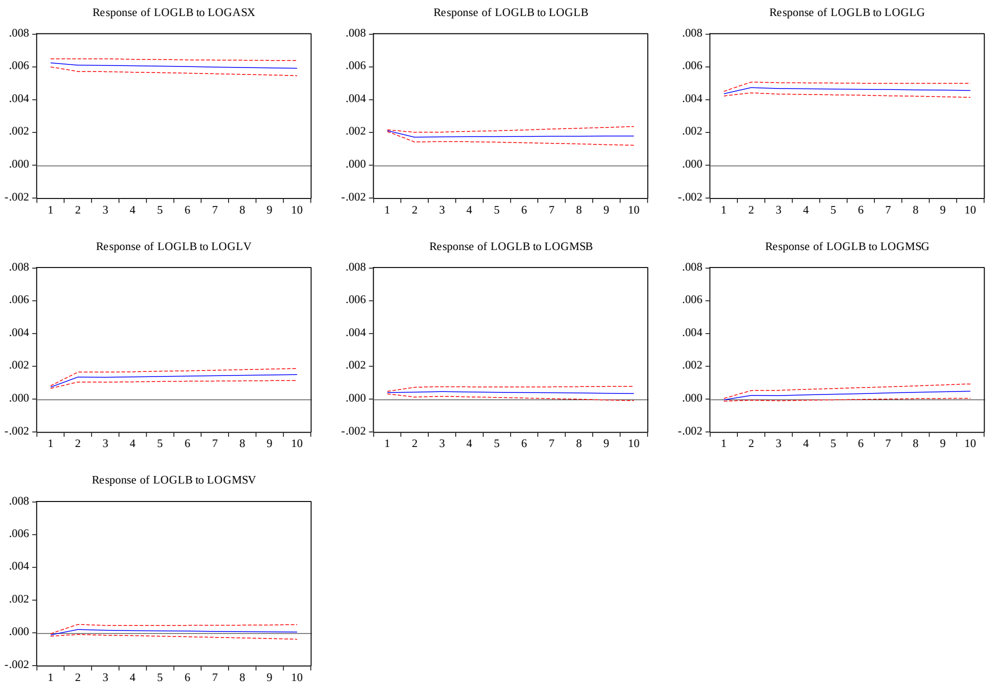


Figure D.3 Response to Cholesky one S.D. Innovations–response of large-cap growth equity mutual funds, the full study period.

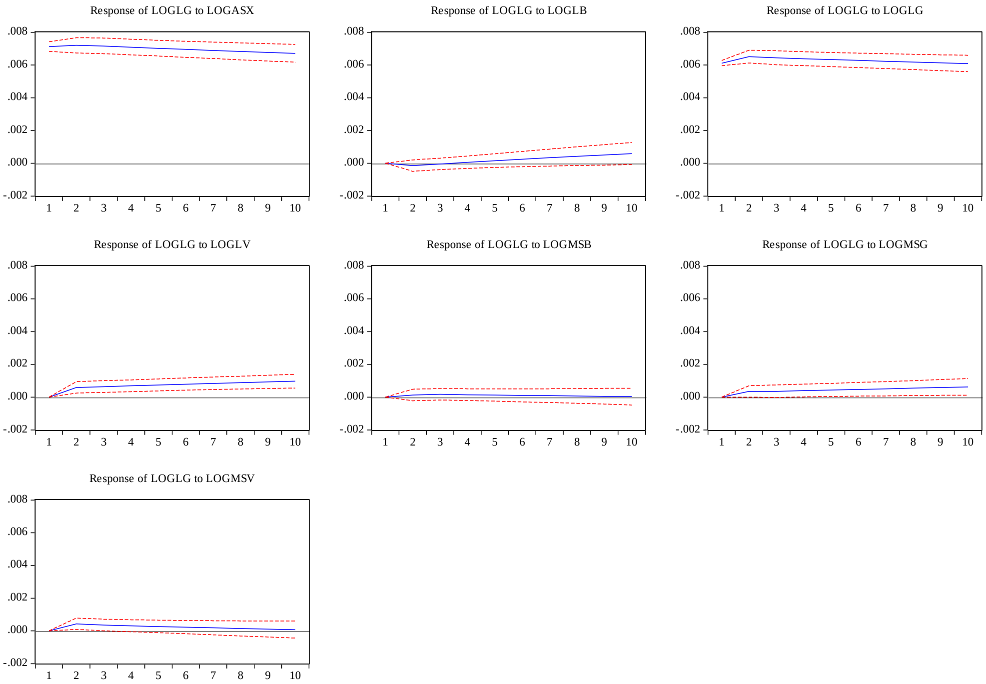


Figure D.4 Response to Cholesky one S.D. Innovations–response of large-cap value equity mutual funds, the full study period.

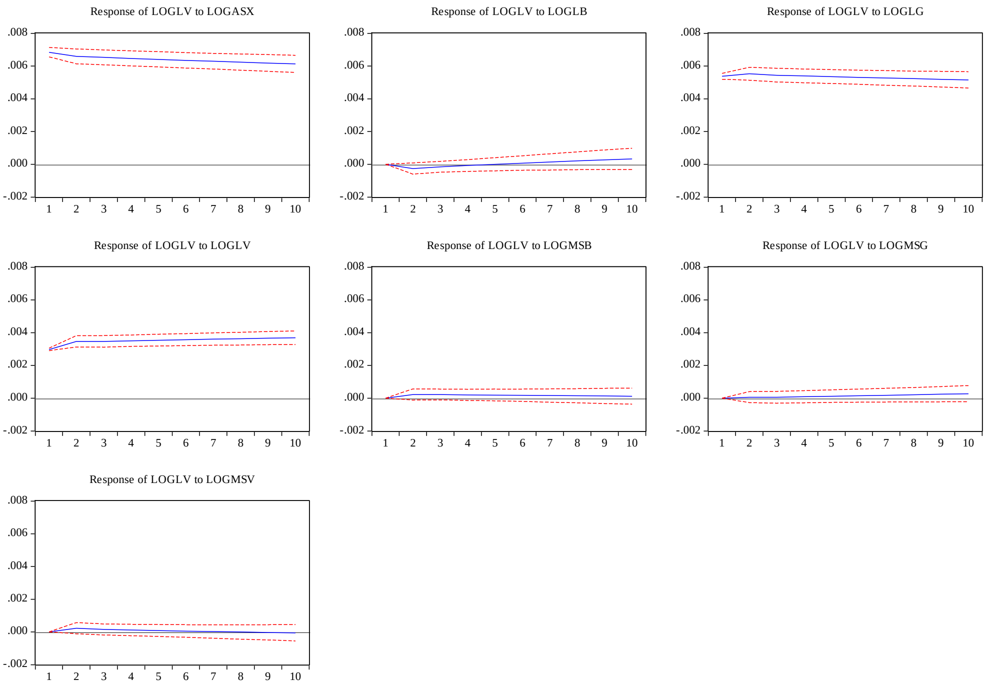


Figure D.5 Response to Cholesky one S.D. Innovation– response of middle and small-cap blend equity mutual funds, the full study period.

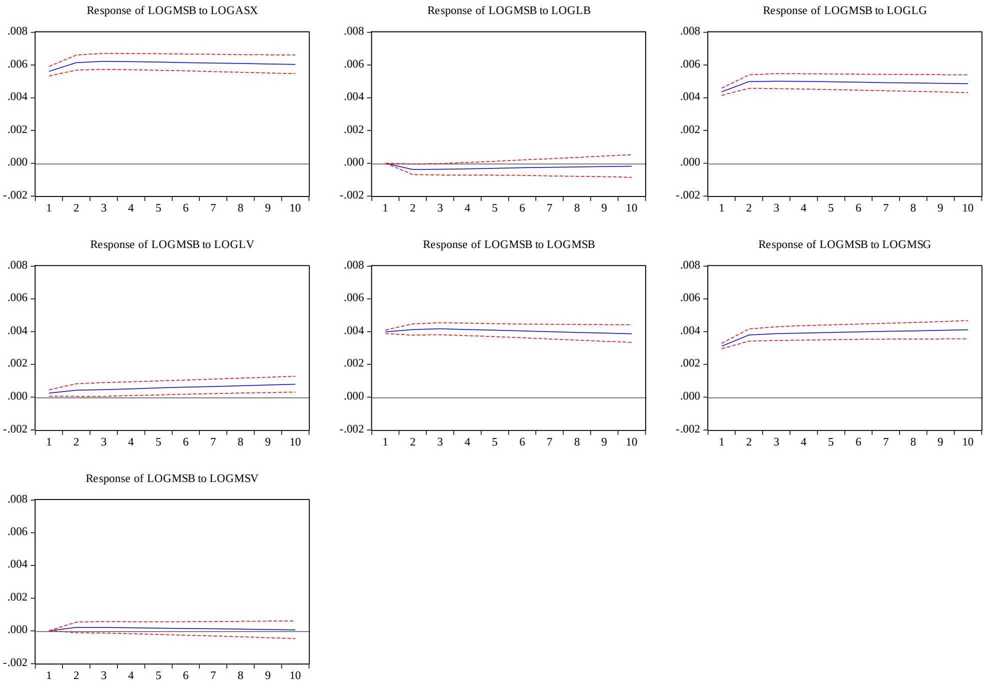


Figure D.6 Response to Cholesky one S.D. Innovations–response of middle and small-cap growth equity mutual funds, the full study period.

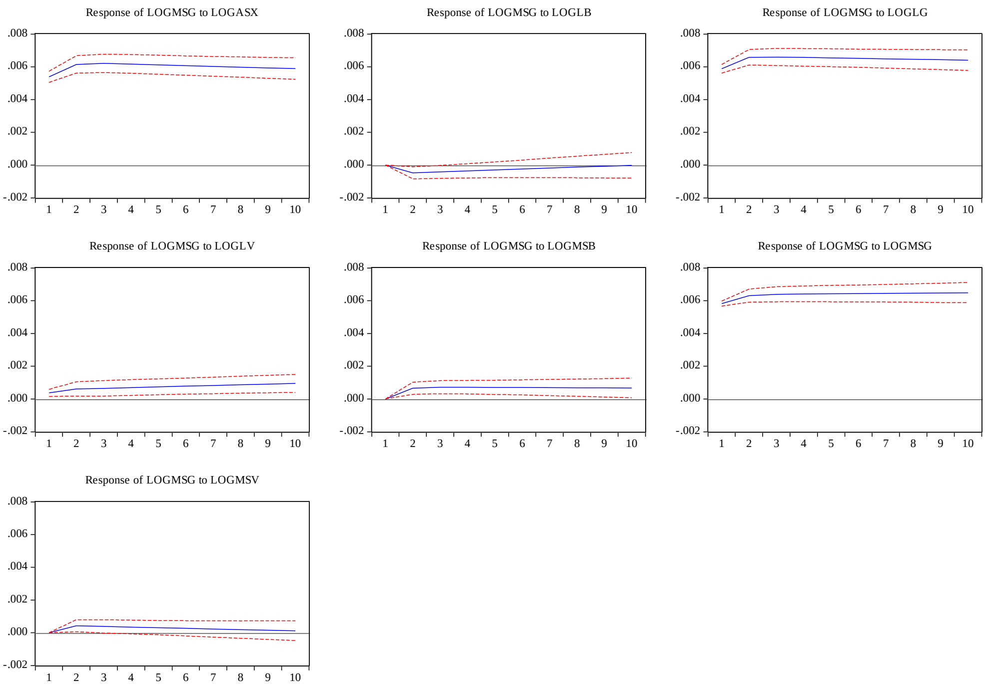
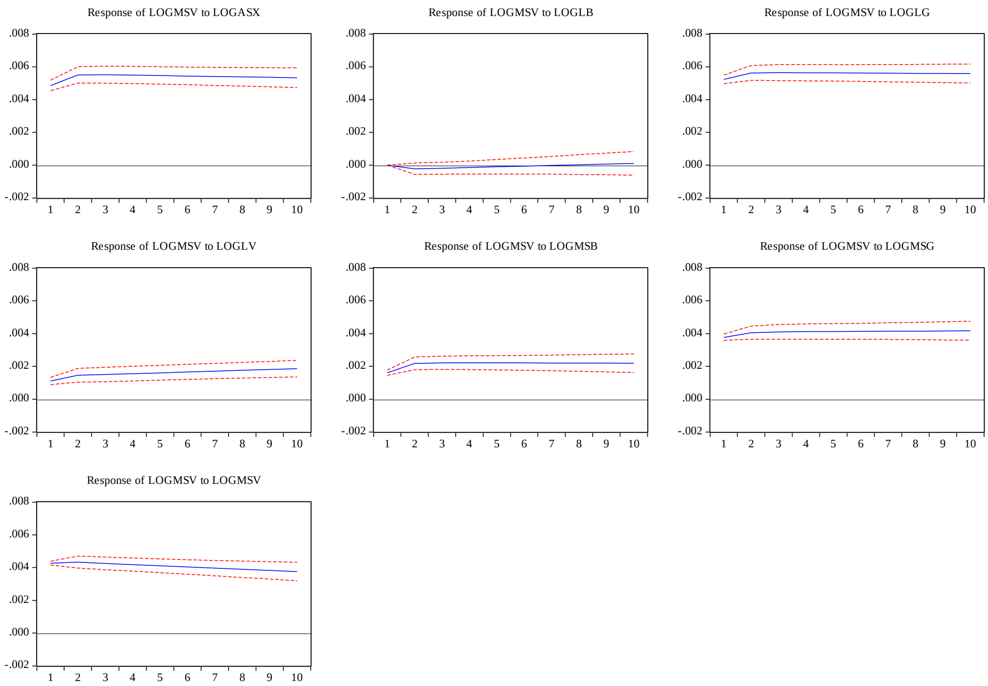


Figure D.7 Response to Cholesky one S.D. Innovations–response of middle and small-cap value equity mutual funds, the full study period.



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