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**Article**

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## RESEARCH ARTICLE

# Cointegration and causality analysis of dynamic linkage between stock market and equity mutual funds in Australia

Sasipa Pojanavatee<sup>1\*</sup>

**Abstract:** The existing literature finds conflicting results on the magnitude of price linkages between equity mutual funds and the stock market. The study contends that in an optimal lagged model, 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 evidence shows that the long-run pricing of equity mutual funds are cointegrated with the stock market index. 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.

**Keywords:** equity mutual fund, cointegration analysis, causality test, vector autoregression (VAR)

## AUTHOR BIOGRAPHY

Sasipa Pojanavatee has been a lecturer in financial management at Silpakorn University, Thailand for over 10 years. She recently completed her doctoral degree at Curtin University, Australia in 2013. Her doctoral thesis titled “An analysis of Australian mutual fund performance and market relationships” focuses on price behaviour and performance of mutual funds. At present, she has been continuing to examine the dynamics of pricing across equity mutual fund categories and the stock market by now applying similar approaches to Asian financial markets.

## PUBLIC INTEREST STATEMENT

The main objective of this research is to investigate the price comovement of the stock market and equity mutual funds. The 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 shows that domestic equity mutual fund prices based on fund category have a 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.

## 1. Introduction

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 evolved into an important topic for investors and academicians consider over the last decade.

The regulation of the managed funds industry in Australia is the responsibility of the Australian Securities and Investments Commission. 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 and conservative 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 super-annuation funds and other large institutions. Retail funds account for 85% of the entire mutual fund market. Additionally, retail equity funds continue to drive growth in the Australian funds management industry, with funds under management of AU\$57,210 million in March 2010 according to the Morningstar Australasia (2010).

The statistics suggest that 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 European Fund and Asset Management Association (EFAMA). Increased access to equity markets provides expanded opportunities for investors to diversify their investments. However, there is limited evidence of Australian equity mutual funds being investigated. New evidence from the Australian market allows individual investors to obtain practical and innovative ways to manage equity mutual funds and to obtain the skills of professional managers in charge of these funds.

Portfolio theory demonstrates that the gains from a diversified portfolio, involve different degrees of price co-movement between securities. Rational expectations theory gives rise to forecasting tests that mirror those adopted when testing the optimality of a forecast in the context of a 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 the price of one security can be used to predict another. It is reasonable to expect that there is some degree of price responsiveness between the stock market and equity mutual funds. The degree and direction to which fund price categories are related to the stock market index are important not only for investors and fund managers with regard to their investment strategies, but also to academics and policy makers examining the implications of investing in domestic equity markets. The primary aim of this study is to examine the magnitude of price linkages between equity mutual funds and the stock market.

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 regionally. 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.

A key difference between current analysis and the above studies is that this study examines price linkages by controlling for various equity mutual fund categories. Previous studies have used standard Engle–Granger techniques to determine the long-run relationship between the variables and test unidirectional causality with a small number of studies taking structural breaks into account. The current study examines long-term equilibrium relationships and short-term exogeneity using VECM based tests of causality, and block exogeneity tests with structural breaks. It is believed, from a thorough search of the literature, that no other study has used Johansen cointegration and the Granger-causality tests to investigate the price linkage between equity mutual funds and market security prices using Australian data. The study contributes further with its investigation of the potential benefits from domestic diversification by using equity mutual fund categories, which have not been addressed in the causal relationships of equity mutual funds previously.

The results indicate that some equity mutual fund categories fail to design their portfolios to beat the stock market. 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. The results show bidirectional Granger-causality along the equity mutual fund categories, 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 suggest a bidirectional 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.

In addition, the Granger causality results suggest a bidirectional relationship between the middle and small-cap equity mutual fund categories, showing 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. The results indicate 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.

The remainder of this study is organized as follows. Section 2 discusses the data and a specific model for investigating price interaction. Section 3 discusses the findings of the primary analysis. Section 4 provides a summary of the findings and policy implications.

## 2. Data and the Construction of Dynamic Pricing Analysis

### 2.1. Data

The study obtains daily closing prices in three different categories of open-ended Australian large-cap equity mutual funds: blend (LB), growth (LG), value (LV), and three Australian middle and small-cap equity mutual funds: blend (MSB), growth (MSG), and value (MSV). Together these companies represent 110 equity mutual funds. The S&P/ASX All Ordinaries index is used as a market portfolio because this index comprises the 500 largest companies in the Australian equities market. Historical daily data on equity mutual fund prices and the market index are obtained from the Morningstar Direct Database over the period 2000–2010. The Quandt–Andrews test (Andrews, 1993; Quandt, 1988) is performed to ascertain an indication of a structural break. The results of testing structural breaks indicate 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.

## 2.2. Dynamic Pricing Models

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). The seminal paper by Granger and Newbold (1974) shows that the problem of spurious regressions exists in those regressions containing nonstationary variables. Therefore, the vector autoregression (VAR) model is designed for use with nonstationary series that are known to be cointegrated (Ben-Zion, Choi, & Hauser, 1996; Chu, 2011). As a result, it is necessary to test the variables for stationarity before proceeding with the analysis of the VAR model. The study performs the Augmented Dickey–Fuller (ADF) (Dickey & Fuller, 1979, 1981) and the Phillips–Perron (PP) (Phillips & Perron, 1988) tests to examine the presence of unit roots of the variables. The VAR and its stability is tested and optimal lag orders are selected using the model selection criteria to find the most parsimonious model. To explore the relationship between equity mutual funds and the S&P/ASX All Ordinaries index for each period, the model is specified as follows:

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

where  $\mu_t$  is intercept and  $\beta_1, \dots, \beta_6$  are coefficients. If the variables are integrated of the same order then the Johansen test for cointegration with a constant and linear deterministic trend is used to test the long-run equilibrium relationship between the variables. If the series are cointegrated, the Vector error correction model (VECM) is estimated using the optimal lag found in the VAR to investigate the transmission mechanism with error correction terms (ECTs) between the variables. For each period, the study performed the VECM model:

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

where  $\mu_t$  is the intercept and  $\gamma_1, \dots, \gamma_7$  are coefficients.  $\Delta$  is the first difference operator;  $\alpha$  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 ( $p$ ). Therefore, Granger-causality tests are compiled with variance decomposition analyses completed when cointegration is present in the VECM. Brooks (2008) mentions that the ordering of the variables is important to calculate for the 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. Results

The study performs a unit root test on both the price levels and first difference of the variables under the null hypothesis that all series variables are nonstationary, and against the alternative hypothesis that all series variables are stationary. This includes in the latter case the errors of the first difference

relationships. The results of the unit root tests are presented in Table 1 for the pre-crisis, post-crisis and full study periods (see Panels 1–3).

Similar unit root test results are found between the ADF and the PP tests during the three study periods. The results of the price level series fail to reject the null hypothesis in that all members of the time series are nonstationary. There are indications that all level price series are nonstationary 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 first difference series are stationary at the 1% level of significance. The studies conclude that the level series of price variables

**Table 1. Unit Root Tests**

Variables	ADF test		PP test	
	Level	First Difference	Level	First Difference
Panel 1: from 2000 to 2007				
ASX	1.1348	-45.7889*	1.4083	-45.9399*
LB	.4229	-21.9619*	.1779	-40.9167*
LG	-.6007	-39.3175*	-.6411	-39.7296*
LV	-.8228	-39.1455*	-.8618	-39.3852*
MSB	-.0050	-26.8410*	-.1457	-41.0886*
MSG	-.9669	-36.7913*	-1.0756	-38.1439*
MSV	-.3490	-39.0157*	-.4599	-39.7594*
Panel 2: from 2007 to 2010				
ASX	-1.6636	-30.6693*	-1.6424	-30.6865*
LB	-1.7169	-30.7550*	-1.7119	-30.7618*
LG	-1.7225	-29.5676*	-1.7357	-29.5762*
LV	-1.7396	-29.8652*	-1.7396	-29.8653*
MSB	-1.6418	-26.4455*	-1.6451	-27.1803*
MSG	-1.5953	-17.4040*	-1.5715	-26.4754*
MSV	-1.6076	-16.9325*	-1.6107	-25.7753*
Panel 3: from 2000 to 2010				
ASX	-1.2208	-54.7326*	-1.1685	-54.8074*
LB	-1.3088	-53.0631*	-1.3564	-53.0877*
LG	-1.4327	-51.4954*	-1.5380	-51.5287*
LV	-1.6791	-52.9487*	-1.6773	-52.9457*
MSB	-1.3516	-32.9270*	-1.5493	-49.8814*
MSG	-1.4695	-32.9833*	-1.6145	-48.9658*
MSV	-1.2564	-34.0135*	-1.4482	-50.5215*

Notes: 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 critical values for the ADF and the PP test statistic with intercept at the .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 .01, .05 and .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 .01, .05 and .10 levels are -3.432, -2.862 and -2.567, respectively.

\*Significance at the 1% level.



are nonstationary and the return series of the variables are stationary data and do not contain a unit root. The study 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 stationary. This means that the series examined are integrated nonstationary processes and 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. 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 criterion (SC) and Hannan–Quinn criterion (HQ). Results of lag order selection, in most cases, suggest that the lag length of VAR is  $p = 3$  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. By selecting lag length criteria, the statistical results 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 VAR. This decision is justified based on the interaction of these variables in a level of relatively efficient Australian stock market (Groenewold & Kang, 1993).

The next stage in the analysis consists of determining whether the equity mutual fund categories are cointegrated with the S&P/ASX All Ordinaries index. 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 the assumption of linear trends in the data, but no trends in the cointegration equations.

The results agree in all three study periods as the equity mutual funds are cointegrated with the stock market index. In the case of the pre-crisis and post-crisis periods, there are two cointegrating vectors using the critical value for Trace and Maximum eigenvalue statistics. In the case of the full study period, the results show that there is one cointegrating vector using the critical value for the Trace and Maximum eigenvalue statistics. Thus, the results strongly suggest that there is an equilibrium long-run relationship between the stock market index prices and equity mutual fund prices.

The existence of cointegration implies Ganger-causality; therefore, the ECT of the VECM indicates exogeneity the speed 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 2 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 1–3).

The results of the estimated ECTs for the pre-crisis period are presented in Panel 1 of Table 2. 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. This indicates that if the S&P/ASX All Ordinaries index prices are too high in the short term, they will decrease by 4.90% per time period to eliminate the discrepancy caused by their own shocks and equity mutual fund price shocks.

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  $-0.020$  implies that the feedback into the short-run dynamic process from the previous period is 2%. The results of the ECT values

**Table 2. Results of ECTs**

Exogenous	$\Delta$ ASX	$\Delta$ LB	$\Delta$ LG	$\Delta$ LV	$\Delta$ MSB	$\Delta$ MSG	$\Delta$ MSV
Panel 1: From 2000 to 2007							
ECT	-.049	.007	.001	.004	-.003	-.020	-.004
	(.008)	(.005)	(.007)	(.007)	(.007)	(.010)	(.009)
	[-6.379]*	[1.254]	[.134]	[.504]	[-.370]	[-2.080]**	[-.445]
	.026{3}	.018{4}	.014{5}	.009{7}	.036{1}	.032{2}	.009{6}
Panel 2: From 2007 to 2010							
ECT	-.043	-.019	-.046	-.036	.010	-.010	.018
	(.023)	(.019)	(.021)	(.021)	(.019)	(.018)	(.017)
	[-1.901]	[-1.022]	[-2.182]**	[-1.749]	[.551]	[-.517]	[1.026]
	.006{7}	.014{4}	.013{5}	.007{6}	.034{3}	.040{2}	.051{1}
Panel 3: From 2000 to 2010							
ECT	-.002	.000	-.004	-.003	-.001	-.002	-.001
	(.010)	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
	[-.825]	[.086]	[-2.475]**	[-1.991]**	[-.746]	[-1.311]	[-.690]
	.004{7}	.013{4}	.010{5}	.005{6}	.029{1}	.027{2}	.018{3}

Notes:  $\Delta$  denotes the difference operator, standard errors in ( ), t-statistics in [ ] and Adjusted R-squared 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)). ECT represents the error correction term.

\*Significance level at 1%.

\*\*Significance level at 5%.

for the joint significance of the other equity mutual fund categories lagged endogenous variables show it is not a significant adjusted effect to long-run equilibrium relationships.

The results of the estimated ECTs for the post-crisis period are presented in Panel 2, Table 2. 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 fund categories do not contribute significantly to changes in the stock market index prices during the post-financial-crisis period. An ECT of  $-.043$  implies that the feedback into the short-run dynamic process from the previous period is 4.3%. The ECT shows that the speed of an adjustment of the stock market index prices from short-run to long-run equilibrium is slow, and that none of the equity mutual fund categories contribute to much change in the S&P/ASX All ordinaries index prices in the long run, with the exception of the middle and small-cap blend equity mutual funds at the 5% level of significance.

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. 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  $-.046$  implies that if the large-cap growth equity mutual fund prices are too high in the short term, they will decrease by 4.6% per time period to eliminate the discrepancy caused by their own shocks and equity mutual fund price shocks. 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. This indicates that none of the categories 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.



The results of the estimated ECTs for the full study period are presented in Panel 3, Table 2. 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 fund categories do not contribute significantly to changes in the stock market prices. An ECT of the stock market (-.002) 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. 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. An ECT of large-cap growth equity mutual funds (-.004) and large-cap value equity mutual funds (-.003) implies that the feedback of large-cap growth equity mutual funds into the short-run dynamic process from the previous period is very slow. 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. This indicates that none of the categories 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.

Johansen's cointegration tests within the VECM framework are used to identify a long-run equilibrium relationship between variables. Table 3 summarizes the results for both Trace and Maximum eigenvalue statistics for the pre-crisis, post-crisis and full study periods (see Panels 1-3).

In the case of the pre-crisis and post-crisis periods, it shows that there are two cointegrating vectors at the 1% significance level using the critical value for Trace statistics. In the case of the full study period, the results show that there is one cointegrating vector using the critical value for the Trace and Maximum eigenvalue statistics at the 1% significance level. It can be seen that the Trace and the Maximum eigenvalue tests indicate that there is the long-term equilibrium relationship between the equity managed fund prices and the stock market index price. Investors are not likely to achieve considerable benefits by diversifying between these financial instruments in the long-run, as their prices have been shown to have been dependent of each other.

The result suggests that equity mutual fund categories have not tried to design their portfolios to beat the stock market in the long run. The existence of long-run equilibrium 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 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 a long-run price relationship 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.

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 Block Exogeneity Wald tests with a chi-square statistic to indicate the existence of Granger-causality when all variables interact in one system. 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. Table 4 reports the results of the short-run relationships between the specified variables for the pre-crisis, post-crisis and full study periods (see Panels 1-3).

**Table 3. Johansen Cointegration**

Panel 1: From 2000 to 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 2007 to 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 2000 to 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

Notes: The critical values used for the test are defined by Mackinnon, Haug, and Michelis (1999).

\*Null hypothesis of no cointegration can be rejected at the 1% significance level.

The results of the Granger-causality tests for the pre-crisis period are presented in Panel 1 of Table 4 and suggest that 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. 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.

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

**Table 4. Multivariate Causality**

Dependent variable	Chi-square statistics						
	ASX	LB	LG	LV	MSB	MSG	MSV
Panel 1: From 2000 to 2007							
ΔASX		6.586**	4.720***	7.821**	4.587	2.277	5.090***
ΔLB	3.632		11.943*	11.233*	22.327*	35.125*	15.401*
ΔLG	.357	3.392		6.380**	2.274	5.092***	.089
ΔLV	2.011	11.604*	6.758**		5.220***	5.397***	4.637***
ΔMSB	4.033	2.362	2.151	1.49		10.433*	10.178*
ΔMSG	1.449	.453	.028	3.35	7.964**		1.448
ΔMSV	.278	3.9	6.027**	2.421	5.481***	4.621***	
All	15.447	44.283*	32.640*	29.781*	63.517*	57.380*	31.225*
Panel 2: From 2007 to 2010							
ΔASX		.342	1.39	1.8	5.975**	4.226	4.616***
ΔLB	1.848		1.011	.931	1.923	1.918	1.974
ΔLG	3.801	6.317**		8.139**	5.478***	6.777**	5.373***
ΔLV	5.075***	5.915***	3.435		2.997	1.003	1.423
ΔMSB	4.294	3.777	4.414	2.819		2.663	3.823
ΔMSG	3.344	3.757	3.734	2.905	4.655***		3.963
ΔMSV	4.979***	3.513	7.442**	3.368	7.934**	7.279**	
All	23.253**	22.056**	25.807**	24.331**	24.106**	19.717***	14.196
Panel 3: From 2000 to 2010							
ΔASX		3.012	.94	1.815	.397	.338	.303
ΔLB	3.708		3.056	5.214***	9.499*	10.522*	10.202*
ΔLG	2.933	1.706		.971	.321	.267	1.817
ΔLV	6.632**	21.935*	12.393*		8.854**	6.543**	8.424**
ΔMSB	3.553	5.111	3.058	3.792		9.419*	8.920**
ΔMSG	.212	2.288	1.808	2.693	9.211**		3.969
ΔMSV	2.242	7.072**	8.241**	3.103	5.491***	6.329**	
All	24.645**	50.962*	34.266*	24.838**	44.195*	36.587*	29.775*

Notes: 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)).

\*Rejection of the hypotheses of non-causality at the 1% significance level.

\*\*Rejection of the hypotheses of non-causality at the 5% significance level.

\*\*\*Rejection of the hypotheses of non-causality at the 10% significance level.

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.

The results of the Granger-causality tests for the post-crisis period are presented in Panel 2 of Table 4 and show a bidirectional 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 considerably 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. Therefore, 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. 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.

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. 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.

The results of the Granger-causality tests for the full study period are presented in Panel 3 of Table 4 and suggest that 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. 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 greatly 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. 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.

The findings support 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 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.

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 ahead 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 5–7.

**Table 5. Variance Decompositions, Pre-crisis Period**

**Table caption. Ordering for Cholesky: ASX, MSG, LB, LV, MSV, MSB and LG**

VDC of	Days	Percentage of forecast error variance explained by innovation in:						
		$\Delta$ ASX	$\Delta$ LB	$\Delta$ LG	$\Delta$ LV	$\Delta$ MSB	$\Delta$ MSG	$\Delta$ MSV
ASX	1	100.000	.000	.000	.000	.000	.000	.000
	15	93.572	4.120	.051	.306	.193	1.333	.426
	30	70.408	20.091	.643	1.408	.286	5.063	2.100
LB	1	16.097	48.059	.000	.000	.000	35.844	.000
	15	16.058	38.608	.726	1.843	.027	42.228	.510
	30	16.985	34.277	1.190	2.357	.049	43.669	1.473
LG	1	14.432	27.993	9.504	3.765	.026	44.233	.047
	15	10.790	23.968	9.049	6.272	.034	49.574	.312
	30	10.669	23.620	8.106	5.735	.162	50.901	.808
LV	1	13.532	24.758	.000	17.226	.000	44.484	.000
	15	10.919	23.354	.175	22.515	.013	42.887	.137
	30	11.631	22.590	.111	22.514	.036	42.803	.315
MSB	1	5.946	4.542	.000	.030	30.865	55.345	3.273
	15	3.672	3.061	.257	.315	23.262	63.370	6.064
	30	3.393	3.569	.218	.366	18.676	63.568	10.210
MSG	1	2.907	.000	.000	.000	.000	97.093	.000
	15	.976	.179	.183	.563	.101	96.361	1.636
	30	.602	.617	.118	.428	.172	94.289	3.773
MSV	1	3.480	2.868	.000	1.680	.000	60.066	31.906
	15	1.734	2.861	.004	3.085	.372	58.710	33.234
	30	1.676	3.623	.020	3.125	.362	56.363	34.830

Notes: VDC represent the variance decomposition.  $\Delta$  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 forecast error variance decomposition for the Australian stock market index and equity mutual funds during the pre-crisis period (see Table 5) demonstrate that the S&P/ASX All Ordinaries index has a relatively lower strength of exogeneity among the interacting variables. 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 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 (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 less strength of exogeneity in comparison to other equity mutual funds variables. The result shows 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%).

The results of forecast error variance decomposition for the Australian stock market index and equity mutual funds during the post-crisis period (see Table 6) demonstrate that the S&P/ASX All Ordinaries index has a relatively less 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 sizeable 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. Variance Decompositions, Post-crisis Period**

Table caption. Ordering for Cholesky: ASX, LG, LV, MSV, LB, MSB and MSG

VDC of	Days	Percentage of forecast error variance explained by innovation in:						
		$\Delta$ ASX	$\Delta$ LB	$\Delta$ LG	$\Delta$ LV	$\Delta$ MSB	$\Delta$ MSG	$\Delta$ MSV
ASX	1	100.000	.000	.000	.000	.000	.000	.000
	15	94.058	2.313	.056	.749	.006	1.369	1.448
	30	83.786	5.562	.617	1.140	.018	5.683	3.194
LB	1	92.073	3.561	3.929	.435	.000	.000	.002
	15	80.835	8.791	4.083	3.501	.004	1.525	1.260
	30	70.128	12.675	5.390	4.430	.006	5.153	2.219
LG	1	92.411	.000	7.589	.000	.000	.000	.000
	15	86.030	3.845	6.098	1.902	.013	1.228	.884
	30	74.575	8.760	7.267	3.393	.010	4.568	1.426
LV	1	87.972	.000	3.889	8.139	.000	.000	.000
	15	77.256	2.909	2.457	15.209	.177	1.131	.861
	30	68.045	6.518	2.875	16.283	.354	4.145	1.780
MSB	1	78.084	.014	1.686	.181	7.963	.000	12.072
	15	77.613	.352	.674	.242	3.694	2.569	14.856
	30	70.393	1.036	.935	.841	3.051	8.635	15.109
MSG	1	73.310	.082	6.532	.399	1.717	6.216	11.744
	15	70.424	.904	3.538	.177	.933	9.559	14.464
	30	61.550	1.789	4.041	.689	1.087	16.426	14.418
MSV	1	66.954	.000	6.460	.003	.000	.000	26.582
	15	70.806	.387	2.393	.283	.186	2.129	23.815
	30	64.757	1.139	2.017	.459	.214	7.985	23.429

Notes: VDC represent the variance decomposition.  $\Delta$  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 less 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%).

The results of forecast error variance decomposition for the Australian stock market index and equity mutual funds during the full study period (see Table 7) demonstrate that the S&P/ASX All Ordinaries index has a relatively lower 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

**Table 7. Variance Decompositions, Full Study Period**

Table caption. Ordering for Cholesky: ASX, LG, LV, MSB, MSV, and LB

VDC of	Days	Percentage of forecast error variance explained by innovation in:						
		$\Delta$ ASX	$\Delta$ LB	$\Delta$ LG	$\Delta$ LV	$\Delta$ MSB	$\Delta$ MSG	$\Delta$ MSV
ASX	1	100.000	.000	.000	.000	.000	.000	.000
	15	99.067	.140	.223	.159	.025	.004	.384
	30	98.944	.262	.196	.189	.020	.007	.382
LB	1	61.790	7.272	30.102	.835	.000	.000	.000
	15	56.236	5.737	35.293	2.158	.078	.039	.459
	30	55.944	5.797	35.459	2.194	.084	.043	.478
LG	1	57.631	.000	42.369	.000	.000	.000	.000
	15	53.371	.453	45.260	.372	.075	.068	.401
	30	52.445	1.389	45.042	.547	.115	.126	.336
LV	1	55.500	.000	34.093	10.407	.000	.000	.000
	15	50.553	.289	35.343	13.661	.029	.007	.118
	30	49.398	.882	34.713	14.855	.047	.019	.086
MSB	1	41.554	.615	25.065	.113	20.510	.000	12.142
	15	40.787	.575	28.409	.317	14.067	.422	15.423
	30	40.413	.895	28.342	.373	13.879	.497	15.602
MSG	1	29.770	.013	35.404	.171	2.956	17.692	13.994
	15	30.352	.058	35.020	.426	2.886	14.579	16.679
	30	29.691	.232	34.631	.524	2.846	15.262	16.814
MSV	1	27.181	.000	31.400	1.496	.000	.000	39.923
	15	30.701	.199	30.889	2.227	.109	.024	35.851
	30	30.600	.308	30.790	2.326	.104	.030	35.840

Notes: VDC represent the variance decomposition.  $\Delta$  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 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 less 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 (.55%), the middle and small blend equity mutual funds (.37%), the middle and small growth equity mutual funds (.52%), and the middle and small value equity mutual funds (2.33%). Thus, 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.

#### 4. Conclusion

This study presents cointegration and causality approaches to study the price behaviour of equity mutual fund effects on the S&P/ASX All Ordinaries index. In particular, long-run price co-movements of the seven price series are detected by employing the Johansen and Juselius cointegration and VECM methodology, while the VECM coupled Granger-causality and Block Exogeneity Wald test with variance decompositions and an examination of ECT are used to explain price co-movements between the variables in the short-run for pre-crisis, post-crisis, and full study periods.

The results of the cointegration tests reveal that there is long-run equilibrium relationship between equity managed funds and the S&P/ASX All Ordinaries index during the three study periods. This indicates that, in the long-run, the price of equity mutual funds cannot diverge from that of the stock market index since equity mutual funds have not designed their portfolios with the aim of trying to win the market in the long run. The findings support a linear relationship when equity mutual fund prices and the stock market index price are combined, which forces these prices into a long-run equilibrium relationship. According to rational expectations, this study implies that stock market prices can be partially predicted using equity mutual fund prices. This is because equity mutual funds are engaged in passive stock selection and market timing to construct their portfolios in the long run. Hence, equity mutual funds offer an attractive option for investors wanting a passive management strategy and to replicate the behaviour of the Australian stock market.

In the short-run dynamics, the results suggest that the causal relationship runs both ways between equity mutual fund prices and the stock market during the three study periods. This implies that equity mutual funds are not responding to the past changes in the stock market during the pre-crisis period. Consequently, investors cannot find the direction in equity mutual fund prices by observing movements in the stock market. Therefore, the price of the value equity mutual funds can

be predicted by observing movements in the stock market because such finding suggests that value equity mutual funds respond to past changes in the stock market during the post-crisis and full study periods. The results of variance decomposition support the results of Granger-causality tests, indicating that the S&P/ASX All Ordinaries index variable is a strongly exogenous in relation to equity mutual funds during the pre-crisis period.

In terms of the relationships between different equity mutual fund categories, a short-run relationship exists among the equity mutual fund capitalization categories. In addition, the findings suggest a short-term Granger causal relationship, running from middle and small-cap equity mutual funds to large-cap equity mutual funds. This study confirms the previous findings of middle and small-cap equity mutual fund categories, in that they are more active trading strategies than large-cap equity mutual funds, especially during the post-crisis period. Hence, observing movements in particular equity mutual fund prices can be used to forecast the price of the other equity mutual fund categories.

The results of the study clearly encourage policy makers and investors to pay attention to equity mutual funds in Australia. The results confirm the capability of equity mutual funds to replicate the stock market index, for the findings suggest that investing in equity mutual funds is equivalent to investing directly in the stock market. Thus, 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. The underlying rational expectation theory coupled with past evidence in this field is supported by the results of the study.

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#### Article Information

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