"Testing of causality relationship between Indian and Australian mutual funds performance: standard vs customized benchmarks"

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TESTING OF CAUSALITY RELATIONSHIP BETWEEN INDIAN AND AUSTRALIAN MUTUAL FUNDS PERFORMANCE: STANDARD VS CUSTOMIZED BENCHMARKS

Abstract

Most Australian domestic investors rely on fund managers, and in India, this is not the same as they are primarily in direct investment rather than indirect. The study attempts to investigate the causal relationship between the returns of the standard indices, namely BSE500 and ASX300, and customized indices, MIMF and MAMF, for both India and Australia. The study uses econometric tools and techniques such as unit root test, vector error correction model, Wald test, Johansen co-integration, and model efficacy assumptions on the historical closing NAV of the selected mutual fund schemes for the period from April 2008 to March 2018. The econometric investigation using Johansen's Co-Integration test confirmed the co-integration between BSE500, ASX300 and customized indices. Empirical evidence suggests that the Australian customized MAMF index is not Granger-caused by the Indian customized index MIMF, and therefore the MIMF index value cannot be used to predict the future rate of index MAMF returns, and vice versa.

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INTRODUCTION

Since mutual fund units are managed and operated by experienced fund managers who are experts in their fields, they conduct due diligence and investigation much more effectively and speculate more accurately about market developments. Mutual fund units get more funds from people in general to invest and can get the advantage of economies of scale with a lot of contributed funds. A prerequisite for assessing the performance of Indian and Australian mutual fund schemes for examining the chosen schemes is beating or failing to meet expectations compared to the benchmark; therefore, the study evaluates the performance of open-ended equity schemes (Pandow & Butt, 2017).

In this way, mutual fund units have profited in diversified portfolios by investing, and this makes them lucrative for investment proposals. A balanced fund is a scheme that transfers its money into equity class and bond class. An aggressive growth stock fund unit invests in high growth-oriented stocks and focuses on capital gain, and there is no pay from profits 'growth stock' identified with an 'aggressive growth stock'. However, it focuses on having higher capital gains (Mamta & Ojha, 2017).

As most of researchers have evaluated the performance at the levels of scheme, sector, asset classification, and fund management by comparing with the standardized indices, it was decided to assess the dynamics of short- and long-term existing associations between customized Indian Mutual Funds (MIMF) and benchmark BSE500 and customized Australian Mutual Funds (MAMF) and benchmark ASX300, as well as to test the short- and long-term relationship between customized and standard indices. Therefore, a customized index was constructed both for India and Australia, based on price returns of the credit-rated mutual fund schemes. The secondary objective is to investigate the short- and long-run relationship between customized Indian Mutual Funds (MIMF) and customized Australian Mutual Funds (MAMF).

1. LITERATURE REVIEW

The performance phenomenon is a useful indicator for any investor when deciding what fund schemes to consider and how to avoid investment. Fund managers have useful and relevant information on forecasted performance evaluation (Brown & Goetzmann, 1995). Thus, this study tests the relationship pattern by studying the mutual funds' schemes performance in India and Australia, and an effort is made to discuss the issues in detail by using econometric methods. This study is aimed at evaluating open-ended equity schemes and customized benchmark performance for the period from April 2008 to March 2018 using daily scheme returns. In terms of risk implications, this study also presents the performance of mutual fund schemes for systematic risk and total risk using the Treynor, Sharpe and Jensen alpha measures.

Several researchers have analyzed the association between security and mutual fund returns (Rani, & Hooda, 2017). Some studies explain the dynamic relationship between the stock markets (benchmark) and mutual fund schemes (Watson & Wickramanayake, 2012). Even though past examinations have researched the association between securities and mutual funds, there is no reasonable proof for the presence of causality and cointegration relationship (Chu, 2010). In past studies, the Granger model was used to determine the long-term relationship between factors, as well as causality techniques – to determine the short-term equilibrium association. The study inspected the elements among fund and securities returns, the causality and Granger ordinary least square (OLS) strategies (1987) were utilized for a period of 2396 day by day closing values from 1994 to 2003. The causality and cointegration tests recommend that the greater part of inflows can anticipate future performance of the market, and the inflow to the stock exchange returns is reasoned (Christos, Nikitas, Theopfano & Sunil, 2005). The impact of principal factors, namely company, industry, and economy, on the evaluation of mutual fund schemes is justified. The correlation matrix, augmented Dickey-Fuller (ADF) and Granger casualty tests are used to find the connection between variables and their effect on the performance of mutual fund. The research concluded that the real economic variables may not be statistically significant in influencing the mutual fund investment. The analysis of industry shows that the entire mutual fund (managed fund) industry was dominated by only a few players with a huge Asset under Management. The company analysis shows that the Price-to-book ratio and Price-to-earnings ratio have a significant effect on the gains earned by a portfolio followed by its market capitalization and fund/schemes (Rao & Daita 2011). The association between total equity schemes and excess market returns in the Australian market is found using monthly time series data for the period 1990–2009. A unidirectional causal relationship that runs from stock returns to scheme flows according to the Granger causality test affirms a positive association between scheme and security returns (Watson & Wickramanayake, 2012).

The risk-return association of equity schemes is investigated. In this study, the equity scheme's performance is explored. An aggregate of 15 schemes offered by a couple of private firms is contemplated over the period from 1999 to 2013. The capital asset pricing model (CAPM) of the risk and return relationship is used to evaluate the performance of mutual fund schemes. The study plans to review and assess the performance of the chosen schemes positioned by CRISIL. All the chosen funds beat the market and showed the prevalent risk of stable performance (Sharma & Ravikumar, 2013; Rani & Hooda, 2017).

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The primary objective is to conduct a comparative analysis, measure the risk-return of the chosen fund plans, contrast the equivalent and BSE-Sensex, examine the schemes based on their performance and the market index, as well as to analyze whether they outperform or underperform to meet benchmark expectations. Also, the dimension of enhancement of chosen mutual funds' schemes is examined (Nadia & Mora, 2018). The study concluded that a few plans may have higher returns and some may have higher risk. This study examines the long- and short-term equilibrium association homogeneity using Vector Error Correction Model (VECM) tests of causality, Wald test, and diagnostic techniques such as heteroskedasticity, histogram, ARCH effect, and Granger causality test.

2. INDIA AND AUSTRALIA: COMPARATIVE ANALYSIS

Pragmatic research confirms the integration of Indian and global financial markets (Pokhriyal, L. Singh, & S. Singh, 2011; Mandaviya, 2014; Mohanasundaram & Karthikeyan, 2015). Indian stock markets are largely assimilated by global stock markets, more specific to Australia, Germany, the United Kingdom and the United States (Levi, Garag, & Merlyn, 2016; Paramati, Gupta, & Roca, 2012). The Indian equity market is associated in the long run with Australian, US, German, and French equity markets but is not interdependent in the short-run with the United Kingdom, France, the United States, and Australia (Chittedi, 2010; Taneja, 2012).

The opportunities for India from Australian investment are seen as significant, and foreign policy frameworks on investment by India will last to open and provide a diversification strategy for typical investors. Australia's investment in Indian markets increased to USD 6.7 billion in 2017, and investment vehicles have an increasing scope that helps mitigate risk and provide steady returns. While Australian financial specialists will choose their own businesses, the expansion of Australian stock investment in India relates to more profound monetary combinations adding to expanded Australian trade commission and exchange. The objective is set as India is turning into the third biggest Australian outbound venture destination in Asia. However, this may be achievable if India's development and economic reforms proceed at stride and if Australian investors move to India (Austrade, 2017).

India's managed fund industry is a potential source of investment for Australia with USD 2.7 trillion in assets under management that attracts India's attention. It inspires ridiculous desires that a huge level of assets can be financed sensibly in India taking into account Greenfield opportunities in the Indian infrastructure sector. A more noteworthy acclimation among Indian and Australian venture experts can link desire breaches to time skylines choices for investment by Australian assets (The Commonwealth of Australia, 2017).

The Australian infra funds are enormous with USD 220 billion of assets under management. Australian experts visiting India will assume a crucial job in improving information about Australia as an investment house. The Government of India and Australian investors will add to a reasonable long-term portfolio investment affiliation by bridging the expectation gap. The International Finance Corporation (IFC) has set up existence in developing markets, for example, India, with a command for engaging worldwide investment. The Australian Government plays a role in promoting the benefits and the need for financial intermediate organizations. The IFC tends to be an avenue to reinforce nearer two-sided investment ties and assist the industry of Australia to explore the stimulating Indian market (Austrade, 2017).

The comparison between India and Australia shows that India has a higher GDP and Australia has a higher GDP per capita. Australia has a low unemployment rate and high current account balance.

According to the CIA World Fact Book 2018 release, the unemployment rate and the inflation rate for India and Australia are 8.5% and 3.6% and 5.6% and 2%, respectively. The GDP real growth rate is 2.2% in Australia and 6.7% in India, with 87th rank and 96th rank, respectively (The World Bank, 2018).

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Table 1. Country-wise contribution of the world's largest 500 asset managers

Source: Willis Towers Watson Factbook – World Ranking 2017.

Country	1 to 500	Contribution
USA	195	39.00%
UK	42	8.40%
Australia	22	4.40%
India	8	1.60%
Others	233	46.60%

Table 1 shows the contribution of Asset Management Companies (AMC) presence to the top 500 asset managers. The USA is found to have the highest contribution from AMCs to the top 500 results with 39%. The UK stands second with 8.4%, followed by Australia with 4.4% and India with the 1.6% contribution to the world's best 500 asset managers. Only eight Indian AMCs have a global presence.

In Table 2, the United States represents the Americas region, and the United Kingdom represents the European region, Australia and India represent the Asia-Pacific region. The United States and Australia dominate their respective region as a pioneer in the managed fund industry (mutual fund industry). Also, there is over ten-year consistency (2008 to 2018) with an average of 88.59% contribution by the US, 9.56% by the UK, 38.67% by Australia, and 3.51% by India as a presence in the global mutual fund industry.

Therefore, this study examines the relationship between India and the other countries in the context of assets under management by categorizing them according by region, namely Americas, Europe, and Asia-Pacific. As the Americas and Europe mutual fund (managed fund) industry is highly developed, Australia is reasonably considered as a variable to be used to study and compare with India (both countries belong to the Asia-Pacific region).

3. METHOD

After the extensive literature review, the essential lagged variables for analyses are considered to test long- and short-run associations using a Vector Error Correction Model. The investigation related to this study is divided into BSE500 and customized Indian Mutual Fund (MIMF), as well as ASX300 and customized Australian Mutual Fund (MAMF) for all study periods.

3.1. Construction of customized Indian and Australian mutual funds (MIMF and MAMF)

MIMF is a customized mutual fund representing India. The customized index is constructed based on all the selected mutual fund schemes used for the study; they include Aggressive Hybrid, Conservative Hybrid, Equity-Linked Savings Scheme, Focused funds, Index funds, Large-Cap, Mid-Cap, Multi-Cap, Small Cap, and Thematic – Infrastructure and Value funds.

Table 2. Worldwide open-end funds – total net assets

Source: International Investment Funds Association.

Year	World	Americas	US	Europe	UK	Asia Pacific	Australia	India
2008	101,977,145	51,252,937	45,928,245	39,394,171	2,921,848	11,017,758	4,305,536	310,123
2009	96,811,448	48,855,689	43,751,953	36,787,160	2,666,209	10,802,582	4,130,405	418,020
2010	108,659,593	54,791,381	48,253,496	40,694,250	3,334,317	12,686,448	5,159,564	474,022
2011	117,132,003	58,970,519	51,280,529	44,073,024	3,870,902	13,557,924	5,857,127	414,196
2012	123,880,742	63,853,372	55,450,463	45,321,746	4,300,418	14,158,196	6,339,904	415,700
2013	138,028,093	71,634,995	62,819,758	50,950,348	5,017,138	14,876,077	6,561,400	430,830
2014	152,534,976	79,038,113	69,774,572	56,589,312	5,828,209	16,316,395	6,811,390	494,578
2015	153,113,354	79,386,350	71,436,263	55,181,755	6,381,197	18,000,425	6,172,757	631,952
2016	160,103,798	82,473,699	73,613,807	56,655,927	6,117,265	20,419,432	6,899,929	763,235
2017	184,609,523	94,037,387	83,531,357	65,842,620	7,047,261	24,072,333	8,211,237	1,106,485
2018*	149,530,303	75,563,984	67,599,259	53,374,934	5,782,643	20,077,916	6,298,958	880,636

Note: * represents data available till Q3 2018.

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The schemes were selected from CRISIL and Morningstar. All 173 fund schemes were analyzed, and their daily returns were annualized for quarterly returns for the study period, ten years. Finally, 40 quarterly returns for all ten years are used to compare against the BSE500 and carry out the investigation.

MAMF is a customized mutual fund representing Australia. It is constructed from all the selected mutual fund schemes used for the study, including Blend, Growth, and Value in Large-sized mutual fund schemes, and these schemes were selected from Morningstar Ratings. All 172 fund schemes were analyzed, and their daily returns were annualized for quarterly returns for the study period, ten years. Finally, 40 quarterly returns for all ten years are used to compare against the ASX300 and carry out the investigation.

3.1.1. Statistical application

Return on a portfolio is calculated as follows:

$$R_p = \left[\frac{P_{it} - P_{it-1}}{P_{it-1}}\right] \cdot 100,$$

where R_p is the fund return i at time t, P_{it} is NAV/fund price i at time t.

Daily returns are calculated based on the closing NAV of the Indian and Australian schemes for the study period. Likewise, the returns on the market are considered to be at the average returns for BSE500 and ASX300.

Unit Root Test is used to test the data series stationarity, and after the initial investigation of data unlagged is caught in ordinary least squares method, the lagged models are considered as a necessary investigation in a Vector Error Correction Model. The VECM is intended for cointegrated non-stationary data series (Chu 2011; and Ben-Zion, Choi, & Hauser, 1996). Many variables considered in financial econometrics are non-stationary (Kirchgassner & Wolters, 2007). This study emphasizes the testing of unit roots (ADF) to determine non-stationary, at given levels, predetermined variables, and stationarity of first and second differences.

Three problems are identified relating to the non-stationarity and unit roots and data. To begin, stationary data has waves that will gradually fade away when non-stationary data shocks have infinite steady behavior. The regression methods estimate non-stationary data, they can display misleading associations with a great explanatory power regardless of variables being non-correlated. Lastly, stationary data assumptions are not substantial for non-stationary data.

There are several ways to deal with a test that data series contains unit roots, and three possible structures under the ADF test:

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

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \mu_t, \quad (2)$$

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \mu_t, \quad (3)$$

where Δ is a first-difference, Y_t is a variable checked for stationarity, t is the linear trend (time), and μ_t is a stationarity covariance random error.

The primary structure (equation 1) is correct when it is generated by an arbitrary walk with zero floats and zero mean. The second structure (equation 2) is appropriate when it is created by an arbitrary walk with zero floats and not a zero mean. The third structure (equation 3) is appropriate if the data has not a zero mean and float non-zero, at that point, estimation incorporates both consistent and trend terms. In any case, the unit-roots technique (Perron 1990) contends that the unit root test has low power. At the point when structural breaks are found in the data set, the PP test is presented as dominant as the ADF test (Glynn et al., 2007).

Johansen cointegration tests with the VECM system are used to recognize an association equilibrium between variables in the long run. The cointegration testing of the variables includes the utilization of the likelihood maximum technique (Johansen, 1988). The null hypothesis, r cointegrating relations against k are tested using the Trace test, k is referred to as the number of endogenous factors, for r = 0,1,… , k is embraced. The maximum eigenvalue tests are additionally done under the null hypothesis, r cointegrating relations against the option of $r + 1$. The examination of the model consists of the presumption linear trend in the time series data set, yet no patterns in the cointegrating equations using lagged intervals one or two, as the variables have an increasing pattern (Allen & MacDonald, 1995). The outcomes for both trace and maximum eigenvalue estimates are considered.

When the level of the data set appeared to be non-stationary, there are first difference stationary associations. The cointegration tests of non-stationary data can be used (Granger, 1986). The two cointegrating equations, namely the trace test and the max eigenvalue test (Johansen & Juselius, 1990), are as follows:

$$\lambda_{trace}\left(r\right) = -T \cdot \sum\nolimits_{i=r+1}^{n} \ln(1-\hat{\lambda}_1), \tag{4}$$

$$\lambda_{\max}\left(r, r+1\right) = -T \cdot \ln(1-\hat{\lambda}_{r+1}), \tag{5}$$

where, r is characterized as the vector cointegrating numbers supporting the null hypothesis, T is a sample unit, and $\hat{\lambda}_1$ is the i-th correlation. The trace test can also be called as a joint test.

Vector Error Correction Model (VECM): factors in vector Y_t are of the integrated order, I(1), cointegrated, and the restrictions on cointegration cannot be applied to the VAR model. Shocks are cointegrated if vector error correction (VEC) exists in the data series (Engle & Granger, 1987).

Causality test in the case of cointegration existence; homogeneity tests are then conducted on the VECM. Causality means the capacity of one variable comprising helpful data to foresee and consequently impact the estimation of another variable dependent on the ordinary least squares (Diebold, 2007). The confirmation of causality in variable X_t has anticipated more prominent exactness by utilizing estimations of the Y_t variable in the past, all other factors stay unchanged; this merely confirms that Y_t causes X_t. Subsequently, variables Y_t and X_t can influence together with distributed lags. The model can be built concerning the time-series data at the level form, $I(1)$, and there are distinct ways to deal with the causality test using the VAR procedure; tests of every variable for their cointegration at $I(1)$ include forecasting the following combination:

$$X_t = \alpha + \sum_{i=1}^{u} \beta_i X_{t-i} + \sum_{j=1}^{v} \gamma_j Y_{t-j} + \mu_t, \tag{6}$$

$$Y_t = \alpha + \sum_{i=1}^{w} b_i Y_{t-i} + \sum_{j=1}^{v} C_j X_{t-j} + \mu_t, \tag{7}$$

where $\boldsymbol{\mu}_t$ is zero-mean, *u, v, and w* are lag lengths.

4. RESULTS AND DISCUSSION

Figures 1 and 2 provide visual patterns of both BSE500 and MIMF, and ASX300 and MAMF quarterly returns over the study period, from April 2008 to March 2018. They appear to slant upward when they both tend to be balanced over the study period and BSE500 averages 9.53% return compared to a higher level of 11.84% return for customized MIMF and ASX300 averages 2.47% return compared to a higher level of 6.32% return for customized MAMF. The graphics indicate the possibility that MIMF and MAMF have been influenced by BSE500 and ASX300, respectively. Therefore, the causality between two data sets cannot be established, there is a necessity for supplementary investigation using the unit root test.

Unit Root Test: Table 3 shows the null hypothesis that BSE500 and MIMF have unit roots and are rejected as the calculated critical value (t-value) for MIMF is less than 5% at the second difference *I(2)* at the significance level. The test reveals that the MIMF variable is non-stationary and becomes stationary after the second difference. The outcome of the regression from the VECM model is spurious. To withdraw this, a regression equation is performed with stationary variables after differencing (Granger & Newbold, 1974).

For MIMF, t-value –6.275272 is lower than the calculated Augmented Dickey-Fuller (ADF) test critical t-value (–2.95113) at a 5% significance level. Likewise, for BSE500, at the level, t-value –5.82826 is less than the calculated ADF test calculated critical value (–2.93899) at a 0.05 significance level. Thus, BSE500 and MIMF data sets have no unit root problems and are good to continue with the co-integration test.

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Source: EViews Extract.

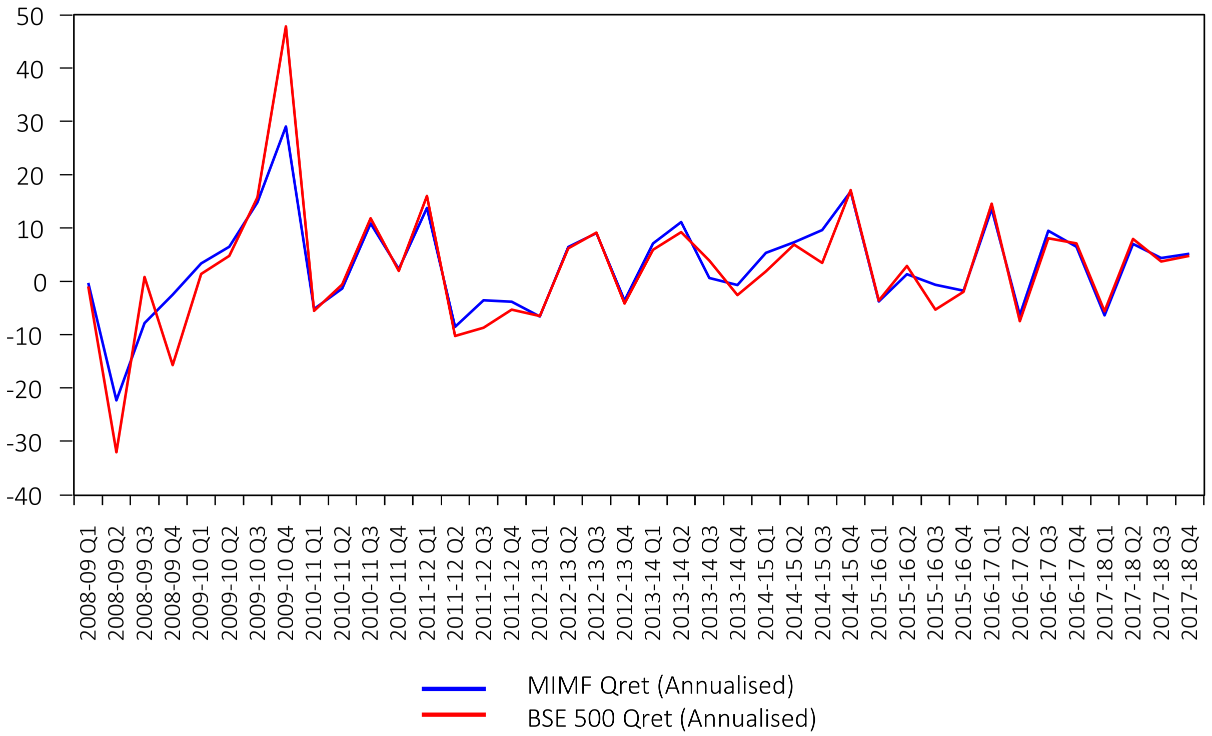

Figure 1. MIMF and BSE500 quarterly returns from April 2008 to March 2018

Source: EViews Extract.

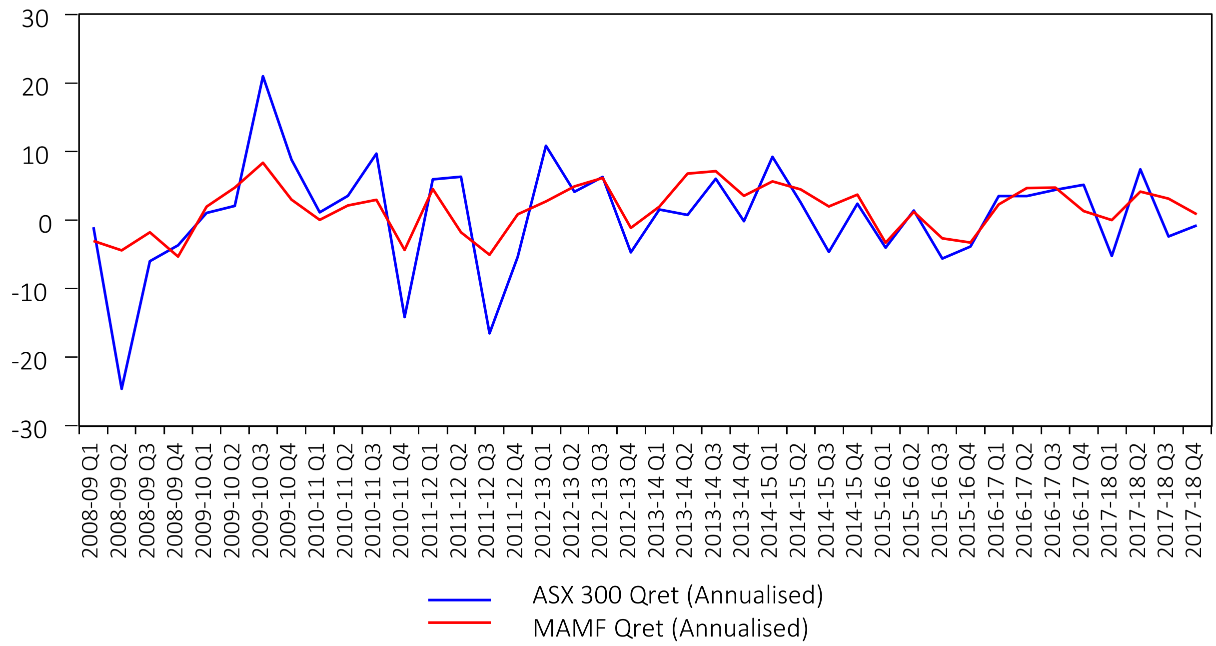

Figure 2. ASX300 and MAMF quarterly returns from April 2008 to March 2018

Table 3. ADF test – MIMF and BSE500

Source: EViews software output.

Particulars	MIMF				BSE500			
	T-statistic	Critical value		P-value	T-statistic	Critical value		P-value
At level	–5.41779	1%	–3.61045	0.0001	–5.82826	1%	–3.61045	0
		5%	–2.93899			5%	–2.93899	
		10%	–2.60793			10%	–2.60793	
At first difference	–4.87989	1%	–3.6329	0.0003	NA	1%	NA	NA
		5%	–2.9484			5%	NA	
		10%	–2.61287			10%	NA	
At second difference	–6.27527	1%	–3.63941	0	NA	1%	NA	NA
		5%	–2.95113			5%	NA	
		10%	–2.6143			10%	NA	

Table 4. ADF test – ASX300 and MAMF

Source: EViews software output.

Particulars	ASX300				MAMF			
	T-statistic	Critical value		P-value	T-statistic	Critical value		P-value
At level	–5.6339	1%	–3.6105	0.0000	–4.3235	1%	–3.6105	0.0015
		5%	–2.9389			5%	–2.9389	
		10%	–2.6079			10%	–2.6079	
At first difference	NIL	1%	NIL	NA	–6.2384	1%	–3.6210	0.0000
		5%	NIL			5%	–2.9434	
		10%	NIL			10%	–2.6103	

Table 4 confirms for MAMF that *t*-value –4.3235 is lesser than the ADF test critical calculated value (–2.9389) at a 5% significance level. Similarly, for ASX300, the calculated t-value (–5.6339) is less than the calculated ADF test critical calculated value (–2.9389) at a 5% significance level. Thus, it has been decided that ASX300 and MAMF have no unit root problem.

Test of Johansen's Co-Integration: Table 5 shows the statistic for the Max. Eigen calculated value (16.59258) greater than the calculated critical value (15.495) specifying that the variables in the long-run associations are bound together. The presence of co-integration between the variables is found for the null hypothesis. In the same way, Max. Eigen test also shows co-integration between the two variables and the presence in the long run, as the Max. Eigen calculated t-statistic value (11.04530) is less than the calculated critical *t*-value (14.26460) at the level of significance 5%. The results indicate the null hypothesis, co-integration between MIMF and BSE500 is not found and rejected at a 0.05 level of significance, since Max. Eigen test and Trace test indicate at most one co-integration equation at the 5% level. Hence,

Table 5. Johansen co-integration test outcome – MIMF and BSE500

Source: EViews software output.

Cointegration test	Level	Eigen values	Trace/Max-Eigen statistic	Critical values (5%)	P-value
Trace test	H_0 r =0 (none) *	0.270634	16.59258	15.49471	0.0341
	H_1 r =1 (At most 1)	0.146572	5.547279	3.841466	0.0185
Max. Eigen	H_0 r =0 (none) *	0.270634	11.04530	14.26460	0.1519
	H_1 r =1 (At most 1)	0.146572	5.547279	3.841466	0.0185

Note: Trace indicates two cointegrating eqn(s), and Max Eigen indicates no cointegration (5%), * Hypothesis rejected at the 5% significance level.

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Table 6. Johansen co-integration test outcome – MAMF and ASX300

Source: EViews software output.

Co-integration test	Level	Eigen values	Trace/Max. Eigen statistics	Critical values (5%)	P-value
Trace test	H_0 r = 0 (none) *	0.38569	20.6256	15.4947	0.0077
	H_1 r = 1 (At most 1)	0.09702	3.5720	3.8417	0.0588
Max. Eigen	H_0 r = 0 (none) *	0.38569	17.0537	14.2646	0.0176
	H_1 r = 1 (At most 1)	0.09702	3.5720	3.8415	0.0588

Note: Trace and Max-Eigen indicate one co-integrating equation; * – hypothesis is rejected at a 5% significance level.

the alternative hypothesis is accepted, and there is cointegration between MIMF and BSE500.

Similarly, no co-integration is found between MAMF and ASX300 data sets; it is rejected at a 0.05 significance level as the trace and Max. Eigen tests show at most one co-integration equation at a 5% significance level (see Table 6). Therefore, it is proposed that a cointegration equation between MAMF and ASX300 is accepted.

Table 7 shows that subsequent analysis involves fitting the data series into a VECM and the outcomes are based on a normalized eigenvector; they show a positive long-run association between BSE500 and MIMF, and the calculated co-integrating coefficient for the BSE500 growth is as follows:

$$MIMF = 0.524254BSE500 - \\ -1.99287[-5.76031]. \tag{8}$$

The t-statistic co-integrating coefficient for BSE500 is shown in the parentheses (Table 7). The BSE500 coefficient is negative, which means the existence of positive long-run association between MIMF returns and BSE500 returns. Also, an increase in BSE500 can be associated with an increase in the MIMF returns in India.

Table 7. Co-integrating vector of MIMF and BSE500

Source: EViews software output.

Co-integrating equation		
MIMF	BSE500	Constant
1	–0.524254	–1.99287
	(–0.09101)	
	[–5.76031]	

Note: Standard error is in ( ), t-statistics is in [ ].

Table 8 shows that the negative error correction coefficient (–2.651364) is significant at a 5% significance level, and the t-statistic value is lower (–2.36258) compared to the critical calculated value (1.96) at 5% level of significance. Therefore, this confirms the long-run association between BSE500 and MIMF. Therefore, it can be said that the value of succeeding year MIMF returns is inclined by the base (current) year BSE500 at a 95% confidence level. The VECM outcome shows that MIMF has a positive significant long-run impact on the economic growth and development of the Indian economy, benchmark BSE500.

4.1.1. *Dependent variable: MIMF; Independent variable: BSE500*

System equation

$$\begin{aligned}&D(MIMF) = C(1)\times \\ &\times(MIMF(-1) - 0.52425366658)\times \\ &\times(BSE500)(-1)(-1.99287426315)+ \\ &+C(2)\cdot(D(MIMF(-1)) + C(3))\times \\ &\times(D(MIMF(-2)) + C(4))\times \\ &\times(D(MIMF(-3)) + C(5))\times \\ &\times(D(MIMF(-4)) + C(6))\times \\ &\times(D(BSE500(-1)) + C(7))\times \\ &\times(D(BSE500(-2)) + C(8))\times \\ &\times(D(BSE500(-3)) + C(9))\times \\ &\times(D(BSE500(-4)) + C(10)).\end{aligned} \tag{9}$$

Table 8. Long-run causality variable (least squares) of MIMF and BSE500

Source: Output extract from EViews software.

Coefficient	Coefficient Value	Std. error	t-statistic	Prob.
C (1)	–2.651364	1.122231	–2.362583	0.0262
C (2)	1.960373	0.922896	2.124154	0.0437
C (3)	1.718254	0.737282	2.330524	0.0281
C (4)	1.636550	0.593672	2.756657	0.0107
C (5)	1.078197	0.450670	2.392430	0.0246
C (6)	–1.541256	0.539152	–2.858666	0.0085
C (7)	–1.350486	0.482506	–2.798900	0.0097
C (8)	–1.159884	0.423449	–2.739135	0.0112
C (9)	–0.907368	0.310933	–2.918208	0.0073
C (10)	0.202426	1.406407	0.143931	0.8867
R-squared	0.644686			

C (1) is statistically significant as the p-value is lower than 5% and has a negative coefficient. This indicates a long-term causality resulting from MIMF and BSE500. Therefore, the error correction term variable is significant. Thus, a long-run causality runs from the independent variable to the dependent variable. R-squared (0.644686) statistic estimates the efficiency of the regression analysis in forecasting the values of the dependent variable (MIMF) in the sample. R-squared may be represented as the fraction of the dependent variable (MIMF) variance described by the independent variable (BSE500). Similarly, VECM shows a positive long-run relationship between ASX300 and MAMF. The calculated co-integrating coefficient for the ASX300 growth is as follows:

$$MAMF = 12.3979 - \\ -8.3606 ASX300[-4.1912]. \quad (10)$$

The co-integrating coefficient t-statistic value of ASX300 is given in the parentheses as a negative coefficient for ASX300, indicating a positive long-run association between MAMF returns and ASX300 returns. Also, an increase in ASX300 can be associated with an increase in the MAMF returns in Australia. Table 9 shows that the coefficient error correction term (0.07322) is positive and p-value (0.0075) is less than 5%; it is said that the variable is statistically significant at a 5% significance level, since it is represented by the higher t-statistic calculated value (2.9085 and 3.9536) compared to the critical value (1.96) at a 5% significance level. Therefore, this confirms the relationship between ASX300 and MAMF as a long-term equilibrium and the value of succeeding year MAMF returns are essentially affected by the base (current) year ASX300 at a 95% confidence level. VECM confirms that MAMF has a significant positive long-run impact on the economic growth in Australia, ASX300.

4.1.2. Dependent variable: MAMF Independent variable: ASX300

System equation

$$\begin{aligned} & D(MAMF) = C(1)\times \\ & \times((MAMF(-1) - 8.36056847235)\times \\ & \times(ASX300(-1) + 2.3979182847\ ) + \ C(2))\times \\ & \times(D(MAMF(1)) + C(3))\times \\ & \times(D(MAMF(-2)) + C(4))\times \\ & \times(D(MAMF(-3)) + C(5))\times \\ & \times(D(MAMF(-4)) + C(6))\times \\ & \times(D(ASX300(-1)) + C(7))\times \\ & \times(D(ASX300(-2)) + C(8))\times \\ & \times(D(ASX300(-3)) + \ C(9))\times \\ & \times(D(ASX300(-4)) + C(10)). \end{aligned} \quad (11)$$

C (1) is highly significant as the probability is less than 5% significance level and causality in the long run is running through MAMF and ASX300. However, the coefficient is positive and the p-value is significant as it is less than 0.05; a long-run

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Table 9. Long-run causality variable (least squares) of MAMF and ASX300

Source: Output extract from EViews software.

	Coefficient	Std. error	T-statistic	Prob.
C (1)	0.073215	0.025173	2.908463	0.0075
C (2)	–0.178065	0.302242	–0.589148	0.5610
C (3)	–0.335264	0.373686	–0.897181	0.3782
C (4)	0.030487	0.318235	0.095801	0.9244
C (5)	–0.018329	0.289957	–0.063212	0.9501
C (6)	0.264880	0.224748	1.178562	0.2497
C (7)	0.281440	0.217594	1.293422	0.2077
C (8)	0.065844	0.174555	0.377210	0.7092
C (9)	0.048249	0.142022	0.339725	0.7369
C (10)	–0.096198	0.577872	–0.166470	0.8691
R-squared	0.503705			

causality can be determined. R-squared (0.5037) statistic estimates the efficiency of the regression in forecasting the value of the dependent variable (MAMF). R-squared may be understood as the fraction of the dependent variable (MAMF) variance described by the independent variable (ASX300).

Wald test: Null hypotheses for the short run: c (6) = c (7) = c (8) = c (9) =0.

Table 10 confirms that p-value is less than 5%; this rejects the null hypothesis, resulting in a short-run causality coming through the independent variable (BSE500) to the dependent variable (MIMF) and the independent variable (ASX300) to the dependent variable (MAMF).

Wald statistics is used to check a combination of data series, MIMF and BSE500, and MAMF and ASX300.

- Long-run causality from BSE500 to MIMF and ASX300 to MAMF.
- Short-run causality from BSE500 to MIMF and ASX300 to MAMF.

Table 10. Wald test results for MIMF and BSE500 and MAMF and ASX300

Source: Output extract from EViews software.

Case	Test statistic	Value	df	Prob.
MIMF and BSE500	F-stat	3.935965	(4, 25)	0.0130
	Chi-square	15.74386	4	0.0034
MAMF and ASX300	F-stat	0.758529	(4, 25)	0.5620
	Chi-square	3.034114	4	0.5521

Histogram: Figures 3 and 4 confirm that the null hypothesis is accepted as the Jarque-Bera and probability are more than 5%. Therefore, the residuals are normally distributed and the constructed model is desirable for normality test on MIMF and BSE500 (JarqueBera = 0.72); MAMF and ASX300 (Jarque- Bera = 1.51).

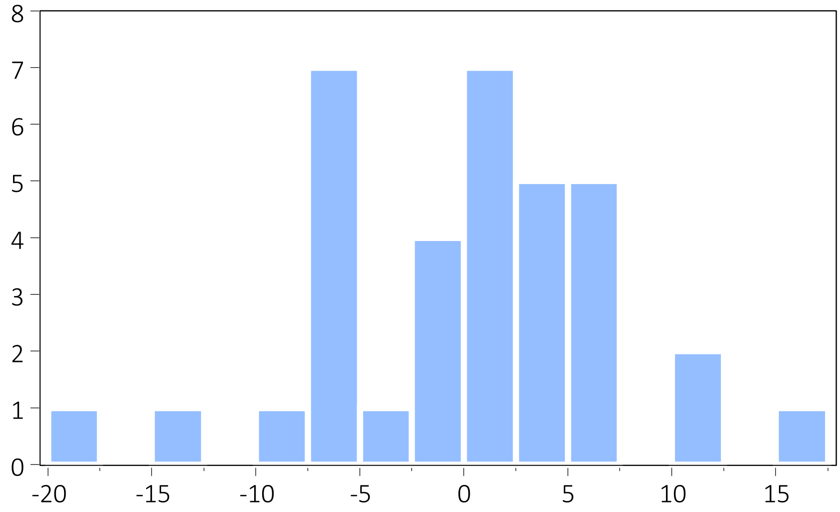
Heteroskedasticity test and serial test: Table 11 shows the observed R-squared and probability. The Chi-square probability is greater than 0.05, indicating that the null hypothesis is accepted. There is no Arch effect and serial correlation. It is a good-fit sign and it satisfies the model specification assumption for the cases; Heteroskedasticity Test (ARCH) results for MIMF and BSE500; MAMF and ASX300 and Breusch Godfrey Serial

Table 11. Heteroskedasticity and serial correlation test

Source: Output extract from EViews software.

		Heteroskedasticity			Serial correlation		
MIMF and BSE500	F-stat	0.2802	Prob. F (4,26)	0.888	1.01212	Prob. F (4,21)	0.424
	Obs. * R-squared	1.28113	Prob. Chi-square (4)	0.865	5.65691	Prob. Chi-square (4)	0.226
MAMF and ASX300	F-stat	1.6635	Prob. F (4,26)	0.189	2.5134	Prob. F (4,21)	0.072
	Obs. * R-squared	6.31696	Prob. Chi-square (4)	0.177	11.3312	Prob. Chi-square (4)	0.023

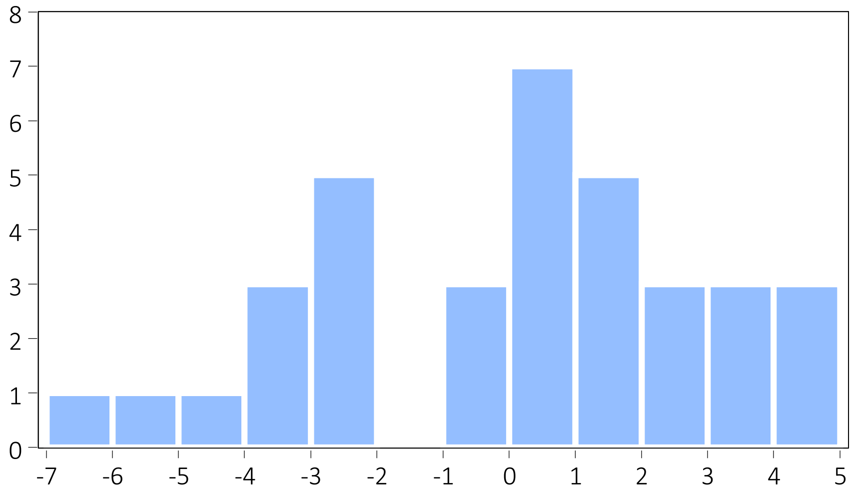
Source: EViews software analysis results.



Series:	Residuals
Sample	6 40
Observations	35
Mean	6.60e-16
Median	0.790599
Maximum	15.34799
Minimum	-18.24443
Std. Dev.	7.020229
Skewness	-0.308036
Kurtosis	3.257345
Jarque-Bera	0.650083
Probability	0.722497

Figure 3. Normality test for MIMF and BSE500

Source: EViews software analysis results.



Series:	Residuals
Sample	6 40
Observations	35
Mean	-2.54e-16
Median	0.519221
Maximum	4.564347
Minimum	-6.991637
Std. Dev.	2.879973
Skewness	-0.453617
Kurtosis	2.533224
Jarque-Bera	1.518059
Probability	0.468121

Figure 4. Normality test for MAMF and ASX300

Correlation Test for MIMF and BSE500; BSE500 and ASX300.

Granger causality test results are shown in Table 12. There is no causality between MIMF quarterly returns and BSE500 quarterly returns, and vice versa. MIMF quarterly returns do not Granger-cause BSE500 quarterly returns and BSE500 quarterly returns do not Granger-cause MIMF quarterly returns; Indian perspective appears to be bi-directional.

BSE500, in fact, does not necessarily lead to increases or decreases in MIMF return levels. Correspondingly, BSE500 does not Granger-cause MIMF, and the MIMF value cannot be employed to forecast the level of BSE500 in future; this is in line with previous similar studies (Gordon, 2017). Similarly, it indicates that, to a significant extent, ASX300 quarterly returns do not essentially have to lead or attract to increasing or decreasing levels of MAMF quarterly returns. Similarly, ASX300 quarterly returns are Granger-caused by MAMF quarterly returns, and, therefore, the value of MAMF quarterly returns cannot be used to forecast the future level of ASX300 quarterly returns.

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Table 12. Granger causality test

Source: Author's computation using EViews software.

Null hypothesis	Obs.	F-stat	Prob.	Decision
BSE500 does not Granger cause MIMF returns	36	0.506	0.732	Accepted
MIMF does not Granger cause BSE500 returns	36	0.481	0.749	Accepted
ASX300 does not Granger cause MAMF returns	36	1.718	0.175	Accepted
MAMF does not Granger cause ASX300 returns	36	1.921	0.136	Accepted

CONCLUSION

Thus, the investigation shows that the returns of the Indian customized fund (MIMF) and BSE500 and Australian customized fund (MAMF) and ASX300 of mutual fund schemes are cointegrated. The presence of cointegrating equations between variables that provide rational expectations theory combined with past research and demonstrate long-run returns will be highly correlated. In the short run, Wald's test aims to identify the causal relationship of variables and the presence of a short-run proof of causal relationships between Indian customized funds (MIMF) and BSE500 and Australian customized funds (MAMF) and ASX300. The results show that any changes in the scheme's NAV (prices) cannot be used to foresee the direction of the Indian customized fund (MIMF) and BSE500 and the Australian customized fund (MAMF) and ASX300, respectively.

Thus, investing in specific mutual funds offers an alluring alternative for investors who need to build their portfolios in order to provide a similar pattern of the Indian and Australian benchmark indices. The proof of cointegration and causality suggests the likelihood of arbitrage benefitting, as investors are more likely to gain knowledge into the mutual fund performance, not just only depending on the movement of a standard index like BSE500 and ASX300. Fund managers achieve incredible success according to a positive alpha, which means that an investor should rely on numerous tools and techniques available to evaluate mutual fund schemes using performance indicators.

FUTURE RESEARCH

There is a scope for investment banks to make their customized indices publicly available for investors so that they can make the benchmark analysis rather than relying on the national standard index as a whole to compare against a fund or portfolio created by fund managers of asset management companies.

AUTHOR CONTRIBUTIONS

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Supervision: J. K. Raju.
Validation: J. K. Raju.
Writing – original draft: B. R. Manjunath, M. Rehaman.
Writing – review & editing: B. R. Manjunath, J. K. Raju, M. Rehaman.

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