

# Relationship Analysis of Selected Stocks and Funds

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## ABSTRACT

Over the past ten years, the number of mutual fund (MF) folios in India has increased fourfold due to rising SIP inflows, resulting in a nearly seven-fold growth in MF assets. Bipartite networks in finance, connecting funds and stocks, offer insights crucial for investment strategies. These tools give investors the information they need to evaluate how well their money has been invested or could be invested. Without considering risk-adjusted returns, an investor may unintentionally make a judgment that is obscured because they are unable to understand the big picture of investments. The purpose of this research is to examine the relationship of select Indian equity mutual funds and their portfolio holdings from the period January 2022 to December 2022 in the form of different stocks. Analyzing community detection reveals sectoral clusters, while performance analysis tracks historical trends. The analysis method used the computation of risk adjusted returns through Sharpe, Treynor, Jensen ratios and the creation of a bipartite network for the identification of mutual fund portfolio overlap. Additionally examined is the relationship between stocks because of their inclusion in the same portfolios.

## KEYWORDS

Relationship analysis, Sharpe ratio, Treynor ratio, Jensen ratio, Bipartite network.

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## INTRODUCTION

The expanding Mutual Fund Industry in India has established its position in the personal finance industry in India and has commenced lot of prospects to investors to diversify their investments across different sectors and investment avenues. Today we cannot assume our financial system and sector without Mutual Fund industry. The growth of Mutual fund industry is clearly visible in context of assets under management which increased by 5.7% in 2022 contributing a total increase by Rs 2.2 lakh crore and making a total of Rs 39.88 lakh crore in the same year. Mutual fund industry asset base also increased because of the increase in the SIP inflows contributing around Rs 13,000-crore in November 2022. Not only this, the number of mutual fund schemes and funds also seen a sharp rise in 2022, because of the investors' increased awareness about equities and their capacity to generate wealth over an extended term, investors increased their flows in the equity-oriented schemes. Equity funds have gained greatly this year because of low yields and a robust equities market, resulting in a significant shift out of debt and into equity. Equity schemes, index funds and ETFs seen an upsurge which accounted for a total of Rs 1.61 lakh crore and Rs 1.65 lakh crore inflows respectively, but debt schemes negatively contributed into total outflow of Rs 2.5 lakh crore in the year 2022.

As per these significant changes that took place in the year 2022, it would be interesting to analyze the performance and conduct relationship analysis of different funds and stocks.

This study investigates the topology of networks in Indian equities mutual funds using investment portfolios of different funds. Using bipartite networks and one-mode projection, network analysis is used to find and analyze the interrelationships that exist between mutual funds that invest in similar financial assets. This phenomenon is a financial network of assets and funds that overlap. As per the financial literature, understanding the network's topology is crucial since the assets distributed by each fund affect both its financial success and the industry's structure. As a result, financial contagions such as asset fire sales and mutual fund runs are affected in terms of stability and propagation. Both risk and industrial development suffer as a result.

As a result, the financial system, particularly the banking sector, has caught the interest of the networks literature, which wants to know more about its structure and how changes to it affect the risk of financial contagions forming and spreading. Portfolio overlaps relates to indirect exposure generated by two or more investors with exposure to the same financial asset, such as pension funds, hedge funds, and mutual funds. Very little attention is given to such a phenomenon in the financial system. The current research investigates the difficulties of portfolio overlaps using network analysis. The study covers all the equity diversified mutual fund schemes held by the top ten corporations, which comprise small, mid, and big cap companies. In addition, the study focused on obtaining an

accurate conclusion from which an investor may select the best funds from a variety of equities mutual funds.

Sharpe, Treynor, and Jensen's alpha were used in the bulk of the research to evaluate funds. However, employment of the Bipartite Network Model in this study accounts for extra variables like the interaction between the Stock Company and its mutual fund holding scheme.

The study of selected companies along with their equity mutual fund schemes and their portfolio holdings analysis in India is very desirable because it provides a full grasp of relationship analysis of equity mutual fund schemes, which is crucial for investors wanting a consistent return on their investment. These investors are frequently bewildered when it comes to choosing the ideal programme. This study will provide light on the fascination with inter-institutional holdings linkages. Because of its capacity to illustrate how equities are related to mutual funds and detect the implications of interactions, a bipartite network analysis approach is suggested to analyze the structure of both stocks and funds.

## LITERATURE REVIEW

The relationship between stocks and mutual funds has garnered significant attention in financial literature due to its implications for market dynamics, investor behavior, and portfolio management strategies. This literature review aims to synthesize existing research on the interconnectedness between stocks and mutual funds, exploring how their interactions shape financial markets and investment outcomes.

### Interdependencies in Portfolio Construction:

Studies have examined how mutual funds construct their portfolios and the impact of stock selection on fund performance (Fama & French, 2010). Researchers have investigated factors influencing mutual fund managers' stock choices, such as firm size, liquidity, and valuation metrics (Carhart, 1997). Understanding these interdependencies is crucial for assessing mutual fund performance and portfolio diversification strategies.

Sharma et al. (2014) analyzed the performance of various mutual fund schemes against a benchmark index to determine which scheme outperformed or underperformed the benchmark, concluding that because India is a developing economy, almost every sector is likely to experience significant growth in the future. Performance analysis of select mutual fund schemes was compared by Adhav and Chauhan (2015) using benchmark index. They identified that the performance of schemes has been superior to the last 5 years. Kaur (2014) used various measures such as standard deviation, beta, R-square, Sharpe, Treynor, and Fama's measure to examine the risk and return components of these mutual fund schemes, as well as the relationship between NAV and market portfolio return, and discovered that open-ended debt mutual funds did not outperform the benchmark indicator. Jayalakshmi

and Palanichamy (2020) used various measures such as Sharpe, Treynor, and Jensen's investment portfolio to compare the return and risk of select HDFC mutual fund undergrowth schemes to the benchmark index. They concluded that Sharpe and Treynor provide a positive response to the decision-making process, whereas Jensen's measure provides a negative response. Dhume and Ramesh (2011) studied the risk-return analysis of sector mutual funds and determined that, except for the infrastructure sector, all sector funds beat the market. Raj et al. (2018) applied multiple statistical indicators to understand the risk-return connections for SBI and HDFC mutual funds. One year of NAV data was collected for the study, which was then analyzed utilizing ratios such as the Treynor, Sharpe, and Jensen ratio, standard deviation, and beta. The findings suggested that the HDFC mutual fund had a better overall rate of return than the SBI mutual fund, but the SBI fund was less volatile than the HDFC fund.

Chitra (2018) has done performance analysis on NAV data from January 2007 to March 2017 using mutual fund risk and return characteristics of UTI Dividend Yield fund. The author also compared it with other selected schemes which demonstrates that the UTI Dividend Yield fund has the greatest rating, as well as a low standard deviation and beta value. Ravichandran (2017) analyzed the performance of mutual fund firms, studied the risk return parameter for mutual fund performance, and investigated the goal of evaluating future investments in open ended equity mutual fund schemes, and identified the performance of open-ended equity mutual fund schemes. The study comprised 20 investment programmes from various industries during January 2013 and March 2017. The annual return was compared to NAV data from the previous five years. Sharpe's, Treynor's and Jensen's Ratio with beta and standard deviation are used to compare funds and, the analysis shows that Reliance Diversified Power Sector Fund and Birla Sunlife Equity Fund are appropriate for low-risk investors because of their low beta in comparison with all other funds.

Prasad (2016) examined the performance of several Reliance Mutual Fund plans. The purpose of the paper was to assess the previous performance of selected open ended equities mutual funds and conduct a risk return analysis on them. Ten equity schemes were chosen for the study, and 5 years of NAV data were collected and analysed for performance analysis. The result suggested that investors with a high-risk tolerance for better returns could invest in the Reliance Banking Fund, while those with a moderate risk and return profile should go for the Reliance Small Cap Funds, and those with a low risk and return profile should choose the Tax Saver ELSS. Bhagyasree (2016) investigated the performance of 30 mutual fund schemes that were picked at random. Each day's closing NAVs were tracked for five years. Tata Equity Opportunity funds had the best returns, while Reliance Growth funds had the worst. Fourteen of the thirty mutual funds were considered low risk, while the others were considered high risk. Eight schemes with beta values greater than one are high-risk. All the reviewed funds had positive Sharpe ratios, with 14

of them outperforming the benchmark. In terms of Sharpe ratio, the top three funds were Tata Equity Opportunities Funds, HDFC Large Cap Fund, and Franklin India Flexi Cap Fund.

Various researchers have applied Treynor, Sharpe, and Jensen ratios along with beta and standard deviation to conduct performance analysis of the market.

### Price Dynamics and Market Efficiency:

Research has explored the relationship between stock prices and mutual fund flows, investigating how investor sentiment and fund inflows/outflows affect stock valuations (Shleifer & Summers, 1990). Studies have also examined the role of mutual funds in price discovery and market efficiency (Wermers, 2000). Understanding these dynamics is essential for evaluating market efficiency and the transmission of information between stocks and mutual funds.

The relationship between stocks and their mutual fund holdings can be represented in the form of bipartite graphs which can be used to model various real-life situations. Numerous authors have been using graphs to represent quantitative investments. Bescos et al. (2019) combined the structural data of a financial graph with a huge amount of node and edge features to perform node classification. Saha et al. (2022) discussed formulation of stock market graph formulation, filtering, and clustering, along with stock movement prediction, and portfolio optimization using graph theoretical approach. Arcangelis and Rotundo (2014) explored the equity exposure of Italian equity mutual funds and its portfolio holdings. The evidence in the study shows that fund managers take common decisions on stock holdings both for benchmark constraints and for style management decisions.

### Herding Behavior and Systemic Risk:

The phenomenon of herding behavior among mutual fund investors has been a focal point of research, with studies investigating its repercussions on market volatility and systemic risk (Barberis et al., 1998). Scholarly inquiry has explored how herding behavior impacts stock prices and mutual fund performance, particularly during market downturns (Scharfstein & Stein, 1990). This understanding is paramount for identifying systemic risks and implementing regulatory measures to mitigate market disruptions induced by herding behavior.

### Performance Evaluation and Investor Behavior:

A wealth of literature has assessed mutual fund performance vis-à-vis stock benchmarks, analyzing the factors contributing to fund outperformance or underperformance (Jensen, 1968). Additionally, researchers have scrutinized investor behavior in mutual funds, investigating the determinants of fund flows and investor sentiment (Grinblatt & Titman, 1989). This comprehension is pivotal for evaluating investment strategies and devising optimal portfolio allocations.

Table 1: Quarterly Sharpe Ratio of Selected Companies: Mutual Funds for the period January 2022 to December 2022

Company and its Mutual Fund Name	Period			March 2022 Quarter(1)			June 2022 Quarter(2)			Sep 2022 Quarter(3)			Dec 2022 Quarter(4)		
	Rf	$\sigma_p$	Sharpe Ratio	Rp	Sharpe Ratio	$\sigma_p$	Rp	Sharpe Ratio	$\sigma_p$	Rp	Sharpe Ratio	$\sigma_p$	Rp	Sharpe Ratio	
Axis Bank Ltd Axis Mutual Fund	4.28	2.51	4.01	14.71	4.01	2.54	14.31	3.95	2.52	14.32	3.98	2.51	14.38	3.97	
Tataj Timanra Ltd Bajaj Finserv Mutual Fund	4.28	2.59	4.07	14.82	4.07	2.46	14.79	4.27	2.63	14.37	3.84	2.51	14.50	4.06	
Bharti Airtel Ltd. Rishi Airtel Mutual Fund	4.28	2.66	3.90	14.67	3.90	2.65	14.66	3.91	2.61	14.74	3.89	2.51	14.33	4.01	
HDFC Bank HDFC Multi Cap Fund	4.28	2.56	3.96	14.48	3.96	2.67	14.41	3.79	2.49	14.44	4.08	2.49	14.35	4.04	
Housing Development Finance Corporation Ltd. HDFC Housing Finance Opportunities Fund	4.28	2.59	4.00	14.65	4.00	2.57	14.27	3.89	2.63	14.52	3.90	2.62	14.78	4.01	
ICICI Bank ICICI Prudential Large and Mid Cap Fund	4.28	2.79	3.95	14.56	3.95	2.54	14.43	3.99	2.70	14.46	3.78	2.67	14.39	3.87	
Infosys Ltd Infosys Large Cap Fund	4.28	2.63	3.93	14.64	3.93	2.51	14.50	4.07	2.65	14.41	3.82	2.66	14.62	3.88	
Reliance Industries Limited Reliance Mutual Fund	4.28	2.57	4.04	14.68	4.04	2.62	14.59	3.94	2.51	14.42	4.04	2.66	14.54	3.85	
State Bank of India SBI Large and Mid-Cap Fund	4.28	2.60	3.95	14.55	3.95	2.59	14.66	4.00	2.47	14.37	4.09	2.52	14.25	3.94	
Tata Consultancy Services Tata Multi Asset Opportunities Fund	4.28	2.70	3.77	14.46	3.77	2.55	14.30	4.02	2.58	14.49	3.92	2.58	14.77	4.07	

Source: Authors own compilation

Table 2: Quarterly Treynor Ratio of Selected Companies Mutual Funds for the period January 2022 to December 2022

Period	March 2022 Quarter			June 2022 Quarter			Sep 2022 Quarter			Dec 2022 Quarter		
	Ro (%)	Treynor Ratio	Ap (%)	Ro (%)	Treynor Ratio	Ap (%)	Ro (%)	Treynor Ratio	Ap (%)	Ro (%)	Treynor Ratio	Ap (%)
<b>Company and its Mutual Fund Name</b> Axis Bank Ltd	1.17	4.28	14.41	0.09	14.31	0.09	14.38	0.09	14.38	0.09	14.38	0.09
<b>Rajaj Finance Ltd</b> Rajaj Finance Mutual Fund	1.47	4.28	14.82	0.07	14.70	0.07	14.77	0.07	14.60	0.07	14.60	0.07
<b>Bharti Airtel Ltd.</b> Bharti Airtel Mutual Fund	0.80	4.28	14.67	0.11	14.66	0.11	14.44	0.11	14.71	0.12	14.71	0.12
<b>HDFC Bank</b> HDFC Multi Cap Fund	1.14	4.28	14.48	0.09	14.41	0.09	14.41	0.09	14.41	0.09	14.41	0.09
<b>Housing Development Finance Corporation Ltd.</b> HDFC Housing Opportunities Fund	1.28	4.28	14.65	0.08	14.27	0.08	14.52	0.08	14.78	0.08	14.78	0.08
<b>ICICI Bank</b> ICICI Prudential Large and Mid Cap Fund	1.08	4.28	14.96	0.10	14.48	0.09	14.46	0.09	14.49	0.10	14.49	0.10
<b>Infosys Ltd</b> Infosys Large Cap Fund	0.89	4.28	14.64	0.13	14.50	0.11	14.40	0.11	14.63	0.13	14.63	0.13
<b>Kaifirma Industries Limited</b> Kaifirma Mutual Fund	1.11	4.28	14.68	0.09	14.50	0.09	14.48	0.09	14.54	0.09	14.54	0.09
<b>State Bank of India</b> SBI Large and Mid-Cap Fund	1.19	4.28	14.55	0.09	14.66	0.08	14.47	0.08	14.71	0.08	14.71	0.08
<b>Tata Consultancy Services</b> Tata Multi Asset Oppotunities Fund	0.75	4.28	14.16	0.14	14.50	0.14	14.19	0.14	14.77	0.14	14.77	0.14

Source: Authors' own compilation

This comprehensive literature review underscores the profound interconnectedness between stocks and mutual funds and its far-reaching implications for market efficiency, investor behavior, and portfolio management. Continued research endeavors are imperative to elucidate evolving market dynamics, regulatory responses to systemic risks, and the impact of technological advancements on stock-fund interactions. Enhanced understanding of these interdependencies will empower policymakers and investors to fortify market stability and enhance investment outcomes. This paper enables us to understand the relationship between stocks and mutual funds.

## OBJECTIVES OF THE STUDY

1. To examine the bipartite network of selected stocks and mutual funds, as well as its projections.
2. To investigate how overlap and linkages between selected companies' stocks and funds are affecting the funds' selection and performance.

Our study aims to investigate the intricate dynamics between mutual funds and their constituent stocks, specifically focusing on how the composition of these stocks (small, mid, and big cap) affects the mutual funds' risk-adjusted returns. This relationship analysis is crucial for portfolio managers and investors to make informed decisions.

## METHODOLOGY & DATA ANALYSIS

The study is based on secondary data covering top 10 companies having higher market value which is recorded in BSE and NSE as on 31<sup>st</sup> December 2021 namely: ICICI Bank, HDFC Bank, Infosys, Reliance Industries, Housing Development Finance Corporation, Tata Consultancy Services, Bharti Airtel, State Bank of India, Axis Bank and Larsen & Toubro. Daily data of selected equity diversified mutual fund schemes containing a mix of small, mid, and big cap companies from January 1, 2022, to December 31, 2022, is used for analysis purposes. The selected companies within these mutual funds span across different market capitalizations to study their impact on the funds' performance and relationships.

The bipartite network of selected stocks and funds, as well as its projection, is the subject of this research. The selected scheme's portfolio returns were compared over four quarters. While evaluating a stock and a fund for the purpose of investing in, various factors are taken into consideration. In this research, four measures are taken, namely:

**Sharpe ratio:** Sharpe Ratio is a measure for calculating risk-adjusted return. Developed by Nobel laureate William F. Sharpe. The Sharpe ratio is "the average return earned in excess of the risk-free rate per unit of total risk":

Where = return of portfolio

= risk-free rate

= standard deviation of the portfolio's excess return

Where, the risk-free rate is the 10-year average treasury rate. The portfolio return is calculated by averaging the returns of mutual funds. The Sharpe ratio corrects a portfolio's past performance (or expected future performance) for the investor's excess risk. When compared to similar portfolios or funds with lower returns, a high Sharpe ratio is advantageous. The higher the Sharpe ratio of a portfolio, the better its risk-adjusted performance. If the Sharpe ratio is negative, it means that either the risk-free rate is higher than the portfolio's return or the portfolio's return is expected to be negative.

**Treynor ratio:** Treynor ratio, also known as the reward-to-volatility ratio, is a metric for returns that exceed those that might have been gained on a riskless investment, per each unit of market risk:

$$\text{Treynor Ratio} = \frac{(R_p - R_f)}{\beta_p}$$

Where:  $R_p$  =Portfolio return

$R_f$  =Risk-free rate

$\beta_p$  = Beta of the portfolio

Where, the risk-free rate is the 10-year average treasury rate. The portfolio return is calculated by averaging the returns of mutual funds. The beta for one year is collected from the web.

The Treynor ratio is a risk/return metric that allows investors to account for systematic risk in portfolio returns. A higher Treynor ratio indicates that a portfolio is a better investment. A higher ratio result is more desirable and indicates that a given portfolio is probably a better investment.

**Jensen's alpha:** Jensen's alpha or just "Alpha", measures the excess of expected return and portfolio return. Expected return is calculated using CAPM model. Higher value indicates the extremely good perform.

$$\text{Alpha} = R(i) - (R(f) + \beta \times (R(m) - R(f)))$$

Where:

$R(i)$  = the realized return of the portfolio or investment

$R(m)$  = the realized return of the appropriate market index

$R(f)$  = the risk-free rate of return for the time period

$\beta$  = the beta of the portfolio of investment with respect to the chosen market index

Where, the risk-free rate is the 10-year average treasury rate. The portfolio return is calculated by averaging the returns of mutual funds. The beta for one year is collected

from the web. The expected market return is calculated using 1-year Nifty 50 data and a quarterly base.

Jensen's measure is the difference between how much a person returns and how much the market returns. Jensen's metric is commonly known as alpha. When a manager outperforms the market while taking on risk, they are said to have "delivered alpha" to their clients. The measure considers the time period's risk-free rate of return. If the value is positive, the portfolio is making a profit. In other words, a positive Jensen's alpha value indicates that a fund manager has "beaten the market" with their stock-picking abilities.

The higher the Sharpe ratio, the better the investment because it represents a larger return on investment proportionate to the level of risk assumed. A portfolio as a whole or a particular stock or investment can be assessed using the ratio. Table 1 shows that the Sharpe ratio of all the mutual funds is positive. It means that all the mutual funds are better in their risk-adjusted performance. The portfolio of Bajaj finance ltd has the highest Sharpe ratio in the first and second quarter of the year 2022.

During the third quarter of the year State Bank of India's risk adjusting performance was highest whereas for ICICI Bank it was lowest. In December 2022, Tata consultancy services portfolio is having highest positive Sharpe ratio whereas the portfolio of Reliance Industries limited is having lowest positive Sharpe ratio in fourth quarter.

The fund with a larger standard deviation would have a lower Sharpe ratio if the returns offered by the two funds are identical. The fund must provide a higher return to maintain a better Sharpe ratio to offset the higher standard deviation. Put simply, it indicates the additional profit that an investor receives for assuming greater risk. It follows intuitively that an asset free of risk has a Sharpe ratio of zero. Above table 1 confirms that TCS has the highest standard deviation in quarter 1 but returns from the same company mutual fund are not adequate to compensate against that standard deviation. Rest in all other three quarters standard deviation of TCS fund reduces making its Sharpe ratio to be highest in third quarter.

The portfolio modification may result in an overall fall in risk, but it also raises the ratio, indicating a better risk/reward scenario. If the portfolio changes results in a decrease in the ratio, many financial analysts would view the portfolio addition as carrying an unacceptable amount of risk, and the portfolio change would not be made even though it would offer good returns.

Ratio analysis comes before almost every investment decision made in the financial sector. Comprehending measurements in conjunction with goals is an essential skill for all players in the market. This is because these ratios provide important information about several characteristics of an investment, most notably its potential profitability.

Table 2 depicts that the Treynor ratio of all the mutual funds are positive. Treynor ratio calculates the excess

returns that a financial asset or collection of securities generates for each additional unit of risk that the portfolio assumes. The ratio, also known as the reward-to-volatility ratio, indicates the extent to which an investor receives compensation for taking on systematic risk. All the selected companies invested their funds in competent investment alternatives and thereby earning sufficient returns on their invested funds. In all the four quarters of the year 2022 Tata Multi Asset Opportunities Fund has the highest Treynor Ratio. Thereby indicating that TCS fund outperformed in terms of their selection of investment opportunities and their funds are more desirable among the investors as their portfolio management is good. Whereas the portfolio of Bajaj Finserv Mutual Fund is having lowest positive Treynor ratio indicating that the company need to wisely choose their investment avenues and would focus on revising the portfolio of their investments.

By removing the volatility risk from each investment, the Treynor ratio serves as an analytical tool that facilitates the comparison of various prospects. Even though one investment has a larger beta than the other, it could have a lower Treynor ratio. Treynor ratio removes volatility risk, which lets you make an impartial decision. Certain portfolios may outperform others in the short term rather than the long run.

Jensen's measure, or Jensen's alpha, is a risk-adjusted performance indicator used in finance to assess, given the amount of risk as determined by the capital asset pricing model (CAPM), the excess returns achieved by a portfolio or investment in relation to its projected returns.

Table 3 indicates that the Jensen's Alpha of all the selected funds for all the quarters are high except September quarter. This means that all the fund managers of all companies have "beaten the market" with their stock-picking abilities, confirming that all the select companies' funds returns are significantly higher than the risk adjusted returns.

An indispensable tool for portfolio management is Jensen's alpha. It assists fund managers and investors in determining whether a portfolio's higher returns are the result of risk-taking or successful investing tactics. It is very helpful in figuring out how well portfolio managers provide value for investors.

### **Bipartite Network Analysis:**

A bipartite graph is a graph where the vertices can be divided into two mutually exclusive sets such that all edges connect a vertex in one set to a vertex in another set. There are no edges between vertices in the mutually exclusive sets. These graphs can be used to represent many systems, ranging from mutualistic networks of group interactions to investment networks in finance. The bipartite networks are useful for studying situations where financial institutions possess overlapping exposures to different asset classes.

Table 3

### Quarterly Jensen's Alpha of Selected Companies Mutual Funds for the period January 2022 to December 2022

Period		March 2022 Quarter	June 2022 Quarter	Sep 2021 Quarter	Dec 2021 Quarter
Company Mutual Fund Name		Jensen's Alpha	Jensen's Alpha	Jensen's Alpha	Jensen's Alpha
Axis Bank Ltd	Axis Mutual Fund	9.29%	7.76%	0.40%	15.80%
Bajaj Finance Ltd	Bajaj Finserv Mutual Fund	9.47%	8.57%	1.56%	17.45%
Bharti Airtel Ltd.	Bharti Airtel Mutual Fund	9.78%	8.09%	0.33%	14.17%
HDFC Bank	HDFC Multi Cap Fund	9.34%	8.15%	1.61%	15.85%
Housing Development Finance Corporation Ltd.	HDFC Housing Opportunities Fund	9.41%	7.99%	1.72%	17.01%
ICICI Bank	ICICI Prudential Large and Mid-Cap Fund	9.47%	8.05%	1.12%	15.80%
Infosys Ltd	Infosys Large Cap Fund	9.70%	8.48%	2.66%	14.87%
Reliance Industries Limited	Reliance Mutual Fund	9.57%	8.13%	0.83%	15.91%
State Bank of India	SBI Large and Mid-Cap Fund	9.37%	8.04%	0.10%	16.00%
Tata Consultancy Services	Tata Multi Asset Opportunities Fund	9.61%	8.75%	3.92%	14.31%

Source: Authors' own compilation

The fund common-holding bipartite network is initially constructed in this research to find the correlations among funds resulting from common stock holdings. Based on the market value of the bulk-holding stocks of each fund and the assumption that 'N' open-end funds hold a total of K stocks, the co-holding network is projected from a pre-constructed network between stocks and funds. The presence of co-holding between two funds is represented by an edge connecting fund nodes. The market value of the co-holding stocks that are held by the two funds is known as the edge weight, and it indicates the extent of influence between the two funds.

This study draws a bipartite graph on information between stocks and its mutual fund holdings. The fund data set consists of Indian equity mutual funds investing in domestic stocks as of December 31st, 2022. "Power BI: Data Visualization Software" was used to create the Bipartite Network model. The relationship between mutual funds and their constituent stocks is analysed using a bipartite network approach. This network consists of nodes representing mutual funds and stocks, with edges indicating the inclusion of stocks in the mutual funds.

The analysis begins by constructing a network based on the mutual funds' stock holdings. This approach helps us understand how the composition of stocks in mutual funds impacts their performance and risk profiles. If mutual fund owns stock in company, a link is formed between the two only if links from a mutual fund to a stock exists. As a result, the starting and ending nodes of each link belong to distinct sets.

Bipartite Network Model is used in this study to account for extra variables like the interaction between the Stock Company and its mutual fund holding scheme. Such a network can be projected into the space of relationships among mutual funds as follows: two funds are connected if they have at least one stock in common. Therefore, the number of stocks that the two funds have in common link connecting them. The node's degree is split into in-degree and out-degree. In Fig 1, in degree of each node represents the amount of different funds that buy shares of company in company whereas out-degree represents the number of different stocks that belong to the portfolio of fund. Fig 1, the bipartite network, is drawn using Power BI: Data Visualization tool.



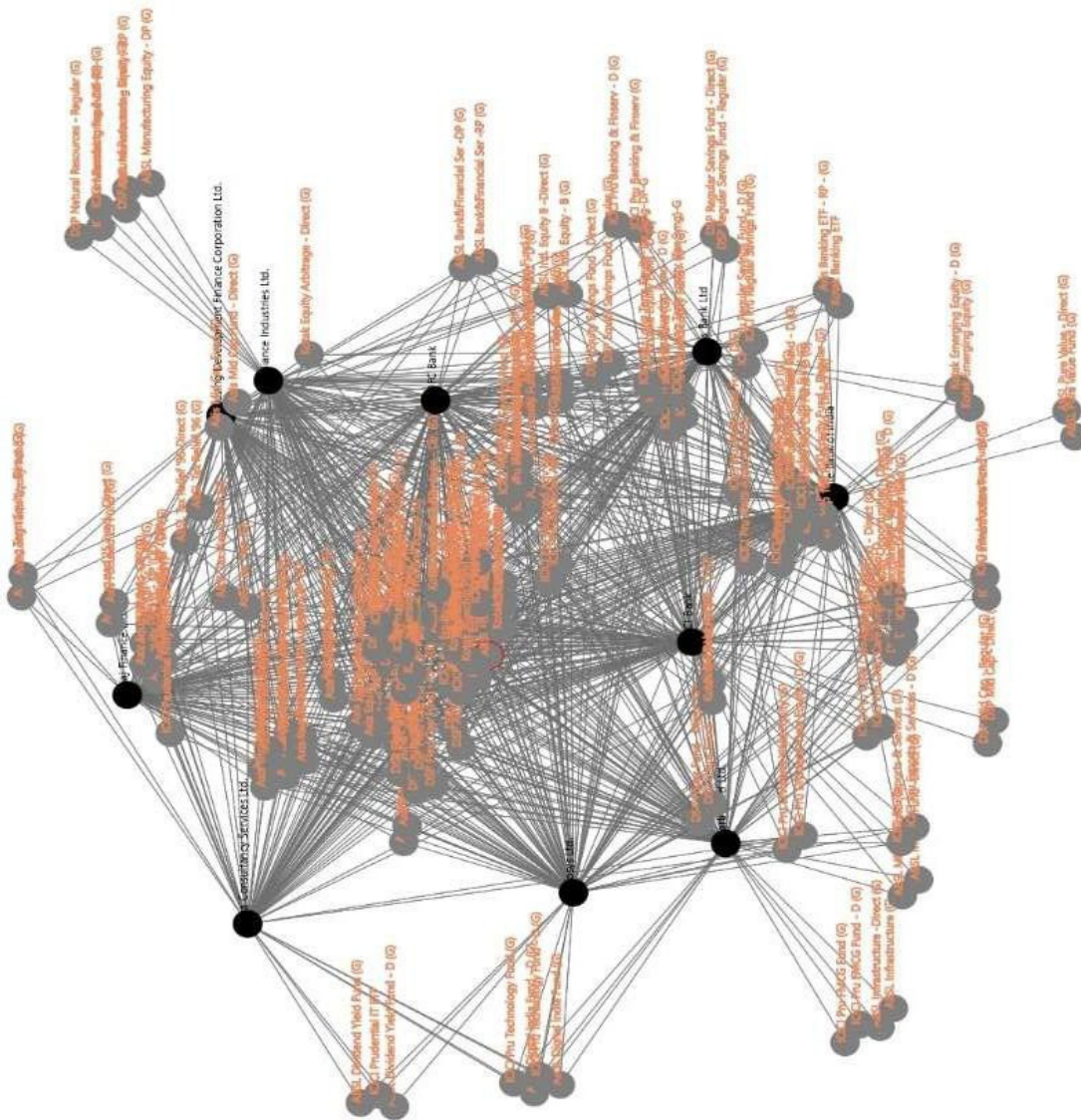


Figure 1: Bipartite Graph

The grey nodes are funds, while the black nodes are stocks. Such a network can be projected into the space of mutual fund relationships as follows: two funds are connected if they share at least one stock. As a result, the weight of the link connecting the two funds is determined by the number of stocks they share. The network diagram in Fig. 1 depicts a dense cluster surrounded by many stocks. Dense cluster shows that fund managers take common decisions on stock holdings as per stock indices performance and sectoral performance in the economy. Inter-nodal effects can also result from “herding effects” among investors. Mutual assets built on common assets have the potential to spread risk and result in larger losses than balance sheet exposures.

## CONCLUSION

The performances of the top ten portfolio equity mutual fund schemes were examined over the course of a year, from January 2022 to December 2022. The fund scheme returns were calculated using the quarterly opening and closing NAVs of various schemes. The past performances of the selected mutual fund schemes were studied to check performance based on Sharpe ratio, Treynor ratio, and Jensen’s ratio to measure result, and the results of the same would be informative for current and prospective investors to make wise investment/financial decisions. Positive returns have been achieved by all schemes. Furthermore, for all selected mutual fund schemes, the Sharpe ratio was positive, indicating that the mutual funds performed at or above the risk-free rate.

The complex network analysis methodology was used to describe how stocks are related to mutual funds and to detect the implications of the interactions. The findings show a large core group of portfolios that share many stocks, whereas other funds invest in a broader range of stocks. Inter-nodal effects, particularly those stemming from herding effects among investors, can significantly impact financial markets. When investors engage in herding behavior, they tend to follow the actions of

others rather than making independent decisions based on fundamentals. This can lead to the formation of asset bubbles or panics, causing prices to deviate from their intrinsic values.

Mutual assets built on common assets, such as mutual funds or exchange-traded funds (ETFs), can exacerbate these effects. These investment vehicles pool together funds from multiple investors and invest them in a diversified portfolio of assets. However, if a significant portion of investors in these funds engage in herding behavior, it can lead to amplified market movements.

Regulators and policymakers closely monitor these inter-nodal effects to understand systemic risks and develop measures to enhance financial stability. Strategies such as stress testing, increased transparency, and appropriate regulation of financial institutions and investment products can help mitigate the adverse consequences of herding behavior and inter-nodal effects on financial markets.

Similarities in the holdings of Indian funds were examined that invest in domestic stocks in this study. As per the empirical evidence, fund managers make common stock holding decisions as per the performance of the indices in the entire financial markets and different sectors contribution in the economy.

The study investigated how overlap affected performance and risk (raw performance, Sharpe Ratio, standard deviation, and beta coefficient). Research findings confirm that, at least for samples containing blue chip stocks, overlap is predictive of performance similarity, even though comparison to and influence of many other factors should not be overlooked. The intersection of small cap holdings, which is typically used for tactical asset allocation, makes fund final performance difficult to differentiate.

The analysis technique involves building a bipartite network and detecting mutual fund portfolio overlap. The relationship between stocks is also investigated because they are in the same portfolios.

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