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Momentum Effect, Value Effect, Risk Premium and Predictability of Stock Returns – A Study on Indian Market

ABSTRACT

Efficient market hypothesis (EMH), one of the central pillars of modern financial theories, often fails to explain the ‘financial anomalies’. One fatal challenge of EMH probably comes from the theoretical assumption of ‘rational man’. According to EMH, the fully rational investor may change his demand for financial assets on the basis of available information. According to EMH, at any given point of time, the stock price should reflect all the available information, and predictability of stock returns should be impossible. However, the literature shows ample evidence of abnormal returns related to firm and market specific attributes. In financial literature, these variations are often termed as ‘financial anomalies’. Within the framework of behavioural finance, there are research results that contain evidence on predictability of future stock market returns based on financial anomalies (Stanivuk, Skarica, and Tokic, 2012). Value effect and momentum effect are the two prominent financial anomalies (Ho, Chien-Wei, 2012). This paper explores the predictability of Indian stock market returns using multiple discriminant analysis. Our result shows that the risk premium, momentum and value effect may have significant power for predicting the Indian stock market returns. The validity test of the model also corroborates the impact of financial anomalies over predictability of stock returns.

Keywords: Value effect, momentum effect, risk premium, behavioral finance, stock returns, multiple discriminant analysis, predictability

GEL Classification: G12, C39
INTRODUCTION

Predictability of stock returns from the perspective of financial anomalies is an interesting topic to explore for financial researchers. This paper explores the predictability of Indian stock market on the basis of risk premium, value effect and momentum effect. Despite of the existence of papers that explain the predictability of stock returns on the basis of investor sentiment proxies (Baker & Wurgler J, 2000, Bandopadhyay A & Jones, A.L, 2006; Brown, G.W., & Cliff, M.T, 2004), there are very few work that explains the predictability of Indian stock market from the context of asset pricing models, and financial anomalies. In this paper, we considered risk premium (Sharpe, 1964; Lintner, 1966), value effect (Chan, Hamao, and Lakonishok, 1991) and momentum effect (Jegadeesh and Titman, 1993) for exploring the predictability of Indian stock market.

Our study is based on Indian security market data. We considered the Fama-French (1992) three factor model along with the momentum factor as developed by Carhart (1997). We applied the four factor Carhart model on Indian stock market data to see if they are really useful in predicting the Indian stock market. The result of our empirical study shows enough predictability power of the momentum effect (WML), value effect (HML) and risk premium ($r_{M} - r_{F}$). As we did not find much significant correlation between size effect (SMB) and the market return, therefore the predictability of size effect is not considered in this paper.

Our primary question is, whether the risk premium, size effect and the value effect are really capable of predicting the future market returns. The validation of the model also corroborates the impact of financial anomalies on future stock market returns.

LITERATURE REVIEW AND MOTIVATION

Behavioral finance has emerged as a fresh approach to address the anomalies of traditional finance theory. Behavioral finance theories does not consider the assumption of rational participants. Empirical results show that the efficient market hypothesis often may not be able to explain the financial phenomena e.g. firm characteristics such as size effect and value/growth stocks, Long –run reversals, short-term momentum etc.

The original capital asset pricing model (CAPM), as proposed by Sharpe (1964), Lintner (1965), and Mossin (1966) assumes that investors are rational creature and the relationship between asset betas, and expected return changes in a linear fashion. Fama and French (1992) challenged this view by demonstrating that beta is unrelated to asset return. A behavioral explanation of this phenomenon is the role played by ‘noise traders’ in the market. ‘Noise’ trading or unsophisticated trading often takes place due to optimistic or pessimistic beliefs or sentiments by unsophisticated traders (Black, 1986). According to Antoniou, C., Doukas, J.A. &
Subrahmanyam, A. (2015), noise traders’ activities affect the high beta stocks more at the time of optimism.

Value effect was first noted by Basu (1977), who observed that firms having high earning/price ratio (E/P) earn higher return than estimated by CAPM. Similarly, later on researchers discovered that stocks with high Book value / market value (B/M), Cash flow / price (C/P) also earns abnormally high return compared to those having lower E/P, B/M, and C/P (Banz, 1981; Lakonishok, Shleifer, and Vishny, 1994; Fama and French, 1998).

One behavioral explanation for value effect is linked to investor irrationality, which leads to abnormal earning by high B/M portfolios. According to Lakonishok, Shleifer, and Vishny (1994) investors make error in expecting future earnings on growth and value stocks. They become overoptimistic about the past good performers, and also over pessimistic about the past poor performers. This leads to over pricing of growth stocks and under pricing of value stocks. The views expressed by Lakonishok, Shleifer, and Vishny (1994) also supported by empirical evidence (La Porta, Lakonishok, Shleifer, and Vishny, 1997; Skinner and Sloan, 2002).

Another important financial anomaly called momentum effect is first noticed by Jegadeesh and Titman (1993). They found stocks that generated high return over the past three to twelve months (winners) outperform the stocks that generated low returns (losers) over the next three to twelve months.

Momentum effect found ample empirical support both at industry level as well as in international markets (Moskowitz and Grinblatt, 1999, Rouwenhorst, 1998; Griffin, Ji, and Martin, 2003, 2005). The behavioural explanation of momentum effect is based upon investor psychology and market inefficiency (Barberis, Shleifer, and Vishny, 1998; Daniel, Hirshleifer, and Subrahmanyam, 1998; Hong and Stein, 1999). ‘Conservatism bias’, ‘representative heuristic’, and ‘self-attribution bias’ are considered responsible for momentum effect (Barberis, Shleifer, and Vishny, 1998; Daniel, Hirshleifer, and Subrahmanyam, 1998).

Momentum profits are attributed to the bounded rationality of investors, who use partial information when updating their information (Hong and Stein, 1999). An argument is momentum profits arise only under optimism, and are driven principally by strong momentum in losing stocks (Antoniou, C., Doukas, J.A. & Subrahmanyam, A, 2013).

Fama and French (1993) proposed a three factor model to capture the average returns associated with US markets.

\[
R_i(t) – R_f(t) = \alpha_i + b_i (R_{mt} – R_f) + s_i \text{SMB}(t) + h_i \text{HML}(t) + e_i(t) \quad \text{------------------------ (1)}
\]

In this regression equation, \(R_i(t)\) is the return on asset i for month t, and \(R_f(t)\) is the risk free rate. \(\text{SMB}(t)\) explains the size effect on stock returns, and is the difference between the returns on diversified portfolios of small stocks and big stocks. \(\text{HML}(t)\) represents the value effect. It is the difference between returns on diversified portfolios high book-to-market (value) stocks and low book-to-market (growth) stocks. Carhart (1997) further added momentum effect to equation (1),
\[ R_i(t) - R_f(t) = \alpha_i + b_i (R_{mt} - R_{ft}) + s_i \text{SMB}(t) + h_i \text{HML}(t) + w_i \text{WML}(t) + e_i(t) \]  

\[ (2) \]

In equation (2), the difference of past returns between winners’ portfolio and the losers’ portfolio for month t is termed as WML. WML represents the momentum effect of stocks returns.

Fama and French (1992), and Carhart (1997) proposed the model on the basis of US market data. Fama and French (2012) also examined the size, value, and momentum effect in international markets.

Pandey and Sehgal (2015) examined the size effect in Indian market. Their study shows evidence of strong size effect in Indian stock market. Sehgal and Jain (2011) also tasted the momentum patterns in Indian market. Their finding shows momentum profits in Indian context for prior return portfolios are stronger for 6-6 compared to 12-12 strategies. Sehgal and Tripathi (2007) also identified significant value effect in Indian market.

Though there are studies in India that demonstrates existence of size, value and momentum effect in Indian market, there are few studies that explores on the issue of predictability on the basis of asset pricing models. Our paper adds to the existing literature by exploring the predictability of Indian stock markets by using the asset pricing model.

So, the literature provides ample evidence that value effect and momentum effect results from the behavioural anomaly of investors. Our motivation behind this paper is to explore if the value effect and momentum effect may be used for predicting the future stock market returns. Despite the existing literature documents that investor sentiment exhibits certain degree of predictability of stock returns, few studies address the issues with respect to the Indian stock market return. This paper attempts to shed light on how financial anomalies can help to enhance our understanding of stock price behaviour when it plays various roles in the asset pricing models from the perspective of Indian market.

The purpose of this paper is to propose new directions of the roles of investor sentiment that researchers could adopt in the analysis of the explanatory power of value effect and momentum effect for stock price behaviour.

**RESEARCH OBJECTIVE AND METHODOLOGY**

The objective of this paper is to assess the predictability of stock returns in relation to the investor sentiment. To achieve this objective, we investigated the role investor sentiment may play in asset pricing. The paper aims to examine the ability of momentum and value premium in predicting the stock market returns. As discussed earlier, in literature, there is ample evidence that investor sentiment captures the momentum and value premium.

In this paper, we considered the WML, HML, and market premium as independent variable and examines the efficacy of investor sentiment as predictors of stock market returns. This paper seeks to understand the effect of investor sentiment on the predictability of stock returns. As
discussed earlier, WML, HML, and market premium possesses a behavioral explanation to explore.

To achieve the abovementioned objective, we started with Capital asset pricing model (CAPM), and then added two extensions to it. The first one is the momentum factor as documented by Jegadeesh and Titman (1993), and the second one is the value premium.

The momentum factor is represented by winners-versus-loser (WML) portfolio. And the value premium is represented by high-minus-low (HML) portfolio. We considered the Nifty 50 as a proxy for market portfolio.

**Sample Composition**

The secondary data of Nifty used in this analysis has been collected from the website of National Stock Exchange of India (NSE) [www.nseindia.com](http://www.nseindia.com). The data for SMB, HML, WML, and Risk Premium is sourced from *Data library for Indian market* maintained by Indian Institute of Management, Ahmedabad [http://www.iimahd.ernet.in/~iffm/Indian-Fama-French-Momentum/four-factors-India-90s-onwards-IIM-WP-Version.pdf](http://www.iimahd.ernet.in/~iffm/Indian-Fama-French-Momentum/four-factors-India-90s-onwards-IIM-WP-Version.pdf) The monthly data is being collected for the period starting from January, 2004 to February 2014. The data for March 2014 to December 2015 is used for validation of model.

As the sample size is high (>40), therefore the normality test is not a pre-requisite for applying parametric tests (Elliott & Woodward, 2007). Therefore, normality test is not mandatory in this case. However, the Q-Q plots of the variables are shown in annexure 1.

**Period of the Study**

The sample period starts from January, 2004 to February 2014 for classification purposes. Also the data from March 2014 to December, 2015 is used for validation of the model.

**Variables Specification**

In the proposed model, we considered the winner minus loser (WML), high minus low (HML), and market risk premium (RP) as independent variables. The impact of investor sentiment on momentum effect and value effect is well discussed in literature. In this paper, we will test the effect of investor sentiment on stock returns in Indian market. In the present study, we tried to understand, if the investor sentiment really influences the stock return in Indian market. Before choosing the variables and applying Discriminant Analysis, we first need to classify the nifty return as ‘impacted’ and ‘not impacted’. While there is no definitive method for defining a market return as ‘impacted’ or ‘not impacted’ here we have used a method that is simple and
Objective: if the return of Nifty over a given month rose above the average market return, it is considered as ‘impacted’ by investor sentiment, and otherwise it is classified as ‘not impacted’ by investor sentiment. Here we have taken monthly Nifty (Index of National Stock Exchange) return as proxy for market return. To obtain the return at the end of each month, we have used the ending price of last trading day for each month. We considered Nifty return as market return proxy, as it represents around 65% of total market capitalization as of May, 2016. NSE is also the largest trading platform for stocks in India.

The return has been calculated by the following formula

\[
\text{Return of Stock} = \frac{P_t - P_{t-1}}{P_{t-1}} \times 100.
\]

Where,

\( P_t \) = Price at the T month

\( P_{t-1} \) = Price at the T-1 month

\[
\text{Market return} = \frac{Nifty(t) - Nifty(t-1)}{Nifty(t-1)} \times 100
\]

Similarly \( Nifty(t) = Nifty \) at the t month and \( Nifty(t-1) = Nifty \) at the (t-1) month.

We considered the monthly data for the period starting from December 2003 to February 2014. As discussed earlier we have taken dependent variable as ‘impact’ or ‘no-impact’ and five independent variables.

Table 1: Dependent variable

| Impact on Nifty Return | Description                                      |
|------------------------|--------------------------------------------------|
| Impact                 | Return above average Market return i.e Nifty     |
| No Impact              | Return below average Market return i.e Nifty     |

Table 2: Dependent Variable Encoding

| Original Value | Internal Value |
|----------------|----------------|
| Impact         | 1              |
| No Impact      | 0              |
Table 3: Independent variables

| Name of the Variables | Description of the variables |
|-----------------------|------------------------------|
| HML                   | High minus low               |
| WML                   | Winner minus Loser           |
| Risk_Prem             | Risk Premium                 |

EMPIRICAL TESTING

First, we constructed the correlation matrix as shown in table (4). As may be observed from table 4, the significance of correlation between SMB and nifty return is 0.570, which implies there is hardly any relationship between SMB portfolio return and Nifty return. So, we decided to exclude SMB from discriminant function and include only risk premium ($r_{m} - r_{f}$), HML and WML.

Table 4: Correlation Matrix

|                  | Nifty_Ret | SMB          | HML            | WML            | Risk_prem      |
|------------------|-----------|--------------|----------------|----------------|----------------|
| **Nifty_Ret**    | Pearson Correlation | 1            | -0.054         | 0.315**        | 0.350**        | -0.879**       |
| Sig. (2-tailed)  | 0.570     | 0.001        | 0.000          | 0.000          | 0.000          |
| N                | 115       | 115          | 115            | 115            | 115            |
| **SMB**          | Pearson Correlation | -0.054       | 1              | 0.469**        | -0.041         | 0.195(*)       |
| Sig. (2-tailed)  | 0.570     | 0.000        | 0.667          | 0.037          |
| N                | 115       | 115          | 115            | 115            |
| **HML**          | Pearson Correlation | -0.315**     | 0.469**        | 1              | -0.119         | 0.408**        |
| Sig. (2-tailed)  | 0.001     | 0.000        | 0.206          | 0.000          |
| N                | 115       | 115          | 115            | 115            | 115            |
From Table 5, we get the discriminant equation (3) as

\[ Z = -0.118 + 0.138 \times \text{Risk}_\text{Prem} + 0.047 \times \text{HML} - 0.007 \times \text{WML} \]

To calculate the Cutting Score Z for unequal size of two groups we use the formula

\[ Z = \frac{n_0 Z_0 + n_1 Z_1}{2} \]

Where \( Z_0 = \) Group Centroids for ‘No impact’ and \( Z_1 = \) Group Centroids for ‘Impact’. Here \( n_0 = 71 \), \( n_1 = 44 \) and \( Z_0 = 0.598 \), \( Z_1 = -0.965 \). Substituting the values in the equation, we get cutting score of -0.005

Now from the Discriminant equation as above, if put the values of the variables Risk premium, HML and WML, we will get a score. If the score is more than -0.001, it will be classified as IMPACT otherwise NO IMPACT.

Table 5: Canonical Discriminant Function Coefficients (Using SPSS)

| Function | Coefficient |
|----------|-------------|
| HML      | 0.047       |
| WML      | 0.007       |
| Risk_prem| 0.138       |
| Constant | -0.118      |

Source: Authors’ own

Unstandardized coefficients

The coefficients displayed in this table are the coefficients of the canonical variable. The coefficients are used to compute canonical variable scores for each case.
Table 5: Functions at Group Centroids

| Nifty Binary | Function |
|--------------|----------|
| No Impact    | 0.598    |
| Impact       | -0.965   |

Source: Authors’ own

*Unstandardized canonical discriminant functions evaluated at group means.

Classification Accuracy

The classification table helps to assess the performance of the model by cross tabulating the observed response categories with the predicted response categories.

Table 6: Classification Results (Using SPSS)

| Classification Results(a) | Nifty Binary | Predicted Group Membership | Total |
|---------------------------|--------------|-----------------------------|-------|
|                           |              | 0   | 1   |       |
| Original Count            | No Impact    | 59  | 12  | 71    |
|                           | Impact       | 5   | 39  | 44    |
| %                         | No Impact    | 83.1| 16.9| 100.0 |
|                           | Impact       | 11.4| 88.6| 100.0 |

Source: Authors’ own

The Table 6 shows the comparison of the observed and the predicted performance of the Nifty return and to the extent that it can be correctly predicted. This table measures the degree of success of the classification for this sample. The number and percentage of cases correctly classified and misclassified are displayed. From the above Table 6 it is demonstrated that the
companies, which does not get impacted by investors’ behaviour, have 83.1% correct classification rate, while companies that got impacted by investors’ behaviour have 11.4% correct prediction rate. Overall correct classification was observed in 85.2% of original grouped cases.

**Tests of Goodness of Fit**

The ranks and natural logarithms of determinants printed are those of the group covariance matrices.

**Table 7: Log Determinants (Using SPSS)**

| Nifty_Binary               | Rank | Log Determinant |
|----------------------------|------|-----------------|
| No Impact                  | 3    | 10.575          |
| Impact                     | 3    | 10.665          |
| Pooled within-groups       | 3    | 10.669          |

Source: Authors’ own

In the multi-group model, log determinant values provide an indication of which groups covariance matrices diverge most. For each group, its log determinant is the product of the eigenvalues of its within group covariance matrix. The rank is the row or column rank which is the maximum number of linearly independent rows or columns. From Table 7, it is clear that all three variables are linearly independent and all three variables are important for measuring the performance of the index. The present study also estimated the Box’s M statistic, which provides useful information about the calibration of the model. Box’s M statistic tests the null hypothesis of equal population covariance matrices.

The significance of Box’s M statistic is based on an F transformation. The hypothesis of equal covariance matrices is rejected if the significance level is small (less than say 0.10). The hypothesis of equal covariance matrices is not rejected if the significance level is large (more than say 0.10). The test can be significant when within-group sample sizes are large or when the assumption of multivariate normality is violated. Here the value of significant level is very large i.e. 0.373 which implies it is highly accepted. So we can conclude that there is no significant difference between covariance matrices of two populations. So we can classify the two populations by DA.
Table 8: Box’s Statistics

Test Results

| Test Results                  |       |
|-------------------------------|-------|
| Box’s M                       | 6.676 |
| F Approx.                     | 1.078 |
| df1                           | 6     |
| df2                           | 55,229.995 |
| Sig.                          | 0.373 |

Source: Authors’ own

*Tests null hypothesis of equal population covariance matrices.

Table 9: Structure Matrix (Using SPSS)

| Structure Matrix              | Function |
|-------------------------------|----------|
| Risk_prem                    | 0.964    |
| HML                           | 0.502    |
| WML                           | -0.363   |

Source: Authors’ own

*Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions. Variables ordered by absolute size of correlation within function.

The structure matrix contains within-group correlations of each predictor variable with the canonical function. This matrix provides another way to study the usefulness of each variable in
the discriminant function. Risk premium has the highest correlation with the discriminant scores, followed by percentage increase in HML, and WML.

Validation of the Model.

Model validation requires checking the model against independent data to see how well it predicts. Typically, the steps of model fitting start with collecting an independent data set and validating the results on it. To validate our model, we have taken 21 test samples as given in the annexure III. The validation result is given in the Table 10.

Table 10: Classification Results

|       | Prediction | Total |
|-------|------------|-------|
|       | Impact     | No Impact |
| Actual| Impact     | 9      | 2     | 11    |
|       | No Impact  | 2      | 8     | 10    |
|       | 81.81%     | 80%    | 21    |

80.95% of original grouped cases correctly classified.

Source: Authors’ own

The Table 10 shows the comparison of the observed and the predicted performance of the evaluation data set and to the extent that it can be correctly predicted. The 81.81% of the times impact on Nifty return were classified correctly while 80% of the times no impact on Nifty return were predicted correctly. The overall prediction rate is 80.95%. So we can conclude that our model equation can reasonable predict the performance of Nifty by using three predictor ratios.

Scope For Future Research and Conclusion

The study employs the multiple discriminant analysis models, to determine whether the sentiment of investors significantly affect the performance of the stock returns.

We used three proxies finally to represent the investor sentiments. These proxies are Risk premium, High minus low (HML) and Winner minus loser (WML). The study reveals significant impact of investor sentiment on stock returns. The model shows that the three proxies can classify up to 85.2% into two categories ‘impact’ and ‘no impact’. The model is also validated by using monthly data from March, 2014 to December, 2015. The overall prediction rate is 80.95%
in case of validation period. This indicates that our model is reasonably good in predicting the future stock market returns by using the investor sentiment proxies.

We identified two important areas for future scope of research. One important point to note here is that the model is structured after deleting the outliers. Therefore, in extreme situations of euphoria or depression, it may be challenging to apply the model most suitably. A further development of this model may be required for capturing the predictability factor at the time of extreme scenarios.

Secondly, we covered the entire period of February, 2004 to January, 2014 in this period. This is a long period that went through both optimistic phase as well as pessimistic phase. A future research may be taken up to explore, if the predictability of momentum effect, value effect, and risk premium varies with prevailing optimism and pessimism in the market.
Annexure-I

Normal Q-Q Plot of Risk prem

Normal Q-Q Plot of HML

Normal Q-Q Plot of WML

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Annexure II - Sample Data Set (116 Observations)

| Month | Risk_Prem | HML   | WML   | Nifty | Nifty_Ret | Nifty_RetBinary |
|-------|-----------|-------|-------|-------|-----------|-----------------|
| 200312 | 19.05120044 | 11.74731 | -2.60308 | 2139.93 |           |                 |
| 200401 | 5.658387764 | -9.34468 | 5.27027 | 2062.42 | 0.036221 | 1               |
| 200402 | 1.259000985 | -7.93819 | 2.585612 | 2052.4 | 0.004858 | 1               |
| 200403 | 0.041122209 | -5.17401 | 7.982136 | 2020.25 | 0.015665 | 1               |
| 200404 | 3.433906011 | 6.650796 | 1.245006 | 2048.22 | -0.01384 | 0               |
| 200405 | 7.709809881 | 7.336307 | -4.21523 | 2062.42 | 0.013475 | 0               |
| 200410 | 1.279246178 | 4.62564 | 4.988939 | 2069.39 | -0.02414 | 0               |
| 200411 | 9.896722188 | 15.44902 | 1.827413 | 2268.99 | -0.09645 | 0               |
| 200412 | 9.247121509 | 8.249964 | 1.87281 | 2418.88 | -0.06606 | 0               |
| 200501 | 1.993262619 | -1.63239 | 4.39615 | 2393.76 | 0.010385 | 1               |
| 200502 | 3.844331065 | 6.037351 | 4.01612 | 2447.94 | -0.02263 | 0               |
| 200503 | 3.411059082 | 0.314559 | 5.557902 | 2369.69 | 0.031966 | 1               |
| 200504 | 4.678075783 | 5.508978 | -1.71103 | 2214.96 | 0.065295 | 1               |
| 200505 | 8.435881594 | 13.07745 | -1.50125 | 2433.73 | -0.09877 | 0               |
| 200506 | 3.369301629 | 1.431353 | -0.97732 | 2599.93 | -0.06829 | 0               |
| 200507 | 6.921827866 | 8.900859 | 9.521326 | 2711.24 | -0.04281 | 0               |
| 200508 | 6.072395349 | 21.64431 | 8.994249 | 2801.99 | -0.03347 | 0               |
| 200509 | 5.622392125 | -14.6792 | -3.36966 | 3066.15 | -0.09428 | 0               |
| 200510 | 9.981096925 | -8.0784 | -6.33627 | 2795.89 | 0.088143 | 1               |
| 200511 | 11.26517381 | -3.00652 | 4.384687 | 3127.8 | -0.11871 | 0               |
| 200512 | 6.14434945 | -5.32001 | 4.166527 | 3353.37 | -0.07212 | 0               |
| 200601 | 6.176885323 | 0.318021 | 8.030291 | 3549.92 | -0.05861 | 0               |
| 200602 | 2.095883818 | -4.14746 | -0.46853 | 3639.43 | -0.02521 | 0               |

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| Year     | Value1  | Value2  | Value3  | Value4  | Value5  | Value6  |
|----------|---------|---------|---------|---------|---------|---------|
| 200603   | 9.445545186 | -4.45819 | 7.16075 | 4028.82 | -0.10699 | 0       |
| 200604   | 6.961848509  | 7.546438 | 4.971222 | 4155.54 | -0.03145 | 0       |
| 200605   | 14.18822699  | 0.312349 | -0.05668 | 3642.31 | 0.123505 | 1       |
| 200606   | 4.718756797  | -9.48618 | 6.570333 | 3721.71 | -0.0218  | 0       |
| 200607   | 0.824822822  | -1.54574 | -2.29739 | 3745.46 | 0.00638  | 0       |
| 200608   | 8.814090459  | 4.674531 | -4.53126 | 4073.55 | -0.0876  | 0       |
| 200609   | 5.99737031   | -2.58423 | 5.34209  | 4288.97 | -0.0218  | 0       |
| 200610   | 4.18712711   | 0.56038  | 6.390882 | 4476.5  | -0.04372 | 0       |
| 200611   | 4.741706122  | -1.09861 | -3.32966 | 4729.13 | -0.05643 | 0       |
| 200612   | 0.363988489  | 13.10443 | 3.399343 | 4758.45 | -0.0062  | 0       |
| 200701   | 3.002935889  | -2.35327 | -2.55517 | 4504.73 | 0.080553 | 1       |
| 200702   | 8.653237639  | -3.25327 | -2.55517 | 4504.73 | 0.080553 | 1       |
| 200703   | 0.069616519  | -1.99339 | -0.7247  | 4605.89 | -0.02246 | 0       |
| 200704   | 6.877461388  | -0.5807  | 0.225539 | 4934.46 | -0.07134 | 0       |
| 200705   | 5.148924996  | 0.356322 | 1.663965 | 5185.95 | -0.05097 | 0       |
| 200706   | 1.743298769  | 3.230293 | -0.78482 | 5223.82 | -0.0073  | 0       |
| 200707   | 4.691409513  | 1.96421  | -1.435   | 5483.25 | -0.04966 | 0       |
| 200708   | 1.380811833  | 16.6705  | 0.027155 | 5411.29 | 0.013124 | 1       |
| 200709   | 13.48829416  | 14.87359 | 3.956491 | 6094.11 | -0.12618 | 0       |
| 200801   | 20.13190877  | -2.84969 | 1.185848 | 6245.45 | -0.02483 | 0       |
| 200802   | 0.935052836  | -4.50007 | -2.98656 | 6356.92 | -0.01785 | 0       |
| 200803   | 13.06570607  | -8.06556 | -4.9839  | 5762.88 | 0.093448 | 1       |
| 200804   | 11.69764203  | 5.63356  | 0.708803 | 6289.07 | -0.09131 | 0       |
| 200805   | 7.010602395  | 0.825354 | -3.98828 | 5937.81 | 0.055852 | 1       |
| 200806   | 19.89981968  | -4.26879 | -2.58969 | 4929.98 | 0.169731 | 1       |
| 200807   | 7.215044987  | 2.151253 | 2.122408 | 5297.47 | -0.07454 | 0       |
| 200808   | 0.148913937  | -3.55362 | -2.77073 | 5337.28 | -0.00751 | 0       |
| 200809   | 13.67368806  | -6.15106 | 4.029424 | 4807.2  | 0.099317 | 1       |
| 200810   | 28.59684511  | -1.41488 | 7.329911 | 3539.57 | 0.263694 | 1       |
| 200811   | -6.94915423  | -0.67334 | 11.60046 | 3379.53 | 0.045215 | 1       |
| 200812   | 11.1800236   | 0.380473 | -16.5652 | 3635.87 | -0.07585 | 0       |
| Date     | Value1 | Value2 | Value3 | Value4 | Value5 | Value6 |
|----------|--------|--------|--------|--------|--------|--------|
| 200901   | 4.840050098 | 0.1105 | 12.29892 | 3538.57 | 0.026761 | 1       |
| 200902   | 4.784089043 | 0.597062 | 4.816556 | 3403.33 | 0.038219 | 1       |
| 200903   | 7.370561977 | -6.47966 | -7.11922 | 3720.51 | -0.0932 | 0       |
| 200904   | 15.96390879 | 2.765784 | -16.4228 | 3480.75 | 0.064443 | 1       |
| 200905   | 35.43233947 | 4.838734 | -25.8241 | 4448.95 | -0.27816 | 0       |
| 200906   | 2.632174353 | -3.9843 | 2.578913 | 4375.5 | 0.01651 | 1       |
| 200907   | 7.876201597 | 0.064642 | -0.07695 | 4636.45 | -0.05964 | 0       |
| 200908   | 2.306624505 | 11.35739 | -5.25882 | 4732.35 | -0.02068 | 0       |
| 200909   | 7.378475904 | 2.994355 | 2.161749 | 4958.95 | -0.04788 | 0       |
| 200910   | 6.681428376 | -3.7415 | 10.56274 | 4711.7 | 0.049859 | 1       |
| 200911   | 7.430555465 | 1.885419 | 5.774941 | 4941.75 | -0.04883 | 0       |
| 200912   | 4.479858283 | 4.579933 | -2.5882 | 5178.95 | -0.04788 | 0       |
| 201001   | 3.390150576 | -0.5962 | 1.417594 | 4882.05 | 0.057228 | 1       |
| 201002   | 1.224281969 | 1.056227 | 3.858059 | 4922.3 | -0.00824 | 0       |
| 201003   | 3.785098857 | 3.424411 | 1.342831 | 5282 | -0.07308 | 0       |
| 201004   | 1.468775805 | 2.680367 | 2.633886 | 5278 | 0.000757 | 1       |
| 201005   | 3.890289421 | -6.31948 | -2.47617 | 5066.55 | 0.040063 | 1       |
| 201006   | 4.331692551 | -3.0872 | -1.63198 | 5269.05 | -0.03997 | 0       |
| 201007   | 1.419114619 | 4.482085 | 5.288242 | 5367.6 | -0.0187 | 0       |
| 201008   | 0.303834985 | 3.488453 | 4.143739 | 5408.7 | -0.00766 | 0       |
| 201009   | 7.804940179 | 2.928615 | -0.29244 | 6018.3 | -0.11271 | 0       |
| 201010   | 0.187792891 | 5.651148 | 3.37052 | 6017.7 | 9.97E-05 | 1       |
| 201011   | 5.716919406 | -9.73634 | 5.360069 | 5751.95 | 0.044161 | 1       |
| 201012   | 2.516976689 | 1.428324 | -6.11173 | 6134.5 | -0.06651 | 0       |
| 201013   | 10.40447196 | -1.9267 | 4.811695 | 5512.15 | 0.101451 | 1       |
| 201014   | 4.513735547 | -12.0195 | 2.761942 | 5303.55 | 0.037844 | 1       |
| 201015   | 7.109843831 | 6.509008 | 1.31593 | 5654.25 | -0.06613 | 0       |
| 201016   | 0.408010068 | 0.777512 | 0.805566 | 5749.5 | -0.01685 | 0       |
| 201017   | 3.341716794 | -0.54076 | 4.313941 | 5476.1 | 0.047552 | 1       |
| 201018   | 0.512674719 | -2.77452 | 4.726908 | 5471.25 | 0.000886 | 1       |
| 201019   | -1.505264 | 3.918115 | 5482 | -0.00196 | 0       |
| Year   | Month | Value 1 | Value 2 | Value 3 | Value 4 | Value 5 | Value 6 | Value 7 | Value 8 | Value 9 | Value 10 | Value 11 | Value 12 | Value 13 | Value 14 |
|--------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----------|-----------|-----------|----------|----------|
| 2011   | 1     | 2.191470796 | -7.41094 | 10.49578 | 4839.6  | 0.117184 | 1        |         |         |         |           |           |           |          |          |
|        | 2     | -2.35125062 | -2.33933 | -1.08748 | 4943.25 | -0.02142 | 0        |         |         |         |           |           |           |          |          |
|        | 3     | 4.11682992 | -1.36321 | -1.15675 | 5360.7  | -0.08445 | 0        |         |         |         |           |           |           |          |          |
|        | 4     | 9.725929742 | -0.90672 | 9.554955 | 4710.05 | 0.121374 | 1        |         |         |         |           |           |           |          |          |
|        | 5     | -6.42038165 | -2.33771 | 7.516806 | 4624.3  | 0.018206 | 0        |         |         |         |           |           |           |          |          |
|        | 6     | 12.45614557 | 5.765315 | -20.1996 | 5204.7  | -0.12551 | 0        |         |         |         |           |           |           |          |          |
|        | 7     | 4.167073414 | -0.35845 | -2.24835 | 5429.3  | -0.04315 | 0        |         |         |         |           |           |           |          |          |
|        | 8     | 2.951309397 | -2.2183  | 9.089304 | 5295.55 | 0.024635 | 1        |         |         |         |           |           |           |          |          |
|        | 9     | 1.232863991 | -0.41175 | 2.925124 | 5429.3  | -0.04315 | 0        |         |         |         |           |           |           |          |          |
|        | 10    | -6.50819436 | -1.88441 | 7.045711 | 4920.4  | 0.052056 | 1        |         |         |         |           |           |           |          |          |
|        | 11    | 5.2653384   | -1.24542 | -3.52984 | 5278.9  | -0.07286 | 0        |         |         |         |           |           |           |          |          |
|        | 12    | 1.787628689 | 1.160866 | 4.719254 | 5099.85 | 0.033918 | 1        |         |         |         |           |           |           |          |          |
|        | 13    | 0.382108577 | -1.36283 | 7.429752 | 5258.5  | -0.03111 | 0        |         |         |         |           |           |           |          |          |
|        | 14    | 7.111338886 | 0.629309 | -8.66671 | 5703.3  | -0.08459 | 0        |         |         |         |           |           |           |          |          |
|        | 15    | 2.035432967 | -2.69317 | 4.065245 | 5664.3  | 0.006838 | 1        |         |         |         |           |           |           |          |          |
|        | 16    | 3.475401398 | 9.273402 | 8.707083 | 5850.3  | -0.03805 | 0        |         |         |         |           |           |           |          |          |
|        | 17    | 1.068703843 | 0.652251 | 0.074747 | 5908.35 | -0.00485 | 0        |         |         |         |           |           |           |          |          |
|        | 18    | 0.699156525 | -2.81072 | -1.20987 | 6074.65 | -0.02815 | 0        |         |         |         |           |           |           |          |          |
|        | 19    | 7.513593177 | -9.54694 | 8.707083 | 5850.3  | 0.036932 | 1        |         |         |         |           |           |           |          |          |
|        | 20    | 2.811515581 | -5.67386 | 11.45508 | 5682.55 | 0.028674 | 1        |         |         |         |           |           |           |          |          |
|        | 21    | 3.136965097 | 16.63648 | -1.99271 | 5871.45 | -0.03324 | 0        |         |         |         |           |           |           |          |          |
|        | 22    | -0.02142657 | -2.15367 | 6.818743 | 5985.95 | -0.0195  | 0        |         |         |         |           |           |           |          |          |
|        | 23    | 4.572904121 | 2.117858 | 18.19907 | 5842.2  | 0.024051 | 1        |         |         |         |           |           |           |          |          |
|        | 24    | 3.033841924 | 4.883628 | 9.180279 | 5886.2  | -0.00753 | 0        |         |         |         |           |           |           |          |          |
|        | 25    | 4.470324408 | -3.11985 | -10.1004 | 5471.8  | 0.070402 | 1        |         |         |         |           |           |           |          |          |
|        | 26    | 4.618587075 | 3.912544 | -1.40827 | 5833.2  | -0.06605 | 0        |         |         |         |           |           |           |          |          |
|        | 27    | 7.096491222 | 1.146991 | -4.55864 | 6144.9  | -0.05344 | 0        |         |         |         |           |           |           |          |          |
|        | 28    | 1.204701547 | 4.800859 | -3.26407 | 6176.1  | -0.00508 | 0        |         |         |         |           |           |           |          |          |
|        | 29    | 2.806798658 | 5.243662 | -1.69688 | 6313.8  | -0.0223  | 0        |         |         |         |           |           |           |          |          |
|        | 30    | -6.71917    | 9.667885 | 6089.5  | 0.035525 | 1        |         |         |         |         |           |           |           |          |          |
| Year | Value 1 | Value 2 | Value 3 | Value 4 | Value 5 | Value 6 |
|------|---------|---------|---------|---------|---------|---------|
| 2014 | 4.68615 | 1.50518 | -3.5106 | 4.48657 | 6276.95 | -0.03078 |
|      | Average | -0.01176 | 0       |         |         |         |

Source: Authors' own
## Annexure-III- Validation Data Set (21 Observation)

| Month   | HML    | WML    | Rm-Rf | Nifty Ret | Nifty Binary | Model Value | Model Binary |
|---------|--------|--------|-------|-----------|--------------|-------------|--------------|
| 201403  | 3.42032| 9.71963| 7.136766 | 6695.9 |           |             |              |
| 201404  | 9.870077 | 4.03236 | 0.423661 | 6782.75 | 1.297062 | 1 | 0.37613238 | 1 | Match |
| 201405  | 12.63898 | 15.6519 | 11.52618 | 7229.95 | 6.593196 | 1 | 1.957081326 | 1 | Match |
| 201406  | 7.853882 | 3.179349 | 6.615012 | 7508.8 | 3.856873 | 1 | 1.18625961 | 1 | Match |
| 201407  | -9.25885 | 2.2068 | -0.70688 | 7790.45 | 3.750932 | 1 | -0.66615762 | 0 | No Match |
| 201408  | -4.76137 | 2.01949 | 2.017242 | 7954.35 | 2.103858 | 1 | -0.04926855 | 0 | No Match |
| 201409  | 1.776142 | 3.78611 | 0.654095 | 7968.85 | 0.18229 | 0 | 0.082246556 | 1 | No Match |
| 201410  | 0.474683 | 4.145719 | 2.780563 | 8169.2 | 2.514165 | 1 | 0.317047803 | 1 | Match |
| 201411  | -0.52368 | 5.418325 | 2.090624 | 8588.25 | 5.129633 | 1 | 0.183821658 | 1 | Match |
| 201412  | -3.00988 | 2.148539 | 2.17779 | 8200.7 | 4.51256 | 0 | 0.54495994 | 0 | Match |
| 201501  | -0.06407 | 4.709791 | 4.375959 | 8808.9 | 7.41644 | 1 | 0.515839385 | 1 | Match |
| 201502  | -2.74868 | 0.12825 | 0.402858 | 8844.6 | 0.405272 | 0 | 0.19249109 | 0 | Match |
| 201503  | -8.15642 | 4.764915 | 3.51066 | 8341.4 | 5.68935 | 0 | 0.95246835 | 0 | Match |
| 201504  | 4.030583 | 1.43558 | 3.16123 | 8305.25 | 0.43338 | 0 | 0.37486172 | 0 | Match |
| Year   | Inflow | Outflow | Δ | 1993-94 | 1994-95 | 1995-96 | 1996-97 | 1997-98 | 1998-99 | 1999-00 | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2020-21 |
|--------|--------|---------|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 201505 | -5.0424| 3.4034  | 2.7807| 8433.6  | 1.5460  | 0       | 0.0525754| 1       | Match   |
| 201506 | 8.04626| -1.7237| 1.7038| 8381.1  | -0.6231 | 0       | 0.7192350| 0       | Match   |
| 201507 | 2.62455| 9       | 8.5318| 2.7284  | 8532.8  | 1.8106  | 22       | 1       | 0.4416090| 5       | Match   |
| 201508 | 9.54413| 3.8461 | -6.8358| 8001.9  | -6.2218 | 4       | -1.4829967| 8       | Match   |
| 201509 | 2.08252| 2.2296 | 1.0279| 7868.5  | -1.6677 | 2       | 0.1463755| 5       | Match   |
| 201510 | 4.21891| 5.5923 | 1.1879| 8065.8  | 2.5074  | 66      | 0.2050853| 17      | Match   |
| 201511 | 2.72874| 0.2606 | 0.9581| 7942.7  | -1.5262 | 0       | -0.1237954| 5       | Match   |
| 201512 | 1.38797| 3.0442| 0.6169| 7861.0  | -1.0279 | 9       | 0.0536893| 63      | 1       | No Match |

|        |        |        |        | Average |        |        |        |
|--------|--------|--------|--------|---------|--------|--------|--------|
| N      | 21     | Matched| 17     | 0.8291  | 28     | 0.0056560| 82     |
| Not Matched | 4 |        |        |         |        |        |        |

Source: Authors' own
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