# Exploring and Exploiting Value Anomaly in Indian Stock Market Using Discriminant Analysis

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***ABSTRACT***

*Presently, the studies on value anomaly are conducted mainly using factor models or Sharpe ratio which results into either asserting or rejecting its existence in a particular market. However, the reality is far from such a binary classification. Therefore, by applying Discriminant Analysis the study demonstrate that what part of the excess returns on value stocks should be designated as the fair return i.e. 'value premium', and what part of it should be looked upon as a disproportionately higher return i.e. 'pricing anomaly'. Further, it also show that how long the value premium persists in the market. This knowledge can help investors decide optimum holding period for value stocks. This study is based on Indian stock market. The study found that the value effect is clearly evident in India; however, with passage of time its magnitude is decreasing. This study also document that the optimum holding period for a portfolio of value stocks happened to be of two to three years.*

***Keywords: Asset Pricing, Value Anomaly, Efficient Market Hypothesis, Discriminant Analysis, Indian Stock Market.***

## Introduction

Asset pricing continues to be one of the most investigated topics in financial economics mainly due to abnormally higher returns observed on value stocks and small-sized stocks. Value stocks are those whose Price-to-Book (P/B) ratio is lower as contrasted to growth stocks. Small-sized stocks are those whose market capitalisation is lower than their counterparts which are called as large-sized stocks. Many empirical studies found that value stocks and small-sized stocks gave higher returns. However, since the return is a reward for the risk, the debate is centred around whether the higher returns are coupled with equally the higher risk or not. As far as the measurement of return is concerned, there is a complete unanimity; but there is a disagreement for the measurement of risk, which emanates from the possibility of taking different perspectives for defining the risk. Interestingly, all the perspectives are equally valid in their own context. Thus, the root cause of the debate is the many different ways of looking at the risk. Therefore, it is very necessary that the right perspective for the right context is taken, and accordingly the right technique of analysis is employed in studying the asset pricing scenarios.

The choice of the right technique of analysis is the key factor in ensuring the quality of the findings of any scientific inquiry. The study propose that the application of Discriminant Analysis in studying pricing anomalies can enhance the quality of research in the area of asset pricing, which seems to have been ignored so far. On the issue of the reliability of this technique, Alayande and Adekunle (2015) note, “Discriminant analysis often produces models whose accuracy approaches (and occasionally exceeds) more complex modern methods.” The major application of Discriminant Analysis in finance has been in the area of prediction of financial performance using financial ratios with Altman (1968) pioneering its use for prediction of corporate bankruptcy. Here, Discriminant Analysis can prove to be a more robust technique for deciding as to how far the excess returns are the reward for excess risk, and how far not. Put other way round, different approaches adopted by different scholars lead to conclude in a binary way, and designate the excess returns as either 'value premium' type, or or 'value anomaly' type. In real life, it is not a binary, or say a mutually exclusive, type of an event. In most of the cases, it would be a mix of both. That is, one part

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of the excess return may be due to excess risk, but the other part may be characterised as truly a disproportionately higher return. The Discriminant Analysis has that power of bifurcating the excess returns into those two types, and as a result it raises a factually correct picture of the situation.

Emerging Markets (EMs) differ from the developed markets not only on the parameters of GDP, inflation rate, per capita income, etc. Rather, their economic and financial fabric also seems to be differing significantly. As a result, the standard economic models often provide inconsistent and inconclusive results in these markets. As compared to developed markets, the EMs are characterised by higher volatility, and the associated higher returns. However, EMs commands a special significance as they accounted for 59.81% of world GDP (IMF, 2019) and 12% of the MSCI All Country World Index (Melas, 2019). Nevertheless, the historical data shows that the investment in the stock of EMs provided higher long term risk-adjusted returns (Melas, 2019). Therefore, EMs are increasingly being considered as a separate asset class by many investors due to high risk-adjusted returns and its significant contribution to portfolio diversification (Bekaert and Urias, 1996,1999; Bekaert and Harvey, 1997). This study pertains to India, which is an Emerging Market. India has the fourth-highest weightage of 10.27% in the MSCI Emerging Markets Index (MSCI, 2019) and is the seventh-largest stock market on the world map. Additionally, India is expected to hit the market capitalization of $6.1 trillion by 2027 (Morgan Stanley, 2018). This makes a case for selecting India as a representative market within the EMs.

**Literature review on value anomaly in capital asset pricing**

Value effect is widely investigated. Table 1 gives a snapshot view of important studies conducted in the developed as well as emerging markets highlighting the method followed and the broad conclusion in terms of whether the empirical evidence supported the notion of value premium or value anomaly.

**Table 1: Literature Review**

| Author(s) | Year | Country of study | Period | Method followed | Broad Conclusion (Value Premium or Value Anomaly) |
|---|---|---|---|---|---|
| Fama and French | 1992 | United States (US) | 1963-1990 | Factor model | Value Premium |
| Capaul et al. | 1993 | US, France, United Kingdom (UK), Germany, Japan, and Switzerland | 1981-1992 | Sharpe Ratio | Value Anomaly |
| Lakonishok et al. | 1994 | US | 1963-1990 | Factor model | Value Anomaly |
| Brouwer et al. | 1997 | UK, France, Germany, and Netherlands | 1982-1993 | Factor model | Value Anomaly |
| Bauman and Miller | 1997 | US | 1980-1993 | Sharpe Ratio | Value Anomaly |
| Porta et al. | 1997 | US | 1971-1993 | t-Test and Regression | Value Anomaly |
| Arshanapalli et al. | 1998 | 18 major equity markets | 1975-1995 | Factor model | Value Premium |
| Bauman et al. | 1998 | 21 major capital markets | 1986-1996 | Sharpe Ratio | Value Anomaly |
| Fama and French | 1998 | US | 1975-1995 | Factor model | Value Premium |
| Dhatt et al. | 1999 | US | 1979-1997 | Factor model | Value Premium |
| Oertmann | 2000 | Europe, North America and Pacific Rim | 1980-1999 | Factor model | Value Premium |
| Anderson et al. | 2003 | Mongolia | 1995-1996 | Factor model | Value Anomaly |

| | | | | | |
|---|---|---|---|---|---|
| Dimson et al. | 2003 | US | 1955-2001 | Factor model | Value Premium |
| Gonenc and Karan | 2003 | Turkey | 1993-1998 | Factor model | No Value effect |
| Dunis and Reilly | 2004 | UK | 2000-2002 | Sharpe Ratio and t-Test | Value Premium |
| Yen et al. | 2004 | Singapore | 1975-1997 | Factor model | Value Premium |
| Ding et al. | 2005 | Japan, Indonesia, Thailand, Hong Kong, Taiwan, Singapore and Malaysia | 1975-1997 | Factor model | Mixed evidence in different countries. |
| Pätäri and Leivo | 2009 | Finland | 1993-2008 | Factor model | Value Premium |
| Athanassakos | 2009 | Canada | 1985-2005 | Factor model | Value Premium |
| Gharghori et al. | 2013 | Australia | 1993-2004 | Factor model | Value Premium |
| Singh and Kaur | 2015 | India | 1996-2010 | t-Test and F-Score Model | Value Anomaly |
| Xie and Qu | 2016 | China | 2005-2012 | Factor model | Value Premium |
| Cakici et al. | 2016 | 18 emerging stock markets | 1990-2013 | Factor model | Value Premium |
| Perez | 2017 | Thailand | 1999-2016 | Sharpe Ratio, Anderson-Darling Test and Wilcoxon Test | Value Anomaly |
| Garcia and Oliveira | 2018 | Europe | 2003-2015 | Factor model | Value Premium |

**Source:** Authors' compilation

It can be seen that as far as the research approach is concerned, all the studies can be bifurcated into two groups. One group under the influence of Fama-French examine the value effect using the factor models. Taking the premise of efficient market hypothesis, they infer the risk from the realised returns, and thereby designate the excess return as 'value premium'. This group essentially tries to demonstrate that the theory of equivalence between return and risk comes true in real life, too. This band of theorists is in majority who subscribe to the ideology that free markets would turn out to be efficient markets also. However, an important demerit of factor models lies in taking a biased view by inferring the risk from the realised return rather than directly measuring the incidence of risk emanating from those factors. Therefore, another group tries to examine the value effect objectively by directly studying the risk-return profiles of stocks to see whether there is any disproportionately higher return in case of low P/B stocks. However, they use a combined measure of risk-return like Sharpe ratio. Some of them document the existence of value effect in terms of identifying the excess return as risk premium, whereas the rest of them designated it as value anomaly. Not only that the findings under the direct approach are inconsistent, but more than that, this approach suffers from a limitation of using a combined measure of risk-return in terms of their ratio which does not allow to compare the levels of return and risk separately. Therefore, there is a need to search for a method that would directly and separately measure the risk and return so that a meaningful comparison of the two can be made.

**Significance of using discriminant analysis**

The lens that is employ to examine the value effect is unique, and at the same time apparently more scientific. Since bifurcating the firms into value vs. growth is essentially an act of discrimination, the study envisage to subject those two groups to the Discriminant Analysis, and thereby examine how far the factors of return and risk explain the a-priory classification of firms made on the basis of value. This approach is the most sophisticated one for exploring and explaining the value effect. This approach is free from the limitations of the prevalent approaches. As discussed earlier, the Fama-French led factors model approach presumes that the market is efficient, which may not be the case always. Therefore, this approach is free from any such presumption about the market efficiency. Likewise, this approach is also free from the limitation of the

other group that captures the effects of the return and risk into a single metric of 'risk-adjusted return'. Further, neither of the two have any room for capturing a mixed scenario, which is more likely in a real world. Against this, the approach of using Discriminant Analysis is capable of capturing the reality, and show that how far the excess return is due to the excess risk and how far it is due to any imperfections in the market. Additionally, since in reality, the market is not completely efficient, the investors would like to form a portfolio of value stocks and hold it for a particular period to obtain the maximum reward. Interestingly, the Discriminant Analysis is capable of identifying an optimum holding period, too. This property of Discriminant Analysis commands a lot of value for the investors.

**Research objectives and methodology**

This study aims to demonstrate the application of Discriminant Analysis which can reveal that how far the value stocks give disproportionately higher returns, and how to exploit that imperfection in the market by way of deciding an optimum holding period for the value stocks portfolio.

**Period of Study**

Previous to this, extensive work on applying the Discriminant Analysis is done for examining the value anomaly and the size anomaly in the Indian stock market. Capitalizing on it, this paper shows how to apply it and how to interpret the results. The market may not be either completely efficient or completely inefficient at any point in time. Of course, during different phases in its life, it may turn out to be predominantly efficient or predominantly inefficient. Therefore, based on the previous work, this study opts for showcasing what results the Discriminant Analysis produces under different market scenarios. Towards that, value-growth portfolios are formed at three different points of time as shown below, and hold them for a few years.

i) Portfolio formed at the end of March 2003 is held for three years
ii) Portfolio formed at the end of March 2014 is held for five years
iii) Portfolio formed at the end of March 2015 is held for four years

In the above list, the choice of the year 2014 and 2015 is governed by the considerations of identifying the recent years for which the portfolio performance can be measured over the next four to five years. Contrasted to that, the year 2003 is chosen to represent an older period for comparison that would provide the data for next four to five years before the onset of financial crisis.

**Portfolio Formations and Sample Stocks**

At each point of time, three portfolios are formed on median, quartile and decile bases. Towards that, all the stocks are listed in ascending order of their Price-to-Book value ratio. Then, on median bases, the upper half stocks are categorised as value stocks, and the lower half as growth stocks. Likewise, on quartile bases, upper quartile stocks are categorised as value stocks, and the lower quartile as growth stocks. Similarly, the decile based categorisation is done. It is expected that the results of analysis should improve with the classification becoming sharper. If it happens so, then only the approach of classification gets ratified. The numbers of stocks in each set of portfolio are presented in Table 2.

**Table 2: Number of companies in each portfolio**

| Particular | Portfolio | Criterion | No. of companies | | |
|---|---|---|---|---|---|
| | | | Mar-03 | Mar-14 | Mar-15 |
| **Median-based stock classification** | Value stock portfolio | Above the median | 611 | 1012 | 1059 |
| | Growth stock portfolio | Below the median | 611 | 1012 | 1059 |
| **Quartile-based stock classification** | Value stock portfolio | Top Quartile | 306 | 506 | 530 |
| | Growth stock portfolio | Bottom Quartile | 306 | 506 | 530 |
| **Decile-based stock classification** | Value stock portfolio | Top Decile | 122 | 202 | 212 |
| | Growth stock portfolio | Bottom Decile | 122 | 202 | 212 |

**Source**: Authors' compilation

**Source of Data**

The data are sourced from the AceEquity database of Accord Fintech Limited, which compiles and makes the data available as a commercial product to universities.

**Calculation of Parameter Values**

Return: The yearly return is calculated as the geometric mean of the monthly returns. The monthly returns are calculated based on the monthly adjusted prices. Holding period return is also calculated as the geometric return for the entire holding period.

Risk: The risk parameter is defined as the variance of the monthly returns for the given period. As far as the calculation of holding period risk is concerned, it is calculated based on months in a given holding period. Thus, if a holding period is of five years, then the variance is calculated based on 60 months' return covered in that period.

**Techniques of Analysis**

Obviously, the Discriminant Analysis is going to be the main tool of analysis. However, it should be applied only if there is a prima facie evidence of any excess returns on value stocks. Therefore, first t-Test was conducted which proved that the value stocks did command higher excess returns over growth stocks. However, the results are not reported here looking to the limitation of space. The SPSS output for Discriminant Analysis generates many different values. However, only the relevant ones are reported in Table 3.

**Table 3: Summary of Discriminant Analysis Results**

| Holding Period | Value Stock Portfolio | | Growth Stock Portfolio | | Wilks' Lambda | *p* value | Standardised Canonical | | Structure Matrix | | % of Correctly Classified |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Return | Risk | Return | Risk | | | Return | Risk | Return | Risk | |
| **Portfolio formed at the end of March 2003** | | | | | | | | | | | |
| **Median-based stock classification** | | | | | | | | | | | |
| **1** | 66.8 | 1668.37 | 59.52 | 690.77 | 0.95 | 0 | 0.24 | 0.97 | 0.25 | 0.97 | 62.60% |
| **2** | 168.5 | 1390.47 | 120.05 | 839.11 | 0.93 | 0 | 0.99 | 0.06 | 1 | 0.22 | 59.10% |
| **3** | 206.81 | 1193.7 | 163.72 | 718.31 | 0.96 | 0 | 0.92 | 0.34 | 0.94 | 0.4 | 58.30% |
| **Quartile-based stock classification** | | | | | | | | | | | |
| **1** | 68.19 | 2332.17 | 54.76 | 617.64 | 0.91 | 0 | 0.31 | 0.95 | 0.31 | 0.95 | 68.60% |
| **2** | 183.66 | 1956.52 | 102.68 | 1045.64 | 0.83 | 0 | 1.01 | -0.04 | 1 | 0.16 | 67.20% |
| **3** | 218.27 | 1631.33 | 146.39 | 842.9 | 0.92 | 0 | 0.95 | 0.25 | 0.97 | 0.32 | 64.20% |
| **Decile-based stock classification** | | | | | | | | | | | |
| **1** | 74.62 | 3290.4 | 49.15 | 573.8 | 0.86 | 0 | 0.44 | 0.91 | 0.43 | 0.9 | 70.10% |
| **2** | 209.59 | 2770.86 | 87.89 | 1708.43 | 0.72 | 0 | 1.03 | -0.19 | 0.98 | 0.09 | 72.10% |
| **3** | 231.28 | 2193.42 | 125.41 | 1284.46 | 0.89 | 0 | 1 | 0.02 | 1 | 0.17 | 65.00% |
| **Portfolio formed at the end of March 2014** | | | | | | | | | | | |
| **Median-based stock classification** | | | | | | | | | | | |
| **1** | 45.27 | 451.27 | 39.99 | 306.22 | 0.97 | 0 | 0 | 1 | 0.24 | 1 | 57.90% |
| **2** | 61.77 | 421.22 | 38.05 | 306.79 | 0.95 | 0 | 0.53 | 0.76 | 0.67 | 0.86 | 58.80% |
| **3** | 95.82 | 372.46 | 61.87 | 270.94 | 0.94 | 0 | 0.59 | 0.74 | 0.68 | 0.81 | 62.40% |
| **4** | 98.62 | 359.91 | 64.36 | 258.37 | 0.92 | 0 | 0.52 | 0.85 | 0.53 | 0.85 | 62.00% |
| **5** | 62.38 | 342.29 | 37.03 | 254.18 | 0.94 | 0 | 0.47 | 0.93 | 0.38 | 0.89 | 61.30% |
| **Quartile-based stock classification** | | | | | | | | | | | |
| **1** | 47.36 | 516.56 | 34.83 | 269.98 | 0.92 | 0 | 0.14 | 0.96 | 0.33 | 0.99 | 63.20% |
| **2** | 62.19 | 474.04 | 25.66 | 275.84 | 0.88 | 0 | 0.51 | 0.8 | 0.61 | 0.86 | 65.90% |
| **3** | 96.62 | 420.85 | 43.4 | 242.29 | 0.84 | 0 | 0.58 | 0.78 | 0.63 | 0.82 | 70.30% |
| **4** | 97.84 | 401.47 | 41.68 | 228.65 | 0.81 | 0 | 0.56 | 0.86 | 0.51 | 0.83 | 70.90% |
| **5** | 59.94 | 381.94 | 17.35 | 228.68 | 0.83 | 0 | 0.52 | 0.94 | 0.37 | 0.86 | 69.80% |

| Holding Period | Value Stock Portfolio | | Growth Stock Portfolio | | Wilks' Lambda | *p* value | Standardised Canonical | | Structure Matrix | | % of Correctly Classified |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Return | Risk | Return | Risk | | | Return | Risk | Return | Risk | |
| **Portfolio formed at the end of March 2003** | | | | | | | | | | | |
| **Decile-based stock classification** | | | | | | | | | | | |
| **1** | 40.67 | 636.99 | 31.98 | 249.91 | 0.85 | 0 | -0.1 | 1.02 | 0.16 | 1 | 68.30% |
| **2** | 53.34 | 543.19 | 22.03 | 260.31 | 0.84 | 0 | 0.3 | 0.91 | 0.44 | 0.96 | 68.30% |
| **3** | 85.21 | 476.79 | 33.57 | 225.65 | 0.81 | 0 | 0.44 | 0.85 | 0.54 | 0.9 | 74.00% |
| **4** | 84.17 | 456.86 | 28.7 | 214.89 | 0.77 | 0 | 0.45 | 0.9 | 0.44 | 0.89 | 74.80% |
| **5** | 48.2 | 433.47 | 7.14 | 218.88 | 0.78 | 0 | 0.43 | 0.97 | 0.29 | 0.9 | 74.30% |
| **Portfolio formed at the end of March 2015** | | | | | | | | | | | |
| **Median-based stock classification** | | | | | | | | | | | |
| **1** | 17.37 | 376.16 | 0.16 | 266.43 | 0.96 | 0 | 0.61 | 0.63 | 0.8 | 0.82 | 60.30% |
| **2** | 50.92 | 330.15 | 23.12 | 231.25 | 0.94 | 0 | 0.56 | 0.71 | 0.72 | 0.84 | 62.20% |
| **3** | 53.98 | 330.38 | 25.17 | 223.6 | 0.92 | 0 | 0.45 | 0.86 | 0.51 | 0.9 | 63.40% |
| **4** | 18.17 | 317.59 | -2.62 | 222.53 | 0.93 | 0 | 0.39 | 0.95 | 0.33 | 0.92 | 63.20% |
| **Quartile-based stock classification** | | | | | | | | | | | |
| **1** | 16.6 | 394.47 | -6.12 | 244.42 | 0.93 | 0 | 0.63 | 0.63 | 0.79 | 0.8 | 66.20% |
| **2** | 49.74 | 349.89 | 7.58 | 206.58 | 0.87 | 0 | 0.62 | 0.68 | 0.74 | 0.79 | 68.40% |
| **3** | 51.81 | 356.6 | 7.56 | 203.34 | 0.84 | 0 | 0.53 | 0.84 | 0.54 | 0.85 | 69.90% |
| **4** | 16.2 | 346.64 | -16.97 | 205.63 | 0.86 | 0 | 0.46 | 0.94 | 0.36 | 0.89 | 69.50% |
| **Decile-based stock classification** | | | | | | | | | | | |
| **1** | 18.06 | 424.65 | -14.49 | 224.61 | 0.86 | 0 | 0.63 | 0.69 | 0.73 | 0.78 | 71.70% |
| **2** | 50.86 | 387.05 | -5.84 | 199.22 | 0.8 | 0 | 0.64 | 0.69 | 0.73 | 0.77 | 73.80% |
| **3** | 50.53 | 395.32 | -13.3 | 195.18 | 0.75 | 0 | 0.6 | 0.83 | 0.56 | 0.8 | 75.50% |
| **4** | 11.76 | 381.49 | -38.12 | 204.71 | 0.78 | 0 | 0.58 | 0.94 | 0.4 | 0.82 | 75.20% |

**Source:** Compiled by authors based on SPSS 21 output

**Interpretation of Results of Discriminant Analysis**

Some of the output parameters are analogous to the regression analysis output. Wilks' lambda stands for 1-R2. However, in any econometric study, what matters more than the R2 value is the F ratio and its significance level. By that count, the p value of Wilks' lambda assumes more importance. It is significant in all portfolios which validates the reliability of the discriminant function.

Similarly, the coefficients of the standardised canonical discriminant function are also analogous to the beta values of explanatory variables in regression output. The sign is also to be interpreted on the same lines. It can be seen that the return turns out to be the dominant factor for explaining the a-priory classification of stocks into value stocks and growth stocks for the portfolios formed in March 2003. The contribution of risk in discriminating the two portfolios is meagre. The positive values of risk account for only a small part of the excess return. Thus, it is largely a case of 'value anomaly'. Therefore, this period needs to be identified as showing a dismal state of affairs so far as the market efficiency is concerned. Further, the sharper the classification, the greater the incidence of the value effect manifesting as value anomaly. However, just diagonally opposite to it, the other two portfolios formed in March 2014 and March 2015 reverse the results. Thus, those periods can be interpreted as the state of increased market efficiency as the large part of excess return on value stocks is explained by the risk factor.

The Structure Matrix also shows the relative importance of the explanatory variables in terms of their correlation with the discriminant function. The values stand for what can be called as factor loading on the discriminant function. This value has a more standardised interpretation which suggests that a factor having this value of less than 0.3 should be interpreted as less important one. The interpretation of these results is the same as that of the standardised

canonical discriminant function coefficients. Here again, the sharper the classification, the greater the incidence of the value effect manifesting either as value premium or value anomaly, depending on the relative strength of the coefficients of risk and return factors, respectively.

The classification percentages in the Table 3 show how far the a-priory classification is justified. Intuitively, the result value of more than 50 per cent would accord a justification to the a-priory classification; however, the higher the percentage, the better it is. It can be seen that the justification is increasing with sharpening of the classification. This observation not only proves the worth of Discriminant Analysis, but also reinforces the idea of creating a value stocks portfolio for earning disproportionately higher returns.

In fact, since the Discriminant Analysis is not used for predicting the membership of the observations in future, the percentage of correctly classified cases is not important from the perspective of deciding the robustness of the analysis. What is more important is to infer as to what part of excess return is explained by the risk and what part can be attributed to the notion of anomaly. As discussed above, the coefficients of standardised canonical discriminant function, as well as the structure matrix, do that job pretty well. Of course, the magnitude of correctly classified percentage does have very important information content for the investors which can help them decide the optimum holding period. It can be seen from Table 3 that the percentage figures normally increase with increase in the holding period, and having reached the pick they start decreasing after two to three years. It can be argued that the optimum holding period is revealed by the corresponding maximum percentage figure of correctly classified cases. This point is elaborated in Appendix 1.

One more observation is worth noting here. The results of one year holding period are different from that of other holding periods. It is because of the gestation period effect, and should be simply ignored.

**Conclusions and Suggestions**

As discussed earlier, one objective of this paper is to examine the ability of the Discriminant Analysis to reveal that how far the excess returns on value stock portfolios are explained by the factor of risk. This relates to another objective that concerns with inferring about the level of market efficiency leading to a conclusion that in what proportion the excess returns can be divided between the two aspects of 'risk premium' and 'pricing anomaly'. As far as the Indian stock market is concerned, it can be concluded that the level of market efficiency has increased over time, which is evident in the increased contribution of 'risk premium' in explaining the excess returns on value stocks in 2014 and 2015 portfolios in contrast to 2003 portfolios. However, another very important observation that emerges from the use of Discriminant Analysis is that mostly the markets exhibit a mixed state so far as the efficiency is concerned.

The markets may not be always fully efficient or fully inefficient. The loading of risk factor in the Discriminant Analysis reveals that what part of excess return is due to extra risk; and the loading of return factor shows that what part of excess return is an unmixed bless to the holder of value stock portfolio. This is a unique contribution of Discrimination Analysis, which is lacking with other two popular approaches that conclude about the state of market efficiency in a binary way.

Three sets of portfolios are formed at three points of time based on the median, the quartile, and the decile. As a result, the gap between the value portfolio and growth portfolio sharpens with moving from median based to decile based classification. This provides an opportunity to prove the worth of Discriminant Analysis, which is evident in the percentage of correctly classified cases increasing with the classification becoming sharper.

Another worth of Discriminant Analysis lies in the fact that the t-Test keeps on showing significant *p* values over a longer holding period. However, it is the Discriminant Analysis that clearly brings out the right number of years as the optimum holding period

which is proved in Appendix 1. The clue to the optimum holding period can be of a great help to investors. Of course, it goes with the specific performance of a given year/period in future. However, the historical studies based on Discriminant Analysis can help the investors to project the optimum period. Here, it shows up as on an average a three years' period.

In summary, the contribution of this study lies not only in examining the state of value effect objectively, or for that matter, approaching it in an innovative way in terms of applying Discriminant Analysis. This study go a step forward in showing that what part of return on value stocks can be attributed to the associated higher risk, and what part can be taken as an unmixed bless. Further, how long that unmixed bless continues. All these can help the investors design better trading strategies. Finally, this study would like to state that the Discriminant Analysis can also be applies in the similar way to examine the size effect.

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**Appendix 1: Relationship between Yearly, Average, and Holding Period Returns**

| Year | Median-based portfolio | | | Quartile-based portfolio | | | Decile-based portfolio | | |
|---|---|---|---|---|---|---|---|---|---|
| | Value Stock Portfolio | Growth Stock Portfolio | Difference | Value Stock Portfolio | Growth Stock Portfolio | Difference | Value Stock Portfolio | Growth Stock Portfolio | Difference |
| **Yearly Returns** | | | | | | | | | |
| 2003-04 | 66.8 | 59.52 | 7.28 | 68.19 | 54.76 | 13.42 | 74.62 | 49.15 | 25.47 |
| 2004-05 | 103.86 | 62.4 | 41.46 | 118.04 | 50.19 | 67.85 | 137.96 | 41.08 | 96.88 |
| 2005-06 | 40.56 | 45.03 | -4.47 | 37.25 | 44.99 | -7.74 | 25.23 | 39.41 | -14.18 |
| **Average Returns p.a. During the Period** | | | | | | | | | |
| 2003-04 | 66.8 | 59.52 | 7.28 | 68.19 | 54.76 | 13.42 | 74.62 | 49.15 | 25.47 |
| 2003-05 | 84.4 | 60.95 | 23.45 | 91.5 | 52.46 | 39.04 | 103.85 | 45.06 | 58.78 |
| 2003-06 | 68.45 | 55.46 | 12.99 | 71.37 | 49.93 | 21.45 | 73.29 | 43.15 | 30.14 |
| **Holding Period Returns** | | | | | | | | | |
| 2003-04 | 66.8 | 59.52 | 7.28 | 68.19 | 54.76 | 13.42 | 74.62 | 49.15 | 25.47 |
| 2003-05 | 168.5 | 120.05 | 48.45 | 183.66 | 102.68 | 80.98 | 209.59 | 87.89 | 121.7 |
| 2003-06 | 206.81 | 163.72 | 43.08 | 218.27 | 146.39 | 71.88 | 231.28 | 125.41 | 105.86 |

**Source:** Authors' compilation

This Appendix is created to prove the worth of the Discriminant Analysis output relating to the correctly classified cases. It can be seen that in case of the portfolios formed in March 2003, the maximum percentage is obtained for the holding period of 2003-05. The rationale behind it is explained by the figures of 'difference' in the Holding Period returns that are used in the analysis. The difference increases in case of the two year holding period in comparison to a one year holding period. But then, it decreases in case of three year holding period of 2003-06. Thus, 2003-05 becomes the optimum holding period. The Yearly Returns and the Average Returns together explain as to why the gap is