5. Discussion

5.1 *Momentum has significant explanatory power in stock returns*

The first of the pertinent questions that this study aims to find answers for is the one surrounding the momentum effect in the Indian stock market. Starting from Jegadeesh and Titman's seminal work (1993), there has been no dearth of academic literature which delves into the presence of the momentum effect not just in the more developed western markets of Europe and the USA, but also among the emerging markets of Asia and in the South American markets of Argentina, Brazil, Chile and Mexico (Rouwenhorst,1999; Griffin, 2002; Muga and Santamaria, 2007). Similarly, there has been no scarcity of literature that studies the momentum effect in the Indian stock market. As a matter of fact, strong momentum profits have been found in the Indian markets by the likes of Sehgal & Balakrishnan (2013) and Ansari & Khan (2012). Doubts surrounding the persistence of momentum profits during times of economic turbulence have also been attempted to be addressed by the likes of Dhankar & Maheshwari (2017) and by Ali & Joshi (2022), albeit with mixed results. While the former studied the persistence of momentum profits to completely crash during the 2007 global financial crisis, the latter found that even though momentum profits do decline during times of economic uncertainty, there are still certain momentum strategies that can still work even during phases of economic downturns. However, in the face of all the literature surrounding momentum profits, one cannot simply deny the existence and the persistence of momentum profits in the stock market, even if there have been brief periods in time when momentum profits have crashed altogether. Despite the profound quantum of evidence testifying to the existence of the momentum effect, it is simply appalling that Eugene Fama and Kenneth French continue to label momentum as a mere anomaly that isn't worth including in an asset-pricing model, even though Kenneth French maintains a database of the monthly momentum factors

on his website. Therefore, this study aims at establishing the significance of adding a momentum factor to the latest avatar in the evolution of asset-pricing models, the Fama-French Five-Factor model. Dirkx & Peter (2020,) do test an improvised Five-Factor model which is enhanced by adding a sixth factor, momentum, to the existing model. Unfortunately, their study simply ends up comparing the strength of this enhanced model with the Fama-French Three-Factor model by testing the two in the German market. They conclude that the profitability and investment factors do not add explanatory powers of any significance to the overall analysis. However, their study doesn't go beyond making a passing mention of how portfolios formed using the momentum factor have a statistically significant intercept. Also, their study is merely limited to the German market. Therefore, given the dearth of literature on this subject matter, this study aims to explore the possibilities of the momentum effect having the capability of explaining excess returns at statistically significant levels. This study aspires to achieve the aforementioned objective by testing various asset-pricing models, an improvised Six-Factor model, which is simply the Fama-French Five-Factor model enhanced with a momentum factor, being one among them. This testing is done in two parts. First, the different models are tested one at a time by regressing the mean-excess returns of single-sorted portfolios formed on the basis of the momentum effect.

We first regress the returns for the various single-sort portfolios against the single-index Capital Asset Pricing Model. There is a highly distinguishable difference when one compares the results obtained from regressing the mean-excess returns of the ten momentum portfolios with those derived upon regressing returns from other single-sorted portfolios formulated on the Size, Value, Investment and Profitability effects. For portfolios sorted on momentum, the Alpha-intercept for the portfolios P8, P9 and P10, having the strongest momentum effect, is the highest among all the single-sorted portfolios. Additionally, for portfolios that have statistically significant values for the Alpha-intercepts, it is observed that the average value of

the adjusted R squared is much less for the momentum portfolios. The Beta Co-efficients and their corresponding T-values are also much lower for the single-index CAPM when tested against the single-sort momentum portfolios mentioned earlier. These observations clearly indicate that, at the very least, the single-index CAPM is not able to sufficiently explain the mean-excess returns of momentum portfolios that comprise of companies that have strong price action in their favor, thus alluding to the presence of a strong momentum effect in stock returns.

The study then proceeds to regress the mean-excess returns of the various single-sorted portfolios against the extremely popular Fama-French Three-Factor model, which simply adds two more variables, namely Size and Value, to the Market effect from the previous single-index CAPM. Again, the results throw up some interesting observations. The portfolio P10, sorted on the Investment factor and consisting of companies that have had the highest growth in assets, displays the statistically significant Alpha-intercept. Similarly, the portfolios P9 and P10, sorted on the basis of profitability and consisting of the most profitable companies, also have statistically significant values for the Alpha-intercept. The momentum portfolio P10, which comprises of companies that have had the strongest momentum effect during the previous twelve month period, also manages to outperform the model. However, the aforementioned momentum portfolio has a statistically significant Alpha-intercept which is almost twice the value observed for the same parameter when the Three-Factor model is tested against portfolios sorted on the Investment and Profitability factors. Even more interesting is the fact that the value of the adjusted R squared in case of the outperforming Momentum portfolio is half that of the outperforming single-sort portfolios formed on the basis of the Investment effect and the Profitability effect. Thus, even the Three-Factor model displays weakness when used to explain the returns of a momentum portfolio.

This study then moves ahead by regressing the mean-excess returns of the various single-sorted portfolios against the Carhart Four-Factor model, which simply improvises upon the Fama-

French Five-Factor model by adding a fourth factor, Momentum. Once again, it is found that the portfolio P10, sorted on the Investment factor and consisting of companies that have had the highest growth in assets, displays the statistically significant Alpha-intercept. Similarly, the single-sort profitability portfolios P9 and P10, consisting of the most profitable companies, also have statistically significant values for the Alpha-intercept. However, unlike previous observations, none of the momentum portfolios are found to have a significant Alpha-intercept. Even though the value of adjusted R squared observed when the momentum portfolios are regressed against the Carhart Four-Factor model are still lower than the value observed for the concerned parameter when the same is done for other single-sort portfolios, however the difference is not as large as what was observed in case of the CAPM and the Fama-French Three-Factor model. It is also important to point out that Beta Co-efficient for the momentum factor is only significant in explaining the excess returns of the portfolios sorted on the momentum effect. When portfolios sorted on factors other than Momentum are regressed against the Carhart Four-Factor model, the Momentum factor fails to display explanatory power of any statistical significance.

Next, the returns for the different single-sort portfolios are tested against the Fama-French Five-Factor model. The Five-Factor model, proposed by Eugene Fama and Kenneth French, is an improvised version of their earlier asset-pricing model, arrived at by adding two new factors, pertaining to investment and profitability, to the Fama-French Three-Factor model. Upon doing so, it is found that Momentum portfolios P8, P9 and P10, portfolios having the strongest momentum effects, have statistically significant Alpha-intercepts. Moreover, the value of these Alpha-intercepts are greater than the two other single-sort portfolios which also show statistically significant Alpha-intercepts. Those portfolios are the portfolio P10, formed on the Investment factor and comprising of firms that have the highest growth in assets, and the portfolio P1, formed on the size factor and consisting of the smallest firms by market cap.

The value of the adjusted R squared is also considerably lesser for the momentum portfolios. This would suggest the presence of a momentum effect in stock returns that even the Fama-French Five-Factor model is unable to sufficiently explain.

A modified Five-Factor model that includes a Momentum effect but does away with the Value factor from the previous models doesn't do much in terms of explaining excess returns for the different single-sorted portfolios that it is tested against. When this model is tested against the mean-excess returns for momentum portfolios, statistically significant Alpha-intercepts are surprisingly observed for portfolios having moderate momentum effects. However, aside from the statistically significant values of the Beta co-efficient that are observed for the momentum factor upon regressing the returns of momentum portfolios against the modified five-factor model, it is found that the momentum effect is unable to sufficiently explain returns for the portfolios sorted on other factors. Even though these observations might sow seeds of doubts about the momentum effect, however, the wayward nature of the overall results obtained in this case would make one wary of coming to any conclusions with regards to the significance of any particular factor.

When the single-sort portfolios are tested against a Six-Factor model, which comprises of the Fama-French five factors plus a momentum factor as well, the results are somewhat similar to the previous observations. The momentum factor does not display statistically significant Beta co-efficient for any of the single-sorted portfolios, barring the ones sorted on the basis of the momentum effect itself. The sum of the results observed so far would add credence to the argument that the momentum effect does seem to possess significant power to explain portfolio returns.

The study then adopts a more nuanced approach towards portfolio formation, keeping in mind the fact that portfolio managers and investors alike do not form portfolios merely on the basis

of a single factor but consider a multitude of factors before arriving at such decisions. As a matter of fact, given the deluge of information that is freely available on the internet these days, even a novice investor looking to have direct exposure to the equity markets usually ends up taking a more prudent, even if slightly crude and unintended, approach towards formulating his/her portfolio by taking into consideration at least two factors, which usually happen to pertain towards company size and profitability, although it can also be argued that a lot of times retail investors also invest in stocks that have had a good run recently (the momentum effect). Thus, portfolios are then formulated on the basis of double-sorting instead of a single-sort. The double-sort is done on the basis of Size-Investment, Size-Value, Size-Profitability and Size-Momentum factors. The mean-excess returns for these double-sorted portfolios are then regressed against the various asset pricing models being tested, in the same manner as has been described in this section previously. The results obtained are also more or less the same as before. For an asset-pricing model that does not have a momentum factor, a momentum portfolio comprising of previous winners, like the portfolios S/W and B/W consisting of small-size and big-size winners respectively, usually has a statistically significant Alpha-intercept. A portfolio comprising of small-sized winners, S/W, is found to have significantly outperformed the CAPM, and the Fama-French Three-Factor and Five-Factor models, when viewed from a statistical standpoint. On the other hand, the portfolio of big-sized winners, B/W, only shows a statistically significant Alpha-intercept when tested against the CAPM and the Fama-French Five-Factor model. Morever, when the returns for the various single-sort and double-sort portfolios are regressed against a model that does contain the Momentum effect, it is found that this factor is not able to explain returns for portfolios that are formed on factors other than momentum. However, it is important to note that the study observes that despite portfolios comprising of past winners also have statistically significant beta coefficients for the market and size factors, there is still an overarching tendency displayed by momentum portfolios to

generate excess returns that are unexplained by models missing a momentum factor. Thus, one can conclude that even if some of the returns on portfolios comprising of past winners can be explained as an outcome of broader market movements and a size effect, there is definitely a presence of a momentum effect in stock returns as well.

5.2 *The Fama-French Five-Factor model sufficiently explains excess portfolio returns.*

In order to test the sufficiency of the Fama-French Five-Factor model in explaining excess portfolio returns, the study first tests it against the mean-excess returns of portfolios sorted on a single factor. When portfolios sorted on the basis of investment are regressed against the five-factor model, the model is able to explain the excess returns for all but one of the portfolios. The portfolio P10, comprising of companies having the highest asset growth, manages to outperform the model, although the Alpha-intercept is only statistically significant at the 10 percent confidence level.

Next, the study utilizes portfolios sorted on the basis of market size to test the adequacy of the five-factor model. In this instance, it is found that the model is again able to explain the excess returns for nine out of the ten single-sort portfolios formulated on the basis of market size. It is only the portfolio P1, which consists of companies having the smallest market capitalization, which has a significant Alpha-intercept. The Fama-French Five-Factor model is sufficient in explaining returns for portfolios formulated on the basis of profitability and also for portfolios formed on the basis of the value factor. However, for single-sort portfolios formed on the basis of the momentum effect, the model fails miserably.

When the Fama-French Five-Factor model is tested against portfolios sorted on the basis of a momentum effect, the results show that portfolios P8, P9 and P10, which consist of companies having the strongest and most favorable momentum effects, appreciably outperform the model.

The Alpha-intercepts for the aforementioned portfolios are found to be statistically significant at the five percent confidence interval. Thus, the model falls way short on this particular front.

The study then proceeds to evaluate the sufficiency of the Fama-French Five-Factor model by testing it against double-sorted portfolios instead. The model does a much better job of explaining the excess returns of portfolios formed on the basis of the size-investment, the size-profitability and the size-value sorts. However, the five-factor model still proves to be inadequate in explaining the returns for portfolios sorted on the basis of market size and momentum effects. The portfolios S/W, comprising of small-sized companies with the most favorable momentum effects, and B/W, comprising of big-sized companies with the most favorable momentum effects, both outperform the model and have statistically significant Alpha-intercepts. Moreover, the values of the adjusted R squared are also considerably lower in case of the double-sorted momentum portfolios. All these observations indicate that the model does not sufficiently explain momentum returns. However, the model does a fair job in explaining mean-excess returns of portfolios formed on factors other than momentum. On the whole, in order to establish the sufficiency of the Fama-French Five-Factor model, it would be essential to define the parameters within which the model can be considered as sufficient. This study has already established the existence and persistence of a momentum effect in stock returns. Therefore, if the sufficiency of an asset-pricing model is contingent on its ability to explain portfolio returns under any and all conditions, then the five-factor model fails to satisfy that condition due to its failure in explaining momentum returns. However, since all the other asset-pricing models being tested here also suffer from similar shortcomings and yet, are generally accepted, thus the study concludes that the Fama-French Five-Factor model is also sufficient in explaining returns on most of the portfolios.

5.3 *The Five-Factor model as proposed in this study better explains excess portfolio returns.*

In order to prove this hypothesis, the modified five-factor model would need to be thoroughly examined for how it performs when the mean-excess returns for different single-sort and double-sort portfolios are regressed against the proposed model. In addition to testing the model in isolation, the results derived from the testing of the modified five-factor model will then be compared to those obtained when the other asset-pricing models are tested against the same portfolios.

The modified five-factor model finds its origins in the findings of Fama and French (2017), wherein they found that the addition of a profitability factor led to the redundancy of the value factor. Working upon those findings, this study removes the value factor to the model and adds a momentum factor to it. This model is then tested against numerous portfolios. First, the mean excess returns for portfolios sorted on the investment factor are regressed against this improvised Five-Factor model. The results obtained in the process are simply baffling, and not for the right reasons. Only portfolios P1, comprising of companies which have had the least growth in assets, and the portfolio P9, consisting of companies which have shown a strong growth in assets in the preceding year, do not have statistically significant Alpha-intercepts. However, the Beta Co-efficients for the Investment factor are found to be statistically significant only for two Investment portfolios, P9 and P10. When returns for portfolios sorted on the market-size factor are regressed against this improvised five-factor model, the results obtained are equally perplexing.

The portfolios P1 and P2, consisting of the smallest companies by market size, show statistically significant values for the Alpha-intercept. For the sake of argument, one may attribute this outperformance to the premium that investors might expect from investing in

small size companies. Surprisingly, even portfolios P7 and P8, which comprise companies that are comparatively larger in size, but not the largest market size companies, also outperform the model at a statistically significant level. In light of conventional wisdom, which states that small size companies generally outperform large size companies due to the risk premia that investors associate with the former, the observations related to the aforementioned size-sorted portfolios P7 and P8 must be ascribed to a misspecification in the construction of the model rather than any anomalous behavior. A Similar tendency is observed when the mean-excess returns for single-sorted portfolios formed on the basis of profitability are regressed against the same model. It would be rationally justified for a portfolio comprising entirely of the most profitable listed companies to be outperforming the larger market and any asset-pricing model. However, in this case, even portfolios P2 and P3, comprising of companies which have very high losses, also have statistically significant Alpha-intercept. If this outperformance were an outcome of associated risk premiums then even portfolio P1, which consists of companies having the highest losses in the previous year, should have outperformed the model being tested. These observations should draw one back to the earlier conclusion that this improvised five-factor model suffers from a misspecification in factor construction. Next, returns for single-sorted portfolios based on the Value factor are then regressed against the modified five-factor model. The study finds that not just the high value portfolios P1, P2 and P3 show statistically significant Alpha-intercepts, even the ones comprising of moderate value companies, P4 through to P6, also display statistically significant Alpha-intercepts. Moreover, despite the fact that the modified five-factor model includes a momentum factor as well, single-sort momentum portfolios P4 through to P6, which comprise of companies that only have moderate momentum effects, also manage to outperform the model. All these observations would push one towards the conclusion that the modified five-factor model, which excludes a value factor, suffers from some profound errors in factor specifications.

So as to further strengthen the inferences drawn thus far, this study then proceeds to test the modified five-factor model against the mean-excess returns for double-sorted portfolios. Five out of six portfolios formed on the basis of the size-investment sort show statistically significant Alpha-intercepts. This is somewhat appalling since the model itself consists of an Investment factor. The only size-investment portfolio that the model is able to sufficiently explain is the portfolio B/A, comprising of companies having the largest market size and that are also investing most aggressively. Similarly, the model merely succeeds in sufficiently explaining the excess returns for only one of six size-profitability sorted portfolios, the portfolio B/R, which consists of the largest companies by market size that also have the most robust profit margins. When mean-excess returns for the Size-Value sort portfolios are regressed against the improvised Five-Factor model, three out of the six double-sorted portfolios show a statistically significant Alpha-intercept. In addition to the portfolio B/M, comprising of the largest-size companies having high value, the model also fails to explain the returns for the portfolios S/H and B/H, comprising of high value smallest-size and largest-size companies, respectively. What is also more surprising is that for a model which consists of a momentum factor, the modified five-factor model fails to explain the excess returns for two out of four portfolios sorted on the Size-Momentum effects. A portfolio comprising of the smallest-sized winners, S/W, and a portfolio consisting of the largest-sized losers, B/L, significantly outperform the model from a statistical standpoint.

Thus, after testing the improvised five-factor model, the study finds that there are just too many instances where the model has spectacularly fallen short in explaining the mean-excess returns for both the single-sorted portfolios and the double-sorted portfolios. These failures of the model are too many to be ignored. It is clearly evident that the modified five-factor model suffers from some serious misspecification. Therefore, the study concludes that the modified

five-factor model does not do a satisfactory job in explaining returns and is not a better alternative as an asset-pricing model.

5.4 *The Six-Factor model better explains portfolio returns.*

The study evaluates the results observed when the six-factor model is tested against the mean-excess returns of both the single-sorted portfolios and the double-sorted portfolios, and then compares the results with those observed for the other asset-pricing models when tested against the same portfolios. When returns for the single-sorted portfolios are regressed against the Fama-French Three-Factor model, the study finds that a portfolio comprising of companies that have had the highest growth in assets outperforms the model at statistically significant levels. Similarly, the model fails to sufficiently explain the excess returns for portfolios which consist solely of companies that have had the highest profitability in the preceding year. The Fama-French Three-Factor model also falls short when attempting to explain the returns for portfolios which comprise companies that have the most favorable momentum effects. The Carhart Four-Factor model fares almost in the same way. The Carhart Four-Factor model is also unable to explain the excess returns for a single-sort portfolio comprising of companies having the highest asset growth. It is also unable to explain the excess returns for portfolios comprising of the most highly profitable companies, much the same as the Fama-French Three-Factor model. However, where the Fama-French model fails, the Carhart Four-Factor model is at least able to sufficiently explain the excess returns for the momentum portfolios. The Fama-French Five-Factor model suffers from similar shortcomings as the Fama-French Three-Factor model. The Fama-French Five-Factor model is also unable to explain the excess returns for the portfolio of companies that are most aggressively investing in assets, much like its predecessor. Moreover, the model also fails to explain the returns on a portfolio comprising of the smallest-size companies by way of market cap. It also fails to sufficiently explain the excess

returns for portfolios which comprise companies having the most favorable momentum effects. This section will not detail the numerous shortcomings of the modified five-factor model as that has been done previously, in the same section and in extensive detail. The Six-Factor model suffers from weaknesses in the ways which are similar to the Fama-French models, and then some more. It fails to explain the excess returns on a portfolio comprising solely of companies that have been investing most aggressively. However, it also fails to explain the outperformance of a single-sort portfolio formed on the investment factor, which consists of companies that among the most conservative when investing in assets, albeit at the ten percent confidence interval. The Six-Factor model is insufficient in explaining returns on a portfolio of the smallest market-cap companies. However, it also surprisingly fails to explain returns for a portfolio comprising of some of the largest companies by market-capitalization as well, although at the ten percent confidence level. The Six-Factor model is also found to be incapable of sufficiently explaining the excess returns of portfolios formed on the basis of profitability. The Six-Factor model is not only found inept in explaining the excess returns of portfolios comprising of the most profitable companies, it also fails to sufficiently explain the returns of a portfolio comprising of companies that have made losses in the previous year.

The different asset-pricing models are then tested against the double-sorted portfolios, sorted on the size-value, size-profitability, size-investment and size-momentum effects. The Fama-French Three-Factor model falls short in explaining the excess returns for a portfolio comprising of small companies having robust profits. It also fails in explaining the excess returns for a portfolio of small-size companies having the most favorable momentum effects. The Carhart Four-Factor model fails to explain the returns for the portfolios comprising of small companies and large companies that have shown the most aggressive investing behavior. Portfolios comprising of companies that have the most robust profitability also have significant Alpha-intercepts when tested against the Carhart Four-Factor model. The Fama-French model

is only unable to explain the returns for the double-sorted size-momentum portfolios which consist of winners. The Six-Factor model fails to explain the excess returns for the portfolio consisting of small-size companies that have the highest growth in assets. It also falls short in explaining returns for a portfolio comprising of small size companies having robust profits. Surprisingly, a portfolio comprising of big-sized companies having weak profitability also shows significant Alpha-intercept. When the model is tested against the portfolios formed on the size-value sort, the portfolio comprising of small-sized, low value companies has a statistically significant Alpha-intercept. The model also fails to explain the outperformance of a portfolio comprising of big-sized, high value companies. Thus, when one summarizes all of the above findings, it is clearly evident that the Six-Factor model doesn't do a better job of explaining stock returns.