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The Role of Human Capital in Explaining Asset Return Dynamics in the Indian Stock Market During the COVID Era

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Abstract: Over the past decade, multifactor models have shown enhanced capability compared to single-factor models in explaining asset return variability. Given the common assertion that higher risk tends to yield higher returns, this study empirically examines the augmented human capital six-factor model's performance on thirty-two portfolios of non-financial firms sorted by size, value, profitability, investment, and labor income growth in the Indian market over the period July 2010 to June 2023. Moreover, the current study extends the Fama and French five-factor model by incorporating human capital proxy by labor income growth as an additional factor, thereby proposing an augmented six-factor asset pricing model. The Fama and MacBeth (1973) two-step estimation methodology is employed for the empirical analysis. The results reveal that small-cap portfolios yield significantly higher returns than large-size portfolios. Moreover, all six factors significantly explain the time-series variation in excess portfolio returns. Findings reveal that the Indian stock market experienced heightened volatility during the COVID-19 pandemic, leading to a decline in the six-factor model's efficiency in explaining returns. Furthermore, Gibbons, Ross, and Shanken (GRS) test results reveal mispricing of portfolio returns during COVID-19, with a stronger rejection of portfolio efficiency across models. However, the HC6FM consistently shows lower pricing errors and better performance, specifically during and after the pandemic era. Overall, the results offer important insights for policymakers, investors, and portfolio managers in optimizing portfolio selection, particularly during periods of heightened market uncertainty.

Keywords: risk and return; asset pricing models; human capital; COVID-19 pandemic; Fama and MacBeth regression

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1. Introduction

The Capital Asset Pricing Model (CAPM, hereafter) of Sharpe (1964) and Lintner (1965), has been a foundational approach in asset pricing literature for understanding the variability in asset returns (Khan and Afeef, 2024). Conceptualized as a single-factor model that incorporates only market risk, CAPM has faced substantial criticism regarding its assumptions and empirical limitations (Bhandari, 1988; Friend et al., 1978; Gruber and Ross, 1978; Levy, 1983; Roll, 1977). In response to these concerns, Ross (1976) laid the foundation of Arbitrage Pricing Theory (APT), a multifactor model that sought to address CAPM's shortcomings. Subsequently, Cox et al. (1985) extended the CAPM framework by incorporating savings and capital formation to enhance optimal portfolio selection. Compared to CAPM, recently developed multifactor models have demonstrated improved performance in

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explaining the variability in portfolio returns (Thalassinos et al., 2023). While multifactor models have improved the explanation of asset returns, they remain insufficient in fully accounting for the complexities of return behavior, highlighting the need to consider additional anomalies (Kan et al., 2024). The persistent limitations of CAPM have led scholars to identify numerous return anomalies, further highlighting the necessity for more comprehensive models in asset pricing (Harvey et al., 2016). In the financial literature, numerous researchers have identified a wide range of financial anomalies that exert a persistent influence on asset returns (Linnainmaa and Roberts, 2018). For instance, Hou et al. (2020) highlighted 452 financial anomalies and documented that approximately 35% of the anomalies exhibit a statistically significant relationship with asset returns.

Over the last several decades, numerous asset pricing models have been proposed in response to these anomalies. For instance, Fama and French (1993) extended the CAPM by introducing two additional factors namely size and value premiums, resulting in the well-known three-factor model (FF3FM, hereafter). Building upon this, Carhart (1997) incorporated a momentum factor into the FF3FM, giving rise to the four-factor asset pricing model. Later, drawing on the Dividend Discount Model (DDM) of Miller and Modigliani (1961), Fama and French (2015) proposed a five-factor model (FF5FM) by adding investment and profitability factors to the FF3FM. Furthermore, advancing the model, Fama and French (2018) introduced a momentum-based six-factor model (FF6FM) by integrating the momentum factor into the FF5FM.

Recent studies, including Barras (2019), Park et al. (2021), and Roy and Shijin (2018b, 2019), highlight the growing recognition of intellectual capital, namely human capital as a key factor in the asset pricing model. As Campbell (1996) highlighted that human capital represents the true wealth of the economy, therefore, this factor should be integrated into the asset pricing models. In recent years, several anomalies have been incorporated into asset pricing frameworks to capture variability in asset or portfolio returns, one critical risk-mimicking factor that remains overlooked is human capital (Prasad et al., 2024). Subsequently, several studies have demonstrated the importance of human capital in the multifactor model in the international market (Belo et al., 2017; Kim et al., 2011; Kuehn et al., 2017; Lettau et al., 2019; Khan et al., 2022; Khan et al., 2023). Therefore, the above studies in various international markets support the Human capital (HC)-based asset pricing model and confirm its superior performance in global markets. Some of the notable contributions to the six-factor multifactor model are from Shijin et al. (2012), who state that the HC-based multifactor model offers more predictive returns than CAPM.

Over the past few decades, the world has experienced unprecedented disruptions, causing severe impacts on both human life and the global economy. Among various global crises, the COVID-19 pandemic stands out as one of the most destructive and widespread, causing long-lasting and, in some cases, irreversible economic recessions across countries (Reuters, 2020). Since January 2020, COVID-19 has spread worldwide to varied degrees, producing serious issues and crises for the world's financial markets and economy. In the recent past, wars, natural disasters, financial crises, and the observance of recent pandemics have enhanced the level of uncertainty in the market, which exponentially increases the risk aversion level among investors (Baker et al., 2020). On March 11, 2020, the World Health Organization (WHO) officially declared COVID-19 a global pandemic. The emergence of COVID-19 has crashed the market and the spillover is transmitted to other markets, which caused instability around the stock markets (Haroon and Rizvi, 2020; Zaremba et al., 2020; Onali, 2020; Mzoughi et al., 2020; Contessi and De Pace, 2021; He et al., 2020; Liu et al., 2020b). In March 2020, the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE) collectively suffered a 23% contraction in their total market capitalization (Sing and Neog, 2020). Simultaneously, a growing body of research highlights the detrimental effects of the COVID-19 pandemic on global stock markets (Setiawan et al., 2021; Yilmazkuday, 2021; Setiawan et al., 2022).

Recently, several studies tested the performance of the asset pricing model in the Indian equity market. For instance, Harshita et al. (2015) tested the efficiency of competing asset pricing models in the Indian equity market. The authors document that in all cases FF3FM performs better than CAPM and FF5FM. Mishra and Barai (2023) find that entropy, market, size, and value factors substantially account for the fluctuations in excess portfolio returns. Mohanasundaram and Kasilingam (2024) find that firms with low ESG premiums yield higher excess portfolio returns than firms with high ESG premiums. Sehgal et al. (2024) find that the behavioral asset pricing model outperforms FF5FM.

The aforementioned studies have predominantly contributed to empirical literature on asset pricing, but these studies failed to consider human capital's role in asset pricing. Furthermore, these studies also overlooked the performance of the asset pricing model during the COVID-19 pandemic. Additionally, most of the existing studies take monthly data to construct a set of portfolios, while taking daily data to construct portfolios remains scarce. To the best of our knowledge, this study is the first to explore the relevance of the HC6FM (Human capital-six factor model) in India's equity market during the COVID-19 era. Concurrently, Prasad et al. (2024) direct the future avenue for researchers to explore the significance of the HC6FM during the COVID-19 pandemic, which is considered to be the prime motivation of this study. Furthermore, among Asian emerging markets, the Indian economy has experienced remarkable growth across all sectors over the past decade. Similarly, India currently ranks fifth[1] in the global gross domestic product (GDP) ranking and is expected to emerge as the third-strongest economy by 2030[2]. Additionally, it is pertinent to note that the human factor as the sixth factor in the asset pricing model has received significant attention in the global market but has not received significant attention in the Indian market in recent times after 2017 (Prasad et al., 2024). More specifically, India with its vibrant and rapidly evolving stock market and diverse offerings of stocks from various sectors and industries, requires an investigation of the effectiveness and superiority of the six-factor model.

Therefore, to bridge this gap, the current study contributes to the existing literature in many folds. First, our study is the first which examine the role of human capital in the asset pricing model in the Indian stock market during the COVID-19 pandemic. Second, daily data is employed to form a set of thirty-two portfolios. Third, earlier studies predominantly use monthly data to construct portfolios, while studies employing daily data for portfolio construction, particularly those constructing 2×2×2×2×2 portfolios, remain scarce. Fourth, the two-stage estimation method of Fama and MacBeth (1973) is employed to examine the risk-return relationship. Fifth, this study employs the Gibbons, Ross, and Shanken (GRS) test to evaluate the degree of mispricing and compare the performance of the CAPM, FF3FM, FF5FM, and the HC6FM in the Indian equity market during the COVID-19 era. Employing, Fama and MacBeth (1973) regression has many advantages over other methodologies of asset pricing. First, this approach is widely used in empirical literature to capture the effect of different risks beyond market risk (Jagannathan and Wang, 1996; Zada et al., 2018). Second, this approach provides a robust framework for testing whether anomalies persist after controlling for other risk factors (Jegadeesh and Titman, 1993). Third, this methodology highlights the relevance of identifying whether certain risk factors influence excess portfolio returns, which has significant insights for investors and asset managers (Cochrane, 2009).

The estimation yields several notable findings based on monthly data spanning from July 2010 to June 2023. First, the results indicate that the COVID-19 pandemic induced significant volatility in the Indian stock market, leading to inefficient returns accompanied by heightened risk across most portfolios. Notably, among the thirty-two constructed portfolios, small-cap portfolios consistently generate higher returns compared to large-cap portfolios. Furthermore, the market premium substantially captures variability in portfolio returns. Moreover, other factors also exhibit a statistically significant relationship with excess portfolio returns, reinforcing their relevance in asset pricing within the Indian context. Our findings indicate that while the six-factor model captures

[1] https://www.forbesindia.com/article/explainers/top-10-largest-economies-in-the world/86159/1#:~:text=India%20is%20ranked%205th%20in,services%2C%20agriculture%2C%20and%20manufacturing.

[2] https://www.reuters.com/world/india/india-be-worlds-third-largest-economy-by-2030-sp-global-ratings-2023-12-05/#:~:text=India%20to%20be%20world's%20third,2030%20%2DS%26P%20Global%20Ratings%20%7C%20Reuters.

portfolio return variability well across the full sample, its performance diminishes significantly during the COVID-19 and post-pandemic periods.

The organization of this paper is as follows: Section 2 presents a literature review focusing on risk factors and asset returns. Section 3 covers the data, portfolio development, and methodological approach. Section 4 focuses on the empirical analysis, and Section 5 provides the conclusions.

2. Literature Review

2.1. Theoretical Framework and Model Development in Asset Pricing

Modern Portfolio Theory (MPT), introduced by Markowitz (1952, 1959), is widely regarded as the origin of asset pricing. This theory emphasizes the role of utility and risk in identifying optimal investment portfolios by adjusting portfolio weights. Tobin (1958b) contributed further to asset allocation theory by introducing the "separation theorem," which holds that risk-averse investors balance their portfolios between a risk-free asset and a selection of risky assets. Using the Tobin-Markowitz mean-variance framework, Sharpe (1964) advanced the development of the CAPM, which defines a theoretical relationship between expected returns and risk. The CAPM has been expanded in various ways to incorporate multi-period portfolio selection (Mossin, 1968; Samuelson, 1969). Later, Fama (1970) introduced the concept of the Efficient Market Hypothesis (EMH), grounded in the principles of CAPM, which asserts that asset prices fully reflect all available information. The author argued that if predicted returns on stocks are calculated using Sharpe, Lintner, and Mossin's model, then the prices of securities accurately reflect all information. This is attributed to the possibility that the stock market may be in equilibrium, with all available information being incorporated into prices, allowing additional rewards for taking additional risks.

An increasing number of studies have highlighted several financial anomalies which help to explain variations in asset returns. For instance, the price-to-earnings ratio of Basu (1977), the size effect highlighted by Banz (1981), the earnings-to-price ratio by Basu (1983), the debt-to-equity ratio proposed by Bhandari (1988), and the book-to-market equity ratio introduced by Rosenberg et al. (1985). In a related development, Connor and Korajczyk (1989) proposed an equilibrium version of the APT, showing that both the traditional and equilibrium APT models offer similar explanatory power for portfolio return variability. According to Fama and French (1992), market beta, firm size, and book-to-market equity emerge as key variables in explaining the cross-sectional variation in expected returns. Subsequently, Jegadeesh and Titman (1993) investigated stock market efficiency and reported the momentum effect, where stocks that showed strong performance (recommended for purchase) and weak performance (recommended for sale in the past tend to earn significant positive returns in subsequent periods. In a similar vein, several studies document the extent to which mutual fund returns remain persistent across strategies over differing temporal horizons (Hendricks et al., 1993; Goetzmann and Ibbotson, 1994; Brown et al., 1992; Wermers, 1996; Elton et al., 1993; Elton et al., 1996a).

Subsequently, Papp (2022) examines the role of risk premium in excess portfolio returns in BRICS economies. Using a linear regression model, their findings indicate that risk-related factors in BRICS countries incorporate more pricing information regarding anomalies like the mispricing factor. Son and Lee (2022) proposed a novel latent asset pricing model estimating risk exposures through firm-specific data. Using a Graph Convolutional Newton (GCN) framework, their approach consistently outperforms conventional asset pricing techniques. In another comparative study, Kolari et al. (2022) examined the Zero-beta CAPM, relative to competing asset pricing models. Using a global sample, they find that ZCAPM demonstrates superior explanatory power in terms of return dispersion. Hu (2022) investigated the effect of the COVID-19 pandemic on the U.S. stock market using the FF5FM. Their study finds that the model's explanatory power increased during the pandemic, as more industries were influenced by known factors. Moreover, the author remarked that certain industry characteristics remained stable, while new factors emerged, suggesting potential refinements to the model for better crisis adaptation.

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Anuno et al. (2023) find the applicability of the FF5FM in Timor-Leste and emphasize that the SMB and HML factors contribute negatively to the excess returns, while the profitability factor contributes positively in explaining the returns. Eun et al. (2023) examine the dual role of country factors in asset pricing. Their findings indicate that the country factor significantly explains the variability in asset returns. Furthermore, they document that in asset pricing, the country factor performs well, while the local factor performs worse. Wei et al. (2023) examine the performance of CAPM, FF3FM, and FF5FM across regions and industries during COVID-19. The authors employ various statistical methods, namely, regression and correlation analysis, to assess model effectiveness. The findings provide insights into market behavior and the impact of the pandemic on asset pricing. Gao (2023) analyzes the impact of COVID-19 on the U.S. stock market using the FF5FM. Applying multiple linear regression, their findings indicate increased market volatility and returns, with a stronger market value effect and enhanced influence of profitability and investment factors. In the context of risk, Kausar et al. (2024) analyzed the factors of idiosyncratic risk (IR) within BRICS nations, revealing that firms with greater IR are associated with diminished returns. Additionally, Mohanasundaram and Kasilingam (2024) used Fama and Macbeth two-step estimation procedure to examine the role of ESG in the asset pricing framework, their findings indicate that ESG considerations enhance portfolio performance.

2.2. Human Capital: A Key Factor in Asset Pricing Models

The intertemporal consumption-based asset pricing model (ICAPM), initially proposed by Lucas (1978) and further extended by Breeden (1979), has been widely applied in financial literature to bridge asset valuation with intertemporal consumption and investment decisions. The conceptual underpinnings of this model can be traced back to Fisher's (1907) consumption-based theory of interest rates, which posits that the equilibrium interest rate reflects the trade-off between the marginal utility of consumption today and in the future. This paradigm integrates macroeconomic preferences with financial market dynamics, offering a theoretically elegant approach to asset pricing. As Mayers (1972) documents that individuals may hold a significant portion of their wealth, which cannot be easily traded in financial markets. Consequently, the existence of these assets affects individuals' portfolio selection and investment strategies. Similarly, Kim et al. (2011) suggested that HC has predictive value in explaining asset returns. Another study document that CAPM's performance in explaining asset returns increases when human capital replaces market returns (Jagannathan and Wang, 1996).

Concurrently, several studies have demonstrated the importance of human capital in the multifactor model (Belo et al., 2017; Kim et al., 2011; Kuehn et al., 2017; Lettau et al., 2019; Khan et al., 2022; Roy and Shijin, 2018; Maiti and Balakrishnan, 2018; Maiti and Vukovic, 2020; Khan and Afeef, 2024). Similarly, Maharani and Narsa (2023) find that intellectual capital (IC) plays a significant role in explaining asset returns in the Indonesian stock market. More specifically, Khan et al. (2023) highlight the importance of human capital in investment decisions and document the size, value, and human capital valuing the firms. Later, Shijin et al. (2012) highlight that the human capital-augmented six-factor model surpasses the CAPM in forecasting asset returns. Maiti and Balakrishnan (2018) document evidence that the six-factor model provides a more robust explanation for asset return variability over time compared to FF3FM and FF5FM. Recently, Prasad et al. (2024) examined the role of HC in the asset pricing model, employing the Generalized Method of Movement (GMM) framework, their findings indicate that human capital successfully prices time series variability in excess portfolio returns.

3. Data Collection and Research Methodology

This study analyzes the performance of the HC6FM in the Indian equity market over the entire sample period as well as during the COVID-19 pandemic, using data from non-financial firms. Daily stock prices were collected from July 2010 to June 2023, while annual financial statement data spanning 2010 to 2022 were employed for portfolio construction. For the calculation of market risk premium, we take daily data from the Nifty-500 index and daily Treasury bill rates. All data were sourced from Thomson Reuters DataStream. Moreover, we applied several filters to refine our sample, for instance, companies with inadequate or missing values for market capitalization, profitability, investment, and human capital were excluded from the sample. Additionally, firms with irregularities in their daily closing prices, those involved in mergers, incorporations, or amalgamations, and those with a negative book value of equity were also removed from the sample.

Additionally, we acknowledge that survivorship bias commonly associated with emerging markets due to data inconsistencies was not explicitly addressed, as we excluded delisted firms (Bekaert and Harvey, 2000). Moreover, Elton et al. (1996b) suggest that adjusting the sample size can reduce survivorship bias, which we have integrated into our sample selection process. This resulted in a final set of 178 non-financial firms for the construction of portfolios. Additionally, to evaluate the empirical validity of the HC6FM, we split the sample into the following categories; First, we take the whole sample period for analysis, second, we split the sample into during the COVID-19 era and post-COVID-19 periods.

3.1. Portfolio Construction

Following Fama and French's (2015) methodology, we constructed portfolios by first categorizing companies into small (S) and big (B) based on market capitalization. Then, within each size classification, firms were further grouped by book-to-market ratio into high (H) and low (L) value portfolios. Next, these portfolios were divided based on profitability into robust (R) and weak (W) categories. The profitability-sorted portfolios were then further classified based on investment strategy into conservative (C) and aggressive (A) groups. Finally, the resulting portfolios were sorted into low (Lhr) and high (Hhr) labor income growth categories. Moreover, using this five-dimensional sorting approach (2×2×2×2×2), we constructed thirty-two portfolios and derived six risk factors namely SMB (Small-Minus-Big), HML (High-Minus-Low), RMW (Robust-Minus-Weak), CMA (Conservative-Minus-Aggressive), and LBR (Low-Minus-High Labor Income Growth rate). Furthermore, Tables A1 and A2 (see Appendix) show the computation and factor construction of the variables

3.2. Fama and MacBeth (1973) Regression

Recent empirical finance literature reflects a strong interest in the Fama and MacBeth (1973) two-step regression, particularly for its application in factor-based asset pricing (Zada et al., 2018; Khan and Afeef, 2024). To assess risk premia, Fama and MacBeth (1973) proposed a two-step regression process. The first stage regresses portfolio returns on common risk factors over time to estimate betas. In the second stage, these betas serve as explanatory variables in a cross-sectional regression to identify the risk premiums. However, Jensen et al. (1972) and Fama and MacBeth (1973) acknowledged that this approach faces an Errors-in-Variables (EIV) problem due to the estimation error in betas being estimated in the first step rather than observed directly. This issue is typically mitigated by employing diversified portfolios rather than using individual stock returns. Furthermore, Fama and MacBeth (1973) addressed the issue of residual cross-correlation by implementing monthly cross-sectional regressions, as opposed to averaging returns across the full sample. This technique accommodates time-varying betas and facilitates dynamic estimation. The initial time-series regression step generates beta coefficients, which are subsequently used in the second-step regressions to estimate expected returns. Further, the standardized Fama and Macbeth regression is summarized as follows:

$$R_{it} = \alpha_i + \beta_{i1} f_{1t} + \cdots + \beta_{ik} f_{Kt} + \epsilon_{it}, \quad i = 1, .., N, \ \ t = 1, \dots, T, \tag{1}$$

where in Equation (1) R_{it} denotes the return on asset *i* during period *t*, f_{1t} is the realization of the *jth* factor in period *t*, ϵ_{it} demonstrations the distribution of error terms, while N and T respond to the number of assets and periods, respectively.

Furthermore, the basic hypothesis underpinning asset pricing is specified as follows using the two-pass method:

$$H_0 = E[R_t] = \gamma_{0_{1N}} + \gamma_1\beta_1 + \cdots + \gamma_K\beta_K, \quad (2)$$

where in Equation (2), $E[R_t]$ denotes the N-dimensional vector of expected returns, while $\gamma_1, \dots, \gamma_1$ represent the risk premia associated with each factor. The Fama and MacBeth (1973) procedure consists of two stages: First, each asset's return is regressed by analyzing the return series against one or more systematic risk drivers, yielding the asset's exposure to those factors, denoted as $(\hat{\beta})$. Let $\hat{\beta} = (\widehat{\beta}, \dots, \widehat{\beta_K})$ represent the resulting $N \times K$ matrix of the ordinary least square (OLS) coefficient estimates. In the second step, a rolling window regression is applied in each period, regressing asset returns on the estimated betas from step one, as shown in Equation (2).

3.3. Econometric Model

This study employs the following econometric model to examine the validity of HC6FM in the Indian equity market:

$$R_{it} - R_{ft} = \alpha_0 + \beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \beta_6 LBR_t + \epsilon_{it} \quad (3)$$

3.3.1. Fama and Macbeth (1973) Rolling Window Two-pass regression model

$$R_{it} - R_{ft} = \alpha_0 + \beta_1(\beta - MKT_t) + \beta_2(\beta - SMB_t) + \beta_3(\beta - HML_t) + \beta_4(\beta - RMW_t) + \beta_5(\beta - CMA_t) + \beta_6(\beta - LBR_t) + \varepsilon_{it}. \quad (4)$$

The expression in Equation (3) and (4) include $R_{it} - R_{ft}$ represents the excess portfolio return, calculated as the difference between portfolio returns R_{it} and the risk-free rate R_{ft}, the term MKT_t represents the risk premium factor, other factors include size SMB_t, value HML_t, profitability RMW_t, investment CMA_t and human capital LBR_t, and ε_{it} is the error term.

4. Results and Analysis

Table 1 summarizes the key statistics of thirty-two portfolios. Findings reveal that among small portfolios, SHRAH exhibits the highest average return (0.0028) along with the highest standard deviation (0.0224). Furthermore, SHWAL reports the second-highest value among these groups following the highest value of standard deviation. Conversely among these portfolios, SHRCL reports the lowest mean value of 0.0006 along with the lowest standard deviation value of 0.0152. Furthermore, among big portfolios, BHRAH reports the highest mean value along with the highest standard deviation value. While BLRCL reports the lowest mean and highest value of standard deviation. These findings confirm that small stocks considerably report the highest mean value along with standard deviation value as compared to big portfolios. Such findings are in line with the findings of Fama and French (1992, 1993, 2015), who document that small stocks considerably earn higher returns than big stocks along with the highest value of standard deviation.

Table 1. Descriptive Statistics of Portfolios.

Portfolio	Mean	SD	Min	Max
SLWCL	0.0008	0.0181	-0.1214	0.1198
SLWCH	0.0019	0.0179	-0.1342	0.4174
SLWAL	0.0011	0.0206	-0.1337	0.6172
SLWAH	0.0014	0.0227	-0.1374	0.7654
SLRCL	0.0011	0.0220	-0.1532	0.5984
SLRCH	0.0012	0.0216	-0.1273	0.4618
SLRAL	0.0008	0.0156	-0.1536	0.0846
SLRAH	0.0012	0.0197	-0.1628	0.4039
SHWCL	0.0010	0.0185	-0.1596	0.1520

SHWCH	0.0010	0.0190	-0.1795	0.3690
SHWAL	0.0022	0.0268	-0.1317	1.1645
SHWAH	0.0017	0.0195	-0.1487	0.3847
SHRCL	0.0006	0.0152	-0.1496	0.2207
SHRCH	0.0009	0.0162	-0.1317	0.1136
SHRAL	0.0011	0.0223	-0.1591	0.8158
SHRAH	0.0028	0.0224	-0.1342	0.7183
BLWCL	0.0006	0.0186	-0.1308	0.5306
BLWCH	0.0007	0.0156	-0.1619	0.1220
BLWAL	0.0009	0.0167	-0.1231	0.6705
BLWAH	0.0008	0.0162	-0.1557	0.4972
BLRCL	0.0002	0.0186	-0.1754	0.1465
BLRCH	0.0004	0.0172	-0.1861	0.2136
BLRAL	0.0008	0.0228	-0.2034	0.3051
BLRAH	0.0004	0.0164	-0.1424	0.1936
BHWCL	0.0007	0.0169	-0.1149	0.4022
BHWCH	0.0005	0.0123	-0.1119	0.0597
BHWAL	0.0007	0.0144	-0.1477	0.3500
BHWAH	0.0007	0.0151	-0.1231	0.5395
BHRCL	0.0006	0.0149	-0.1324	0.2951
BHRCH	0.0004	0.0164	-0.1406	0.4568
BHRAL	0.0004	0.0148	-0.1344	0.2057
BHRAH	0.0009	0.0185	-0.1315	0.5651

Note: In this table, SD stands for standard deviation; Min and Max represent the lowest and highest observed values.

Table 2 shows the summary statistics of risk factors. The market risk factor reports the highest mean value among other risk factors. Such findings indicate that market risk premiums yield higher returns along with the highest value of standard deviation. Further, labor income growth premium reports the second highest mean value following market risk premium. Additionally, this factor reports the lowest standard deviation value as compared to other risk factors. Moreover, size and investment premium report the third and fourth highest mean values among the group along with standard deviation values. Conversely, value and profitability report a negative mean value as compared to other risk factors.

Table 2. Descriptive Statistics of Risk Factors.

	Mean	**SD**	**Kurt**	**Skew**	**Min**	**Max**
RM-RF	0.0655	0.0205	0.5556	0.2555	-0.1761	0.0352
SMB	0.0007	0.00681	153.6252	4.4634	-0.0964	0.1800
HML	-0.0003	0.0042	119.8638	-3.7769	-0.1060	0.053
RMW	-0.0001	0.0023	9.0985	0.3094	-0.0220	0.027
CMA	0.0005	0.0016	12.9300	-0.7439	-0.0221	0.0114
LBR	0.007	0.0014	189.5816	-6.2209	-0.0406	0.0127

Note: Refer to Table 1.

Table 3 illustrates the correlations among the study variables, indicating that size, value, profitability, and investment premiums are negatively correlated with the market risk premium, whereas the human capital premium shows a positive correlation with the market risk premium. Additionally, all correlation coefficients are below 0.80, confirming the absence of multicollinearity concerns (Gujarati, 2009).

Table 3. Correlation Matrix.

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	RM-RF	SMB	HML	RMW	CMA	LBR
RM-RF	1					
SMB	-0.0023	1				
HML	-0.0047	-0.8523	1			
RMW	-0.0331	-0.5907	0.6532	1		
CMA	-0.0006	0.2826	-0.3573	-0.5657	1	
LBR	0.0139	-0.0028	-0.0337	-0.2671	0.5655	1

The Fama and MacBeth (1973) regression results presented in Table 4 indicate a significant positive effect of market premium (MKT) on portfolio excess returns of small and big portfolios. Where the findings of size premium (SMB) indicate that a small portfolio (SLWCL, SLWCH, SLWAL, SLWAH, and SLRCL) exhibits a significant and positive relationship with excess returns of small-stock portfolios. Contrastingly, some small portfolio reports (SLRCH) report positive and insignificant associations. Further, for big portfolios, we find that size premium exhibits a positive and statistically significant relationship with excess returns of large portfolios except for BHWAH and BHRAL where we find a positive and insignificant association. Conversely, we report that SMB has a negative significant and insignificant association with excess portfolio returns of big stocks (BHWCL, BHWCH, BHRCL, and BHRCH). For value premium, we report that HML demonstrates a significant positive association with excess portfolio returns of small stocks except (SLWAL, and SLRAL) where we report positive and insignificant association. Moreover, our findings report that the value premium demonstrates a significant positive association with excess portfolio returns of big stocks, except for BHWCL, BHWCH, and BHWAL where we report positive and insignificant associations. Further, we observe that profitability premium exhibits a substantial positive and negative association with excess portfolio returns of small and big stocks. Additionally, we find that investment premium exhibits notable positive and negative influences on excess portfolio returns of small and big stocks except for SHRAH, BLWAL, and BLRAL, where we report negative and insignificant associations. Last, for the human capital premium we report that LBR positively and significantly related to excess portfolio returns of small and big stocks except for SHRCL, BLRCL, BHRCL, and BHRCH, where we report that LBR has a negative and insignificant impact on excess portfolio returns.

Table 4. Human Capital Six-Factor Model: Full Sample Performance Insights.

	Intercept	MKT	SMB	HML	RMW	CMA	LBR	Adj-R^2	F-stat
SLWCL	-0.016	0.747	0.472	0.830	-2.072	0.041	4.922	0.5151	601.4478
	(-16.309)***	(50.484)***	(5.455)***	(5.607)***	(-10.536)***	(0.156)	(18.695)***		
SLWCH	-0.017	0.721	1.164	1.168	-2.207	2.776	-5.064	0.5508	694.2576
	(-18.757)***	(52.413)***	(14.443)***	(8.478)***	(-12.064)***	(11.313)***	(-20.680)***		
SLWAL	-0.016	0.749	0.828	0.188	-4.689	-4.843	-1.854	0.5574	712.8815
	(-15.883)***	(49.522)***	(9.338)***	(1.243)	(-23.295)***	(-17.949)***	(-6.883)***		
SLWAH	-0.017	0.728	0.491	-0.176	-4.577	-4.738	-3.588	0.5006	567.6558
	(-15.108)***	(43.318)***	(4.987)***	(-1.047)	(-20.471)***	(-15.800)***	(-11.996)***		
SLRCL	-0.016	0.749	1.135	-1.131	0.576	-2.164	-1.030	0.4594	481.3671
	(-14.088)***	(43.560)***	(11.271)***	(-6.569)***	(2.519)**	(-7.053)***	(-3.367)***		
SLRCH	-0.016	0.749	0.1211	-1.448	-0.162	-2.150	-1.402	0.3795	346.7658
	(-12.808)***	(41.024)***	(1.131)	(-7.914)***	(-0.670)	(-6.598)***	(-4.313)***		
SLRAL	-0.015	0.766	0.797	0.169	-0.167	-1.002	0.868	0.4762	514.9120
	(-15.563)***	(53.099)***	(9.428)***	(1.168)	(-0.871)	(-3.895)***	(3.379)***		
SLRAH	-0.016	0.748	0.915	-0.921	-0.284	-2.605	-0.569	0.4832	529.5348
	(-15.199)***	(47.470)***	(9.914)***	(-5.833)***	(-1.357)	(-9.265)***	(-2.031)**		
SHWCL	-0.016	0.748	1.339	2.257	-1.639	-0.979	1.432	0.4189	408.5613
	(-14.565)***	(45.896)***	(14.029)***	(13.827)***	(-7.560)***	(-3.370)***	(4.938)***		
SHWCH	-0.015	0.752	1.310	2.473	-1.331	-0.471	1.240	0.4034	383.2050
	(-13.784)***	(44.780)***	(13.315)***	(14.698)***	(-5.960)***	(-1.572)	(4.147)***		

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SHWAL	-0.017	0.732	2.448	0.918	-2.229	-4.536	-3.887	0.5281	633.7345
	(-13.704)***	(39.978)***	(22.827)***	(5.006)***	(-9.156)***	(-13.886)***	(-11.907)***		
SHWAH	-0.015	0.761	1.978	1.944	-1.630	-2.033	-1.130	0.4787	520.1856
	(-13.786)***	(47.587)***	(21.095)***	(12.128)***	(-7.661)***	(-7.124)***	(-3.966)***		
SHRCL	-0.016	0.750	1.432	1.466	-1.215	-1.503	-0.072	0.5165	604.9256
	(-18.065)***	(55.204)***	(17.992)***	(10.775)***	(-6.729)***	(-6.205)***	(-0.301)		
SHRCH	-0.015	0.757	1.374	1.717	-0.853	-0.524	-0.471	0.4698	501.8840
	(-15.774)***	(51.637)***	(15.993)***	(11.687)***	(-4.377)***	(-2.006)**	(-1.803)*		
SHRAL	-0.016	0.754	1.753	1.125	-1.679	-3.118	-2.937	0.4660	494.3445
	(-13.667)***	(43.497)***	(17.254)***	(6.476)***	(-7.281)***	(-10.077)***	(-9.515)***		
SHRAH	-0.019	0.687	2.726	2.291	-0.813	-0.081	-3.889	0.5048	577.3112
	(-17.599)***	(42.747)***	(28.962)***	(14.237)***	(-3.808)***	(-0.283)	(-13.595)***		
BLWCL	-0.017	0.740	0.780	0.726	-1.584	-3.140	-4.310	0.5032	573.5707
	(-16.651)***	(49.204)***	(8.862)***	(4.823)***	(-7.922)***	(-11.710)***	(-16.106)***		
BLWCH	-0.017	0.734	0.639	0.751	-0.501	-5.1485	2.417	0.5016	570.0349
	(-17.886)***	(52.960)***	(7.864)***	(5.410)***	(-2.717)**	(-20.809)***	(9.791)***		
BLWAL	-0.018	0.714	0.513	0.969	0.642	-0.173	-1.048	0.4033	383.1169
	(-17.330)***	(46.691)***	(5.726)***	(6.325)***	(3.155)***	(-0.636)	(-3.851)***		
BLWAH	-0.017	0.739	0.783	0.351	-0.130	-1.304	-2.215	0.4705	503.2758
	(-17.189)***	(51.236)***	(9.258)***	(2.433)***	(-0.677)	(-5.067)***	(-8.621)***		
BLRCL	-0.016	0.745	0.353	1.955	-2.706	-1.161	-0.352	0.4038	383.9604
	(-14.738)***	(44.862)***	(3.633)***	(11.758)***	(-12.258)***	(-3.919)***	(-1.190)		
BLRCH	-0.0159	0.757	0.506	2.010	-2.363	-0.929	-0.573	0.4410	447.0834
	(-14.924)***	(48.894)***	(5.588)***	(12.962)***	(-11.471)***	(-3.364)***	(-2.081)**		
BLRAL	-0.014	0.770	0.761	4.038	-3.727	-0.455	-2.117	0.4204	411.1000
	(-11.346)***	(41.437)***	(6.996)***	(21.698)***	(-15.089)***	(-1.373)	(-6.402)***		
BLRAH	-0.015	0.757	0.197	1.356	-2.210	-1.427	-0.442	0.4454	455.0700
	(-15.198)***	(49.959)***	(2.218)**	(8.929)***	(-10.963)***	(-5.280)***	(-1.640)		
BHWCL	-0.016	0.742	-0.103	0.181	-1.746	-1.931	-1.329	0.4205	411.1779
	(-15.463)***	(47.656)***	(-1.138)	(1.162)	(-8.433)***	(-6.951)***	(-4.794)***		
BHWCH	-0.016	0.751	-0.216	0.174	-1.101	-0.617	0.546	0.5265	629.7362
	(-18.949)***	(60.457)***	(-2.976)**	(1.401)	(-6.663)***	(-2.787)***	(2.468)**		
BHWAL	-0.016	0.752	0.238	0.156	-1.478	-1.866	-1.466	0.5053	578.5120
	(-17.543)***	(56.163)***	(3.036)**	(1.169)	(-8.295)***	(-7.808)***	(-6.147)***		
BHWAH	-0.017	0.736	0.024	-0.590	-1.318	-2.292	-2.352	0.5126	595.5022
	(-18.579)***	(54.788)***	(0.311)	(-4.388)***	(-7.372)***	(-9.558)***	(-9.833)***		
BHRCL	-0.017	0.733	-0.306	0.184	-1.646	-1.710	-0.275	0.4554	473.6692
	(-17.571)***	(51.666)***	(-3.682)***	(1.293)	(-8.718)***	(-6.753)***	(-1.089)		
BHRCH	-0.016	0.743	-0.394	0.259	-1.427	-1.317	-0.425	0.4274	422.9418
	(-15.787)***	(48.802)***	(-4.414)***	(1.697)*	(-7.046)***	(-4.848)***	(-1.569)		
BHRAL	-0.017	0.738	0.119	0.274	-1.663	-1.949	-0.540	0.4671	496.5039
	(-17.963)***	(52.702)***	(1.461)	(1.956)*	(-8.927)***	(-7.803)***	(-2.167)**		
BHRAH	-0.016	0.746	0.393	0.074	-2.017	-2.510	-2.942	0.4529	468.9103
	(-15.187)***	(47.240)***	(4.247)***	(0.468)	(-9.597)***	(-8.906)***	(-10.465)***		

Note: The value in parentheses shows the t-statistic, and */**/*** shows the level of significance at 1, 5, and 10% level, respectively.

Table 5 presents the empirical findings of the model during the COVID-19 pandemic. Results indicate that the market premium (MKT) is positively and significantly related to excess portfolio returns of small and big portfolios, but the predictive power for explaining the association significantly decreases. More interestingly, we report that SMB exhibits a significant and positive association with excess portfolio return of small stocks during COVID-19. Such findings indicate that size premiums significantly prices in the Indian equity market during the COVID-19 pandemic. Conversely, in big stocks, we report positive, negative, and insignificant associations. Further, we report that the performance of value premium significantly improved during the COVID-19

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pandemic compared to the full sample estimation. Results indicate that HML exhibits a significant, positive association with excess portfolio returns of small and big stocks. Where for profitability premium, we report positive, negative, and significant associations between RMW and excess portfolio returns of small and big stocks. Contrastingly, we observe that during COVID-19 investment premiums exhibit a significant negative influence on excess portfolio returns. Additionally, LBR shows a positive but statistically insignificant relationship with excess portfolio returns during the pandemic period. Last, in comparison to the predictive power of the augmented six factors model, the performance of this model significantly decreased during the COVID-19 pandemic as highlighted by the significant and insignificant association of risk factors with excess portfolio returns.

Table 5. Human Capital Six-Factor Model: Insights from the COVID-19 Crisis Period.

	Intercept	MKT	SMB	HML	RMW	CMA	LBR	Adj-R²	F-stat
SLWCL	-0.027	0.269	0.896	1.115	-2.300	-3.378	12.029	0.4738	95.8393
	(-14.854)***	(5.681)***	(4.462)***	(3.798)***	(-4.409)***	(-4.350)***	(15.374)***		
SLWCH	-0.027	0.240	1.035	1.177	-1.829	3.626	-5.667	0.3149	49.4072
	(-17.337)***	(5.696)***	(5.811)***	(4.519)***	(-3.951)***	(5.262)***	(-8.164)***		
SLWAL	-0.027	0.245	1.015	0.922	-7.069	-8.383	0.517	0.4381	83.1231
	(-16.500)***	(5.566)***	(5.445)***	(3.378)***	(-14.584)***	(-11.612)***	(0.712)		
SLWAH	-0.026	0.278	0.548	0.785	-6.167	-7.621	0.788	0.3547	58.9071
	(-16.984)***	(6.816)***	(3.172)***	(3.104)***	(-13.708)***	(-11.394)***	(1.170)		
SLRCL	-0.026	0.291	1.345	0.629	-1.318	-3.050	0.613	0.1890	25.5431
	(-12.686)***	(5.404)***	(5.893)***	(1.883)*	(-2.222)***	(-3.454)***	(0.689)		
SLRCH	-0.024	0.324	1.203	0.318	-0.929	-2.289	0.007	0.2037	27.9477
	(-12.434)***	(6.255)***	(5.481)***	(0.991)	(-1.629)	(-2.696)***	(0.008)		
SLRAL	-0.024	0.325	1.668	0.948	-1.614	-3.903	1.070	0.2423	34.6785
	(-12.000)***	(6.093)***	(7.381)***	(2.866)***	(-2.747)***	(-4.463)***	(1.214)		
SLRAH	-0.024	0.342	1.384	0.483	-2.174	-3.919	-0.257	0.2657	39.1085
	(-12.250)***	(6.540)***	(6.259)***	(1.494)	(-3.782)***	(-4.580)***	(-0.301)		
SHWCL	-0.025	0.312	2.346	2.276	-1.745	-2.432	-0.463	0.2942	44.9149
	(-13.608)***	(6.290)***	(11.184)***	(7.416)***	(-3.201)***	(-2.997)***	(-0.567)		
SHWCH	-0.025	0.329	2.544	2.771	-2.558	-3.764	0.701	0.3116	48.6676
	(-12.759)***	(6.422)***	(11.724)***	(8.734)***	(-4.537)***	(-4.487)***	(0.829)		
SHWAL	-0.025	0.276	2.371	2.330	-1.146	-2.129	-0.043	0.2937	44.8044
	(-14.580)***	(5.961)***	(12.092)***	(8.125)***	(-2.250)**	(-2.808)**	(-0.054)		
SHWAH	-0.022	0.342	2.323	2.538	-0.708	-1.366	0.643	0.2453	35.2409
	(-11.891)***	(6.788)***	(10.901)***	(8.140)***	(-1.279)	(-1.657)*	(0.774)		
SHRCL	-0.029	0.212	2.011	2.220	-2.149	-3.309	1.201	0.2756	41.0832
	(-17.739)***	(4.881)***	(10.939)***	(8.253)***	(-4.498)***	(-4.652)***	(1.676)*		
SHRCH	-0.028	0.206	2.394	2.865	-2.579	-3.554	-0.122	0.2216	30.9870
	(-13.420)***	(3.686)***	(10.124)***	(8.281)***	(-4.196)***	(-3.886)***	(-0.131)		
SHRAL	-0.024	0.342	2.114	2.428	-1.813	-2.299	-0.664	0.2148	29.8234
	(-11.725)***	(6.310)***	(9.216)***	(7.234)***	(-3.040)***	(-2.590)**	(-0.742)		
SHRAH	-0.028	0.211	1.645	2.001	-2.165	-3.159	0.307	0.1780	23.8136
	(-15.569)***	(4.425)***	(8.135)***	(6.763)***	(-4.119)***	(-4.038)***	(0.390)		
BLWCL	-0.027	0.269	0.896	1.115	-2.300	-3.378	-3.973	0.2003	27.3782
	(-14.854)***	(5.681)***	(4.462)***	(3.798)***	(-4.409)***	(-4.350)***	(-5.074)***		
BLWCH	-0.027	0.240	1.035	1.177	-1.829	-12.378	10.332	0.4364	82.5690
	(-17.337)***	(5.696)***	(5.811)***	(4.519)***	(-3.951)***	(-17.958)***	(14.883)***		
BLWAL	-0.027	0.270	0.781	0.763	1.403	-0.181	0.510	0.1284	16.5125
	(-19.475)***	(7.371)***	(5.042)***	(3.369)***	(3.485)***	(-0.303)	(0.846)		
BLWAH	-0.027	0.254	0.783	0.943	1.366	0.178	0.795	0.0855	10.8531

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	(-16.458)***	(5.901)***	(4.300)***	(3.541)***	(2.886)**	(0.253)	(1.120)		
BLRCL	-0.024	0.352	1.228	2.513	-3.491	-2.946	-0.163	0.1365	17.6478
	(-10.339)***	(5.749)***	(4.742)***	(6.631)***	(-5.186)***	(-2.940)***	(-0.162)		
BLRCH	-0.023	0.365	1.235	2.433	-3.265	-3.072	0.340	0.1540	20.1678
	(-11.033)***	(6.455)***	(5.166)***	(6.955)***	(-5.254)***	(-3.322)***	(0.365)		
BLRAL	-0.026	0.247	2.319	11.770	-13.393	-3.827	-0.120	0.5668	138.8337
	(-7.853)***	(2.758)***	(6.120)***	(21.243)***	(-13.598)***	(-2.611)**	(-0.086)		
BLRAH	-0.024	0.320	0.819	1.655	-1.887	-3.316	1.382	0.1263	16.2255
	(-13.531)***	(6.644)***	(4.022)***	(5.554)***	(-3.565)***	(-4.209)***	(1.741)*		
BHWCL	-0.025	0.281	-0.091	0.056	-1.426	-2.165	-0.353	0.0673	8.6001
	(-14.415)***	(6.159)***	(-0.465)	(0.201)	(-2.837)***	(-2.894)***	(-0.475)		
BHWCH	-0.027	0.253	0.391	0.643	-1.656	-2.237	0.025	0.0830	10.5288
	(-17.135)***	(5.998)***	(2.189)**	(2.461)**	(-3.566)***	(-3.237)***	(0.036)		
BHWAL	-0.027	0.240	0.110	0.270	-1.450	-1.853	0.289	0.0618	7.9418
	(-17.032)***	(5.752)***	(0.625)	(1.047)	(-3.159)***	(-2.712)**	(0.420)		
BHWAH	-0.027	0.234	0.104	0.091	-1.319	-2.119	0.458	0.0788	10.0093
	(-19.548)***	(6.286)***	(0.666)	(0.395)	(-3.224)***	(-3.479)***	(0.746)		
BHRCL	-0.027	0.268	0.461	0.686	-1.888	-2.815	-0.689	0.0851	10.7959
	(-14.705)***	(5.570)***	(2.258)**	(2.297)**	(-3.560)***	(-3.566)***	(-0.855)		
BHRCH	-0.024	0.334	0.155	0.402	-2.506	-3.403	0.024	0.1103	14.0643
	(-13.707)***	(7.087)***	(0.778)	(1.377)	(-4.827)***	(-4.404)***	(0.031)		
BHRAL	-0.025	0.308	0.352	0.704	-1.800	-3.132	1.098	0.1013	12.8765
	(-15.234)***	(6.952)***	(1.883)*	(2.571)**	(-3.698)***	(-4.322)***	(1.504)		
BHRAH	-0.024	0.311	0.265	0.576	-2.817	-4.289	0.698	0.1080	13.7541
	(-13.218)***	(6.306)***	(1.271)	(1.888)*	(-5.195)***	(-5.313)***	(0.858)		

Note: Refer to previous tables for significance level indicators.

Table 6 illustrates the augmented six-factor model's performance after the pandemic, showing that market premium (MKT) positively and significantly impacts excess returns in small and big portfolios. Such findings indicate that market risk premium is significantly priced in three sample conditions (full, during, and post-COVID-19). Conversely, the predictive power of SMB, HML, RMW, CMA, and LBR has significantly decreased during this period.

Table 6. Human Capital Six-Factor Model: Insights from the Post-Pandemic Era.

	Intercept	MKT	SMB	HML	RMW	CMA	LBR	Adj-R2	F-stat
SLWCL	-0.049	0.234	0.100	-0.655	1.352	3.000	11.334	0.6170	57.3849
	(-8.538)***	(2.644)**	(0.322)	(-1.072)	(1.557)	(2.313)**	(8.187)***		
SLWCH	-0.043	0.337	0.268	-0.349	1.641	14.028	-11.929	0.5003	36.0362
	(-8.471)***	(4.337)***	(0.982)	(-0.652)	(2.159)**	(12.352) ***	(-9.838)***		
SLWAL	-0.045	0.299	0.030	-0.615	-3.345	-2.660	-1.184	0.1777	8.5627
	(-6.894)***	(2.975)***	(0.085)	(-0.888)	(-3.395)***	(-1.810)*	(-0.755)		
SLWAH	-0.040	0.367	0.464	0.949	-3.415	-1.619	1.288	0.2177	10.7415
	(-7.197)***	(4.261)***	(1.533)	(1.598)	(-4.050)***	(-1.285)	(0.958)		
SLRCL	-0.038	0.400	0.224	-2.241	3.707	3.345	0.009	0.1680	8.0685
	(-5.453)***	(3.710)***	(0.590)	(-3.023)***	(3.509)***	(2.120)**	(0.005)		
SLRCH	-0.041	0.363	0.220	-2.400	3.428	2.815	0.118	0.1981	9.6476
	(-6.389)***	(3.688)***	(0.636)	(-3.535)***	(3.555)***	(1.955)*	(0.077)		
SLRAL	-0.048	0.256	-0.254	-3.151	4.150	2.218	-1.285	0.1642	7.8748
	(-8.146)***	(2.829)***	(-0.797)	(-5.046)***	(4.679)***	(1.674)*	(-0.908)		
SLRAH	-0.047	0.287	0.135	-3.147	4.584	2.201	0.924	0.1931	9.3749
	(-6.942)***	(2.780)***	(0.373)	(-4.427)***	(4.541)***	(1.460)	(0.574)		
SHWCL	-0.046	0.295	1.052	1.298	1.087	1.558	1.008	0.0750	3.8369
	(-7.086)***	(2.992)***	(3.034)***	(1.912)*	(1.127)	(1.081)	(0.655)		

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SHWCH	-0.047	0.276	2.059	1.681	1.649	2.431	0.947	0.1551	7.4271
	(-6.306)***	(2.419)**	(5.118)***	(2.133)**	(1.473)	(1.454)	(0.531)		
SHWAL	-0.046	0.269	0.829	-0.074	0.772	0.719	-0.591	0.1121	5.4194
	(-8.716)***	(3.306)***	(2.900)**	(-0.136)	(0.970)	(0.605)	(-0.466)		
SHWAH	-0.042	0.351	0.820	0.366	0.298	1.095	-0.413	0.1211	5.8222
	(-7.653)***	(4.136)***	(2.742)**	(0.625)	(0.358)	(0.881)	(-0.312)		
SHRCL	-0.039	0.396	0.998	0.330	1.339	2.546	-0.096	0.1521	7.2767
	(-6.416)***	(4.226)***	(3.028)***	(0.511)	(1.461)	(1.859)*	(-0.065)		
SHRCH	-0.053	0.200	1.830	0.546	1.625	3.106	-1.236	0.1757	8.4584
	(-7.348)***	(1.833)***	(4.749)***	(0.723)	(1.516)	(1.940)*	(-0.723)		
SHRAL	-0.046	0.275	1.235	1.626	-0.019	1.929	-1.444	0.1010	4.9317
	(-8.015)***	(3.143)***	(4.010)***	(2.695)***	(-0.022)	(1.507)	(-1.057)		
SHRAH	-0.041	0.345	1.185	1.666	-0.197	0.980	-0.032	0.0943	4.6443
	(-6.581)***	(3.595)***	(3.509)***	(2.519)**	(-0.210)	(0.698)	(-0.021)		
BLWCL	-0.049	0.234	0.100	-0.657	1.352	3.000	-4.665	0.0747	3.8257
	(-8.538)***	(2.644)**	(0.322)	(-1.072)	(1.557)	(2.313)**	(-3.370)***		
BLWCH	-0.043	0.337	0.268	-0.349	1.641	-1.971	4.070	0.1176	5.6636
	(-8.471)***	(4.337)***	(0.982)	(-0.652)	(2.159)**	(-1.736)*	(3.356)***		
BLWAL	-0.040	0.368	-0.083	-0.403	2.363	1.822	-0.024	0.1723	8.2872
	(-9.424)***	(5.646)***	(-0.363)	(-0.898)	(3.704)***	(1.911)*	(-0.023)		
BLWAH	-0.046	0.298	0.578	0.737	6.880	9.897	0.127	0.2957	15.6947
	(-6.049)***	(2.582)**	(1.423)	(0.926)	(6.086)***	(5.861)***	(0.070)		
BLRCL	-0.041	0.361	-0.020	1.471	-1.724	0.654	2.878	0.1303	6.2459
	(-6.259)***	(3.580)***	(-0.062)	(2.116)**	(-1.746)*	(0.443)	(1.828)*		
BLRCH	-0.040	0.385	0.345	1.536	-0.771	1.919	0.110	0.1061	5.1532
	(-6.713)***	(4.244)***	(1.080)	(2.455)**	(-0.868)	(1.446)	(0.078)		
BLRAL	-0.047	0.275	-0.519	0.289	-0.133	2.502	-2.302	0.1242	5.9641
	(-10.104)***	(3.881)***	(-2.080)**	(0.590)	(-0.192)	(2.411)**	(-2.078)**		
BLRAH	-0.047	0.285	0.522	1.754	2.499	5.505	-0.920	0.1715	8.2466
	(-7.345)***	(2.933)***	(1.527)	(2.616)**	(2.626)**	(3.872)***	(-0.606)		
BHWCL	-0.050	0.225	-0.978	-1.174	0.800	1.915	-0.820	0.0651	3.4377
	(-8.611)***	(2.547)**	(-3.147)***	(-1.928)*	(0.925)	(1.482)	(-0.595)		
BHWCH	-0.056	0.147	-0.562	-1.056	1.525	2.491	-0.360	0.0705	3.6536
	(-12.013)***	(2.080)**	(-2.261)**	(-2.168)**	(2.205)**	(2.411)**	(-0.326)		
BHWAL	-0.045	0.310	-0.499	-1.020	1.414	1.595	-0.526	0.0712	3.6812
	(-8.427)***	(3.826)***	(-1.752)	(-1.828)	(1.784)*	(1.347)	(-0.416)		
BHWAH	-0.042	0.340	-0.603	-1.119	-0.036	0.865	0.302	0.0754	3.8539
	(-6.705)***	(3.538)***	(-1.785)*	(-1.689)	(-0.038)	(0.615)	(0.201)		
BHRCL	-0.041	0.362	-1.140	-0.723	-0.100	1.792	0.757	0.1110	5.3716
	(-6.114)***	(3.558)***	(-3.184)***	(-1.031)	(-0.100)	(1.204)	(0.476)		
BHRCH	-0.039	0.405	-0.454	-1.246	1.526	1.786	0.314	0.0795	4.0240
	(-5.903)***	(3.994)***	(-1.273)	(-1.782)	(1.536)	(1.204)	(0.198)		
BHRAL	-0.044	0.313	-1.263	-1.085	-0.136	1.587	0.203	0.1300	6.2313
	(-7.717)***	(3.575)***	(-4.100)***	(-1.797)*	(-0.158)	(1.239)	(0.148)		
BHRAH	-0.045	0.306	-0.485	-1.134	1.561	2.333	-1.728	0.0530	2.9571
	(-7.245)***	(3.246)***	(-1.464)	(-1.745)*	(1.692)*	(1.693)*	(-1.174)		

Note: Refer to previous tables for significance level indicators.

Table 7 presents a model comparison based on adjusted R^2 (Adj-R^2). Findings demonstrate that risk factors substantially account for capturing the variability in excess portfolio returns over the full sample. The augmented six-factor model exhibited a notable decline in predictive power during the COVID-19 pandemic relative to the entire sample period. More specifically, post-COVID-19 analysis shows a gradual improvement in the model's efficiency in explaining time-series variability relative to the pandemic period.

Table 7. Model Comparison Based on Adj-R^2.

Portfolio	Full Sample	During COVID-19	Post-COVID-19
SLWCL	51.51%	47.38%	61.70%
SLWCH	55.08%	31.49%	50.03%
SLWAL	55.74%	43.81%	17.77%
SLWAH	50.06%	35.47%	21.77%
SLRCL	45.94%	18.90%	16.80%
SLRCH	37.95%	20.37%	19.81%
SLRAL	47.62%	24.23%	16.42%
SLRAH	48.32%	26.57%	19.31%
SHWCL	41.89%	29.42%	7.50%
SHWCH	40.34%	31.16%	15.51%
SHWAL	52.81%	29.37%	11.21%
SHWAH	47.87%	24.53%	12.11%
SHRCL	51.65%	27.56%	15.21%
SHRCH	46.98%	22.16%	17.57%
SHRAL	46.60%	21.48%	10.10%
SHRAH	50.48%	17.80%	9.43%
BLWCL	50.32%	20.03%	7.47%
BLWCH	50.16%	43.64%	11.76%
BLWAL	40.33%	12.84%	17.23%
BLWAH	47.05%	8.55%	29.57%
BLRCL	40.38%	13.65%	13.03%
BLRCH	44.10%	15.40%	10.61%
BLRAL	42.04%	56.68%	12.42%
BLRAH	44.54%	12.63%	17.15%
BHWCL	42.05%	6.73%	6.51%
BHWCH	52.65%	8.30%	7.05%
BHWAL	50.53%	6.18%	7.12%
BHWAH	51.26%	7.88%	7.54%
BHRCL	45.54%	8.51%	11.10%
BHRCH	42.74%	11.03%	7.95%
BHRAL	46.71%	10.13%	13.00%
BHRAH	45.29%	10.80%	5.30%

Table 8 presents the GRS and GRS-F test results, indicating partial rejection of the null hypothesis of portfolio efficiency in certain periods, suggesting that the models do not fully capture systematic risks. During the full sample period, the GRS statistics are relatively low, with the FF3FM being marginally significant. The mean absolute alpha values are also low, with the FF3FM and HC6FM models both showing the smallest value, indicating minimal mispricing and relatively efficient asset pricing throughout the sample period. Whereas during the COVID-19 period, the GRS statistics became more significant across all models, indicating a stronger rejection of portfolio efficiency during this crisis period. The mean absolute alpha values increase compared to the full sample, with the HC6FM and FF5FM both showing the smallest value. This suggests that although these models experienced increased mispricing during COVID-19, they were still relatively more efficient compared to the CAPM and FF3FM. In the post-COVID-19 period, the GRS statistics decreased slightly, indicating some improvement in model performance compared to the COVID-19 period. The HC6FM records the lowest GRS value, suggesting a relatively better performance among the models. Additionally, the mean absolute alpha value for HC6FM is the smallest, indicating that the

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human capital-based model has fewer pricing errors in the post-pandemic recovery period. Overall, the findings indicate that the HC6FM model generally performs better during both the COVID-19 and post-COVID-19 periods, as reflected by lower mean alpha values and GRS statistics. These results are consistent with Fama and French (2015), who noted that asset pricing models often face challenges in capturing systematic risks during turbulent periods, but the inclusion of human capital factors appears to improve pricing accuracy.

Table 8. Compariosn of Competing Asset Pricing Model (CAPM, FF3FM, FF5FM and HC6FM) in Crisis Period using GRS Test.

	GRS 2 Test (Mean Alpha)				GRS F Test			
Period	**CAPM**	**FF3FM**	**FF5FM**	**H6FM**	**CAPM**	**FF3FM**	**FF5FM**	**H6FM**
Full Sample Result	0.0012	0.0005	0.0008	0.0005	1.6214	1.5311*	1.3686	1.3530
During COVID-19	0.0051	0.0035	0.0033	0.0033	1.9090**	1.5830**	1.4774**	1.9645**
Post COVID-19	0.0033	0.0033	0.0033	0.0024	1.4720	1.1574	1.0939	1.0549

Note: Refer to previous tables for significance level indicators. .

Table 9 reports the results of the rolling window Fama and Macbeth (1973) two-pass regression. Factor loadings are estimated over a 36-month rolling window that moves forward monthly, incorporating the subsequent month and dropping the earliest. The analysis reveals that the examined risk factors fail to adequately account for future portfolio return variations in the Indian equity market. More specifically, factor loadings show inconsistent statistical significance across portfolios in the two-pass regression. Therefore, associated risk premiums did not fully capture the variability in future returns. The model's poor performance across portfolios implies that past betas are ineffective predictors. These outcomes concur with the findings of Khan and Afeef (2024) and Thalassinos et al. (2023) in emerging market contexts.

Table 9. Rolling Window Estimation of Fama-Macbeth Two-Pass Regression.

	Intercept	**MKT**	**SMB**	**HML**	**RMW**	**CMA**	**LBR**	**Adj-R^2**
SLWCL	-0.0702	0.0024	0.0064	0.0020	0.0011	0.000916	0.0001	0.0489
T-stat	-72.2217	2.0110	1.7663	1.6441	1.4975	1.7701	1.1615	
SLWCH	-0.0663	-0.0055	0.0067	0.0013	0.0004	-0.000	0.0000	0.0250
T-stat	-79.1715	-3.8846	1.4541	2.2648	1.7281	-0.1025	0.4129	
SLWAL	-0.0661	-0.0075	0.0112	0.0042	0.0007	0.0007	-0.0003	0.0735
T-stat	-83.6256	-1.5418	1.6083	1.9448	3.4113	3.9300	-2.4380	
SLWAH	-0.06445	0.0048	0.0058	0.0033	0.0004	0.0010	-0.0006	0.0351
T-stat	-90.6357	1.2346	1.3424	5.3093	1.8728	1.0163	-3.8694	
SLRCL	-0.06688	0.0021	0.0054	0.0033	-0.0006	0.0006	-0.0001	0.0198
T-stat	-99.5328	1.7158	0.9093	1.0054	-3.0207	3.2063	-1.1147	
SLRCH	-0.06598	0.0031	0.0130	0.0075	-.0000	0.0019	-0.0011	0.0812
T-stat	-108.923	2.4986	1.4533	1.9839	-0.3911	1.9263	-1.4039	
SLRAL	-0.06821	0.0021	0.0066	0.0024	-0.0013	-0.0018	0.0006	0.0496
T-stat	-115.357	1.5683	0.8843	0.4920	-3.5923	-6.3367	3.9575	
SLRAH	-0.06569	0.0031	0.0117	0.0086	-0.0009	0.0016	-0.0012	0.0866
T-stat	-102.648	2.3803	1.5856	1.8306	-4.4226	2.2958	-1.0406	
SHWCL	-0.06878	0.0021	0.0045	0.0010	0.0000	0.0014	-0.0010	0.0491
T-stat	-100.805	1.7825	1.7074	2.2476	0.1341	1.9226	-6.5919	
SHWCH	-0.07025	-0.0001	0.0056	-0.0001	-0.0006	0.0002	-0.0007	0.0599
T-stat	-103.22	-0.1094	1.9891	-0.3210	-1.9550	1.3746	-1.9328	
SHWAL	-0.0663	0.0000	0.0025	0.0021	-0.0005	0.0007	-0.0008	0.0090
T-stat	-77.3799	0.0397	1.1125	3.7453	-2.4147	1.6193	-1.5088	
SHWAH	-0.06219	0.0002	-0.0009	-0.0013	0.0015	0.0010	0.0000	0.0175
T-stat	-80.7939	0.16333	-1.4755	-2.7981	6.2560	1.6104	0.0098	

SHRCL	-0.0674	-0.0029	0.0062	0.0020	0.0016	0.0011	0.0000	0.0377
T-stat	-115.306	-1.9253	1.2492	3.9403	5.0360	5.0005	0.3667	
SHRCH	-0.0687	-0.0005	0.0079	0.0007	0.0000	-0.001	0.0005	0.0652
T-stat	-122.519	-0.434	1.1147	1.2761	0.1098	-3.1259	2.5737	
SHRAL	-0.0679	0.0034	0.0048	0.0006	0.0002	0.0013	-0.0011	0.0310
T-stat	-93.4774	2.0313	1.5209	0.9491	1.0368	5.4830	-5.9427	
SHRAH	-0.06544	-0.0041	0.0028	-0.0013	0.0005	0.0015	-0.0009	0.0350
T-stat	-101.534	-2.9971	1.5302	-2.1888	2.5342	5.5717	-4.0773	
BLWCL	-0.06368	-0.0033	0.0052	0.0017	0.0005	0.0014	-0.0003	0.0465
T-stat	-78.2327	-2.4137	0.5969	0.0763	2.6813	1.0016	-2.6296	
BLWCH	-0.06534	0.0026	0.0049	-0.0011	0.0032	0.0003	0.0006	0.0754
T-stat	-106.335	2.1191	1.5301	-2.1043	12.0568	2.0090	4.5877	
BLWAL	-0.0646	-0.0006	-0.0011	-0.0038	0.0023	-0.0007	0.0006	0.0213
T-stat	-129.276	-0.3872	-1.1048	-1.4324	7.1503	-2.1957	2.8409	
BLWAH	-0.0657	-0.0045	0.0052	0.0022	0.0004	0.0011	-0.0009	0.0251
T-stat	-148.212	-2.7938	1.3308	1.4960	1.7822	1.0542	-4.4441	
BLRCL	0.0647	0.0015	-0.0074	-0.0017	-0.0006	-0.0017	0.0007	0.1112
T-stat	171.5765	1.9102	-2.2557	-0.1849	-3.7956	-1.2916	0.5361	
BLRCH	-0.06592	0.0035	0.0061	0.0021	0.0008	0.0020	-0.0011	0.0742
T-stat	-114.026	2.7645	1.6352	1.5818	3.0341	1.0968	-0.0673	
BLRAL	-0.0693	0.0039	-0.0013	0.0023	0.0013	0.0022	-0.0009	0.0957
T-stat	-112.137	1.5975	-1.6827	1.4354	3.8294	1.0180	-1.1929	
BLRAH	-0.0624	-0.0004	0.0055	0.0002	0.0024	0.0015	-0.0002	0.0867
T-stat	-119.741	-0.3256	1.1242	0.4291	10.2281	1.2697	-1.8392	
BHWCL	-0.0618	-0.0059	0.0048	0.0003	0.0029	0.0012	0.0001	0.0752
T-stat	-122.718	-4.0883	1.6591	0.5589	11.5979	2.0974	0.6908	
BHWCH	-0.0653	-0.0046	0.0128	0.0071	-0.0006	0.0014	-0.0014	0.0681
T-stat	-159.717	-3.1221	1.6462	1.9474	-2.2672	1.5043	-6.5962	
BHWAL	-0.0623	-0.0128	0.0067	-0.0010	0.0024	0.0014	-0.0001	0.0999
T-stat	-142.911	-1.4526	1.2676	-1.4713	1.6671	1.5588	-0.9245	
BHWAH	-0.0629	-0.0005	0.0159	0.0066	-0.0001	0.0025	-0.0012	0.1155
T-stat	-142.268	-0.3131	1.0563	2.6443	-0.3713	1.4085	-1.9908	
BHRCL	-0.0622	-0.0022	0.0136	0.0067	0.0014	0.0028	-0.0014	0.1511
T-stat	-132.926	-1.6026	1.3609	1.1522	5.1163	1.8996	-1.3971	
BHRCH	-0.0646	0.0049	0.0162	0.0092	-0.0003	0.0025	-0.0018	0.1476
T-stat	-142.829	1.7705	1.6240	15.4588	-1.0714	1.9393	-1.5075	
BHRAL	-0.0622	-0.0064	0.0056	-0.0004	0.0034	0.0016	-0.0003	0.0878
T-stat	-132.686	-4.4835	2.5129	-0.7713	1.3850	1.5185	-1.8934	
BHRAH	-0.0635	-0.0035	0.0055	-0.0007	0.0013	0.0008	-0.0005	0.0531
T-stat	-122.226	-2.5085	1.4195	-1.2746	1.2106	1.9202	-3.0780	

4.1. Discussion

The findings of this study align well with previous research. Consistent with the theoretical foundation laid by Markowitz (1952), a portfolio that maximizes returns while minimizing variance is considered efficient. In line with the CAPM framework, findings reveal that market premium significantly captures variability in portfolio returns. More specifically, our empirical findings reaffirm the central role of the market risk premium in explaining return variability across portfolios, consistent with foundational asset pricing theories such as CAPM and its multifactor extensions. Moreover, the significant pricing of factors in the Indian market echoes the multifactor framework advocated by Fama and French (1992, 2015) and the emerging literature emphasizing the importance of human capital as a vital explanatory variable (Jagannathan and Wang, 1996; Khan et al., 2023; Khan

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and Afeef, 2024). Additionally, the Fama and French three-factor (FF3FM) and five-factor (FF5FM) models effectively capture risk exposures reflected in excess portfolio returns.

Similarly, Kolari et al. (2022) demonstrated that the ZCAPM outperforms traditional models such as CAPM, FF3FM, and C4FM in explaining returns dispersion using global data. Liu (2023) documented that CAPM, FF3FM, and FF5FM models significantly explain portfolio return variability during the COVID-19 pandemic. However, the observed decline in model performance during and after the COVID-19 pandemic aligns with recent findings that crisis periods introduce market anomalies and structural shifts that challenge traditional asset pricing frameworks (Hu, 2022; Wei et al., 2023). Kausar et al. (2024), examining BRICS economies, found that firms with higher idiosyncratic risk (IR) experience lower returns compared to firms with lower IR. Our results corroborate the growing literature that identifies human capital, proxy by salaries and wages, as a significant factor in forecasting the time-series fluctuations of asset returns (Roy and Shijin, 2018: Prasad et al., 2024). Furthermore, the superior explanatory power of the six-factor model during the full sample period supports prior studies suggesting that incorporating human capital enhances the model's ability to capture asset return dynamics, especially in emerging economies with growing human capital potential (Maiti and Balakrishnan, 2018; Maharani and Narsa, 2023).

5. Conclusion

The MPT of Markowitz (1952, 1959) has attracted extensive scholarly attention in examining the risk-return relationship. Building on this foundation, the seminal works of Sharpe (1964) initiated the development of asset pricing models. Over the past decades, CAPM has been widely used to explore the nuanced dynamics between risk and return. However, the restrictive assumptions of CAPM have been challenged, leading researchers to propose multifactor models aimed at better explaining the variability in asset returns. Despite these advancements, such models often fall short of fully capturing asset return variations across different financial markets. Moreover, their performance and robustness during periods of economic and financial crises, geopolitical tensions, invasions, and pandemics have not been sufficiently explored. This study addresses existing research gaps by testing the HC6FM in the Indian equity market. Daily stock prices of Nifty-500 companies from July 2010 to June 2023, alongside yearly balance sheet data (2010-2022), are used to form 32 portfolios per Fama and French's (2015) method. Data is divided into full, COVID-19, and post-COVID periods to evaluate model robustness across different market phases. Fama and MacBeth's (1973) regression results highlight that the pandemic induced marked volatility, leading to many portfolios with inefficient returns and increased risk. Smaller portfolios generate superior returns but at the expense of higher risk relative to larger portfolios.

Our results confirm that across all portfolios, the market premium plays a significant role in explaining return variability over time. In addition, size, value, profitability, investment, and human capital factors are significantly linked to excess portfolio returns, indicating these factors are meaningfully priced in the Indian market. The six-factor model demonstrates superior explanatory power during the full sample period compared to the pandemic and post-pandemic phases, with a marked reduction in model efficiency during and after the COVID-19 crisis. Importantly, our study extends the FF5FM by incorporating the human capital factor, operationalized as labor income growth rate, which significantly prices the variability in asset returns. This finding suggests that investors should incorporate human capital considerations when conducting fundamental and technical analyses of Indian companies. Results indicate that incorporating human capital, such as labor income growth, into asset pricing models greatly improves their explanatory power in emerging markets like India. To enable this integration, labor data infrastructure and corporate reporting must be strengthened. During economic disruptions, models like HC6FM can offer deeper insights into market vulnerabilities.

Future research could extend this study by applying the HC6FM to other emerging markets, thereby testing its generalizability across diverse economic settings. Incorporating additional factors such as ESG scores and uncertainty premiums may further enhance the model's explanatory strength, particularly during periods of financial instability. Moreover, using advanced estimation techniques like GMM or IV-GMM could improve the precision of factor pricing.

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Abbreviations

The following abbreviations are used in this manuscript:

CAPM	Capital Asset Pricing Model
C4FM	Carhart Four Factor Model
FF3FM	Fama and French Three-Factor Model
FF5FM	Fama and French Five-Factor Model
FMB	Fama and Macbeth Regression
P	Portfolio

Appendix A

Table A1. Variable Computation and Definition.

Variable	Proxy	Computation	References
Market Premium	MKT	RM-RF	Sharpe (1964)
Size Premium	SMB	Market Capitalization	Fama and French (1993)
Value Premium	HML	Book value of equity/Market value of Equity	Fama and French (1993)
Profitability Premium	RMW	EBIT/Book Value of Equity	Fama and French (2015)
Investment Premium	CMA	Growth in Total assets	Fama and French (2015)
Human Capital	LBR	Growth in Salaries and Wages	Roy and Shijin (2018), Khan et al. (2022), Thalassinos et al., 2023; Prasad et al. (2024)

Table A2. Portfolio Construction.

Sort	Breakpoints	Factor constructions
Sort (2x2x2x2x2) the data on	Size: Index median	$SMB_{B/M}$= (SL+SH)/2 – (BL+BH)/2
Size and book-to-market ratio Size		$SMB_{Op=}$ (SR+SW)/2 – (BR+BW)/2
and operating profitability		$SMB_{Inv=}$ (SC+SA)/2 – (BC+BA)/2
Size and investment		$SMB_{Lbr=}$ (SLhr+SHhr)/2 – (BLhtr+BHhr)/2
Size and human capital		

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