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Role of human assets in measuring firm performance and its implication for firm valuation

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Abstract

The purpose of the study is to evaluate the role of human asset in firm performance and its implication for firm valuation. To do so a modified five-factor model with human asset designed for capturing the size, value, profitability and investment in average portfolio returns that performs better than both Fama–French (1993) three- and Fama–French (2015) five-factor model. Study redefines CMA factors as CvMAv that includes human assets in it. The main problem with the modified five-factor model with human asset is the microcap with conservative investment stocks whose returns behave like that low-value unprofitable firms.

Keywords: Human asset, Factor models, Asset Pricing, Risk

JEL Classification: G12

1 Introduction

Knowledge-based economy gained momentum over manufacturing-based economy in last few decades. Business firms nowadays specially giving significant importance to develop their human assets to gain competitive advantages over the other firms. Human assets are intangible in nature and generally not captured by balance sheet items. Accurate measurement of firm's human assets is bit complex; one reason could be as Bontis et al. (2000) pointed out that human assets of a firm are not under direct control of the firm. In spite of knowing the fact that human assets are important in valuing the firm still most of the firm valuation are done considering only the balance sheet items. Collins et al. (1997) added investors could gain additional by gathering information on the firms' human assets. Last few decades are spectator of several risk factors and factor models for firm valuations [see Maiti (2020a, b)]. CAPM [Sharpe (1964), Lintner (1965) and Mossin (1966)] was the seminal model that challenged over the period of time by several researchers like Fisher Black (1972), Fama and MacBeth (1973), Ross (1976), Banz (1981), Reinganum (1981), Gibbons (1982), Basu (1983), Shanken (1985) and Bhandari (1988). There after several multifactor models developed and challenged such as Ross (1976) APT model, Fama–French (1993) three-factor model, Fama–French (2015) five-factor model and others. Further studies by Haugen and Baker (1996), Cohen et al. (2002), Fairfield et al. (2003), Titman et al. (2004), Novy-Marx (2013), Hou et al. (2014), Clarke (2016), Chiah et al. (2016), Balakrishnan and Maiti (2017), Maiti and Balakrishnan (2018, 2020), Maiti (2019a, b, c), Maiti (2020a, b) and others find that these model are not global and there is a scope for more robust valuation model.

Most of the studies discussed above do not include a measure for human assets in their valuation models. Notably it was the Campbell (1992, 1992) studies that strongly argued firm valuation excluding human assets may lead to serious errors. Other studies by Fama and Schwert (1977), Jagannathan and Wang (1996), Jagannathan et al. (1998), Rosett (2001) and Qin (2002) also find that human asset is an important factor in explaining the cross-sectional risk return variations. The present study will examine the role of human asset investment in firm valuation in Indian context. Present study will use Fama–French (1993) three-factor and Fama–French (2015) five-factor model in a time series setup to test the risk return relationship and finally results will be compared to newly proposed model to justify its robustness than the former two models. The nobleness of the present study lies in several ways first altogether a new robust five-factor asset pricing model developed with human asset investment which found to be superior than existing valuation models; second, in Indian context human asset investment factor is almost untouched by previous studies except Maiti (2019a, b, c), Maiti and Balakrishnan (2018, 2020) and few others.

2 Literature review

Campbell (1996) shows that by ignoring human asset CAPM overstates the risk investing in financial assets and understates the risk aversion coefficient. Study also finds intertemporal model using human asset to be more robust than the traditional CAPM in explaining risk return relationship. Similarly, Jagannathan and Wang (1996) study also find that the intertemporal model with human asset is more sustainable than CAPM. The study also argues that human assets are tradable such as in mortgage and life insurance markets. Thereafter Rosett (2001) and Qin (2002) added that human asset is positively related to the equity returns. Chen et al. (2005) study find that during the period between 1977 and 2001, there is significant increase in the gap between the book value and market value of the US companies. The study mentioned that ignorance of valuable assets by the financial statement could be the reason behind the gap between the book value and market value as similar to the Collins et al. (1997) findings. The study also confirms that 80% of the firm's market value is missing in the financial statement of the firm. Knowledge-based aspect of the firms' human asset is considered by Crook et al. (2011). Study argues that human asset characteristics are unique for each firm; human asset of a firm is difficult to copy, replicate and duplicate. Hence, a firm could gain sustainable competitive advantages over other firms by developing its human asset.

In general successful firms pay higher compensation to develop human assets that in turn leads to higher productivity and increase value of the firm. Pantzalis and Park (2009), Edmans (2011) and others study show empirically that market is often unable to price the human asset accurately especially for the small-size firms. From the above discussion it is clear that human asset factor is important in relationship to determining the firm valuation. The main problems lie with human asset is that it is very difficult to measure and none of the available techniques that are used by previous study are able to measure the human asset factor accurately. Human asset investment seems to be one of the very important factors that are related to the stock returns and on the other hand, very limited number of studies are done on human asset in this aspects. Considering the emerging markets, very limited number of studies are done on human asset and firm valuation in Indian context. All such factors justify the need of present study and study results will have serious implication for the other emerging and developed markets.

3 Data and methodology

3.1 Data

The study uses monthly data for total 431 companies those are listed in the BSE 500 index and the study period is from July, 2003 to November, 2016. Study uses Market capitalization (MC) as proxy for Size; Price to Book (P/B) ratio as proxy for Value; BSE 200 index monthly return as proxy for Market (R_m) and 91-day T-Bills return as proxy for risk-free rate (R_f). Total asset growth (TA) without human asset act as the proxy for Investment (CMA) and it is calculated by the formula $[(TA_t - TA_{t-1})/TA_{t-1})]$ as similar to Hou et al. (2015) and return on equity (ROE) used as the proxy for profitability as similar to Haugen and Baker (1996). Total salary and wage expense used as the proxy for human asset (HA) as similar to Hansson (2004), Draca et al. (2011), and Bell and Machin (2016). Traditionally investment in human asset considers as the cost to the company and not as the investment Petty and Guthrie (2000). But significant number of studies by Bontis (2003) and Wright et al. (2001) argued that human asset should be considered as the investment of the firm rather than expenses in today's knowledge-based economy where human asset has greater importance in determining the value of the firm. So present study defined a new factor for investment with human asset (CvMAv) as the total asset growth (TAM = TA + HA) including human asset that acts as the proxy for Investment factor (CvMAv) and it is calculated by the formula $[\{(TA + HA)_t - (TA + HA)_{t-1}\}/(TA + HA)_{t-1})]$.

3.2 Portfolio construction methodology

Single and double shorting techniques are deployed to construct the study and mimicking portfolios. Every year in the month of June (t) based on market capitalization of the stocks using single sorting technique five equal weighted portfolios are constructed. Five market capitalization (MC)-based portfolios are named P1 to P5 in ascending order of size. Then again in the month of June next year ($t+1$) the rank revised using the same process and continued every year till 2016. Following the same procedure other portfolios based on P/B, ROE, TA and TAM are constructed and named. Then every year in the month of June (t) using double sorting technique 25 value weighted portfolios are constructed from the cross of five MC and P/B sorted portfolios. Portfolio consists of small size (MC) and low P/B stocks named as the MP11, similarly portfolio with big size (MC) and high P/B stocks named as MP55. Then again in the month of June next year ($t+1$) the rank revised using the same process and continued every year till 2016. Following the same procedure using double sorting technique three sets of 25 portfolios are constructed from the each individual crosses of five 'MC & ROE', 'MC & TA' and 'MC & TAM' sorted portfolios, respectively. The portfolios were named in the similar fashion as explained in case of 'MC & *P*/*B*' cross and again in the month of June next year ($t+1$) the rank revised using the same process and continued every year till 2016.

Using the similar process, other portfolios are constructed to derive the mimicking portfolios as described below. Every year in the month of June (t) based on market capitalization (MC) of the stocks using single sorting technique two equal weighted portfolios are constructed similar to Balakrishnan and Maiti (2017), Maiti and Balakrishnan (2018, 2020), Maiti (2019a, b, c) and other studies. The portfolios are named Small (S) and Big (B) in ascending order of size (MC). Then again in the month of June next year ($t+1$) the rank revised using the same process and continued every year till 2016. Then using Fama–French (1993) breakpoints (30:40:30) based on *P*/*B* three weighted portfolios are constructed. Portfolio consists of bottom 30% stocks with low *P*/*B* ratio named value (*V*), top 30% stocks with high *P*/*B* ratio named growth (*G*) and rest 40% stocks were placed into the neutral portfolio. Then again in the month of June next year ($t+1$) the rank revised using the same process and continued every year till 2016. Then every year in the month of June (t) using double sorting technique six value weighted portfolios are constructed from the cross of two MC and three *P*/*B* sorted portfolios. These formed six portfolios are named as S/L, S/N, S/G, B/L, B/N and B/G, where S/L consists of small size and low *P*/*B* stocks whereas B/G consists of big size and high *P*/*B* stocks. Similarly using Fama–French (1993) breakpoints (30:40:30) based on ROE, TA and TAM three sets of three weighted portfolios are constructed from each of these variables. Portfolio consists of bottom 30% stocks with low ROE named Weak (W), top 30% stocks with high ROE named Robust (R) and rest 40% stocks were placed into the neutral portfolio. Then portfolio consists of bottom 30% stocks with low TA named Conservative (*C*), top 30% stocks with high TA named Aggressive (*A*) and rest 40% stocks were placed into the neutral portfolio. Similarly portfolio consists of bottom 30% stocks with low TAM named Conservative Value (CV), top 30% stocks with high TAM named Aggressive value (AV) and rest 40% stocks were placed into the neutral portfolio. Then again in the month of June next year ($t+1$) the rank revised using the same process and continued every year till 2016. Then every year in the month of June (t) using double sorting technique three sets of six value weighted portfolios are constructed from the each individual cross of 'two MC & three ROE', 'two MC & three TA' and 'two MC & three TAM' sorted portfolios, respectively. Then formed portfolios were named in similar fashion as described in case of 'two MC & three ROE' cross.

3.3 Mimicking portfolios

Study uses five mimicking portfolios SMB (Size), LMH (value), RMW (profitability), CMA (Investment without human asset) and CvMAv (Investment with human asset) and they are calculated as explained below:

$$\mathrm{SMB} = (S/L + S/M + S/H)/3 - (B/L + B/M + B/H)/3, \tag{1}$$

$$\mathrm{LMH} = (S/L + B/L)/2 - (S/H + B/H)/2, \tag{2}$$

$$\mathrm{RMW} = (S/R + B/R)/2 - (S/W + B/W)/2, \tag{3}$$

$$\mathrm{CMA} = (S/C + B/C)/2 - (S/A + B/A)/2, \tag{4}$$

$$\mathrm{CvMAv} = (S/\mathrm{Cv} + B/\mathrm{Cv})/2 - (S/\mathrm{Av} + B/\mathrm{Av})/2. \tag{5}$$

The present study uses three regression models:

Fama–French three-factor model

$$R_{\mathrm{Pt}} - R_{\mathrm{Ft}} = a + b\,(R_{\mathrm{Mt}} - R_{\mathrm{Ft}}) + s\,\mathrm{SMB}_t + l\,\mathrm{LMH}_t + e_t \tag{6}$$

where SMB and LMH mimic the risk factors whereas s and l are the portfolio's responsiveness to (sensitivity coefficients) SMB and LMH factors, respectively.

Fama–French Five-factor model

$$R_{\mathrm{Pt}} - R_{\mathrm{Ft}} = a + b\,(R_{\mathrm{Mt}} - R_{\mathrm{Ft}}) + s\,\mathrm{SMB}_t + l\,\mathrm{LMH}_t + p\,\mathrm{RMWt} + t\,\mathrm{CMAt} + e_t \tag{7}$$

where SMB, LMH, RMW and CMA mimic the risk factors whereas s, l, p and t are the portfolio's responsiveness to (sensitivity coefficients) SMB, LMH, RMW and CMA factors, respectively.

Modified five-factor model with Human Asset

$$R_{\mathrm{Pt}} - R_{\mathrm{Ft}} = a + b\,(R_{\mathrm{Mt}} - R_{\mathrm{Ft}}) + s\,\mathrm{SMB}_t + l\,\mathrm{LMH}_t + p\,\mathrm{RMWt} + h\,\mathrm{CvMAvt} + e_t \tag{8}$$

where SMB, LMH, RMW and CvMAv mimic the risk factors whereas s, l, p and t are the portfolio's responsiveness to (sensitivity coefficients) SMB, LMH, RMW and CvMAv factors, respectively.

4 Explanatory variables

Descriptive statistics of the explanatory variables are shown in Table 1. The average monthly market premium of 1% ($t = 2.151$), size premium of 1.3% ($t = 5.177$) and value premium of 0.8% ($t = 2.164$) seem quite attractive in terms of investment; results are similar to Fama–French (1993, 2015) in US market. Investment based on size of the firms has higher probability to yield more returns to the investors. Profitability, investment and human asset factor yields comparatively much lower average monthly premium than market, size and value factor. That implies that risks associated with these factors are lower and risk adverse investors should consider these factors while making investment decision.

Correlation matrix for the explanatory variables is shown in Table 2. Market is negatively related to the profitability and investment factors whereas positively related to size, value and investment with human asset factors. Theoretically findings are correct and similar to Fama–French (2015) in US context. Value and investment with human

Table 1 Descriptive statistics for the independent variables

	Rm	SMB	LMH	RMW	CMA	CvMAv
Mean returns	0.010	0.013	0.008	0.001	0.001	0.002
Standard deviations	0.059	0.031	0.047	0.006	0.028	0.012
T-statistics	2.151	5.177	2.164	2.115	0.617	2.115

Table 2 Correlation matrix for explanatory variables

	RM	SMB	LMH	RMW	CvMAv	CMA
RM	1					
SMB	0.283	1				
LMH	0.329	0.063	1			
RMW	− 0.352	− 0.041	− 0.843	1		
CvMAv	0.306	0.287	0.171	− 0.338	1	
CMA	− 0.133	0.286	0.215	− 0.346	0.162	1

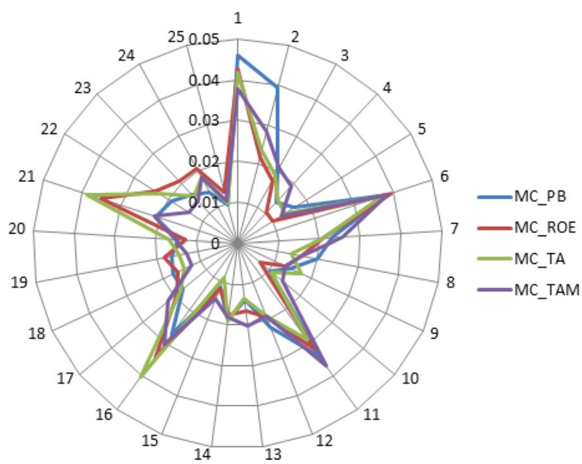

Fig. 1 Radar graph shows 25 portfolios mean returns based on MC_PB, MC_ROE, MC_TA and MC_TAM crosses

asset factors are positively related to other factors except profitability factor. The correlations between the explanatory variables are within the limit and in all cases standard errors are less.

5 Empirical results

Figure 1 shows the average return pattern for 25 portfolios constructed based on MC_PB, MC_ROE, MC_TA and MC_TAM. In all the cases portfolio 1 returns outperformed the returns from other portfolios and similarly portfolio 25 has the lowest average returns in all the cases. The return patterns clearly reveal that investors can gain abnormal returns by following size-based investment strategy. Figure 1 also reveals that there is manifestation of other factors (value, profitability, investment) too and there exists certain patterns which need to be identified.

Details of each portfolio formed from each cross are shown in Table 3 for further discussion.

MC_PB: First portfolio consists of small size and low P/B stocks yield average monthly return of 4.6% ($t = 5.490$) which is at least four times higher than the average monthly return of last portfolio. Holding value (P/B) constant in each column the average monthly return decreases with increase in size and this is known as the size effect. Consider first column keeping low-value (P/B) constant first portfolio at the top of

Table 3 Summary statistics of 25 portfolios formed on MC_PB, MC_ROE, MC_TA and MC_TAM

Panel A (mean excess returns)

	MC_PB					MC_ROE				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.046	0.039	0.034	0.027	0.021	0.043	0.039	0.032	0.034	0.035
2	0.039	0.023	0.022	0.017	0.019	0.022	0.021	0.019	0.019	0.024
3	0.020	0.020	0.014	0.017	0.016	0.018	0.016	0.017	0.016	0.021
4	0.014	0.014	0.019	0.016	0.014	0.010	0.013	0.018	0.018	0.021
Big	0.016	0.010	0.011	0.015	0.010	0.010	0.007	0.012	0.013	0.013
	MC_TA					MC_TAM				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.042	0.037	0.029	0.040	0.039	0.038	0.039	0.037	0.030	0.022
2	0.024	0.021	0.019	0.018	0.023	0.028	0.026	0.019	0.022	0.014
3	0.019	0.013	0.013	0.014	0.016	0.021	0.016	0.020	0.012	0.014
4	0.014	0.017	0.019	0.015	0.018	0.019	0.013	0.018	0.013	0.019
Big	0.014	0.011	0.009	0.017	0.010	0.013	0.014	0.014	0.015	0.011

Panel B (standard deviations)

	MC_PB					MC_ROE				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.106	0.101	0.093	0.083	0.087	0.109	0.164	0.095	0.090	0.091
2	0.149	0.100	0.084	0.084	0.078	0.111	0.099	0.086	0.086	0.083
3	0.109	0.104	0.082	0.088	0.076	0.112	0.101	0.092	0.086	0.082
4	0.116	0.097	0.108	0.089	0.067	0.110	0.100	0.089	0.084	0.069
Big	0.108	0.104	0.087	0.089	0.067	0.103	0.100	0.086	0.080	0.078
	MC_TA					MC_TAM				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.103	0.107	0.099	0.145	0.104	0.110	0.099	0.141	0.092	0.087
2	0.099	0.094	0.088	0.085	0.096	0.112	0.093	0.088	0.088	0.085
3	0.096	0.088	0.093	0.093	0.101	0.103	0.091	0.087	0.101	0.083
4	0.093	0.089	0.088	0.087	0.111	0.101	0.079	0.084	0.089	0.075
Big	0.082	0.074	0.080	0.086	0.094	0.092	0.104	0.089	0.082	0.077

Panel C (*T*-statistics)

	MC_PB					MC_ROE				
	Low	2	3	4	High	Low	2	3	4	High
Small	5.490	4.843	4.615	4.187	3.086	4.953	3.043	4.228	4.803	4.902
2	3.324	2.961	3.330	2.633	3.101	2.465	2.673	2.854	2.873	3.610
3	2.347	2.436	2.159	2.508	2.742	1.991	1.987	2.299	2.405	3.241
4	1.510	1.851	2.204	2.327	2.718	1.195	1.650	2.502	2.774	3.851
Big	1.927	1.267	1.659	2.093	1.841	1.233	0.921	1.719	2.017	2.117
	MC_TA					MC_TAM				
	Low	2	3	4	High	Low	2	3	4	High
Small	5.123	4.425	3.736	3.538	4.708	4.344	4.946	3.304	4.186	3.138
2	3.022	2.800	2.755	2.701	2.982	3.187	3.474	2.719	3.189	2.076
3	2.507	1.942	1.848	1.972	1.980	2.595	2.236	2.934	1.569	2.140

Table 3 (continued)

	MC_TA					MC_TAM				
	Low	2	3	4	High	Low	2	3	4	High
4	1.984	2.436	2.729	2.130	2.095	2.418	2.056	2.734	1.809	3.120
Big	2.165	1.859	1.388	2.453	1.346	1.748	1.759	2.067	2.390	1.752

column with small-size stocks' portfolio yields average monthly return of 4.6% ($t=5.490$) whereas average monthly return reduced more than thrice to 1.6% ($t=1.927$) for the bottom portfolio in the column with big-size stocks. Same observation is observed for all other columns that indicate there is a strong size effect in portfolio return patterns. Similarly holding size (MC) constant in each row the average monthly return decreases with increase in value and this is known as the value effect. Consider first row keeping small-size constant first portfolio at the extreme left of the first row with low-value stocks' portfolio yields average monthly return of 4.6% ($t=5.490$) whereas average monthly return reduced almost half to 2.1% ($t=3.086$) for the bottom portfolio in the column with big-size stocks. Similar observation reflects in all other rows also indicate that there is a strong value effect in portfolio return patterns. The study findings are similar to Fama–French (2015) study in US context.

MC_ROE, MC_TA and MC_TAM: Clear size effect is observed in portfolios formed from MC_ROE, MC_TA *and* MC_TAM crossed portfolios. In MC_ROE cross portfolio holding size constant for first three rows shows no clear pattern but last two rows with big-size portfolios show weak profitability effect as similar to Novy-Marx (2013) and Fama–French (2015) findings. Holding size constant for both the MC_TA and MC_TAM crosses no much clear portfolio return pattern observed while traversing through any of the other rows.

Figure 2 shows the 3D view of return patterns for all the portfolios formed from MC_PB, MC_ROE, MC_TA and MC_TAM crosses, respectively. More complex return patterns are observed in case for MC_ROE, MC_TA and MC_TAM cross portfolios as frequent change in slope can be observed in Fig. 2.

6 Asset pricing results

6.1 Three-factor regression

Three-factor regression results with market, size and value are shown in Table 4. A regression model is said to be a best model which is able to capture all alpha values equal to zero. Five portfolios found significant (alpha values not equal to zero where t(a) is more than 1.96) for MC_PB, MC_ROE & MC_TA and four portfolios found significant in case of MC_TAM portfolios. Average alpha value (intercepts) for MC_PB, MC_ROE, MC_TA and MC_TAM cross portfolios found to be 0.0034, 0.0049, 0.0034 and 0.0033, respectively. The average values of intercepts are not closer to zero for all the cases and average R-Square value (%) for MC_PB, MC_ROE, MC_TA and MC_TAM cross portfolios are 78.7, 76.4, 76.6 and 73.8, respectively (see Table 7). Expect for the MC_TAM cross portfolio consists of microcaps (First portfolio) that are not captured by the three-factor regressions. The study findings are similar to the global findings of Aharoni et al. (2013) and Fama–French (2015).

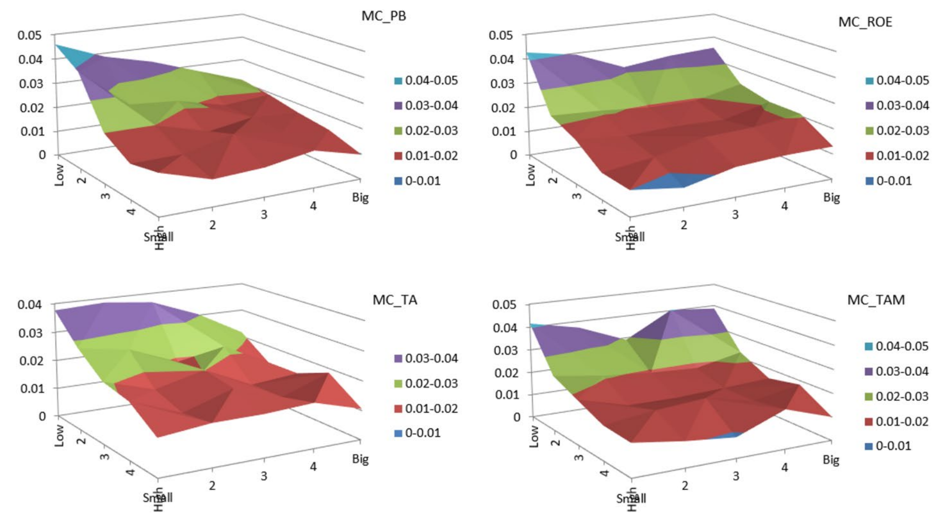

Fig. 2 Visual 3D surface images for 25 portfolios mean returns formed on MC_PB, MC_ROE, MC_TA and MC_TAM

Microcaps remain the problem for most of the crosses expect MC_TAM cross. Since three-factor model is unable to explain all risk return relationship, this study further estimates five-factor regression with market, size, value, profitability and investment (without human investment).

6.2 Five-factor regressions (without human asset investment)

Five-factor regression results with market, size; value, profitability and investment (without human investment) are shown in Table 5.

MC_PB: Five portfolios found to be significant with average alpha value of 0.0047 and 79.9 average *R*-square (%). Market and value slopes found to be highly positive, size slopes are positive for small-size stock portfolio but becomes slightly negative toward big-size portfolios. Five factors provide more information than three-factor model on the risk return relationship for the first portfolio with microcaps. In column one with low-value stocks, the coefficient of profitability (RMW) factor has positive slopes for microcaps whereas it changes its sign on increase of size. This indicates that first portfolio with combination of low value and microcaps is much dominated by the low-value stocks with aggressive investment and marginal profitability but yields higher returns than other portfolios as shown in Table 3. Value (LMH) coefficients are highly positive for low *P*/*B* stock portfolio and become negative for high *P*/*B* stock portfolios. MC_PB cross is not based on the investment factor but it seems that results are aligned with it as low *P*/*B* stock portfolios show lower negative investment (CMA) than high *P*/*B* stock portfolios. Theoretically, it justifies as low *P*/*B* firms are conservative investment nature whereas high *P*/*B* firms have aggressive investment nature.

MC_ROE: Five portfolios found to be significant with average alpha value of 0.0048 and 78.2 average *R*-square (%). Profitability (RMW) and investment (CMA) coefficient changes its sign on moving from low ROE stock portfolios to the high ROE stock portfolios. High positive investment (CMA) and less negative profitability (RMW) coefficient

Table 4 FF three-factor regression results $R_{Pt} - R_{Ft} = a + b\,(R_{Mt} - R_{Ft}) + s\,SMB_t + l\,LMH_t + e_t$

Panel A (MC_PB

	a					**RM**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.013	0.009	0.009	0.002	−0.004	1.038	1.093	1.103	1.011	1.096
2	0.001	−0.001	0.000	−0.005	0.002	0.804	1.075	0.951	1.021	1.019
3	−0.006	−0.003	−0.003	0.001	0.003	1.118	1.199	0.920	1.139	0.979
4	−0.003	0.001	0.006	0.002	0.004	1.050	0.952	1.258	1.139	0.866
Big	0.003	0.000	0.002	0.002	0.001	0.994	1.106	1.024	1.139	0.911
	S					***L***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.423	1.220	0.967	1.193	1.231	0.631	0.414	0.183	0.062	−0.165
2	1.464	0.772	0.795	0.893	0.629	1.433	0.427	0.282	0.148	−0.152
3	0.680	0.575	0.415	0.471	0.358	0.813	0.470	0.295	−0.064	−0.115
4	−0.184	−0.096	−0.135	0.270	0.248	1.121	0.666	0.247	−0.064	−0.227
Big	−0.361	−0.401	−0.287	0.270	0.181	0.998	0.628	0.303	−0.064	−0.270
	***t*(*a*)**					***t*(RM)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	2.601	1.966	2.262	0.522	−1.119	15.455	17.404	19.464	21.447	21.491
2	0.135	−0.113	0.061	−1.560	0.683	6.286	16.486	18.565	21.907	22.855
3	−1.979	−0.774	−0.763	0.156	0.984	19.763	22.420	18.153	25.087	23.376
4	−0.821	0.155	1.987	0.611	1.536	19.386	16.925	21.962	23.993	21.939
Big	0.928	−0.158	1.047	0.611	0.239	21.391	25.439	31.552	23.993	28.252
	***t*(*s*)**					***t*(*l*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	9.517	8.727	7.670	11.378	10.844	6.230	4.366	2.147	0.874	−2.151
2	5.142	5.321	6.977	8.615	6.335	7.425	4.345	3.651	2.110	−2.259
3	5.400	4.834	3.679	4.659	3.841	9.533	5.830	3.862	−0.940	−1.820
4	−1.528	−0.769	−1.058	2.552	2.820	13.720	7.857	2.861	−0.889	−3.813
Big	−3.496	−4.147	−3.978	2.552	2.527	14.238	9.581	6.192	−0.889	−5.559

Panel B MC_ROE

	a					**RM**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.006	0.007	0.004	0.007	0.008	1.076	0.776	0.998	1.037	1.108
2	−0.006	−0.003	−0.001	−0.002	0.005	1.091	1.051	1.011	1.073	1.037
3	−0.007	−0.002	0.000	−0.001	0.008	1.106	1.115	1.083	0.991	1.028
4	−0.009	−0.002	0.007	0.009	0.010	1.150	0.996	0.957	0.953	0.903
Big	−0.003	−0.005	0.002	0.003	0.005	1.136	1.123	1.027	1.013	1.006
	S					***L***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.667	1.189	1.094	1.175	1.351	0.617	1.251	0.457	0.210	−0.110
2	0.858	0.669	0.658	0.925	0.629	0.808	0.562	0.183	−0.068	0.006
3	0.618	0.232	0.294	0.421	0.197	0.764	0.451	0.244	0.270	−0.004
4	0.214	−0.043	−0.163	−0.099	0.300	0.611	0.680	0.360	0.130	−0.200
Big	−0.222	−0.220	−0.158	−0.018	−0.003	0.516	0.469	0.220	−0.028	−0.209

Table 4 (continued)

	t(a)					t(RM)				
	Low	2	3	4	High	Low	2	3	4	High
Small	1.997	0.566	0.979	1.831	1.916	16.349	4.765	16.617	18.954	19.143
2	− 1.330	− 0.620	− 0.151	− 0.660	1.491	16.180	18.117	19.342	20.701	20.755
3	− 1.476	− 0.405	0.051	− 0.308	2.597	16.007	18.809	21.125	19.774	23.729
4	− 1.775	− 0.416	1.968	2.433	3.518	17.190	17.404	18.116	18.402	23.898
Big	− 0.739	− 1.501	0.622	1.103	1.628	23.714	25.233	27.717	25.631	25.179
	t(s)					**t(l)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	11.381	3.279	8.188	9.654	10.493	6.217	5.091	5.051	2.547	− 1.257
2	5.718	5.185	5.659	8.019	5.660	7.949	6.428	2.322	− 0.872	0.084
3	4.018	1.758	2.575	3.778	2.039	7.330	5.050	3.161	3.566	− 0.057
4	1.436	− 0.338	− 1.390	− 0.862	3.572	6.051	7.871	4.519	1.669	− 3.509
Big	− 2.080	− 2.220	− 1.915	− 0.202	− 0.039	7.136	6.984	3.938	− 0.476	− 3.473

Panel C MC_TA

	a					RM				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.009	0.005	0.001	0.009	0.006	1.051	1.143	1.071	0.788	1.108
2	0.000	− 0.001	− 0.003	0.000	0.000	1.080	1.048	0.969	0.929	1.086
3	− 0.004	− 0.004	− 0.004	0.000	− 0.004	1.099	0.978	1.139	1.119	1.093
4	0.000	0.004	0.006	0.002	0.005	1.049	1.016	0.988	0.984	1.282
Big	0.003	0.002	0.000	0.009	− 0.001	0.971	0.830	1.004	1.031	1.181
	S					**L**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.629	1.314	1.073	1.274	1.448	0.262	0.536	0.458	0.920	0.371
2	0.700	0.704	0.667	0.449	0.793	0.556	0.345	0.448	0.403	0.270
3	0.653	0.385	0.349	0.164	0.494	0.478	0.345	0.226	0.200	0.306
4	0.179	0.005	0.027	− 0.009	− 0.011	0.195	0.314	0.333	0.339	0.078
Big	0.052	− 0.131	− 0.120	− 0.304	− 0.042	0.135	0.282	0.070	0.151	0.018
	t(a)					**t(RM)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	2.029	1.103	0.285	1.975	1.997	16.214	18.425	17.937	5.504	16.419
2	− 0.101	− 0.311	− 0.711	0.017	− 0.090	19.564	17.682	19.469	17.775	17.412
3	− 1.107	− 1.012	− 1.250	− 0.086	− 0.760	22.238	18.320	25.376	22.580	15.654
4	0.055	1.279	1.978	0.669	1.000	17.536	20.961	20.534	22.067	18.501
Big	0.775	0.734	− 0.145	3.479	− 0.417	21.513	22.036	32.640	28.766	26.228
	t(s)					**t(l)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	10.303	9.518	8.074	4.002	9.649	2.529	5.724	5.086	4.264	3.641
2	5.698	5.337	6.021	3.863	5.717	6.676	3.860	5.969	5.109	2.870
3	5.939	3.239	3.495	1.490	3.180	6.419	4.283	3.337	2.677	2.908
4	1.346	0.048	0.248	− 0.088	− 0.074	2.162	4.299	4.589	5.038	0.748
Big	0.516	− 1.569	− 1.750	− 3.814	− 0.419	1.978	4.961	1.518	2.800	0.270

Table 4 (continued)

Panel D MC_TAM

	a					RM				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.003	0.013	0.002	0.003	−0.001	1.291	0.851	0.819	0.957	0.897
2	0.001	0.002	0.001	0.000	−0.002	1.192	1.015	0.973	0.923	0.933
3	−0.006	−0.001	0.005	−0.004	0.002	1.224	1.040	1.046	1.124	0.904
4	0.001	−0.001	0.006	0.003	0.007	1.187	0.834	0.906	0.907	0.914
Big	0.004	0.002	0.002	0.007	0.001	0.987	1.307	1.083	0.965	1.000
	S					*L*				
	Low	2	3	4	High	Low	2	3	4	High
Small	1.615	0.901	1.457	1.164	0.867	0.125	0.662	0.988	0.355	0.387
2	0.831	0.811	0.443	0.757	0.289	0.579	0.431	0.317	0.449	0.327
3	1.053	0.392	0.305	0.132	0.031	0.185	0.269	0.076	0.405	0.393
4	0.399	0.176	0.090	−0.261	0.178	0.202	0.371	0.295	0.529	0.003
Big	−0.171	−0.043	0.039	−0.231	0.030	0.133	0.004	0.098	0.177	−0.130
	t(*a*)					*t*(RM)				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.700	2.456	0.241	0.731	−0.333	19.444	11.308	6.202	15.261	14.943
2	0.238	0.425	0.263	−0.053	−0.408	17.029	17.696	17.117	16.392	17.245
3	−1.294	−0.377	1.372	−0.856	0.453	19.507	19.014	19.696	19.405	19.013
4	0.173	−0.199	1.975	0.804	2.158	19.411	16.829	16.299	19.323	19.951
Big	0.861	0.537	0.718	2.725	0.499	15.506	26.744	23.671	26.202	28.262
	t(*s*)					*t*(*l*)				
	Low	2	3	4	High	Low	2	3	4	High
Small	10.930	5.377	4.962	8.346	6.495	1.250	5.831	4.962	3.751	4.275
2	5.335	6.351	3.503	6.041	2.400	5.484	4.979	3.701	5.285	4.004
3	7.542	3.218	2.580	1.025	0.294	1.955	3.261	0.950	4.638	5.478
4	2.935	1.593	0.729	−2.495	1.749	2.191	4.967	3.519	7.470	0.046
Big	−1.207	−0.394	0.386	−2.813	0.379	1.389	0.061	1.427	3.185	−2.429

Panel E R^2

	MC_PB					MC_ROE				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.733	0.741	0.749	0.785	0.768	0.757	0.342	0.733	0.754	0.732
2	0.510	0.716	0.750	0.793	0.782	0.755	0.769	0.751	0.755	0.760
3	0.819	0.823	0.745	0.820	0.795	0.743	0.771	0.791	0.771	0.811
4	0.854	0.776	0.812	0.810	0.768	0.754	0.782	0.767	0.747	0.797
Big	0.876	0.884	0.908	0.810	0.847	0.856	0.868	0.876	0.839	0.825
	MC_TA					MC_TAM				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.734	0.774	0.756	0.346	0.719	0.756	0.612	0.415	0.691	0.682
2	0.792	0.734	0.785	0.750	0.718	0.740	0.747	0.722	0.726	0.730
3	0.824	0.752	0.842	0.811	0.678	0.753	0.756	0.752	0.780	0.783
4	0.721	0.803	0.798	0.822	0.737	0.755	0.735	0.710	0.813	0.753
Big	0.795	0.826	0.900	0.884	0.847	0.680	0.852	0.822	0.864	0.858

Table 5 Regression results of Fama–French five-factor model for 25 portfolios $R_{Pt} - R_{Ft} = a + b\,(R_{Mt} - R_{Ft}) + s\,SMB_t + l\,LMH_t + p\,RMWt + t\,CMAt + e_t$

Panel A MC_PB

	a					*b*				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.010	0.011	0.012	0.003	−0.002	1.063	1.076	1.100	0.993	1.087
2	0.010	0.004	0.002	−0.004	0.005	0.657	1.050	0.949	0.990	0.988
3	−0.004	0.000	−0.001	0.002	0.003	1.122	1.176	0.908	1.104	0.962
4	−0.002	0.003	0.012	0.005	0.006	1.042	0.936	1.184	1.109	0.838
Big	0.004	0.001	0.003	0.008	0.003	0.991	1.081	1.023	1.104	0.893
	S					***L***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.417	1.232	0.925	1.216	1.200	0.921	0.254	−0.032	−0.071	−0.408
2	1.697	0.747	0.761	0.943	0.659	0.578	−0.001	0.106	−0.018	−0.414
3	0.622	0.583	0.415	0.545	0.396	0.617	0.202	0.151	−0.184	−0.161
4	−0.178	−0.097	−0.056	0.304	0.291	1.042	0.465	−0.350	−0.304	−0.387
Big	−0.372	−0.371	−0.290	−0.157	0.184	0.922	0.439	0.278	−0.215	−0.484
	R					***T***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.384	−0.221	−0.241	−0.196	−0.288	0.066	−0.086	0.179	−0.132	0.120
2	−1.343	−0.536	−0.198	−0.266	−0.373	−1.283	0.064	0.145	−0.273	−0.189
3	−0.201	−0.359	−0.189	−0.228	−0.097	0.260	−0.075	−0.023	−0.386	−0.195
4	−0.110	−0.263	−0.857	−0.348	−0.251	−0.044	−0.025	−0.478	−0.207	−0.240
Big	−0.089	−0.276	−0.029	−0.230	−0.282	0.041	−0.176	0.012	−0.142	−0.043
	***t*(*a*)**					***t*(RM)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.908	2.216	2.722	0.875	−0.414	15.406	16.546	18.995	20.395	20.935
2	1.068	0.816	0.544	−1.037	1.472	5.273	15.992	18.059	20.855	21.893
3	−0.935	−0.058	−0.341	0.492	1.076	19.494	21.491	17.326	24.189	22.307
4	−0.584	0.639	3.041	1.281	2.032	18.513	16.143	21.892	22.942	20.902
Big	1.108	0.433	1.099	2.724	1.157	20.565	24.309	30.323	28.350	27.447
	***t*(*s*)**					***t*(*l*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	9.281	8.562	7.217	11.290	10.436	5.204	1.523	−0.216	−0.569	−3.063
2	6.155	5.143	6.547	8.973	6.600	1.807	−0.006	0.786	−0.148	−3.580
3	4.882	4.814	3.580	5.390	4.145	4.178	1.436	1.124	−1.572	−1.454
4	−1.425	−0.755	−0.467	2.845	3.280	7.215	3.124	−2.522	−2.456	−3.759
Big	−3.483	−3.772	−3.889	−1.821	2.555	7.455	3.851	3.215	−2.151	−5.798
	***t*(*r*)**					***t*(*T*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.958	−1.195	−1.466	−1.418	−1.949	0.368	−0.509	1.182	−1.042	0.884
2	−3.793	−2.872	−1.323	−1.969	−2.905	−3.948	0.376	1.058	−2.208	−1.609
3	−1.228	−2.306	−1.267	−1.757	−0.788	1.735	−0.524	−0.168	−3.244	−1.737
4	−0.689	−1.595	−5.574	−2.535	−2.201	−0.301	−0.163	−3.391	−1.640	−2.291
Big	−0.649	−2.183	−0.306	−2.082	−3.049	0.324	−1.518	0.139	−1.402	−0.512

Table 5 (continued)

Panel B MC_ROE

	a					RM				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.008	0.019	0.005	0.004	0.005	1.088	0.558	0.995	1.040	1.126
2	− 0.003	0.001	0.002	− 0.003	0.003	1.084	1.027	1.010	1.051	1.042
3	− 0.001	0.005	0.000	− 0.003	0.007	1.068	1.062	1.072	0.975	1.022
4	− 0.001	0.002	0.010	0.009	0.010	1.104	0.944	0.933	0.956	0.893
Big	0.003	0.000	0.005	0.005	0.003	1.107	1.093	1.000	0.980	1.002
	S					***L***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.589	1.528	1.093	1.234	1.364	0.433	− 0.035	0.418	0.505	0.179
2	0.796	0.655	0.611	0.991	0.659	0.452	0.204	− 0.028	− 0.061	0.201
3	0.598	0.234	0.320	0.507	0.238	0.190	− 0.208	0.214	0.429	0.093
4	0.177	0.023	− 0.152	− 0.111	0.312	− 0.132	0.297	0.111	0.126	− 0.274
Big	− 0.259	− 0.229	− 0.150	0.034	0.037	− 0.007	0.050	− 0.075	− 0.228	− 0.079
	R					***T***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	− 0.165	− 2.009	− 0.051	0.328	0.365	0.363	− 1.874	− 0.001	− 0.254	− 0.024
2	− 0.407	− 0.455	− 0.231	− 0.055	0.226	0.258	0.019	0.203	− 0.330	− 0.120
3	− 0.732	− 0.863	− 0.065	0.127	0.087	0.019	− 0.102	− 0.133	− 0.404	− 0.193
4	− 0.936	− 0.564	− 0.337	0.006	− 0.108	0.077	− 0.382	− 0.092	0.057	− 0.067
Big	− 0.648	− 0.539	− 0.394	− 0.311	0.131	0.111	− 0.013	− 0.081	− 0.285	− 0.182
	***t*(*a*)**					***t*(RM)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.980	1.718	1.019	1.025	1.159	16.267	3.609	15.935	18.960	19.054
2	− 0.546	0.260	0.430	− 0.681	0.891	15.948	17.504	18.997	19.864	20.367
3	− 0.284	1.228	0.120	− 0.790	2.175	15.628	18.865	20.157	19.533	23.010
4	− 0.189	0.512	2.494	2.326	3.611	17.494	16.547	17.247	17.768	22.802
Big	0.874	− 0.155	1.740	1.767	1.109	24.559	25.196	27.147	24.667	24.622
	***t*(*s*)**					***t*(*l*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	10.731	4.464	7.909	10.165	10.425	2.525	− 0.088	2.610	3.587	1.181
2	5.293	5.045	5.195	8.465	5.815	2.590	1.356	− 0.206	− 0.450	1.528
3	3.955	1.875	2.715	4.588	2.422	1.083	− 1.438	1.566	3.354	0.821
4	1.271	0.179	− 1.269	− 0.931	3.594	− 0.818	2.028	0.796	0.912	− 2.729
Big	− 2.591	− 2.385	− 1.836	0.384	0.407	− 0.061	0.447	− 0.795	− 2.238	− 0.760
	***t*(*r*)**					***t*(*T*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	− 0.868	− 4.569	− 0.285	2.106	2.173	2.082	− 4.645	− 0.007	− 1.772	− 0.154
2	− 2.106	− 2.727	− 1.527	− 0.364	1.550	1.456	0.124	1.467	− 2.393	− 0.899
3	− 3.767	− 5.395	− 0.430	0.893	0.691	0.108	− 0.692	− 0.960	− 3.100	− 1.668
4	− 5.220	− 3.480	− 2.191	0.036	− 0.970	0.469	− 2.569	− 0.650	0.409	− 0.655
Big	− 5.055	− 4.372	− 3.756	− 2.752	1.133	0.942	− 0.117	− 0.848	− 2.751	− 1.716

Table 5 (continued)

Panel C MC_TA

	a					RM				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.010	0.006	0.002	0.018	0.005	1.098	1.156	1.074	0.592	1.089
2	0.001	0.002	0.001	0.002	0.001	1.082	1.038	0.950	0.917	1.022
3	−0.001	−0.002	−0.003	0.001	−0.003	1.110	0.996	1.124	1.097	1.012
4	0.004	0.008	0.007	0.003	0.011	1.036	1.002	0.986	0.963	1.189
Big	0.007	0.004	0.001	0.008	0.003	0.968	0.829	0.996	1.020	1.109
	S					***L***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.438	1.246	1.055	1.638	1.528	0.214	0.402	0.415	0.028	0.479
2	0.654	0.662	0.652	0.449	0.933	0.383	0.034	0.150	0.253	0.070
3	0.553	0.297	0.378	0.201	0.712	0.188	0.194	0.166	0.075	0.235
4	0.143	−0.022	0.003	0.031	0.120	−0.137	0.014	0.205	0.238	−0.532
Big	−0.029	−0.164	−0.122	−0.254	0.066	−0.245	0.128	−0.037	0.232	−0.422
	R					***T***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	−0.187	−0.109	−0.038	−1.517	0.065	0.716	0.322	0.083	−1.940	−0.383
2	−0.182	−0.366	−0.376	−0.196	−0.396	0.207	0.169	0.031	−0.020	−0.724
3	−0.283	−0.113	−0.106	−0.199	−0.304	0.460	0.416	−0.155	−0.199	−1.101
4	−0.399	−0.366	−0.145	−0.170	−0.925	0.134	0.096	0.098	−0.214	−0.742
Big	−0.419	−0.169	−0.139	0.057	−0.681	0.350	0.142	−0.003	−0.238	−0.603
	t(a)					***t*(RM)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	2.316	1.385	0.373	1.803	1.014	18.752	18.242	17.314	4.406	15.812
2	0.350	0.441	0.146	0.407	0.329	19.149	17.292	18.852	16.965	16.805
3	−0.236	−0.569	−1.024	0.250	−0.727	23.439	18.659	24.216	21.480	15.793
4	0.836	2.131	2.035	0.935	2.314	17.092	20.515	19.855	20.993	18.111
Big	2.110	1.291	0.342	3.054	1.014	22.806	21.628	31.404	28.133	27.144
	***t*(*s*)**					***t*(*l*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	11.095	8.881	7.684	5.504	10.026	1.428	2.471	2.610	0.082	2.710
2	5.227	4.978	5.846	3.753	6.928	2.641	0.221	1.158	1.822	0.446
3	5.271	2.516	3.683	1.775	5.022	1.548	1.416	1.397	0.570	1.429
4	1.067	−0.207	0.031	0.308	0.826	−0.879	0.111	1.609	2.025	−3.161
Big	−0.307	−1.937	−1.740	−3.167	0.734	−2.253	1.307	−0.461	2.493	−4.027
	***t*(*r*)**					***t*(*T*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	−1.126	−0.605	−0.218	−3.970	0.330	4.690	1.950	0.516	−5.531	−2.134
2	−1.130	−2.142	−2.623	−1.275	−2.292	1.401	1.078	0.235	−0.143	−4.562
3	−2.100	−0.744	−0.804	−1.371	−1.667	3.724	2.986	−1.279	−1.493	−6.585
4	−2.315	−2.638	−1.028	−1.306	−4.957	0.849	0.750	0.754	−1.788	−4.330
Big	−3.471	−1.548	−1.539	0.554	−5.859	3.158	1.423	−0.039	−2.519	−5.657

Table 5 (continued)

Panel D MC_TAM

	a					RM				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.003	0.014	0.009	0.004	−0.004	1.317	0.845	0.673	0.962	0.934
2	0.005	0.006	0.002	−0.001	−0.001	1.170	0.989	0.982	0.938	0.935
3	−0.003	0.001	0.008	−0.002	0.002	1.212	1.037	1.031	1.085	0.901
4	0.005	0.000	0.007	0.004	0.007	1.158	0.837	0.867	0.891	0.923
Big	0.009	0.005	0.003	0.008	0.003	0.947	1.264	1.069	0.956	0.985
	S					***L***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.544	0.900	1.717	1.135	0.817	0.152	0.581	0.277	0.294	0.643
2	0.814	0.798	0.399	0.741	0.269	0.234	0.047	0.238	0.570	0.264
3	1.031	0.348	0.298	0.221	0.021	−0.070	0.035	−0.141	0.286	0.324
4	0.388	0.149	0.168	−0.245	0.160	−0.224	0.296	0.143	0.392	0.035
Big	−0.166	0.018	0.060	−0.231	0.028	−0.345	−0.281	0.009	0.064	−0.325
	R					***T***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.104	−0.105	−1.180	−0.051	0.383	0.357	−0.005	−1.397	0.140	0.285
2	−0.435	−0.490	−0.062	0.174	−0.063	0.033	0.009	0.207	0.096	0.091
3	−0.312	−0.264	−0.278	−0.241	−0.081	0.074	0.183	0.002	−0.458	0.039
4	−0.546	−0.072	−0.273	−0.193	0.060	0.000	0.124	−0.410	−0.095	0.098
Big	−0.630	−0.432	−0.137	−0.147	−0.254	−0.092	−0.342	−0.116	−0.011	−0.017
	***t*(*a*)**					***t*(RM)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.637	2.478	0.981	0.837	−0.896	19.324	10.802	5.219	14.804	15.251
2	0.914	1.357	0.457	−0.338	−0.223	16.360	17.119	16.745	16.075	16.655
3	−0.680	0.241	1.880	−0.579	0.632	18.807	18.607	18.885	18.519	18.273
4	1.151	0.026	1.731	1.158	1.964	18.841	16.329	15.398	18.368	19.411
Big	1.907	1.329	0.943	3.020	1.250	14.882	25.835	22.560	25.124	27.341
	***t*(*s*)**					***t*(*l*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	10.232	5.194	6.015	7.886	6.028	0.871	2.895	0.837	1.762	4.093
2	5.146	6.241	3.078	5.738	2.164	1.274	0.317	1.580	3.807	1.832
3	7.232	2.826	2.469	1.702	0.195	−0.423	0.247	−1.007	1.906	2.558
4	2.850	1.310	1.349	−2.286	1.516	−1.422	2.252	0.992	3.153	0.291
Big	−1.177	0.163	0.572	−2.747	0.349	−2.112	−2.241	0.071	0.657	−3.519
	t(r)					**t(T)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.535	−0.470	−3.218	−0.275	2.201	2.008	−0.027	−4.151	0.825	1.785
2	−2.142	−2.981	−0.372	1.047	−0.394	0.175	0.059	1.354	0.628	0.621
3	−1.704	−1.667	−1.789	−1.446	−0.575	0.440	1.262	0.016	−2.999	0.306
4	−3.125	−0.494	−1.708	−1.399	0.446	−0.002	0.928	−2.794	−0.749	0.794
Big	−3.483	−3.105	−1.021	−1.355	−2.478	−0.557	−2.680	−0.940	−0.115	−0.184

Table 5 (continued)

Panel E R^2										
	MC_PB					**MC_ROE**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.740	0.744	0.762	0.789	0.777	0.768	0.452	0.733	0.771	0.741
2	0.571	0.734	0.757	0.801	0.794	0.770	0.782	0.762	0.764	0.768
3	0.827	0.829	0.747	0.832	0.799	0.768	0.810	0.792	0.790	0.817
4	0.854	0.780	0.845	0.818	0.778	0.798	0.800	0.774	0.747	0.799
Big	0.876	0.888	0.908	0.881	0.856	0.882	0.884	0.886	0.850	0.832
	MC_TA					**MC_TAM**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.800	0.782	0.757	0.467	0.730	0.763	0.613	0.484	0.693	0.694
2	0.799	0.748	0.797	0.753	0.753	0.749	0.763	0.727	0.728	0.732
3	0.851	0.771	0.845	0.815	0.750	0.759	0.766	0.757	0.792	0.784
4	0.736	0.816	0.802	0.827	0.782	0.771	0.738	0.725	0.815	0.754
Big	0.833	0.834	0.902	0.890	0.884	0.705	0.863	0.824	0.865	0.863

for microcap portfolio indicate that first portfolio with low profitability microcaps is dominated by firm whose stocks behave like unprofitable firms with aggressive investment.

MC_TA: Six portfolios found to be significant with average alpha value of 0.0043 and 78.9 average *R*-square (%). Here also like previous case high positive investment (CMA) and less negative profitability (RMW) coefficient for microcap portfolio indicate that first portfolio with low profitability microcaps is dominated by firm whose stocks behave like unprofitable firms with aggressive investment and the problem with microcap remains unsolved.

MC_TAM: Four portfolios found to be significant with average alpha value of 0.0047 and 74.9 average *R*-square (%). The biggest problem lies with Fama–French (2015) is microcaps due to high negative profitability (RMW) and investment (CMA) factor but it is well captured with MC_TAM cross portfolio. So, it indicates that it is not the asset pricing problem but the way how portfolios constructed are of much importance.

From the above discussion, it is very much clear that microcap is the problem for most of the crosses as similar to Fama–French (2015) findings. Study result also confirms that Fama–French (2015) five model is not better than Fama–French (1993) three-factor model in Indian context. Further study confirms Fama–French five-factor model is not a global similar to studies by Hou et al. (2014), Clarke (2016), and Chiah et al. (2016).

Then study runs modified five-factor model with human asset investment with market (Rm), size (SMB), value (LMH), profitability (RMW), and investment with human asset (CvMAv).

6.3 Modified five-factor regressions (with human asset investment)

The regressions' result of the modified five-factor model with human asset investment is shown in Table 6.

Table 6 Regression results of Modified Five-Factor Model with human asset for 25 portfolios $R_{Pt} - R_{Ft} = a + b\,(R_{Mt} - R_{Ft}) + s\,\mathrm{SMB}_t + l\,\mathrm{LMH}_t + p\,\mathrm{RMWt} + h\,\mathrm{CvMAvt} + e_t$

Panel A MC_PB

	a					*b*				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.007	0.009	0.011	0.002	−0.001	0.950	1.017	1.034	0.971	1.093
2	0.010	0.003	0.001	−0.004	0.004	0.833	0.987	0.886	1.017	0.977
3	−0.004	−0.001	−0.001	0.001	0.003	1.099	1.145	0.930	1.123	0.957
4	−0.003	0.002	0.010	0.003	0.005	1.021	0.896	1.145	1.062	0.814
Big	0.004	0.001	0.003	0.007	0.002	0.984	1.097	1.014	1.100	0.883
	S					***L***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.157	1.047	0.828	1.109	1.262	1.128	0.402	0.045	0.014	−0.458
2	1.634	0.613	0.660	0.902	0.557	0.629	0.106	0.186	0.015	−0.333
3	0.666	0.475	0.463	0.439	0.304	0.582	0.287	0.114	−0.100	−0.088
4	−0.248	−0.208	−0.345	0.103	0.133	1.098	0.553	−0.120	−0.144	−0.261
Big	−0.374	−0.400	−0.308	−0.223	0.140	0.924	0.462	0.293	−0.162	−0.449
	R					**h**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.641	−0.012	−0.175	−0.060	−0.375	0.665	0.410	0.320	0.197	−0.095
2	−1.033	−0.409	−0.120	−0.171	−0.231	−0.458	0.358	0.315	−0.031	0.158
3	−0.296	−0.233	−0.233	−0.045	0.036	0.017	0.227	−0.126	0.073	0.130
4	−0.029	−0.143	−0.466	−0.100	−0.041	0.151	0.258	0.475	0.391	0.271
Big	−0.095	−0.213	−0.013	−0.134	−0.228	0.025	−0.014	0.049	0.094	0.087
	***t*(*a*)**					***t*(RM)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.543	1.924	2.535	0.635	−0.284	13.802	15.171	17.172	19.059	19.974
2	1.006	0.582	0.314	−1.089	1.221	6.094	14.510	16.288	20.033	20.538
3	−0.854	−0.280	−0.235	0.251	0.842	17.952	20.050	16.908	22.639	20.965
4	−0.724	0.423	2.464	0.839	1.608	17.293	14.842	20.224	21.469	19.427
Big	1.093	0.371	1.032	2.522	1.004	19.383	23.261	28.576	26.745	25.836
	***t*(*s*)**					***t*(*l*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	7.459	6.935	6.107	9.664	10.241	6.505	2.380	0.294	0.109	−3.322
2	5.309	3.999	5.385	7.892	5.195	1.826	0.618	1.359	0.114	−2.777
3	4.832	3.693	3.734	3.928	2.958	3.774	1.997	0.819	−0.797	−0.764
4	−1.867	−1.529	−2.705	0.924	1.408	7.382	3.635	−0.840	−1.157	−2.471
Big	−3.268	−3.766	−3.857	−2.411	1.815	7.221	3.891	3.272	−1.563	−5.214
	***t*(*r*)**					***t*(*h*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	3.450	−0.067	−1.079	−0.438	−2.540	4.217	2.670	2.320	1.684	−0.759
2	−2.800	−2.227	−0.820	−1.250	−1.795	−1.461	2.295	2.529	−0.269	1.453
3	−1.792	−1.509	−1.571	−0.334	0.289	0.122	1.731	−1.000	0.645	1.240
4	−0.179	−0.878	−3.051	−0.751	−0.365	1.115	1.865	3.657	3.449	2.821
Big	−0.690	−1.669	−0.137	−1.211	−2.470	0.211	−0.129	0.607	0.994	1.114

Table 6 (continued)

Panel B MC_ROE

	a					***b***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.007	0.017	0.004	0.003	0.004	1.013	0.727	0.964	1.030	1.082
2	− 0.003	0.000	0.002	− 0.003	0.003	1.041	0.983	0.982	1.095	1.065
3	− 0.003	0.004	0.000	− 0.003	0.005	0.979	1.043	1.054	1.016	0.966
4	− 0.002	0.001	0.009	0.008	0.010	1.049	0.938	0.917	0.915	0.873
Big	0.002	− 0.001	0.005	0.004	0.003	1.073	1.076	1.018	0.983	0.996
	S					***L***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.542	1.212	1.014	1.108	1.241	0.471	0.218	0.481	0.606	0.277
2	0.791	0.549	0.622	0.972	0.668	0.455	0.289	− 0.036	− 0.046	0.193
3	0.379	0.145	0.222	0.451	0.020	0.364	− 0.137	0.292	0.474	0.267
4	0.068	− 0.143	− 0.228	− 0.194	0.234	− 0.045	0.429	0.171	0.192	− 0.213
Big	− 0.301	− 0.277	− 0.138	− 0.071	− 0.051	0.027	0.088	− 0.084	− 0.144	− 0.010
	R					***h***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	− 0.185	− 1.324	0.032	0.508	0.497	0.288	− 0.124	0.193	0.187	0.288
2	− 0.451	− 0.349	− 0.280	0.028	0.238	0.135	0.268	0.072	− 0.112	− 0.081
3	− 0.509	− 0.752	0.062	0.261	0.350	0.541	0.168	0.175	− 0.057	0.438
4	− 0.837	− 0.320	− 0.240	0.080	− 0.015	0.304	0.221	0.142	0.228	0.156
Big	− 0.625	− 0.487	− 0.390	− 0.148	0.256	0.156	0.110	− 0.067	0.119	0.125
	***t*(*a*)**					***t*(*b*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.502	1.430	0.872	0.772	0.928	14.323	4.186	14.738	17.767	17.609
2	− 0.565	0.050	0.431	− 0.681	0.917	14.486	16.084	17.441	19.352	19.736
3	− 0.674	1.052	− 0.081	− 0.853	1.698	14.103	17.653	18.884	18.775	21.662
4	− 0.397	0.203	2.332	2.153	3.398	15.977	15.427	16.143	16.296	21.330
Big	0.754	− 0.280	1.776	1.458	0.873	22.691	23.645	26.214	23.062	23.150
	***t*(*s*)**					***t*(*l*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	9.679	3.097	6.881	8.484	8.969	2.643	0.498	2.921	4.146	1.789
2	4.886	3.990	4.901	7.630	5.501	2.514	1.876	− 0.257	− 0.322	1.419
3	2.426	1.087	1.762	3.702	0.199	2.080	− 0.919	2.074	3.477	2.374
4	0.458	− 1.044	− 1.785	− 1.531	2.539	− 0.273	2.797	1.197	1.355	− 2.061
Big	− 2.826	− 2.700	− 1.579	− 0.741	− 0.521	0.223	0.764	− 0.862	− 1.345	− 0.091
	***t*(*r*)**					***t*(*h*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	− 0.971	− 2.821	0.181	3.243	2.997	1.779	− 0.311	1.285	1.404	2.044
2	− 2.323	− 2.113	− 1.844	0.181	1.636	0.820	1.912	0.555	− 0.861	− 0.654
3	− 2.715	− 4.714	0.409	1.788	2.903	3.399	1.241	1.365	− 0.459	4.281
4	− 4.726	− 1.948	− 1.566	0.529	− 0.137	2.018	1.582	1.092	1.774	1.666
Big	− 4.895	− 3.964	− 3.721	− 1.284	2.204	1.439	1.052	− 0.755	1.220	1.270

Table 6 (continued)

Panel C MC_TA

	a					*b*				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.009	0.005	0.001	0.017	0.003	0.968	1.034	1.007	0.829	1.056
2	0.001	0.001	0.000	0.001	0.001	1.025	0.991	0.940	0.912	1.087
3	− 0.001	− 0.002	− 0.004	0.000	− 0.005	1.039	0.935	1.126	1.064	1.096
4	0.003	0.007	0.007	0.003	0.008	0.986	0.951	0.955	0.978	1.148
Big	0.007	0.005	0.001	0.007	0.001	0.934	0.856	0.991	1.005	1.105
	S					***L***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.393	1.063	0.918	1.467	1.292	0.249	0.547	0.524	0.166	0.667
2	0.590	0.608	0.639	0.428	0.809	0.434	0.077	0.160	0.269	0.169
3	0.555	0.306	0.322	0.039	0.487	0.186	0.187	0.212	0.203	0.415
4	0.069	− 0.115	− 0.037	− 0.015	− 0.280	− 0.078	0.087	0.237	0.275	− 0.214
Big	0.023	− 0.038	− 0.135	− 0.387	− 0.185	− 0.287	0.028	− 0.027	0.338	− 0.222
	R					***h***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	− 0.278	0.019	0.087	− 0.970	0.383	0.450	0.598	0.372	− 0.508	0.393
2	− 0.155	− 0.342	− 0.368	− 0.171	− 0.130	0.254	0.211	0.047	0.041	− 0.043
3	− 0.373	− 0.201	− 0.018	0.006	0.139	0.213	0.177	0.065	0.298	0.023
4	− 0.348	− 0.289	− 0.122	− 0.082	− 0.369	0.243	0.270	0.144	0.010	0.620
Big	− 0.540	− 0.327	− 0.124	0.240	− 0.305	0.040	− 0.240	0.031	0.210	0.324
	***t*(*a*)**					***t*(*b*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	2.086	1.066	0.116	1.572	0.641	15.137	16.100	15.723	5.385	14.610
2	0.204	0.325	0.112	0.363	0.135	17.303	15.719	17.718	16.027	15.933
3	− 0.262	− 0.568	− 1.140	− 0.098	− 0.930	20.169	16.257	22.939	20.032	14.357
4	0.688	1.925	1.928	0.827	1.633	15.551	18.772	18.313	20.050	16.423
Big	2.138	1.672	0.293	2.641	0.344	20.259	21.547	29.695	26.274	24.082
	***t*(*s*)**					***t*(*l*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	9.668	7.349	6.364	4.232	7.934	1.547	3.380	3.247	0.428	3.664
2	4.421	4.282	5.345	3.341	5.264	2.907	0.482	1.199	1.878	0.984
3	4.782	2.362	2.908	0.327	2.834	1.432	1.290	1.712	1.517	2.157
4	0.485	− 1.005	− 0.314	− 0.133	− 1.781	− 0.489	0.683	1.802	2.237	− 1.213
Big	0.224	− 0.421	− 1.803	− 4.493	− 1.792	− 2.472	0.278	− 0.319	3.504	− 1.918
	***t*(*r*)**					***t*(*h*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	− 1.609	0.108	0.503	− 2.334	1.961	3.068	4.063	2.533	− 1.440	2.371
2	− 0.967	− 2.012	− 2.568	− 1.110	− 0.703	1.872	1.458	0.388	0.313	− 0.273
3	− 2.682	− 1.296	− 0.133	0.042	0.676	1.808	1.346	0.574	2.444	0.131
4	− 2.034	− 2.113	− 0.868	− 0.622	− 1.956	1.674	2.323	1.206	0.086	3.870
Big	− 4.336	− 3.046	− 1.379	2.326	− 2.463	0.376	− 2.634	0.405	2.391	3.086

Table 6 (continued)

Panel D MC_TAM

	a					*b*				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.000	0.011	0.010	0.005	− 0.002	1.138	0.691	0.912	1.002	1.006
2	0.002	0.005	0.002	0.000	− 0.001	1.027	0.944	0.954	0.969	0.938
3	− 0.006	0.001	0.007	− 0.003	0.002	1.079	0.995	0.995	1.142	0.905
4	0.003	0.000	0.006	0.004	0.008	1.077	0.796	0.873	0.912	0.976
Big	0.007	0.003	0.002	0.009	0.004	0.864	1.212	1.048	0.969	1.011
	S					***L***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.229	0.504	1.769	1.292	1.114	0.402	0.895	0.237	0.169	0.407
2	0.464	0.686	0.412	0.858	0.314	0.512	0.136	0.227	0.478	0.228
3	0.724	0.316	0.207	0.184	0.046	0.174	0.061	− 0.068	0.316	0.304
4	0.181	0.094	0.019	− 0.228	0.333	− 0.060	0.339	0.262	0.379	− 0.103
Big	− 0.416	− 0.250	− 0.039	− 0.205	0.087	− 0.146	− 0.068	0.087	0.043	− 0.372
	R					***h***				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.361	0.305	− 0.967	− 0.240	0.022	0.934	0.958	− 0.791	− 0.316	− 0.585
2	− 0.079	− 0.375	− 0.115	0.035	− 0.127	0.867	0.278	0.067	− 0.237	− 0.067
3	− 0.009	− 0.265	− 0.183	− 0.115	− 0.114	0.781	0.167	0.223	− 0.129	− 0.041
4	− 0.332	− 0.039	− 0.041	− 0.193	− 0.138	0.501	0.191	0.166	− 0.087	− 0.375
Big	− 0.354	− 0.090	− 0.013	− 0.172	− 0.312	0.564	0.488	0.185	− 0.070	− 0.152
	***t*(*a*)**					***t*(*b*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.092	2.066	1.032	1.112	− 0.372	17.528	9.182	6.493	14.802	16.266
2	0.380	1.141	0.463	− 0.116	− 0.137	14.907	15.710	15.380	15.890	15.869
3	− 1.340	0.159	1.693	− 0.599	0.682	17.380	16.959	17.466	18.046	17.422
4	0.791	− 0.107	1.422	1.201	2.443	17.291	14.824	14.429	17.864	20.151
Big	1.519	0.750	0.714	3.091	1.448	13.468	24.320	21.128	24.206	26.912
	***t*(*s*)**					***t*(*l*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	8.407	2.976	5.592	8.473	7.997	2.457	4.721	0.669	0.990	2.613
2	2.991	5.069	2.951	6.245	2.359	2.949	0.902	1.452	3.109	1.529
3	5.177	2.389	1.612	1.291	0.392	1.112	0.414	− 0.476	1.982	2.324
4	1.292	0.779	0.142	− 1.984	3.055	− 0.383	2.507	1.719	2.943	− 0.841
Big	− 2.883	− 2.227	− 0.350	− 2.274	1.029	− 0.904	− 0.543	0.700	0.427	− 3.934
	***t*(*r*)**					***t*(*h*)**				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	2.059	1.502	− 2.550	− 1.315	0.130	6.278	5.552	− 2.457	− 2.035	− 4.129
2	− 0.426	− 2.312	− 0.687	0.213	− 0.796	5.487	2.017	0.470	− 1.696	− 0.493
3	− 0.051	− 1.673	− 1.192	− 0.675	− 0.810	5.489	1.241	1.712	− 0.889	− 0.345
4	− 1.976	− 0.271	− 0.251	− 1.396	− 1.057	3.513	1.555	1.199	− 0.742	− 3.381
Big	− 2.042	− 0.666	− 0.095	− 1.591	− 3.074	3.841	4.268	1.631	− 0.761	− 1.768

Table 6 (continued)

Panel E R^2

	MC_PB					MC_ROE				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.766	0.755	0.768	0.791	0.777	0.767	0.376	0.736	0.770	0.748
2	0.535	0.742	0.765	0.795	0.794	0.768	0.787	0.759	0.756	0.767
3	0.824	0.832	0.749	0.821	0.797	0.784	0.811	0.794	0.777	0.833
4	0.855	0.785	0.847	0.828	0.782	0.803	0.795	0.775	0.752	0.802
Big	0.876	0.886	0.908	0.880	0.857	0.883	0.885	0.886	0.844	0.830
	MC_TA					MC_TAM				
	Low	2	3	4	High	Low	2	3	4	High
Small	0.785	0.798	0.766	0.370	0.732	0.806	0.677	0.448	0.699	0.719
2	0.801	0.750	0.797	0.753	0.719	0.790	0.769	0.724	0.732	0.732
3	0.841	0.761	0.843	0.819	0.680	0.798	0.766	0.762	0.781	0.784
4	0.740	0.821	0.803	0.823	0.777	0.788	0.740	0.714	0.815	0.770
Big	0.822	0.839	0.902	0.890	0.868	0.730	0.872	0.826	0.866	0.866

MC_PB: Two portfolios found to be significant with average alpha value of 0.0040 and 80.1 average *R*-square (%). Market and value slopes found to be highly positive; here, size slopes become positive for big-size portfolio (which was not in case with Fama–French (2015) five-factor regression results). Similar to Fama–French (2015) in column one with low-value stocks, the coefficient of profitability (RMW) factor have positive slopes for microcaps whereas it changes its sign on increase of size. This indicates that first portfolio with combination of low value and microcaps is much dominated by the low-value stocks with aggressive investment and marginal profitability but yields higher returns than other portfolios as shown in Table 3. The biggest problem that lies with Fama–French (2015) is microcaps due to high negative profitability (RMW) and investment (CMA) factor but it is well captured by modified five-factor model with human asset as these factors become more positive.

MC_ROE: Three portfolios found to be significant with average alpha value of 0.0043 and 77.9 average *R*-square (%). Profitability (RMW) changes its sign on moving from low ROE stock portfolios to the high ROE stock portfolios but not investment (CMA) coefficient as in case with Fama–French (2015) five-factor regressions. Biggest problem with Fama–French (2015) is that first portfolio with low profitability microcaps is dominated by firm whose stocks behave like unprofitable firms with aggressive investment due to high positive investment (CMA) and less negative profitability (RMW) coefficient which is well captured by the modified five-factor model with human asset as an addition of human asset reduces high positive investment factor.

MC_TA: Three portfolios found to be significant with average alpha value of 0.0043 and 78 average *R*-square (%). Here also like previous case high positive investment (CMA) and less negative profitability (RMW) coefficient for microcap portfolio indicate that first portfolio with low profitability microcaps is dominated by firm whose

Table 7 Summary of the factor regressions

Model	No of significant intercepts				R-Square (%)			
	MC_PB	MC_ROE	MC_TA	MC_TAM	MC_PB	MC_ROE	MC_TA	MC_TAM
3 Factor	5	5	5	4	78.7	76.4	76.6	73.9
5 Factor	5	5	6	4	79.9	78.2	78.9	74.9
5 Factor (Human Asset)	2	3	3	3	80.1	77.9	78	75.9

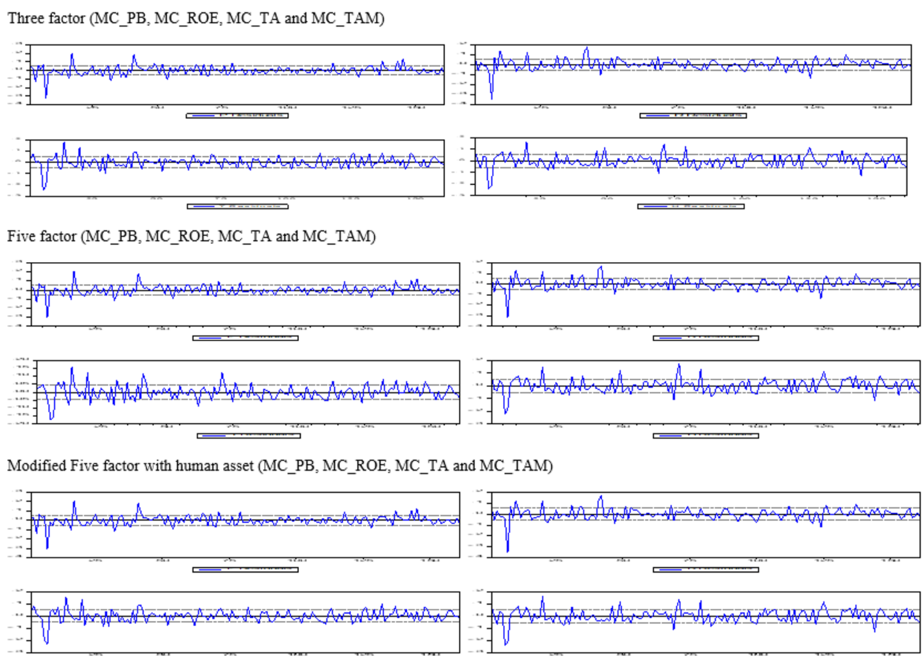

Fig. 3 Residual graphs for three-, five- and modified five-factor regressions for first Portfolio (Microcap)

stocks behave like unprofitable firms with aggressive investment and microcap not captured by the model.

MC_TAM: Three portfolios found to be significant with average alpha value of 0.0041 and 75.9 average *R*-square (%). Similar to Fama–French three factors (1993) and Fama–French five factors (2015), microcap is well captured by the modified five-factor model with human asset.

Study results find that modified five-factor model with human asset is robust than both Fama–French three- and five-factor models as it able to capture most of the portfolios risk return relationship. The detailed summary of all the regressions: Fama–French three-factor, Fama–French five-factor and Modified five-factor with human asset are shown in Table 7.

7 Residual graphs

Then residual graphs of first Portfolio with microcaps of all regressions: Fama–French three-factor, Fama–French five-factor and Modified five-factor with human asset are shown in Fig. 3. Residual more closer to zero said to be the best model fit or model is able to capture maximum risk return relationship. Residual graphs of Fama–French three-factor and Fama–French five-factor do not show much of difference but high peaks are reduced in case of Modified five-factor with human asset that justifies superiority of the later.

Though asset pricing results and residual graphs confirm the superiority of Modified five-factor with human asset over both Fama–French three-factor and Fama–French five-factor models but it will be well justified if it passes model performance test.

7.1 Model performance test

The study uses very prominent asset pricing model test designed by Gibbons et al. (1989). The GRS test results are shown in Table 8 for all the factor models used in the study. GRS test rejects all the Fama–French three-factor regressions except for MC_TAM and study findings are in line with Fama–French (2015) findings and do not support Connor and Sehgal (2003) findings in Indian context. GRS test also rejects three of the Fama–French five-factor model (2015) for MC_PB, MC_ROE & MC_TA crosses as similar to Fama–French (2015) findings in US context. All of the Modified five-factor models with human asset except MC_TA cross and one Fama–French five-factor model for MC_TAM crosses pass the GRS test. Further, lower value of GRS test *F*-Statistics once again confirms the superiority of Modified five-factor model with human asset over both Fama–French three-factor and Fama–French five-factor models.

Table 8 Summary of GRS test results for all the Factor models

Fama–French three-factor	GRS F-statistics	*p* value	Average absolute alpha value	Average R^2 (%)
MC_PB*	1.754	0.026	0.003	78.7
MC_ROE*	2.303	0.001	0.004	76.4
MC_TA*	1.673	0.045	0.003	76.6
MC_TAM	1.227	0.228	0.003	73.9
Fama–French five-factor				
MC_PB*	1.640	0.039	0.004	79.9
MC_ROE*	1.766	0.021	0.004	78.2
MC_TA*	1.594	0.050	0.004	78.9
MC_TAM	1.475	0.084	0.004	74.9
Modified five-factor with human asset				
MC_PB	1.514	0.054	0.004	80.1
MC_ROE	1.532	0.052	0.004	77.9
MC_TA*	1.589	0.050	0.004	78
MC_TAM	1.497	0.076	0.004	75.9

* Significant @ 5% level

8 Conclusion

Both size and value effects are dominating in the portfolios average mean excess return patterns in Indian context. The portfolio average mean excess return with microcap stocks outperformed the other portfolios for every cross as similar to Fama–French (1993, 2015) findings in US context. The study also finds that portfolios formed based on MC_ROE, MC_TA and MC_TAM cross show complex return patterns as portfolios as average mean excess return patterns frequently change its slope but in spite of that size effect is consistent for all crosses. For all the crosses except MC_TAM portfolio with microcaps are not captured by the Fama–French (1993) three-factor model, the findings are in line with Aharoni et al. (2013) and Fama–French (2015) studies. Similarly all the crosses except MC_TA & MC_TAM portfolio with microcaps are not captured by the Fama–French (2015) five-factor model. Moreover study results find that there is no much significant difference lying between the results obtained from Fama–French three- and five-factor models. Traditionally, investment in human asset considers as the cost to the company and not as the investment Petty and Guthrie (2000). But significant number of studies by Bontis (2003) and Wright et al. (2001) argued that human asset should be considered as the investment of the firm rather than expenses in today's knowledge-based economy where human asset has greater importance in determining the value of the firm. So the present study defined a new factor of investment with human asset (CvMAv) instead of Fama–French (2015) investment (CMA) factor which generally do not consider human investment. Then, study performs regressions using modified five-factor model with market (Rm), size (SMB), value (LMH), profitability (RMW), and investment with human asset (CvMAv). The study empirically finds that modified five-factor model is robust than both Fama–French three- and five-factor models. The main problem with the modified five-factor model with human asset is the microcap with conservative investment (including human investment) stocks whose returns behave like that low-value unprofitable firms. Further microcap portfolio's (first portfolio) regression residuals are plotted using residual graphs to check the ability of various factor models that are used in the study for capturing risk return relationships. The residual graphs show more number of higher peaks in case of Fama–French three- and five-factor models' regression residuals than modified five-factor model. Residual graphs further confirm modified five-factor model is able to capture more risk return relationship. Finally study uses GRS test, a more model specific test to evaluate the performance of the various factor models. All of the Fama–French (1993) three-factor except MC_TAM cross and three Fama–French (2015) five-factor models are easily rejected by the GRS test. Whereas all modified five-factor model except MC_TA cross and one Fama–French (2015) five-factor models pass the GRS test. Further the lower values of GRS test *F*-Statistics of modified five-factor model justifies supremacy over both Fama–French three-factor and Fama–French five-factor models.

The study results clearly justify the importance of human asset in firm valuation and ignoring human asset may lead to serious issues. Investors those who are interested to gain from investment premium should consider human asset investment by the firms in making investment decision. Moreover considering human asset investment in valuation of the firms by the investors will have more informational advantages over others. Investors those whose investment patterns are based on size may gain abnormal returns by investing in the microcaps. Study finds that human asset plays a vital role in predicting returns and this has significant implications on public policy content.

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