

Revisiting Fama-French Model through Alternative Size Measures: Evidence from South Asian Countries

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Abstract

The present study aims to analyze the three-factor asset-pricing model applicability in south Asian countries and addressed the methodological issues by introducing alternative measure of size that would increase the estimation competence of Three-Factor Asset-Pricing Model. The study includes the listed companies of major players of South Asia that are China, India, and Pakistan. The sample consist monthly stock prices of 1148 companies that cumulatively represents Pakistan, China, and India over the period from 2001 to 2017. This study assumes the panel data models that includes fixed effect and random effect for the estimation of three Factor Model that ultimately address the methodological gap identified in a context under consideration. The results suggested that market equity is a weak measure of size in emerging economies and total assets as size measure is more efficient than market equity measure. It is also inferred that market equity measure of size is more relevant to matured markets where the investors are well informed, while total assets measure of size is more relevant to emerging economies where the markets are not mature and investors are not well informed. This study provides the new insight and new path by introducing alternate size measure that leads towards the further development in the three-factor model.

Keywords: CAPM, Fama and French Model, SMB, HML, Size Measure, Panel Data

The adoption of efficient and accurate pricing model is one of the essentials to evaluate stock prices and provide assistance to investors in planning and deciding in investment suitably and efficiently. Stock return analysis is the integral part of investor's decision-making process. It is an understood concept that risk is the major factor that need to be considered while making choices and evaluating the investment. In fact, the foundation for maximizing shareholder's wealth requires proper valuation and apt understanding of trade-off relationship between risk and return is essential (J.C. Van Horne & Wachowicz, 2008).

In the context of evaluating risk and return relationship, Capital Asset pricing Model was established by Black, Jensen, and Scholes (1972), Lintner (1965), Sharpe (1964). CAPM suggest that Systematic market Risk (β) is the key aspect that influences the expected return. Testability of exclusive CAPM in different financial markets in order to ration adeptness through approximation of required rate of return and market risk premium has not been proved an effective practice in various markets. This insufficient explanation by CAPM forced scholars to include other variables that explain the cross-sectional variants in returns. The inefficiency of CAPM clues to the development of other models like ICAPM (Merton, 1973) and APT model (Ross, 1976). These models incorporate the economic factors in the model for explaining stock returns as the notion behind this aspect is the macroeconomic characteristic of stock market. However, these models have different scope due to unique dynamics of macroeconomic factors, which is different from firm fundamentals. The present study is focused on the factor that are based on firm fundamentals like size and value measures.

Various studies were done in order to identify the linkage of "Size and Stock Return" (Banz, 1981) and "Book Value and Stock Return" (Bhandari, 1988). Fama and French (1992) established the authenticated asset pricing model that incorporated factors, like Book to Market Ratio and size: The influential and extensive work of Fama and French (1992), recognized size and book to market equity ratio as the two foremost elements that explains cross-sectional expected returns.

Although, the Fama and French model is widely accepted and recognized, but its inefficiency and inapplicability are also observed in previous studies¹. The inapplicability and

¹ See (Bundoo, 2008; O'Brien, Brailsford, & Gaunt, 2008; Prajutasen, 2010)

inefficiency of Fama and French Model (Fama & French, 1992; Taneja, 2010) is mostly seen in emerging economies (Chung, Johnson, & Schill, 2006; Connor & Sehgal, 2001b; Daniel & Titman, 1997; Iqbal, Brooks, & Galagedera, 2008; Kothari, Shanken, & Sloan, 1995) because the financial markets of emerging economies are not that much matured in which the market value depicts actual size and investors are not well informed that makes market capitalization as weak measure of size, which suggest that the inapplicability of Fama and French Model in emerging economies is due to size measure weakness that need to be revisited in order improve the applicability of Fama and French Model. This gap in size measure of Fama and French model for emerging economies need to be addressed as the prior studies in emerging economies ignored size measure inappropriateness due to varied market maturities of emerging economies. The present study attempts to address this gap by introducing alternate size measure which should have different dynamics than market capitalization.

The present study measures the size factor based on total assets instead of market capitalization in Fama and French Factor development and compare the results of Fama and French model based on original size measure, i.e. market capitalization or market equity, with the results of Fama and French model based on alternate size measure, i.e. Total asset, in order to identify improvement in efficiency and applicability of Fama and French model. Prior studies (Ameer, 2013; Foye, 2018; Taneja, 2010) on applicability of Fama and French model in emerging economies adopted the market capitalization as measure of size for SMB factor development (in accordance with Fama and French (1992)), while ignoring the emerging markets unique dynamics and maturity levels in terms of investor information asymmetry, which resulted in inapplicability of Fama and French model. Such outcome questions the ability of market capitalization as appropriate measure of size in emerging economies where market are not that much mature to predict the firm size. Pandey and Mohapatra (2017) also attempted to address the size factor of Fama and French model with total assets and enterprise value, but unable to compare and explain the efficiency of the measures. Moreover, their study is limited to India whereas the present study compares South Asian representative economies with different market behavior and maturity and also evaluate the efficiency of the measure. The present study addresses the gap of size measure inefficiency in emerging economies and adopts the total assets of the firm as size measure for SMB factor development as it is more robust measure of firm size (Pagano & Schivardi, 2003). In this way the research gap related to overlapping issue of market capitalization as adopted in previous studies, in both size and value factor, will be addressed. Total assets as the measure of size is used in variety of studies (Aman, Pourjalali, & Teruya, 2006; Dimitrov & Jain, 2008; Gu, Lee, & Rosett, 2005) and also vital fundamental of firm.

The purpose of this study is to introduce and incorporate the alternative size measures in (Fama & French, 1992, 1993) three factor asset pricing model that may provide efficient results. The incorporation will be done by introducing the total assets of firm as size measure instead of market capitalization. The panel data model is used which is suitable for the data distribution which is three dimensional in nature. Earlier studies were based on regression analysis which is not an appropriate and accurate measure of analysis as they do not follow normal distribution due to which regression provides spurious results. The sample will consist of listed 294 firms of Pakistan Stock exchange, 538 Firms of Shanghai Stock Exchange, and 320 Firms of Bombay Stock Exchange.

This study has a major contribution in terms of applicability of Fama and French model. This study improves the validation of Fama and French model in emerging economies through incorporating alternate size measure, that cater the unique dynamics and maturity of emerging markets, for development of SMB factor, which improves the efficiency and applicability of Fama and French model in emerging economies. This study introduces new paradigm of research in this area with alternate measure of size. Moreover, the present study explores the modified measure of size (i.e. total asset) which is specifically designed for the emerging economies that may be applicable to underdeveloped and African economies.

This paper is segregated as follow: Section 2 abridges review of literature. Section 3 explains methodology, hypothesis, and sample. Section 4 summarizes Financial Model. Section 5 discusses the results and discussion on results estimated through software, Section 6 includes conclusion based on analysis and previous results.

Literature Review

The first model that explained the risk-return relationship of stock return is CAPM (Capital Asset Pricing Model) developed by Sharpe (1964), Lintner (1965), Jensen, Black, and Scholes (1972). The model explained stock return variations through risk premium of market. The modalities of

CAPM is verified empirically by various researchers which showed various mixed and diverse results. CAPM model at first was studied by Douglas (1967). Afterwards, Miller and Scholes (1972) also showed inconsistency with CAPM. Similarly, other studiesⁱⁱ also concluded the results different from CAPM assumptions, confirming the incapability of CAPM in elucidation cross-sectional variations in expected returns.

This CAPM inability lead the practitioners to develop the other multifactor model like ICAPM Model (Merton, 1973), APT Model (Ross, 1976) and others, which are grounded on macroeconomic aspects. Current study overlooks macroeconomic elements because of differences in the dynamics of market and company specific factors.

After CAPM criticism, Fama and French (1992) proposed the model, based on findings of Banz (1981) and Bhandari (1988). The estimation results identified that FF model explains stock returns more efficiently than CAPM model. The model of Fama and French (1992) incorporated three factors i.e. market premium, book to market-equity ratio, and size premium for accommodating cross-sectional differences of stock returns, if the stocks are priced rationally. Fama and French (1993) extended the relationship of size and value factors and recognized the mimic risk factors for efficient explanation of stock returns in a well-diversified portfolio. Fama and French (1995) studied the reliability of the pattern of stock returns in association to size and BE/ME and performance of earnings in association with size and BE/ME. Fama and French (1996) described the patterns in average stock returns that are not elucidated by CAPM such as long term reverse pattern of stock returns in markets and short term continuation pattern of stock returns in stock markets.

The three-factor model has been verified various times in different stock markets of emerging and advanced economies of the globe which undergoes various circumstances and found mixed evidencesⁱⁱⁱ, which is due to the reason that Fama and French Model incorporates a size measure that is calculated using the market capitalization. The size can be measured through total assets (Pandey & Mohapatra; Shalit & Sankar, 1977; James C Van Horne & Wachowicz, 2005; Zaremba & Konieczka, 2015). Moreover, the FF model is based on fundamentals rather than market setups so fundamental size measure is total assets (Lee, 2009). However, the value factor is also incorporate market capitalization with the difference of occurrence, which leads to overlapping of measure. The present study tries to illustrate that instead of capitalization an alternative measure of size i.e. total assets held by any firm could be an effective measure size measure.

Methodology

The methodology of present study explains the sample structure, hypothesis based on the previous studies and theoretical backgrounds that follows to development of financial model for empirical investigation.

Sampling

The present study comprised of sample that was taken from emerging economies of south Asian countries^{iv}. 538 Listed firms were taken from Shanghai Stock Exchange (SSE A Index), 320 listed companies were taken from Bombay Stock Exchange/SENSEX (CNX 500 Index), and 294 firms were taken from Pakistan Stock Exchange that cumulative forms the sample of 1148 firms. These stock markets were selected due same investor behavior in these markets but varied market maturities. The data of monthly stock returns was calculated from these markets from year 2001 to 2017. The main reason for selecting these countries is the same investor behavior pattern as all the neighboring countries and have similar values in terms of investors, due to which these countries are taken for sample consideration.

Hypotheses

The hypotheses are based on Fama and French study (1992) study. these hypotheses are as under.

H₁: Higher stock returns are linked with small-cap stocks and value stocks

H₂: Lower stock returns are linked with large-cap size and growth stocks

H₃: higher stock returns are link to small book value of assets and value stock

Financial Model:

ⁱⁱ Fama and MacBeth (1973), Tinic and West (1984),

ⁱⁱⁱ Drew, Naughton, and Veeraraghavan (2003); Prajutasen (2010) and Srimarksuk (2007)

^{iv} The extended Definition of south Asian countries includes China.

This study is based on the methodology developed by Fama and French (1992) in describing the variables. However, the panel data estimation is used to determine and evaluate the dynamics of CAPM and Fama-French models. The model can be empirically be written as follow.

$$\text{Eq 1} \quad R_i - R_f = f[MRP; SMB_{it}; HML_{it}]$$

The statistical form of the above equation can be written as in Equation 2.

$$\text{Eq 2} \quad (R_i - R_f)_{it} = \beta_1 + \beta_2(R_m - R_f)_{it} + \beta_3(SMB)_{it} + \beta_4(HML)_{it} + \mu_{it}$$

R_i is individual returns of stock of i th company at time t , R_f = Risk free rate of return (3-months Treasury Bills Rate). In India and China, it is 3-months Discount Rate provided by their respective central banks that are people's Bank of China (PBC) and Reserve Bank of India (RBI), R_m is Market return based on respective index, SMB is size factor, where HML is value factor.

Addressing the heteroskedasticity, the transformed equations is as follow:

$$\text{Eq 3} \quad \frac{(R_i - R_f)_{it}}{\sigma_{it}} = \beta_1 \left(\frac{1}{\sigma_{it}} \right) + \beta_2 \left(\frac{(R_m - R_f)_{it}}{\sigma_{it}} \right) + \beta_3 \left(\frac{SMB_{it}}{\sigma_{it}} \right) + \beta_4 \left(\frac{HML_{it}}{\sigma_{it}} \right) + \left(\frac{\mu_{it}}{\sigma_{it}} \right)$$

Further the rearranging the equation 3 for amplifying the heteroskedastic effect the equation 3 can be written as follow:

$$\sum \left(\frac{\mu_{it}}{\sigma_{it}} \right)^2 = \sum \left[\left(\frac{(R_i - R_f)_{it}}{\sigma_{it}} \right) - \beta_1 \left(\frac{1}{\sigma_{it}} \right) - \beta_2 \left(\frac{(R_m - R_f)_{it}}{\sigma_{it}} \right) - \beta_3 \left(\frac{SMB_{it}}{\sigma_{it}} \right) - \beta_4 \left(\frac{HML_{it}}{\sigma_{it}} \right) \right]^2$$

The higher value of σ , diminishes the weight assigned to each term. Equation Parameters can be estimated through minimization of the equation 4.

Stock returns (R_i):

This study used the natural log measure to calculate the stock return with minimal changes and least moment time. The stock returns calculated as natural log measure as follow:

$$R_i = \ln \left(\frac{P_i}{P_0} \right) \quad (P_0 \text{ is the stock price at } t_0)$$

Market Return (R_m)

Market return is calculated through natural log method in this study as it can detect minute variations and tends to zero. It is calculated by following formula

$$R_m = \ln \left(\frac{MI_t}{MI_0} \right) \quad (MI \text{ is the market Index})$$

Small minus Big (SMB):

Adopting the methodology of Fama and French (1992) the size factor is proxied through Total Capitalization i.e. market value of stock (on December 31st) times number of outstanding shares. The SMB (small minus big stock) factor is established in the similar manner as in three factor model. SMB is measured by evolving six size-based portfolios S/H, S/N, S/L, B/H, B/N, B/L grounded on size factor and BE/ME factor. The number of cross-sections varies in each portfolio^v.

$$SMB = \frac{(S/L - B/L) + (S/N - B/N) + (S/H - B/H)}{3}$$

The alternate measure of size is total assets, so models are tested with traditional SMB based on market capitalization and presumed efficient SMB based on Total assets^{vi} of the firm as on Dec 31st.

High minus Low (HML)

Based on the methodology of Fama and French Model the Book to market value of equity proxied for value of the firm. Book to market equity is calculated by dividing book value of equity (BE) by market value of equity (ME) of firm dated 31st December of fiscal year. The HML (high minus low) depicts the difference between the portfolio weighted returns of high BE/ME firms and the

^v Fama and French (2015 used 25 portfolios instead of 6 portfolios. However, such approach is applicable to developed and mature market. The markets of developing countries are not that much mature to be segregated in 25 different categories due to which Fama and French (1992) approach is used. Moreover, no evidence is found in terms of Fama and French (2015) approach being applicable to emerging economies

^{vi} Variety of studies has taken total assets are measure of size (Aman et al., 2006; Dimitrov & Jain, 2008; Gu et al., 2005)

portfolio returns of low BE/ME firms. The portfolios are developed using methodology of Fama and French (1992). Four weighted portfolios are developed i.e. S/H, S/L, B/H, and B/L.

$$HML = \frac{(S/H - S/L) + (B/H - B/L)}{2}$$

Empirical Results

The models proposed in above methodology section is estimated using panel data approach. The above models are estimated repeatedly by changing the SMB measures from market equity to Total Assets. The results of each country are separately discussed and variations in results due to change in SMB measures will be discussed concurrently. Table I to IV shows the results of Panel Data, Wald Tests, Fixed Effect Redundant Test, and Hausmen Test related to Pakistan. Table V to VIII shows the concurrent results of India and Table IX to XII shows the results of China in concurrent manner.

PAKISTAN

Table I: Fixed effect and Random effect (Pakistan)

Parameters	MARKET EQUITY					TOTAL ASSETS				
	Pooled EGLS	Cross-Section Fixed Effect	Cross-section Random Effect	Two Way Random effect	Period Random Effect	Pooled EGLS	Cross-Section Fixed Effect	Cross-section Random Effect	Two Way Random effect	Period Random Effect
C	-0.04 (-31.47)*	-0.04 (-24.76)*	-0.04 (-24.82)*	-0.04 (-6.24)*	-0.04 (-6.22)*	-0.04 (-30.00)*	-0.04 (-22.90)*	-0.04 (-22.96)*	-0.04 (-6.01)*	-0.04 (-6.00)*
MPREM	0.69 (69.85)*	0.63 (44.28)*	0.63 (44.40)*	0.63 (11.16)*	0.63 (11.13)*	0.72 (73.04)*	0.68 (47.06)*	0.68 (47.18785)	0.68 (12.36)*	0.68 (12.33)*
SMB	-0.01 (-3.82)*	-0.03 (-7.32)*	-0.03 (-7.34)*	-0.03 (-1.84)	-0.03 (-1.84)	0.08 (18.29)*	0.11 (-15.95)*	0.11 (-16.02)*	0.11 (-4.20)*	0.11 (-4.18)*
HML	0.003 (0.62)	-0.005 (-0.68)	-0.005 (-0.68)	-0.005 (-0.17)	-0.005 (-0.17)	-0.02 (-5.50)*	-0.05 (-9.36)*	-0.05 (-9.39)*	-0.05 (-2.46)	-0.05 (-2.45)
Sum of Squares Residual	3183.71	3189.29	3192.96	3034.75	3034.70	3170.54	3175.15	3178.82	3034.75	3034.70
F-Stat	1667.44*	7.12*	689.26*	43.56*	43.33*	1796.34*	7.84*	759.88*	52.19*	51.92*

*Significance level at 1%

**Significance level at 5%

The values in brackets are the t-values

Table II: *Wald Redundant Coefficient Test (Pakistan)*

Restrictions	Market Equity		Total Assets	
	Pooled EGLS		Pooled EGLS	
	Value	t-value	Value	t-value
C(1)=0	-0.037	-31.47*	-0.035	-29.88*
C(2)=1	-0.313	-31.77*	-0.276	-27.74*
C(3)=0	-0.012	-3.82*	0.083	18.23*
C(4)=0	0.003	0.62	-0.021	-5.49*
C(3)=1	-1.012	-327.34*	-0.917	-202.08*
C(4)=1	-0.997	-215.92*	-1.021	-266.31*

*Significance level at 1%

**Significance level at 5%

Table III. *Hausmen Test (Pakistan)*

Variable	Market Equity			Total Assets		
	Fixed	Random	Var (Diff.)	Fixed	Random	Var(Diff.)
MPREM	0.63	0.63	0.00	0.68	0.68	0.00
HML	-0.03	-0.03	0.00	0.11	0.11	0.00
SMB	-0.005	-0.005	0.000	-0.05	-0.05	0.00

*Significance level at 1%
**Significance level at 5%

Table I depicts the fixed and random effect heterogeneity of Pakistan. The results presented that the market premium and size beta are significant ($p < 0.05$), but HML is insignificant, when size factor is based on market capitalization or market equity. However, when SMB measurement basis is changed to total assets, the HML became significant showing that total assets as the measure of size beta is more efficient than original measure of size shown by Fama and French (1992). The model showed that the required rate of return is the function of market beta, size beta and value beta. Among all factors, the factor loading of market premium is greater that is 0.69 showing that the required rate of return is mostly explained by market premium. The SMB factor loading based on market equity) is negative showing that the mimicking portfolio based on large cap stocks outperformed and the factor loading ranges -0.01 to -0.03, but the relationship became positive with improved factor loadings (range from 0.08-0.11) when SMB developer is changed from market equity to total assets showing the premium is attached to small stocks due to general notion of greater chances of default. These results are consistent with other emerging studies (Chen, Novy-Marx, & Zhang, 2011; Chen & Zhang, 2010; Connor & Sehgal, 2001a; Djajadikerta & Nartea, 2005). The HML loading factor remained negative showing that mimicking portfolio based on growth stocks outperformed value stocks in Pakistan Market. However, the HML is significant when size factor is derived through total assets and depicts that market is predominantly of growth stock. Prior studies (Chen et al., 2011; Chen & Zhang, 2010; Connor & Sehgal, 2001a; Djajadikerta & Nartea, 2005) unable to attain the significance of value premium as there size measure is based on market equity. Furthermore, the results have major input towards the heterogeneity of variables. The SMB variable is cross sectional heterogenous, while showing insignificance for period heterogeneity, when size factor is derived from market equity, but when the size factor is derived from total assets then size factor shows significance for all types of heterogeneities. The sum of squared residual is also reduced when size measure is shifted from market equity to total asset showing the greater fitness of the model. The F-stat is significant at $p < 0.05$, confirming the goodness of fit and well specification of the model.

The Wald Coefficient restriction test identifies the true value of factor loading that shows that the coefficient is significantly different from 0 and 1, showing that the coefficient depicts the true value of market, size and value betas. The redundant fixed effect test falls in favor of pooled EGLS results and Hausmen test in table IV, which shows the least difference among the result of fixed and random

effects. Moreover, the F-stats showed the model significance and reduction in squared residuals shows the efficiency of alternative measure of SMB based on total assets. The Wald results also showed that the SMB employed through total assets have greater true value than based on market equity.

INDIA

Table V: Fixed effect and Random effect (India)

Parameters	MARKET EQUITY					TOTAL ASSETS				
	Pooled EGLS	Cross-Section Fixed Effect	Cross-section Random Effect	Two Way Random effect	Period Random Effect	Pooled EGLS	Cross-Section Fixed Effect	Cross-section Random Effect	Two Way Random effect	Period Random Effect
C	0.002 (3.58)*	0.005 (5.60)*	0.005 (5.60)*	0.005 (1.41)*	0.005 (1.41)	0.002 (3.19)*	0.005 (6.17)*	0.005 (6.17)*	0.005 (1.47)	0.005 (1.47)
MPREM	1.004 (139.54)*	1.074 (119.33)*	1.074 (119.33)*	1.074 (29.96)*	1.074 (29.95)*	0.988 (134.02)*	1.062 (114.74)*	1.062 (114.74)*	1.062 (27.25)*	1.062 (27.24)*
SMB	0.080 (18.18)*	0.139 (25.17)*	0.139 (25.17)*	0.139 (6.32)*	0.139 (6.32)*	0.043 (11.10)*	0.089 (18.27)*	0.089 (18.27)*	0.089 (4.34)*	0.089 (4.34)*
HML	0.002 (0.42)	-0.012 (-2.05)**	-0.012 (-2.05)**	-0.012 (-0.51)	-0.012 (-0.51)	0.024 (5.29)*	0.027 (4.59)*	0.027 (4.59)*	0.027 (1.09)	0.027 (1.09)
Sum of Squares Residual	973.38	972.03	977.73	933.29	933.29	979.88	977.90	983.61	933.29	933.29
F-Stat	8784.97*	58.45*	6180.47*	389.25*	389.13*	8681.28*	57.18*	6044.82*	340.67*	340.56*

*Significance level at 1%

**Significance level at 5%

The values in brackets are the t-values

Table V. Wald Redundant Coefficient Test (India)

Restrictions	Market Equity		Total Assets	
	Pooled EGLS		Pooled EGLS	
	Value	t-value	Value	t-value
C(1)=0	0.002	3.578*	0.002	3.19*
C(2)=1	0.004	0.509	-0.012	-1.630
C(3)=0	0.080	18.179*	0.043	11.095*
C(4)=0	0.002	0.422	0.024	5.285*
C(3)=1	-0.920	-208.93*	-0.957	-247.04*
C(4)=1	-0.998	-208.21*	-0.976	-210.93*

*Significance level at 1%

**Significance level at 5%

Table VI. Hausmen Test (India)

Variable	Market Equity			Total Assets		
	Fixed	Random	Var (Diff.)	Fixed	Random	Var(Diff.)
MPREM	1.07	1.07	0.00	1.06	1.06	0.00
HML	0.14	0.14	0.00	0.09	0.09	0.00
SMB	-0.01	-0.01	0.00	0.03	0.03	0.00
*Significance level at 1%						
**Significance level at 5%						

Table V demonstrate the cross-section period fixed and random effect results along with the weighted EGLS of India. The results show the significance of market beta, size beta based on market equity and also of intercept, but HML shows insignificance ($p < 0.05$), when size factor is based on market equity. Comparing to the results in which SMB based on total Assets, the results show significance of all the factors establishing that, when the SMB factor based on total assets is incorporated contrary to the Market Equity measure of SMB, the HML factor showed the significance confirming the efficiency and significance of the three-factor asset-pricing model in which size factor is developed on total assets compared to the original model in which size measure is based on Market Equity.

The SMB based on either market equity or total asset remained significantly positive ($p < 0.05$) in case of India showing that small-cap stocks outperforms large-cap stocks due to high risk associated with small cap stock, which is consistent with prior studies (Chen et al., 2011; Chen & Zhang, 2010; Connor & Sehgal, 2001a; Djajadikerta & Nartea, 2005; Drew, 2003). HML becomes positively significant ($p < 0.05$) in model that incorporates SMB with total asset, showing that mimicking portfolio based on value stocks outperformed growth stocks, which is completely in line with the assumptions of Fama and French model. Prior studies (Drew, 2003; Eun & Huang, 2007; Fama & French, 2012) depicted the insignificance of HML in emerging economies, but their results are based on market equity-based size factor. Such results confirm the market equity as weak measure of size in emerging economies. From the results it is also seen that the stock returns are predominantly explained by market beta as the market beta has the highest factor loadings. Moreover, from results it is also inferred that the factor loadings shows improvement when total assets is adopted as developer of size factor.

The results further depict that all the variables except HML possesses cross-sectional heterogeneity and period heterogeneities while HML depicts only cross-sectional heterogeneities. The F-statistics significance ($p < 0.05$) shows the fitness of model and also confirms the specifications of the model. These results also confirm the market equity as weak size measure in emerging economies.

The table VI displays the statistics of Wald Coefficient restrictions, which depicts that the true value of betas (market, size, value) and intercepts with significance when SMB is measured through total assets, rather than original measure of SMB. The market premium beta is insignificant at unity assumption in Wald Test that is also supportive to the results of table V. The table VII displays the

Redundant Fixed Effect test results which revealed that EGLS is more efficient than fixed effect. Table VIII shows the Hausmen Test that depicts least difference in both effects.

CHINA

Table VII. *Fixed effect and Random effect (China)*

Parameters	MARKET EQUITY					TOTAL ASSETS				
	Pooled EGLS	Cross-Section Fixed Effect	Cross-section Random Effect	Two Way Random effect	Period Random Effect	Pooled EGLS	Cross-Section Fixed Effect	Cross-section Random effect	Two Way Random effect	Period Random Effect
C	-0.022	0.02	0.02	0.02	0.02	-0.028	0.02	0.02	0.02	0.02
	(-44.9)*	(-42.32)*	(-42.32)*	(-2.89)**	(-2.89)**	(-56.5)*	(-53.89)*	(-53.89)*	(-3.71)*	(-3.71)*
MPRE	0.489	0.49	0.49	0.49	0.49	0.484	0.48	0.48	0.48	0.48
M	(99.3)*	(96.99)*	(96.99)*	(6.63)*	(6.61)*	(98.9)*	(96.58)*	(96.58)*	(6.66)*	(6.64)*
SMB	0.393	0.40	0.40	0.40	0.40	0.398	0.41	0.41	0.41	0.41
	(71.14)*	(71.04)*	(71.04)*	(4.85)*	(4.84)*	(77.97)*	(77.72)*	(77.72)*	(5.36)*	(5.34)*
HML	-0.118	0.12	0.12	0.12	0.12	0.079	0.07	0.07	0.07	0.07
	(-20.38)*	(-21.27)*	(-21.27)*	(-1.45)	(-1.45)	(11.83)*	(11.02)*	(11.02)*	(0.76)	(0.76)
Sum of Squares Residual	1316.21	1314.83	1316.41	798.29	798.28	1301.41	1300.02	1301.06	798.29	798.28
F-Stat	6361.84*	34.88*	6232.16*	28.94*	28.81*	6758.7*	37.03*	6616.96*	31.27*	31.13*

*Significance level at 1%

**Significance level at 5%

Table VIII. Wald Redundant Coefficient Test (China)

Restrictions	Market Equity		Total Assets	
	Pooled EGLS		Pooled EGLS	
	Value	t-value	Value	t-value
C(1)=0	-0.022	-44.87*	-0.028	-56.54*
C(2)=1	-0.511	-103.96*	-0.516	-105.56*
C(3)=0	0.393	71.13*	0.398	77.97*
C(4)=0	-0.118	-20.38*	0.079	11.83*
C(3)=1	-0.607	-110.09*	-0.602	-117.77*
C(4)=1	-1.118	-192.98*	-0.602	-117.77*

*Significance level at 1%, **Significance level at 1%

Table IX. Hausmen Test (China)

Variable	Market Equity			Total Assets		
	Fixed	Random	Var (Diff.)	Fixed	Random	Var(Diff.)
MPREM	0.49	0.49	0.00*	0.49	0.49	0.00
HML	0.41	0.41	0.00*	0.41	0.41	0.00*
SMB	-0.13	-0.13	0.00*	0.08	0.08	0.00*

*Significance level at 1%

**Significance level at 5%

Table IX illustrates the results of China. The results depicted that the market premium has highest factor loading i.e. 0.50 with significance ($p < 0.05$) showing that required rate of return is dependent on market beta. With market equity based SMB measure the fixed and random effect model and EGLS shows significance of all incorporated factors of Fama and French (1992). The significance of all factors also prevails when the SMB factor measure is changed to total assets. However, the sum of squared residual reduced when SMB measure is shifted from market equity to total assets showing the greater explanatory power of model, when SMB is measured through total assets. The positive significant size beta in both measures (market equity and total asset) showed that mimicking portfolio based on small cap stocks outperformed large cap stocks due to risk associated with small firms. Which is consistent with the prior studies (Chen et al., 2011; Chen & Zhang, 2010; Connor & Sehgal, 2001a; Djajadikerta & Nartea, 2005; Drew, 2003).

The HML remained negative and significant when Fama and French model is estimated using SMB based on market equity depicting that mimicking portfolio based on growth stocks outperformed value stocks and market is predominantly of growth stocks. However, the factor loading of HML becomes positive when SMB factor is shifted from market equity measure to total asset measure of size for SMB factor suggesting that value stock outperformed the growth stock and market is predominantly of value stock. These results are inconsistent with prior studies (Lam, 2005; Pandey & Mohapatra, 2017; Srimarksuk, 2007) of emerging economies as prior studies unable to identify significance in most of emerging economies. From heterogeneity perspective, it is seen that all variables except HML possesses cross sectional as well as period heterogeneities while HML only possesses cross sectional heterogeneities. The F-statistics significance ($p < 0.05$) shows fitness of the model and suggest model is well specified.

The Table X showed Wald coefficient restriction test of china, confirming that the coefficients of SMB and HML are different from 0 and 1 in both cases. The redundant fixed effect test in table XI showed outperformance of EGLS, while Hausmen Tests Results in Table XII showed that greater efficiency of fixed effect than random effect with significance ($p < 0.05$). The results confirm the efficiency of total assets as the measure of size factor over market equity measure of size in China.

Results Consolidation

From the results it is inferred that market equity is a weak measure of size in emerging economies and total assets as size measure is more efficient than market equity measure, consistent to prior studies (Cakici, Fabozzi, & Tan, 2013; Zaremba & Konieczka, 2014). It is also inferred that market equity measure of size is more relevant to matured markets where the investors are well informed, while total assets measure of size is more relevant to emerging economies where the markets are not mature and investors are not well informed. Further deliberations of the results also identified certain pattern in efficiency of size measures like the sample of this study is from Pakistan India and China and if these economies are ranked based on market maturity then China is most matured market among them afterwards India and then Pakistan. The results also depicted the same market maturity and investor information asymmetry. The most insignificance is seen in Pakistan results and least insignificance is seen in China, suggesting that emerging market with less maturity needs alternate size measure that is total assets when applying Fama and French model. Such revisit of Fama and French model bring new insight in application of Fama and French Model in emerging economies.

Conclusion

The present study analyzed the applicability of three factor asset pricing model in those emerging market that have similar investor behavior. Moreover, this study also evaluated the alternative measure of size factor that improved the efficiency of three factor model in emerging economies. Prior studies concluded inefficiency and inapplicability of Fama and French model which is because financial markets of emerging economies are not that much matured in which the market value depicts actual size and investors are not well informed that makes market capitalization as weak measure of size, which suggest that the inapplicability of Fama and French Model in emerging economies is due to size measure weakness. The present study evaluated the efficiency of alternate size measure that is total asset instead of market capitalization. The empirical findings of this study confirmed that the alternate measure of size factor, which is based on total assets increases the efficiency of Fama and French model. The incorporation of size factor based on market value in model brings the insignificance of HML factor in case of India and Pakistan due to overlapping of

measures, which is similar to what reported in prior studies (Drew, 2003; Eun & Huang, 2007; Fama & French, 2012). In case of China, all factors show significant results when Fama and French model is estimated with each size measure, but the sum of squared residual also improved when SMB factor is measured through Total Assets, showing the efficiency of three factor model based on SMB developed through Total Assets. The significance of the market Beta, Size Beta, and Value Beta shows the applicability of Fama and French Model in India, China and Pakistan, but alternate size measure which works as SMB developer is more efficient than market equity measure in emerging economies. The positive significance of SMB based on total assets showed that the small-cap stocks outperformed large-cap stocks. The negative significance of HML confirms that the value stocks outperformed growth stocks in these emerging markets. The testability of Fama and French model in these countries show the consistency with other studies based on emerging economies such as O'Brien et al. (2008); Tai (2003).

From the results it is inferred that market equity is a weak measure of size in emerging economies and total assets as size measure is more efficient than market equity measure. It is also inferred that market equity measure of size is more relevant to matured markets when the investors are well informed, while total assets measure of size is more relevant to emerging economies where the markets are not mature and investors are not well informed. Further deliberations of the results also identified certain pattern in efficiency of size measures like the sample of this study is from Pakistan India and China and if these economies are ranked based on market maturity then China is most matured market among them afterwards India and then Pakistan. The results also depicted the same market maturity and investor information asymmetry.

This study is very beneficial for long and medium-term investors. In sum up, small-cap stock has higher returns than large-cap stocks. The estimation suggest that China is evolved as most stable market in comparison to all three markets. In case of India and Pakistan, stock premium is majorly guided by market premium. Development of effective policy measure should be taken in order to bring maturity and proficiency in markets of India and Pakistan.

This study has limitations in terms of datasets as only three emerging economies are investigated in this study. The span of emerging economies can be increased in order to increase the generalizability of size measure. Furthermore, the present study didn't address how the alternate measure adjust during and after any economic events which can be done in future research.

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