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Stationarity of the Fama-French Three Factor Model Factor Premiums in India

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ABSTRACT

The monthly factor premium time series for the three factors (market, size and value) in the Fama-French three factor model in India are found to be stationary for period April 01, 1991 till March 31, 2015. The stationarity behavior for the time series is inferred from a visual examination as well as by use of the Augmented Dickey Fuller test (Said & Dickey, 1984; Said, 1991; Fuller, 2009), the Phillips-Perron test (Philips & Perron, 1987) and the KPSS test (Kwiatkowski et al., 1992). Thus. it can be inferred that the investors' return expectations from the overall market have not changed in spite of tremendous developments in the Indian economy and the transformations in the Indian stock market during the study period. It could also be noted that the Granger causality tests involving the market risk premium, size and value premium showed that size premium Granger causes value premium. This implies that at least a part of variation in stock returns due to value could possibly be explained by size.

Keywords: Fama-French three factor model, size premium, value premium, stationarity, stationarity tests (ADF, PP, KPSS), Granger causality

INTRODUCTION

The purpose of this paper is to examine the behavior of the factor premium time series for the three factors in the Fama-French three factor model in the Indian market between April 1991 and March 2015. The three factors are market, size and value. The chosen period was a period of major transformation for the Indian capital market. This period saw the market shift from an open outcry based trading system to a nationwide automated screen based trading system, a shift from paper based

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(that is, share certificate based) trading to dematerialised trading, entry of foreign institutional investors in a huge way, and major regulatory changes.

Raghuram (2009) has studied if the asset pricing behavior in India has changed in the aftermath of the establishment of the National Stock Exchange (NSE) using the Fama-French three factor model. His method was to test if the sensitivities to the factors in the Fama-French three factor model have changed. He concluded that the asset pricing behavior has indeed changed in the aftermath of the establishment of the NSE.

The motivation of this paper is as follows. If the sensitivities to one or more factors in the Fama-French three factor model have changed in the aftermath of the establishment of the NSE, then it may be possible that the behavior of the factor premiums may have changed.

The period 'aftermath of the establishment of the NSE' does not imply that the changes in the factor premiums behavior might be solely due to the establishment of the NSE. The establishment of the NSE did lead to a major transformation in the Indian market – the shift from an open outcry trading system to a nationwide automated screen based trading system. But there had been other major changes and developments in the Indian market during this period.

The finding of this study shows that the factor premium time series for the three factors in the Fama-French three factor model are stationary for the period studied (April 01, 1991 till March 31, 2015). The frequency for the estimation of the factor premiums is monthly. A visual examination of the time series data indicates that the time series for the three factor premiums might be stationary. A rigorous confirmation of the stationarity of the factor premium time series for the three factors is achieved by use of the Augmented Dickey Fuller test (Said & Dickey, 1984; Said, 1991; Fuller, 2009), the Phillips-Perron test (Philips & Perron, 1987) and the KPSS test (Kwiatkowski et al., 1992).

These findings suggest that investors' return expectations from the overall market have not changed in spite of tremendous developments in the Indian economy and the transformations in the Indian stock market during the study period.

Another interesting fact that has emerged from study is that the Granger causality tests involving the market risk premium, size and value premium showed that size premium Granger causes value premium. This implies that at least a part of variation in stock returns due to value could possibly be explained by size. It could also be noted in this context that there are studies providing evidence of the value effect being stronger in small cap stocks compared with large cap stocks among which the noteworthy ones are Fama and French (2012) and Chan and Lakonishok (2004).

The Fama-French Three Factor Model: Background

Fama and French (1993) put forward a factor model that estimates the expected return on the ith portfolio, R_i, using the following three-factors:

(i) The return on the market portfolio R_m less the risk free rate, R_f.

(ii) The difference between the return on a portfolio of low market equity stocks and the return on a portfolio of high market equity stocks (SMB, small minus big); and

(iii) The difference between the return on a portfolio of high-book-to-market stocks and the return on a portfolio of low-book-to-market stocks (HML, high minus low).

The Fama-French three factor model can be stated as follows:

$$R_i - R_f = \beta_i (R_m - R_f) + (s_i * SMB) + (h_i * HML)$$

Where β_i, s_i and h_i are the regression coefficients corresponding to market, SMB and HML respectively.

The developments that led to the Fama-French three factor could probably be traced back to 1970s when researchers began reporting 'anomalies' in the CAPM, that is, patterns in average returns that could not be explained by the CAPM.

One of the first anomalies, namely E/P effect, was reported by Basu (1977). He presented evidence that stocks with high earnings/price ratios (or low P/E ratios) earned significantly higher returns than stocks with low earnings/price ratios. Banz (1981) and Reinganum (1981a) put forth the size effect which meant that the average returns on small capitalisation stocks was much higher than that for large capitalisation stocks. The average returns of the small capitalisation stocks was seen to be much higher than the CAPM return estimates. Stattman (1980) and Rosenberg et al. (1985) found that average returns on US stocks is directly proportional to their book value to market value ratio, a phenomenon unexplained by the CAPM. Likewise, many other variables were shown to have an explanatory power over and above the CAPM market factor in describing the returns on stocks. Bondt and Thaler (1985) discovered long term reversal in stock returns, that is, stocks with low long term past returns tended to have higher future returns and vice versa. Jegadeesh and Titman (1993), in a development over Jegadeesh (1990), gave more clarity to the momentum effect, that is, stocks performing well in the previous three to twelve months continued to do well for the next few months, and stocks not performing well in the previous months continued their poor performance for the next few months. The momentum effect too is unexplained by the CAPM.

Fama and French (1996) show that their three-factor model is able to explain all the anomaly in patterns except for the momentum effect.

The size and value premium in the Fama-French three factor model are of interest to both researchers and practitioners. The Ibbotson SBBI Valuation and Cost of Capital Year Book and the Duff and Phelps Valuation Handbook publish the size premium data for the US market. The size premium data is used for company valuation. Professor Kenneth R. French, the Roth Family Distinguished Professor of Finance at the Tuck School of Business at Dartmouth College, USA maintains regularly updated data on size and value premium on his website which is available for use by researchers as well as practitioners.

The Fama-French three factor model has found support in the emerging and Indian markets too. Drew (2003) proves the applicability of the Fama-French model in Hong Kong, Korea, Malaysia and the Philippines. Bundoo (2008) states that the Fama-French three factor model well describes the returns of stocks listed on the Stock Exchange of Mauritius. Barry et al. (2002) studied size and book-to-market effects in 35 emerging markets during 1985- 2001 using monthly data on individual stocks sourced from Standard and Poor's Emerging Markets Data Base (EMDB 2000). They provide support for the existence of size and value effects in these markets.

Connor and Sehgal (2001) and Mohanty (2001) show that the Fama-French three factor model is a good descriptor of stock returns in the Indian context. Bahl (2006), Tripathi (2008), Raghuram (2009), Taneja (2010) and Balakrishnan (2016) support the applicability of the Fama-French three factor model in the Indian context.

Screen Based Trading (SBT) and Asset Pricing – Direct Tests

Jain (2005) directly tests the hypothesis that the shift to automated electronic trading from floor-based trading leads to decrease in the equity premium demanded by investors. He studies the returns on stock exchanges in 71 countries from January 1973 to August 2001. The equity premium is estimated using the dividends growth model in Fama and French (2002) and the international asset-pricing model in Bekaert and Harvey (1995). The cost of equity (as estimated by the two models) is reduced in the long term post the introduction of electronic trading. Jain (2005) supports the logic that electronic markets lead to improvement in liquidity, informativeness and stock valuation and all these collectively aid in the reduction of the cost of equity.

Screen Based Trading (SBT) and Liquidity, Transaction Costs and Market Efficiency

Screen based trading was first launched in India in November 1994 when a new stock exchange, the National Stock Exchange (NSE), started equity trades on a screen based trading platform. A competing exchange, the Mumbai Stock Exchange (BSE) launched its screen based trading platform called the BSE Online Trading (BOLT) on March 14, 1995 (Till then BSE was functioning only with an open outcry floor based trading system.).

The impact of the introduction of nationwide electronic screen based trading (SBT) and other reforms led to a drastic reduction in the transaction costs in the Indian stock markets. This is summarised in the below table taken from Shah (1999). It could also be noted that during 1999 the Indian market was making the transition

Table 1
SBT and transaction costs

Component	India			Best in the world
		1994	1999	
		Physical	Demat	
Trading				
Fees to intermediaries	3.00	0.50	0.25	0.25
Market impact cost Clearing	0.75	0.25	0.25	0.20
Counterparty risk Settlement	Present	0.00	0.00	0.00
Paperwork	0.75	0.75	0.10	0.05
Bad paper risk	0.50	0.50	0.00	0.00
Stamp duty	0.25	0.25	0.00	0.00
Total	>5.25	2.25	0.60	0.50

Note: The values above are in percentage and for a one–way transaction. Total transaction costs of 0.6% in the demat mode in 1999 imply that a person buying shares worth Rs.100 would have to spend around Rs.100.60. The market impact cost is calculated from the bid-ask spread. Suppose the shares for XYZ Company are quoted at 114.35/114.40. These quotes are for a quantity of 50 shares. Now (bid+ask)/2 = (114.35+114.40)/2 = Rs.114.375. The market impact cost for 50 shares of XYZ Company in percent is calculated as (114.375-114.35)*100/114.35 = 0.0219%.
Source: Shah (1999)

from paper (certificate) based trading to dematerialised trading (paperless trading or demat trading).

Hence, we can see that total transaction costs have declined from being greater than 5.25% in 1994 to 0.6% in the demat mode in 1999. The market impact cost (derived from the bid-ask spread) too has declined from 0.75% in 1994 to 0.25% in 1999.

Shah and Thomas (1996) study the impact of the launch of BOLT, the screen based trading platform of the Mumbai Stock Exchange (BSE). They find that the launch of the BOLT has caused an improvement in liquidity as given by two measures, namely aggregate trading volume and trading frequency at the security level. They also provide evidence for improvement in market efficiency by observing that the skewness and short-term correlation of security returns are diminished in the aftermath of the launch of the BOLT.

Green et al. (2010) also study the impact of the launch of the BOLT on the Mumbai Stock Exchange (BSE). They use two samples of shares, one comprising the more liquid or A shares and the other comprising the less liquid or B shares. They conclude that the introduction of BOLT resulted in a significant improvement in market performance for both A and B shares, in terms of share valuations as well as the LEV (liquidity, efficiency, and volatility) measures. However, they also make an interesting observation that the gains in liquidity and share valuation were more for B shares as compared to A shares.

Studies have been conducted on the repercussions of the launch of screen based trading (SBT) in stock markets outside India. Blennerhassett & Bowman (1998) study the impact of introduction of electronic screen trading system on June 24, 1991 in the New Zealand Stock Exchange (NZSE) (NZSE had an open outcry trading system till then.). They provide evidence in support of reduction of bid-ask spread and transaction costs.

Majnoni and Massa (2001) study the impact of various reforms introduced between 1991 and 1994 in the Italian Stock Exchange, namely creation of specialised intermediaries, obligation to trade on official markets, screen based trading and cash settlement. They conclude that all the reforms, except for cash settlement, have led to increased market efficiency.

Chelley-Steeley and Lucy (2008) examine the impact of the introduction of Xetra, a fully electronic trading system, on June 07, 2000, on the Irish Stock Exchange in Dublin (The Irish Stock Exchange had a floor based trading system till then.). They find that post the introduction of the electronic trading system, the stock prices adjust faster to arrival of new information, clearly indicating an improvement in market efficiency.

Stoll (2006) in his discussion on the impact of electronic trading (fully automated exchanges with screen based trading systems) in the US states that electronic trading has resulted in reduced brokerage commissions, reduced bid-ask spread and increased market efficiency.

Thus, it can be seen that the introduction of screen based trading has improved liquidity, reduced transaction costs and increased market efficiency in India and markets across the world.

Liquidity, Transaction Costs, Market Efficiency and Asset Pricing

O'Hara (2003) reveals a number of authors who have provided empirical evidence that asset prices do reflect liquidity costs - Amihud and Mendelson (1986, 1988), Brennan & Subrahmanyam (1996), Brennan et al. (1998), Chalmers and Kadlec (1998), Chordia et al. (2000), Pastor & Stambaugh (2001) and Amihud (2002). O'Hara (2003) goes on to elaborate that liquidity is like a cost borne by investors and that liquidity costs beyond a point can negatively affect an asset value. It is significant to note that O'Hara (2003) goes on to add that market microstructure does influence liquidity costs and that reduction of these costs through the introduction of an efficient trading mechanism would significantly impact an asset's value.

Amihud and Mendelson (1986), in a study on NYSE (New York Stock Exchange) stocks, examine the effect of illiquidity (measured by the bid-ask spread) on asset pricing. They find that average portfolio risk adjusted returns are positively related to their bid-ask spread and the return spread relationship is a concave curve with the returns increasing at a decreasing rate with increasing spread. Brennan and Subrahmanyam (1996), in a study of the US market, find that there is a significant return premium associated with the variable transaction costs (trade size dependent) and fixed transaction costs.

Pontiff (1996), in a study on closed-end funds in the U.S., provides evidence that arbitrage costs can cause asset prices to deviate from fundamentals. Two types of arbitrage costs are considered - transaction costs (brokerage fees, market impact costs, and bid-ask spreads) and holding costs (borrowing costs, opportunity costs from not being able to fully invest short-sale proceeds, and risk exposure). By using a sample of closed-end funds he proves that discounts observed in closed end funds are due to arbitrage costs (Discount - The traded price of a closed end fund being lesser than the market value of its stock portfolio). Pontiff (1996) demonstrates that transaction costs are positively related to the observed discounts in the closed-end funds. He also suggests that the severity of asset mispricing would be positively related to, among other factors, the securities' bid-ask spreads.

Trading Technology, Market Frictions and Fama-French Factor Premiums

Some authors have directly examined the impact of trading technology and market frictions on the factors and factor premiums in the Fama-French three factor model.

Chordia et al. (2014), in a study on the US markets, provide evidence that improvements in trading technology in the recent years have contributed to significant reduction in transaction costs and increased liquidity facilitating greater anomaly based arbitrage leading to attenuation of anomalies such as size, reversals, momentum and post earnings announcement drift.

Hou and Moskowitz (2005), study the impact of market frictions on asset pricing by examining the delay in the response of a stock's price to information in the US. They state that this delay commands a premium and a part of the delay premium can be explained by the size effect. They also find that idiosyncratic risk is priced only among the most severely delayed stocks. They also observe that the delay premium is strongest for small, value and liquid stocks and is negligible or insignificant for large, glamour and liquid stocks. We can infer from these results of their paper that the factor premiums in the Fama-French three factor model, namely market, size and value premiums, could be affected by a reduction in market frictions.

Hsia et al. (2000) state that since the CAPM beta is a function of returns observed in the market, presence of market frictions that hinder the arbitrage process distorts the returns which in turn distort the beta. The beta then needs other factors to compensate for this distortion. They state that the size and value (book to market equity) factors in the Fama-French three factor model are factors which correct for the presence of market frictions. One could also note here that Amihud and Mendelson (1986) suggest that the 'size' effect in stock returns could be a consequence of the bid-ask spread effect, with firm size possibly acting as a proxy for liquidity.

The Joint Hypothesis Problem (Fama 1991)

While elaborating on the joint hypothesis problem Fama (1991) states that the test of whether stock prices properly reflect all information can only be done in the context of an equilibrium model (an asset pricing model) . Fama (1991) adds that if one were to find an anomalous behavior in stock returns it could be due model mis-specification, market inefficiency or partly due to both mis-specified model and market inefficiency. In this context, it can be reasoned that the performance of the appropriate asset pricing model would improve if the market efficiency improves.

Screen Based Trading Impacts Asset Pricing

Jain (2005) demonstrated that screen based trading (SBT) directly impacts asset pricing and cost of equity.

It has also been seen that screen based trading improves liquidity and market efficiency and leads to reduced transaction costs. It can be inferred from the discussion above that improved liquidity and transaction costs impact performance of asset pricing models in general and in particular, can affect the factors like size in the Fama-French three factor model. Given the reasoning of Fama (1991) on the joint hypothesis problem it is reasonable to state that improvement in market efficiency can have an impact on the asset pricing behavior of the appropriate asset pricing model. Considering all of the above, the present study, which seeks to examine if the Fama-French factor premiums are stationary over a long period of 25 years, has merits.

DATA AND METHODOLOGY

Koller et al. (2015) suggest computing stock returns monthly frequency is preferable to daily or even weekly frequency, especially when stocks could be infrequently traded. Thus, data and returns used in this paper are of monthly frequency.

Monthly closing values of the indices BSE Sensex, BSE 100, BSE 500, BSE MidCap and BSE SmallCap for the period March 1991 till March 2015 (for some of the indices the data is available only from a later date) are taken the official website of the Mumbai Stock Exchange, BSE (www.bseindia.com).

The BSE Sensex is a popular index representing the Indian market comprising the 30 largest, most liquid and financially sound companies across key sectors. The BSE 100 is a large cap index and comprises the top 100 large cap BSE listed companies. The BSE 500 index, comprising 500 companies, constitutes nearly 93% of the total market capitalisation on the BSE and includes all the 20 major industries of the Indian economy. The BSE MidCap and the BSE SmallCap indices, as their names suggest, represent the midcap and small cap segments of the Indian market.

Monthly closing prices of all the stocks listed on the Mumbai Stock Exchange (BSE) are taken from April 1991 till March 2015 from Prowess, a CMIE database (CMIE – Centre for Monitoring Indian Economy). Data on market capitalisation and book value to market value ratio as at the end of the February of every year from 1991 till 2015 are taken, the data again coming from Prowess. The stocks are categorised into, small (S) and big (B) on the basis of their market capitalization – stocks below the median market capitalisation are classified as small (S) and stocks with market capitalisation equal to or greater than the median market capitalisation are classified as big (B). The stocks are categorised into three value categories, low (L), medium (M) and high (H) on the basis of their book value to market value ratio – stocks with their book value to market value ratio less than the 33rd percentile are classified as low value (L) stocks, stocks with book value to market value ratio ranging from the 33rd percentile to the 67th percentile are classified as medium value (M) stocks and those with book to market value ratio above the 67th percentile are classified as high value (H) stocks. The Indian financial year is April 1st of the current year to March 31st of the next year. The intersection of the two size categories and the three value categories results in six portfolios S_L, S_M, S_H, B_L, B_M and B_H. For the six portfolios formed on the basis of market capitalisation data and book value to market value ratio data at the end of the February of a given financial year, equally weighted monthly percentage portfolio returns are computed for the 12 months of the next financial year. For example, for the six portfolios constructed using market capitalisation data and book value to market value ratio data at the end of the February 1992, equally weighted monthly percentage returns are computed for the twelve months from April 1992 till March 1993. Thus, the six portfolios are newly constructed for every financial year.

The construction of the six portfolios, S_L, S_M, S_H, B_L, B_M and B_H as well as the computation of the size and value premiums are as per the procedure followed in Davis et al. (2000).

The size premium, SMB is computed as follows:

$$SMB = \frac{R(S\_L) + R(S\_M) + R(S\_H)}{3} - \frac{R(B\_L) + R(B\_M) + R(B\_H)}{3}$$

The value premium, HML is computed as follows:

$$HML = \frac{R(S\_H) + R(B\_H)}{2} - \frac{R(S\_L) + R(B\_L)}{2}$$

In the above equations, R(S_L), R(S_M), R(S_H), R(B_L), R(B_M) and R(B_H) refer to the equally weighted monthly returns of the portfolios S_L, S_M, S_H, B_L, B_M and B_H respectively. So, a time series of monthly size (SMB) and value (HML) premiums are generated for the time period April 1991 till March 2015.

Davis et al. (2000) follow the above procedure for computing the size premium and value premium so that the former is computed neutral to value and the value premium is computed neutral to size.

The BSE Sensex is taken to be the proxy for the market. Monthly closing prices of the index between March 1991 and March 2015 are obtained from the BSE website, www.bseindia.com. Monthly percentage returns for the BSE Sensex are computed for April 1991 till March 2015.

Choice of Risk-Free Rate

Ansari (2000), in his study on the performance of the capital asset pricing model (CAPM) in the Indian context, used the interest rate offered by commercial banks on term deposits as the proxy for the risk-free rate. Deb et al. (2007), in their work on mutual funds in India, used the yield on government securities of maturity greater than five years as the risk-free rate proxy. Giri (2013), in his paper on the equity risk premium in India, used the yield on 10-year rupee denominated government securities as the risk-free rate. Saxena (2015), in his paper on the equity risk premium in India, considered the yield on a ten-year zero-coupon government bond as the proxy for the risk-free rate.

Stowe (2007) suggests that in the case of research in the context of long term assets like equities yield on a liquid long-term government bond, say with 10 or 20 years of maturity, be considered as the risk-free rate. This view is consistent with that of Armitage (2005) and that of Damodaran (2008).

Thus, from April 1996 till March 2015, monthly data on the annual yield on Government of India bonds with time to maturity of 10 years available on the Reserve Bank of India (RBI) website (www.rbi.org.in) is considered for the risk-free rate. Of course, the annual yield is converted to monthly yield before use in the analysis.

For the period before April 1996, data on the annual yield on Government of India bonds with time to maturity of 10 years is unavailable on the Reserve Bank of India (RBI) website (www.rbi.org.in). However, the website has the annual data

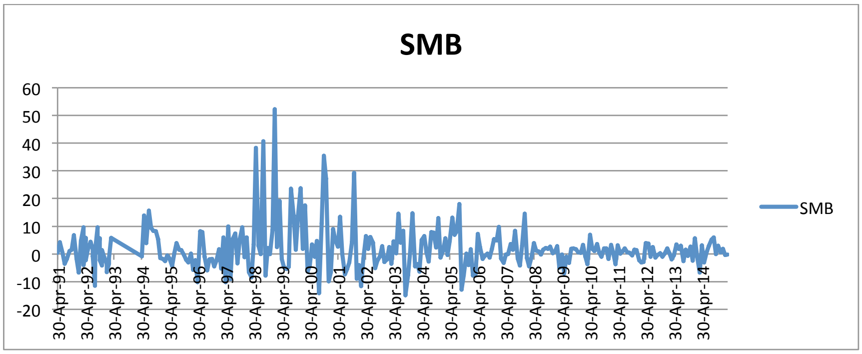

Figure 1. Plot of monthly Size premium (SMB) time series for India for the April 1991 till March 2015
Source. Author's Computation

on annual interest rates for Central and State government dated securities from 1980-81 onwards till the present. Hence, for April 1991 till March 1996, the annual interest rates of Central government dated securities are converted to monthly interest rates and taken as the proxy for the risk-free rate.

RESULTS AND DISCUSSION

Figure 1 shows the plot of the size premium (SMB) for India against time. A visual examination of the chart tells us that the time series might very well be stationary. Also, no visible trend is seen.

Figure 2 shows the plot of the value premium (HML) for India against time. A visual examination of the chart tells us that the time series might very well be stationary. Also, no visible trend is seen.

Figure 3 below shows the plot of the market premium (Rm – Rf) for India against time. A visual examination of the chart tells

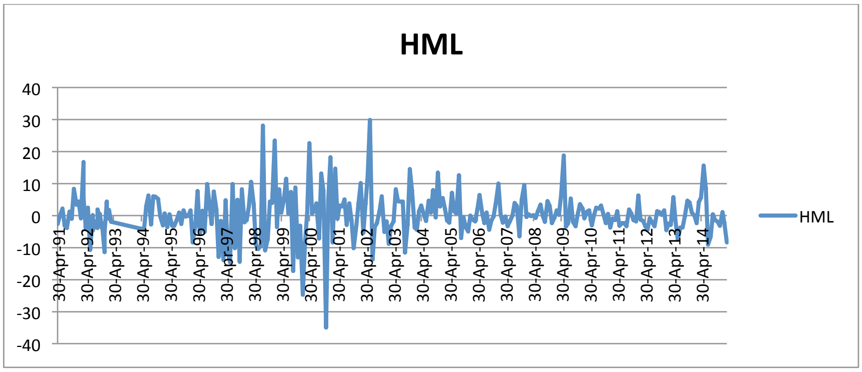

Figure 2. Plot of monthly Value premium (HML) time series for India for the April 1991 till March 2015
Source. Author's Computation

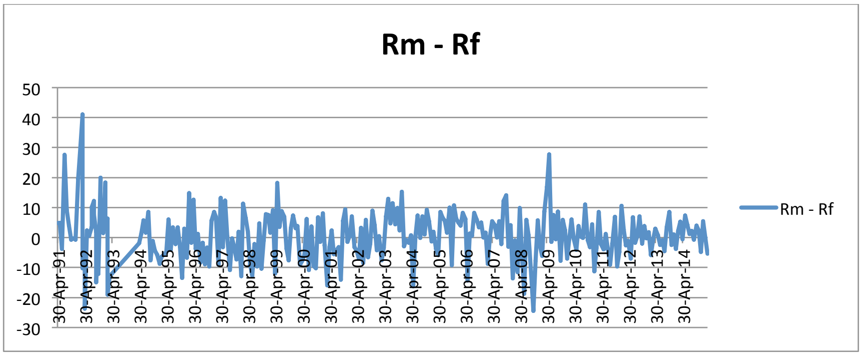

Figure 3. Plot of monthly market premium ($R_m – R_f$) time series for India for April 1991 till March 2015.
Source. Author's Computation

us that the time series might very well be stationary. Also, no visible trend is seen.

Tests for Stationarity

For a rigorous confirmation of the stationarity of the factor premium time series for the Fama-French three factor model factors, three tests for stationarity are run, the Augmented Dickey Fuller test (Said & Dickey, 1984; Said, 1991; Fuller, 2009), the Phillips-Perron test (Philips & Perron, 1987) and the KPSS test (Kwiatkowski et al., 1992).

The Augmented Dickey Fuller Test

The Augmented Dickey-Fuller test, the test with the intercept and not the trend was run for the time series of each of the three factor premiums. The formula for the test run is as follows.

z(t)-z(t-1) = a.z(t-1) + b(1).(z(t-1)-z(t-2)) + ... + b(p).(z(t-p)-z(t-p-1)) + b(p+1) + u(t),

where z(t) is the value of the variable z at time t, t = p+2,...,n, where u(t) is white noise, b(p+1) is the intercept.

Null hypothesis, H_0: z(t) is a unit root process: a = 0.

Alternative hypothesis, H_1: z(t) is stationary process: a < 0.

The test statistic is the t-value of a. The t critical values have to be taken from the specific tables for ADF test and not the standard ‘t’ distribution tables.

The Phillips-Perron (PP) Test

The Phillips-Perron test with intercept but no trend is used to test for stationarity in each of the three factor premium time series. This implies that the following model is used:

z(t) = a.z(t-1) + b + u(t), where u(t) is a zero-mean stationary process.

Null hypothesis, H_0: z(t) is a unit root process (a = 1)

Alternative hypothesis, H_1: z(t) is a stationary process: a < 1

The Phillips-Perron test involves fitting the above regression and the results from the regression are used to calculate the test statistic. The critical values for the Phillips-Perron test statistic can be said to be the critical values for the Dickey–Fuller test statistic that have been made robust to serial correlation by using the Newey & West (1987) heteroskedasticity and autocorrelation-consistent covariance matrix estimator.

The KPSS Test

The KPSS test here is used to test level stationarity in the time series. The following null and alternate hypotheses are used.

Null hypothesis, H_0: z(t) = c + u(t), where u(t) is a zero-mean stationary process and c a constant.

Alternative hypothesis, H_1: z(t) is a unit root process: z(t) = z(t-1)+u(t)

The regression for the null hypothesis is run and results of the regression are used to calculate the KPSS test statistic. The critical values for the KPSS test statistic are provided by Kwiatkowski et al. (1992).

The three tests (ADF, PP and KPSS) were run for each of the three-time series, market premium ($R_m – R_f$), size premium (SMB) and value premium (HML) for the entire time period (May 1991 till March 2015) in the EasyReg econometric software (Bierens, 2015). The results of the tests for each of the three-time series are as follows.

Table 2
SBT and transaction costs

	Market (R_m - R_f)	SMB	HML
Computed ADF Test Statistic	-3.8408*	-2.8129**	-3.4157*
Computed Philips-Perron Test Statistic	-226.15*	-337.05*	-262.21*
Computed KPSS Test Statistic	0.0946	0.1857	0.1565

* Significant at 5% Level of Significance
** Significant at 10% Level of Significance
No stars - Not significant

For the market premium ($R_m – R_f$) time series, the stationarity of the series is confirmed at the 5% significance level by the ADF, PP and the KPSS tests.

For the size premium (SMB) series, the stationarity of the series is confirmed at the 5% significance level by the PP and the KPSS tests. For the SMB series, the ADF test confirms stationarity only at the 10% significance level and not at the 5% significance level.

For the value premium (HML) time series, the stationarity of the series is confirmed at the 5% significance level by the ADF, PP and the KPSS tests.

Factor Premiums of the Fama – French Model for the U.S Market

The monthly factor premium time series for the three factors in the Fama-French three factor model, namely market (R_m – R_f), size (SMB) and value (HML) for the US market for July 1926 till July 2015 are retrieved from Prof. Kenneth R. French's website, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. Stationarity tests for these factor premiums in the US context are conducted to see how the results compare with the Indian case study.

There have been many studies which indicate strong relationships between the US and Indian stock markets. Batareddy et al. (2012) in a study of equity indices of India, China, Taiwan and South Korea, US and Japan between January 1998 till July 2008 repot that the Indian market is cointegrated with the US and Chinese markets. Meric et al. (2011), in a study of the stock markets of the US, Hong Kong, New Zealand, Australia, India, Malaysia, Indonesia, South Korea, Taiwan and Germany from May 15, 2006 till August 5, 2010, show that the stock market returns of the US, Hong Kong, New Zealand, and Australian stock markets Granger cause returns of the Indian stock market. Mukherjee & Mishra (2007), in a study employing the daily closing prices of the major equity indices of 23 countries for the time period 1990 till 2005, provide evidence that the markets of US and five European nations strongly lead the Indian market.

The monthly factor premium time series for the three factors in the Fama-French three factor model, namely market (Rm – Rf), size (SMB) and value (HML) for the US market for the time period July 1926 till July 2015 were taken from the 'Data Library' of Prof. Kenneth R. French's website, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html.

The graphs of the three factors for the US market for the period July 1926 till July 2015 are given below:

Figure 4 below shows the plot of the size premium (SMB) for the US market against time. A visual examination of the chart tells us that the time series might very well be stationary. Also, no visible trend is seen.

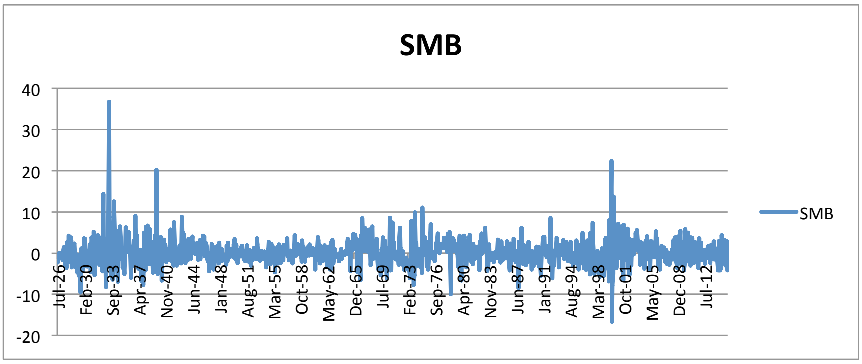

Figure 4. Plot of monthly size premium (SMB) time series for the period July 1926 till July 2015 for the US Market
Source. Author's graph based on data from the 'Data Library' on Prof. French's website

Figure 5 shows the plot of the value premium (HML) for the US market against time. A visual examination of the chart tells us that the time series might very well be stationary. Also, no visible trend is seen.

Figure 6 shows the plot of the value premium (HML) for the US market against time. A visual examination of the chart tells us that the time series might very well be stationary. Also, no visible trend is seen.

The ADF, PP and KPSS tests for stationarity (level stationarity and not trend stationarity) all confirm that all the three factor premium time series ($R_m - R_{f,}$ SMB and HML) for the US market are stationary at 5% level of significance. The tests were run in the EasyReg econometric software (Bierens, 2015) mentioned earlier.

Granger Causality Tests for Market, Size and Value Premiums

The next step was to run multivariate Granger causality tests among various sets of variables. One set of variables comprised the market premium (Rm – Rf), size (SMB) and value (HML) premiums. The other sets

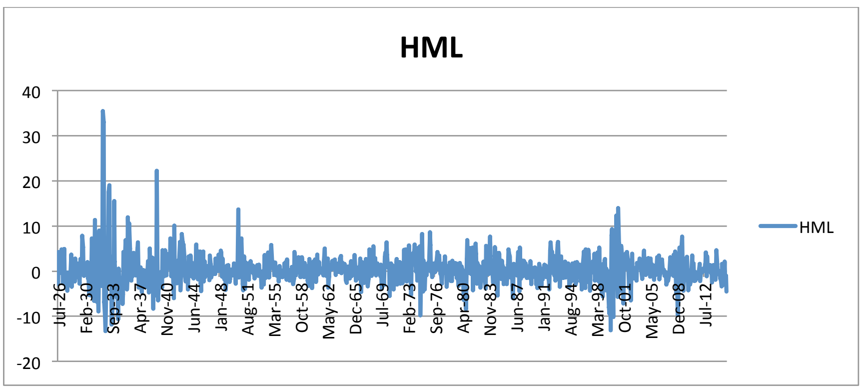

Figure 5. Plot of monthly Value premium (HML) time series between July 1926 and July 2015 for the US Market.
Source. Author's graph based on data from the 'Data Library' on Prof. French's website

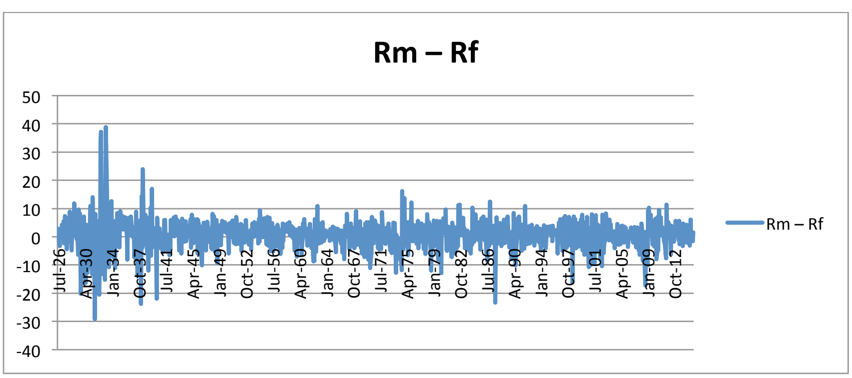

Figure 6. Plot of monthly market premium ($R_m - R_f$) time series for the time period July 1926 till July 2015 for the US Market.
Source. Author's graph based on data from the 'Data Library' on Prof. French's website

Table 3
Stationary test results for factor premiums for US

	Market (R_m - R_f)	SMB	HML
Computed ADF Test Statistic	-6.7418*	-5.0280*	-8.2762*
Computed Philips-Perron Test Statistic	-873.95*	-1145.98*	-684.83*
Computed KPSS Test Statistic	0.0629	0.0472	0.1168

* Significant at 5% Level of Significance
** Significant at 10% Level of Significance
No stars - Not significant

comprised monthly returns on an index, market premium, size and value premiums. The indices considered were BSE 100, BSE 500, BSE MidCap and BSE SmallCap. The monthly returns time series of the indices BSE 100, BSE 500, BSE MidCap and BSE SmallCap were all found to be stationary at 5% level of significance as per the ADF, Phillips-Perron and the KPSS stationarity tests.

The results of the multivariate Granger causality tests are given below. For the vector auto regression (VAR) run for the purposes of the Granger causality test, the lag length was decided on the basis of Akaike information criterion (AIC), Schwarz Bayesian information criterion (BIC) and Hannan-Quinn criterion (HQC).

Table 4
VAR results for Rm – Rf, SMB and HML

	Constant	$(R_m - R_f)_{-1}$	SMB_{-1}	HML_{-1}
R_m - R_f	0.6608	0.1183	-0.0180	-0.0030
	(0.1933)	(0.0482)	(0.7756)	(0.9663)
SMB	1.6002	0.0558	0.0968	0.0495
	(0.001)	(0.3237)	(0.1064)	(0.4659)
HML	0.6178	0.0188	-0.1655	-0.0309
	(0.1415)	(0.7028)	(0.0017)	(0.6021)

Note: The table shows the coefficients for the VAR. The figures in the brackets are the observed significance levels. Time period of the four-time series is April 30, 1991 till March 31, 2015.

Table 5
Lag Order Selection for VAR in Table 4

lags	AIC	BIC	HQC
1	20.5822*	20.7457*	20.6479*
2	20.62275	20.9088	20.7377
3	20.6374	21.0460	20.8017

Note: * gives the lag order selected

It can be inferred from Table 4 that size premium (SMB) Granger causes value premium (HML).

Table 6
VAR results for BSE 100, Rm – Rf, SMB and HML

	Constant	BSE 100_{-1}	$(Rm - Rf)_{-1}$	SMB_{-1}	HML_{-1}
BSE 100	1.8691	−0.6585	0.8190	0.0394	−0.0550
	(0.0010)	(0.0158)	(0.0048)	(0.5644)	(0.4667)
Rm - Rf	1.0657	−0.606806	0.7475	0.0202	−0.0218
	(0.0457)	(0.0189)	(0.0066)	(0.7552)	(0.7604)
SMB	1.5537	0.0696	−0.0164	0.0924	0.0517
	(0.0024)	(0.777)	(0.95)	(0.136)	(0.4503)
HML	0.8433	-0.3380	0.3693	-0.1442	-0.0414
	(0.0571)	(0.1146)	(0.1047)	(0.0078)	(0.4869)

Note: The table shows the coefficients for the VAR. The figures in the brackets are the observed significance levels. Time period of the four-time series is April 30, 1991 till March 31, 2015

Table 7
Lag order selection for VAR in Table 6

lags	AIC	BIC	HQC
1	24.3357*	24.6081*	24.4452*
2	24.3700	24.8603	24.5671
3	24.4015	25.1097	24.6861

Note: * gives the lag order selected

The following can be inferred from Table 6.

1. Market risk premium (R_m - R_f) Granger causes BSE 100.
2. BSE 100 Granger causes market risk premium (R_m – R_f).
3. Size premium (SMB) Granger causes value premium (HML).

Table 8
VAR results for BSE 500, Rm – Rf, SMB and HML

	Constant	BSE 500_{-1}	$(Rm - Rf)_{-1}$	SMB_{-1}	HML_{-1}
BSE 500	1.3021	0.3918	-0.3196	-0.1111	0.0379
	(0.0405)	(0.1716)	(0.3192)	(0.2044)	(0.6584)
Rm - Rf	0.5917	0.1802	-0.1342	-0.088	0.0499
	(0.2966)	(0.4818)	(0.6401)	(0.2613)	(0.5163)
SMB	0.9812	0.4782	-0.5522	0.1172	0.1182
	(0.0659)	(0.0476)	(0.0414)	(0.1114)	(0.1019)
HML	1.0742	0.00292	-0.0133	-0.2786	-0.0109
	(0.0402)	(0.9901)	(0.9599)	(0.0001)	(0.8769)

Note: The table shows the coefficients for the VAR. The figures in the are the observed significance levels. Time period of the four-time series is March 31, 1999 till March 31, 2015

Table 9
Lag order selection for VAR in Table 8

lags	AIC	BIC	HQC
1	23.1158*	23.4861*	23.2661*
2	23.18053	23.8473	23.4511
3	23.1744	24.1374	23.5652

Note: * gives the lag order selected

The following can be inferred from Table 8.

1. BSE 500 Granger causes size premium (SMB).
2. Market risk premium Granger causes size premium (SMB).
3. Size premium (SMB) Granger causes value premium (HML).

Table 10
VAR Results for BSE MidCap, Rm – Rf, SMB and HML

	Constant	BSE MidCap_{-1}	$(\text{Rm - Rf})_{-1}$	SMB_{-1}	HML_{-1}
BSE MidCap	1.8444	0.0392	0.1934	-0.3469	0.2847
	(0.0179)	(0.8482)	(0.4364)	(0.0405)	(0.1560)
Rm - Rf	1.0995	0.0784	-0.0230	-0.1646	0.1876
	(0.0810)	(0.6384)	(0.9092)	(0.2295)	(0.2495)
SMB	0.9264	0.1992	-0.2233	0.0535	-0.0151
	(0.0302)	(0.0790)	(0.1035)	(0.5631)	(0.8906)
HML	0.5243	0.0164	-0.0166	-0.0999	0.2061
	(0.1968)	(0.8793)	(0.8990)	(0.2589)	(0.0513)

Note: The table gives the coefficients for the VAR. The figures in the brackets give the observed significance levels. Time period of the four-time series is May 31, 2003 till March 31, 2015

Table 11
Lag Order Selection for VAR in Table 10

lags	AIC	BIC	HQC
1	23.3169*	23.7839*	23.5065*
2	23.4126	24.2533	23.7540
3	23.5430	24.7574	24.0361

Note: * gives the lag order selected

The following can be inferred from Table 10.

1. Size premium (SMB) Granger causes BSE MidCap.
2. BSE MidCap Granger causes size premium (SMB) (at 8% LOS).

Table 12
VAR results for BSE SmallCap, $R_m - R_f$, SMB and HML

	Constant	BSE SmallCap$_{-1}$	(Rm - Rf)$_{-1}$	SMB$_{-1}$	HML$_{-1}$
BSE SmallCap	2.0298	0.1830	0.0612	-0.4479	0.1873
	(0.0254)	(0.3341)	(0.8065)	(0.0309)	(0.4600)
Rm - Rf	1.1276	0.0635	-0.0098	-0.1801	0.1738
	(0.0719)	(0.6277)	(0.9548)	(0.2073)	(0.3224)
SMB	0.9911	0.2568	-0.2978	-0.0160	-0.1193
	(0.0176)	(0.0036)	(0.0103)	(0.8653)	(0.3056)
HML	0.5270	0.0571	-0.0635	-0.1170	0.1715
	(0.1911)	(0.4990)	(0.5692)	(0.2042)	(0.1310)

Note: The table gives the coefficients for the VAR. The figures in the brackets show the observed significance levels. Time period of the four-time series is May 31, 2003 till March 31, 2015

Table 13
Lag order selection Table 12 for VAR in

lags	AIC	BIC	HQC
1	23.7295*	24.1966*	23.9191*
2	23.8359	24.6766	24.1773
3	24.0068	25.2212	24.4999

Note: * gives the lag order selected

The following can be inferred from Table 12.

1. Small size premium (SMB) Granger causes BSE SmallCap.
2. BSE SmallCap Granger causes small size premium (SMB).

For all the VAR results tabulated, except Table 10 and Table 12, we can see that the small size premium (SMB) Granger causes value premium (HML). If size premium can Granger cause value premium, then at least a part of the variation in stock returns due to value could possibly be captured by size. In case a large portion of the variation in returns due to value is captured by size, then that could point to the value factor becoming redundant and the Fama-French three factor model could reduce to a two-factor model in the Indian context. Taneja (2010) in a study on the Fama-French three factor model in India from June 2004 till June 2009 finds a perfect positive correlation (correlation coefficient of 0.959) between size and value premiums. Mohanty (2001), and Connor and Sehgal (2001) state that the value premium might not be essential in describing stock returns in India. Raghuram (2009), in a study of the Indian market from 1991 till 2006, suggests that post liberalisation the value factor might decrease in importance in India and that the Indian market might be moving towards a two-factor model with market and size as its factors.

According to Cheng and Zhang (1998), the value factor might not play a significant role in describing stock returns in rapidly expanding (developing) economies. In their study of the US, Japan, Hong Kong, Malaysia, Taiwan and Thailand markets from1970 till 1993, they found that value effect is strong in the US, relatively less strong in Japan, Hong Kong, and Malaysia and cannot be detected in Taiwan and Thailand.

It would be interesting to consider the implication of size premium Granger causing value premium in the context of Fama and French (2015). The authors conducted a study of the US market for the time period July 1963 and December 2013 with regards to a five factor asset pricing model comprising market, size, value, profitability and investment factors, and find that the high average value return is fully captured by the exposure of value to the other factors in the model, particularly the profitability and investment factors, rendering the value factor redundant. They make this statement after regressing the value premium on market, size, profitability and investment premiums and then finding the intercept of the regression statistically insignificant. Given that the present study finds size to Granger cause value in the Indian context, a regression of value premium on market, size, profitability and investment premiums in the Indian context might possibly generate a statistically significant coefficient for size. Whether the value premium is rendered redundant in the Indian context could be the subject of future research.

The phenomenon size premium Granger causing value premium can also be seen in the context of literature talking about value premium being stronger in small cap stocks than in large cap stocks. Fama and French (2012), in a study of markets in 23 countries in four regions, namely North America, Japan, Asia Pacific (not including Japan) and Europe, conclude that in all the regions except for Japan value premiums are larger for small capitalisation stocks. Chan and Lakonishok (2004), in a study of the US market, confirm that returns to value investing are more pronounced for small cap stocks compared to large cap stocks. Dhatt et al. (1999) provide evidence supporting the existence of substantial value premium within stocks in the small cap universe in the US. They go on to add that this value premium (within the small cap universe) is of practical significance to investors.

In the tables on VAR results for the various BSE indices, a few other interesting points could be noted. The BSE 500 index, representing 93% of the Mumbai Stock Exchange (BSE)'s market capitalization Granger causes size premium (SMB). There exists a two-way Granger causality between BSE MidCap and size premium (SMB), with size premium (SMB) Granger causing BSE MidCap and BSE MidCap Granger causing size premium (SMB).

CONCLUSION

The monthly factor premium time series for the three factors in the Fama-French three factor model in India are found to be stationary for the time period April 01, 1991 till March 31, 2015. A visual examination of the time series data indicates that the time series for the three factor premiums might be stationary. A rigorous confirmation of the stationarity of the factor premium time series for the three factors is achieved by use of the Augmented Dickey Fuller test (Said & Dickey, 1984; Said, 1991; Fuller, 2009), the Phillips-Perron test (Philips & Perron, 1987) and the KPSS test (Kwiatkowski et al., 1992).

For comparison purposes, the market, size and value factor premium time series for the US market for July 1926 till July 2015 are studied. The time series for all the three factors are found to be stationary.

That the market risk premium, size and value premiums in India are stationary implies investors' return expectations from the overall market have not changed in spite of tremendous developments in the economy and the transformations in the stock market during the study period.

Another interesting fact that has emerged from the study is that size premium (SMB) Granger causes value premium (HML). This could imply that at least a part of the variation in stock returns due to value could be captured by size. One could also note in this context that there are studies providing evidence of the value effect being stronger in small cap stocks compared to large cap stocks, among which the noteworthy ones are Fama & French (2012) and Chan & Lakonishok (2004).

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