Tests of the Fama and French Model in India*

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Abstract

This study empirically examines the Fama-French three-factor model of stock returns for India. We find evidence for pervasive market, size, and book-to-market factors in Indian stock returns. We find that cross-sectional mean returns are explained by exposures to these three factors, and not by the market factor alone. We find mixed evidence for parallel market, size and book-to-market factors in earnings; we do not find any reliable link between the common risk factors in earnings and those in stock returns. The empirical results, as a whole, are reasonably consistent with the Fama-French three-factor model.

1. Introduction

Fama and French (1992) find that the main prediction of the CAPM, a linear cross-sectional relationship between mean excess returns and exposures to the market factor, is violated for the US stock market. Exposures to two other factors, a size-based factor and a book-to-market-based factor, often called a "value" factor, explain a significant part of the cross-sectional dispersion in mean returns. If stocks are priced rationally, then systematic differences in average returns should be due to differences in risk. Thus, given rational pricing, the market, size and value exposures must proxy for sensitivity to pervasive risk factors in returns. Fama and French (1993) confirm that portfolios constructed to mimic risk factors related to market, size, and value all help to explain the random returns to well-diversified stock portfolios. Fama and French (1995) attempt to provide a deeper economic foundation for their three-factor pricing model by relating the random return factors to earnings shocks. They claim that the behaviour of stock returns in relation to market, size and value factors is consistent with the behaviour of earnings. They admit that their findings are weak, especially relating to the value factor, but attribute this to the measurement error problems in earnings data. There is a burgeoning research literature contradicting, confirming, criticizing, and extending the Fama-French model, see for example the discussion and references in Davis, Fama and French (2000).

This paper empirically examines the Fama-French three-factor model for the Indian stock market. We test the one-factor linear pricing relationship implied by the CAPM and the three-factor linear pricing model of Fama and French. We analyze whether the market, size and value factors are pervasive in the cross-section of random stock returns. We investigate whether there are market, size and value factors in corporate earnings similar to those in returns, and whether the common risk factors in earnings translate into common risk factors in returns.

The empirical evidence is generally supportive of the Fama and French model. All three Fama-French factors, market, size, and value, have a pervasive influence on random returns in the Indian stock market. The one-factor CAPM relationship for mean returns can be rejected, but the three-factor model cannot. There is some weak evidence for market, value and size factors in earnings shocks, although our sample is too small to make confident statements. We can find no evidence that the common risk factors in one-year-ahead earnings growth rates are related to the common factors in current portfolio returns.

In section 2 we describe our data and its sources. In Section 3 we analyze and test the pricing models using returns data. In section 4 we examine whether market, value and size factors can be found in corporate earnings, and if there is a discernible relationship between the factors in earnings and in returns. Summary and concluding remarks are provided in section 5.

2. Data
2.1 The Sample Securities

India is a very large emerging market, with about 8000 listed companies. The top ten percent of listed companies account for a major portion of market capitalisation and trading activity; the remainder of the market is thinly traded. Our share price data consists of month-end adjusted share prices of 364 companies from June 1989 to March 1999. A maximum of 117 observations is available for each monthly return series based on these prices. There are some missing observations for some of the individual share series, since some of the companies came onto the exchange on a date later than the initial date of the study period. The sample companies form part of the CRISIL-500 list. CRISIL-500 is a broad-based and value-weighed stock market index in India constructed along the lines of the S&P index in the US. It covers 97 industry groups and gives a representation to companies of varying levels of size and trading activity. The sample companies account for a major portion of market capitalisation as well as average trading volume for the Indian equity market. The bulk of the Indian shares not included in the sample are either thinly traded or do not have accounting and financial information on a continuous basis.

The share data has been obtained from Capital Market Line, a financial database widely used in India by practitioners and researchers. The price data has been adjusted for capitalisation changes such as bonus rights and stock splits. The adjusted share price series has been converted into return series using arithmetic returns. The return calculations have been done using the capital gain component only, since we do not have data on dividends. However, over our sample period, dividend yields on Indian stocks were very small. Equity capital was released to shareholders mostly through cash-based acquisitions, or reinvested. As we will discuss in Section 3, we do not believe that the exclusion of dividends from the return calculations has a marked effect on our results or conclusions therefrom.

2.2 Risk-free Proxy

The implied yield on the month-end auction of 91-day Treasury bills has been used as a risk-free proxy. The data source for 91-day T-bills is the Report of Currency and Finance, an annual publication of the Reserve Bank of India. It should be noted that prior to 1993, 91-day T-bills were regulated in India to have a constant yield of 4.6% per annum, and banks were forced to hold them through government-regulated reserve requirements. This fixed yield was an underestimation of the nominal yields required by investors in this era of high inflation. Since 1993, the 91-day T-bill yield has been exogenously determined on an auction basis. In Section 3, we analyze the effect of this regulated T-bill rate, by using zero-beta variants of the standard model, and differentiating between the regulated and unregulated subperiods.

2.3 Company Attributes

The accounting information has been obtained for the sample companies for the financial years 1989 to 1998. The financial year in India is from April of year t to March of calendar year t+1. The book value per share and number of shares outstanding for the sample companies are recorded in March-end of each year. The data source is CMIE Provis, a provider of financial statement related information for Indian companies. The accounting information combined with share price data has been used to construct measures of size and value employed in the study, as discussed in the next section.

Additionally annual profit information measured as Profit Before Depreciation and Taxes (PBDT) has been collected for the sample companies from 1988 to 1998. The choice of profit figure has been guided by the fact that PBDT figures are seldom negative, making them amenable for growth rate calculations. The earnings information is used in a latter section to explore the economic foundation for common risk factors in stock returns.

3. Tests of the CAPM, Fama-French Model, and Variants

3.1 The Size and Value Sorted Portfolios

In June of each year t from 1989 to 1998, all the sample stocks are ranked on the basis of size (price times shares). The median sample size is then used to split the sample companies into two groups: small (S) and big (B). Book equity to market equity (BE/ME) for year t is calculated by dividing book equity at the end of financial year t by market equity at the end of financial year t. It may be noted that the financial year closing in India is March for all companies every year. The sample stocks are broken into three BE/ME groups based on the breakpoints for the bottom 30% (low), middle 40% (medium) and top 30% (high) of the ranked values of BE/ME for the sample stocks.

We construct six portfolios (S/L, S/M, S/M, B/L, B/M, B/H) from the intersection of the two size and three BE/ME groups. For example S/L portfolio contains stocks that are in the small size group and also in the low BE/ME group while B/H consists of big size stocks that also have high BE/ME ratios. Monthly equally-weighted returns on the six portfolios are calculated from the July of year t to June of year t+1, and the portfolios are re-formed in June of year t+1. The returns are calculated from July of year t to ensure that book equity for year t-1, i.e., March, is known to investors by the time of portfolio formation.

The six size-BE/ME portfolios are constructed to be equally-weighted, as suggested by Lakonishok, Shliefer and Vishny (1994). Fama and French (1996) document that the three factor model does a better job in explaining LSV equally-weighted portfolios as compared with value-weighted portfolios. A recent study by Muneesh and Sehgal (2001) also examines the relationship between these factors and stock returns for the Indian market using equally-weighted portfolios.

3.2 The Factor Portfolios

The Fama-French model involves the use of three factors for explaining common stock returns: the market factor (market index return minus risk-free return) proposed by the CAPM, and factors relating to size and value. For the market index we use the International Finance Corporate Investable India index, a value-weighted index of the returns to Indian stocks. Note that this market index return includes dividend yield.

SMB (Small Minus Big) is meant to mimic the risk factor in returns related to size. SMB is the difference each month between the simple average of the returns of the three small stock portfolios (S/L, S/M and S/H) and the average of the returns on the three big portfolios (B/L, B/M, B/H). It is the difference between the returns on small and big stock portfolios with about the same weighted-average BE/ME. Hence SMB is largely clear of BE/ME effects, focussed on the different behaviour of small and big stocks.

HML (High Minus Low) is meant to mimic the risk factor in returns related to value (that is book-to-market ratios). HML is the difference each month between the simple average of the returns on two high BE/ME portfolios (S/H and B/H) and the average returns on two low BE/ME portfolios (S/L and B/L); it is constructed to be relatively free of the size effect.

3.3 Descriptive Statistics on the Return Series

Table 1 shows the first four moments and the first three autocorrelations of the six size and value sorted portfolio returns and the three factor portfolio returns. The results confirm the worldwide evidence for a negative relation between size and average return. More interestingly, the relation between value and average return is positive for small stocks, but negative for big stocks. This is different from US findings (Fama and French (1992, 1993)) of a strong positive relation between value and average returns irrespective of size. It seems that the Indian market exhibits a strong size effect and a conditional value effect, the latter being present only for small stocks. Fama and French (1995) on the contrary cite a strong value effect and a conditional size effect for the US market. The portfolio returns have fairly high volatility, e.g., the market factor has monthly volatility of 10.26%, which corresponds to an annual volatility of 35.54%. All the portfolios have some positive skewness and positive excess kurtosis. There is some evidence for positive autocorrelations of measured returns, which may reflect stale price effects. Table 2 shows the correlation coefficients between the MKT, SMB and HML factors, which serve as the independent variables in our main regression model.

3.4 Seasonality in the Returns.

Before beginning our pricing tests we digress to examine seasonality, since in the US seasonality in returns has been shown to be related to the Fama-French factor risk premia, e.g., Fama and French (1993). Testing for seasonality in monthly returns is problematic in India since several different seasonal effects can be justified. The financial closing in India is at the end of March. Thus, according to the tax-loss selling hypothesis (Keim (1983)) investors would be inclined to sell loss-making stocks in March and earlier months, and reposition their portfolios in April. An April effect in India is analogous to a January effect for the USA, based on this tax-loss explanation of the January effect in the USA.

The government financial budget in India is presented on the last day of February each year, which could lead to portfolio rebalancing in response to government spending patterns. The conjecture of a March effect is inspired by a recent survey by Sehgal (2001) in which a majority of Indian investors mention such a seasonal pattern in investment behaviour. A January effect might be attributed to a general globalisation of the Indian economy in recent years, including the listing on

NASDAQ of some Indian high-tech companies. Further, foreign institutional investors in the Indian market mostly use a December financial closing in their investment reporting, which could lead to rebalancing and a subsequent January effect.

Lastly, the festival of Divali, which falls in October-November of every year, is very important in its effect on Indian consumption spending. This may push down stock prices in the two festival months, with recovery in the succeeding month. We test for January, March, April and October-November seasonality in mean returns. Table 3 shows simple mean differences and t-statistics testing whether mean returns differ in a given month (or months, for the October-November test). There is no January, March or April effect, but there is evidence for an October-November (Divali) negative return difference. This Divali effect seems to be spread evenly across the size and value spectrum: it appears in the market portfolio excess return and in most of the size and value sorted portfolios but not in the size (small-minus-big) and value (high-minus-low) portfolio return differences.

3.5 Explaining Common Variation in Returns with the Factor Portfolios

Our tests of the Fama-French model use the standard multivariate regression framework (see Campbell, Lo and MacKinlay (1997) for an excellent review) . Let R_{jt} denote the excess return to portfolio j in month t, MKT_t the excess return to the market portfolio, SMB_t the return to the size factor portfolio, and HML_t the return to the value factor portfolio. We estimate the multivariate regression system:

$$R_{jt} = a_j + b_j MKT_t + s_j SMB_t + h_j HML_t + \varepsilon_t, \qquad j=1,...,N ; t=1,\ldots,T \qquad (1)$$

where b_j, s_j, and h_j are the market, size and value factor exposures of portfolio j, a_j is the abnormal mean return of portfolio j, which equals zero under the hypothesized pricing model, and ε_t is the mean-zero asset-specific return of portfolio j. We also estimate and test variants of the Fama-French model by forcing some of the coefficients to be zero, that is, excluding the variables from the regression. Note in particular that (1) can be used to estimate and test the Sharpe-Lintner CAPM by imposing the restriction $s_j=h_j=0$ for all j.

Suppose that (1) is the true model and that ε_t has a multivariate normal distribution and is independently and identically distributed through time. Maximum likelihood estimation of the system (1) is straightforward and decomposes into equation-by-equation time-series ordinary least squares. The estimates are shown in Table 3, both for the full model and for variants that exclude one or more of the factors.

Given rational pricing, in order to justify their use in the asset pricing model the factors must contribute substantially to the risk of well-diversified portfolios. Table 4 shows that the market factor explains by far the largest fraction of common variation in stock returns for the six size and value sorted portfolios. Used alone, the market factor produces an adjusted R^2 of 70-80%; the adjusted R^2 declines to below 25% when the other two factors are used without the market factor. However the other two factors each contributes to explaining these portfolio returns. Except for the portfolio B/L (big, low value stocks) the adjusted R^2 in the three-factor regression is higher than in the one-factor market model regression. For some portfolios, adding HML to the market model regression increases R^2 more than adding SMB; and for other portfolios the reverse holds. In the three-factor regression, the SMB factor has three significant exposures and the HML has four. In summary, the market factor clearly ranks first in explanatory power, but there is no clear ranking of the other two factors.

Note the factor exposure estimates in the three-factor model, at the bottom of Table 4, panel A. As expected, the estimated size exposures increase monotonically with size ranking, and analogously for the estimated value exposures and value ranking. The market exposures of the portfolios are all slightly below one, mostly in the range .8 to .9. Recall that the sorted portfolios are equally weighted and so have a low-capitalization bias relative to the value-weighted market index. In India, as in many emerging markets, low-capitalization stocks tend to have market factor exposures somewhat below one.

Table 4 indicates that, of the variants considered here, the three-factor model provides the most suitable description of pervasive risk in these size and value-sorted portfolios. Our results are limited however by the relatively small number of sorted portfolios we use, and the fact that the only sorting variables available to us rely on the same characteristics of size and value used to create the risk factors. Alternative sorts (such as sorts based on industry categories) and a wider range of sorted portfolios would be valuable to more reliably identify the pervasive risk factors in Indian equities, and confirm or contradict our findings. Next we turn to the tests of mean return predictions.

3.6 Tests of the Cross-sectional Restriction on Mean Returns

We examine whether the risk factors explain the cross-section of mean returns on stocks by focussing on the intercept estimates of the multivariate regression system (1). If the pricing theory holds, the true intercepts equal zero. We test the restriction $a_j = 0$ in two ways. We examine the t-statistics for each individual intercept, and use the adjusted Wald statistic proposed by Gibbons Ross and Shanken (1989) (GRS) to test all the intercepts jointly.

In the model with a market factor alone (the CAPM) the intercepts of the three small stock portfolios are positive and all are significant at the 95% confidence level. Note that the market index return includes dividend yield but the explained portfolio returns do not; this tends to bias the intercept estimates *negatively*. Yet, the CAPM rejection is due to *positive* intercepts for the small size portfolios, supporting our contention that the missing dividend yields are not consequential to the empirical analysis. The GRS statistic is significant with high confidence.

Using the three-factor model, intercept values for all sample portfolios are indistinguishable from zero at the 95% level. The results show the ability of the three-factor model to capture the cross-section of average returns missed by the standard CAPM. Note however that evidence for a value factor premium is mixed; the two-factor model with size and market factors (excluding the value factor) does not produce significantly nonzero intercepts, although adding the value factor lowers the magnitude of the point estimates. There is definitely a (negative) size premium, and there may be a value premium, in Indian equity returns.

3.7 Tests of Zero-beta Variants of the Fama-French Model

Standard multifactor pricing theories, such as the APT, ICAPM and Sharpe-Lintner CAPM, rely on observation of a risk-free rate at which all investors can borrow and lend freely. As mentioned, we have used the Indian government T-bill rate as our observable risk-free return. There are two problems with this assumed rate. First, as discussed above, the observed rate was regulated and fixed at an artificially low level during the first 30 months of our sample period. Second, even in the deregulated period, many Indian equity market investors faced a borrowing rate, and possibly lending rate, much higher than the rate on Indian government T-bills.

We address both of these potential problems by estimating a zero-beta version of (1) in which the appropriate zero-beta rate is estimated rather than observed. Suppose that the true model of expected returns has a zero-beta expected return different from the observed risk-free return. Imposing the condition $a_j=0$ for all j, and replacing the risk-free return, R_f, with the zero-beta expected return, R_z, in (1) gives:

$$R_{jt} + R_f - R_z = b_j(MKT_t + R_f - R_z) + s_j SMB_t + h_j HML_t + \varepsilon_t, \qquad (2)$$

(Note that SMB and HML are unaffected by the use of zero-beta versus risk free return since they are portfolio return differences). Rearranging (2) gives:

$$R_{jt} = (1-b_j)\gamma + b_j(MKT_t) + s_j SMB_t + h_j HML_t + \varepsilon_t, \qquad (3)$$

where $\gamma = R_z - R_f$.

We also estimate a zero-beta version of the model that allows the zero-beta correction (the difference between the true zero-beta and the observed risk-free rate) to differ during the regulated period and unregulated periods. This has the form:

$$R_{jt} = \delta_{1t}(1-b_j)\gamma_1 + \delta_{2t}(1-b_j)\gamma_2 + b_j(MKT_t) + s_j SMB_t + h_j HML_t + \varepsilon_t, \qquad (4)$$

where δ_{1t}, δ_{2t} are dummy variable for the pre and post periods, and γ_1, γ_2 are the seperate zero-beta return premia in the two periods.

Due to the cross-equation restriction, the multivariate regression system (3) does not decompose into equation-by-equation ordinary least squares, and must be estimated as a multivariate system subject to a nonlinear cross-equation constraint (the same applies to (4)). However it is quite straightforward to estimate this nonlinear system. We proceed as follows. First, we estimate the linear system (1) to get initial estimates of the parameters. We use the cross-sectional average of the implied values of γ from the estimated intercepts as an initial estimate for γ. Then we estimate the nonlinear system by maximum likelihood using the Bernt-Hausman-Hall-Hall algorithm with numerical derivatives. The estimates and approximate z-statistics of the coefficients are shown in Table 5. Although the point estimate for the zero-beta premium is substantially higher in the regulated period than in the unregulated period, none of the values is significantly different from zero. The only reliable conclusion is that, given the high volatility of Indian equity returns, the sample size is insufficient to estimate a zero-beta return accurately. We show the time-series mean residual returns, which correspond to the intercept estimates in the unconstrained model (1). The other parameter estimates are very similar to those in the linear model and are not shown; they are available from the authors.

4. Common Risk Factors in Earnings

The evidence that market, size and value equity factors are pervasive risk factors in portfolio returns is consistent with the rational asset pricing explanation for the role of their factor exposures in the cross-section of mean returns. However it does not provide an economic explanation for why these characteristics are sources of pervasive risk in the first place. Fama and French (1995) argue that the pervasive market, size and value factors in returns can be associated with common factors in earnings shocks. We examine the evidence in this regard for India.

We first test for common factors in the year-to-year growth in earnings, measured using PBDT (Profit Before Depreciation and Taxes). PBDT has been employed as a measure of profitability as it is unlikely to be negative thereby posing no problems for growth rate calculations. The common factors in earnings growth are constructed like those in stock returns. EGSMB, the size factor in earnings growth is the simple average of the percentage change in earnings for the three small stock portfolios (S/L, S/M and S/H) minus the average for the three big stock portfolios (B/L, B/M, and B/H). The value factor in earnings growth, EGHML, is the simple average of the percentage change in earnings for the two high BE/ME portfolios (S/H and B/H) minus the average for the two low BE/ME portfolios (S/L and B/L). The market factor in earnings growth, EGMKT, is the average of percentage change in earnings for all stocks.

The time-series regressions of earnings growth for the six portfolios on common factors in earnings growth are shown in Table 6. The results are broadly in line with intuition, with the exception of the SMB factor exposure of the B/M portfolio. (The B/M portfolio is a high cap portfolio and we would expect its exposure to the small-minus-big factor to be negative rather than positive.) The adjusted R^2s of these regressions are reasonably high, reflecting the fact that we are regressing earnings growth rates of portfolios on contemporaneous earnings growth rates of other portfolios. The next two tables attempt to replicate Fama and French's (1995) findings on the links between current portfolio returns and *future* earnings growth. Table 7 relates current portfolio returns to own-portfolio earnings growth next year; Table 8 relates current portfolio returns to factor-portfolio earnings growth next year. It seems our sample size is too small to support any reliable conclusions, since there are virtually no statistically significant findings[1] and the adjusted R^2s are close to zero. Recall that Fama and French (1995) even with their much longer sample period and larger cross-section of earnings data found statistically weak relationships.

Although Table 6 seems to indicate a discernible factor structure in Indian earnings growth rates, the links between these factors and equity return factors are left unresolved by our research. Exploring the relationships between earnings growth and equity returns in India is an important area for future research.

5. Summary and Concluding Remarks

Fama and French offer three central findings in support of their three-factor asset-pricing model. One, there are pervasive market, size and value factors in US equity returns. Two, the linear exposures of US equities to these factors explains the cross-sectional dispersion of their mean returns. Three, the same types of market, size and value factors are pervasive in US earnings growth rates, and these earnings factors can be tied to the equity return factors. This paper examines these three central findings on the Indian equity market. We confirm the first two of them, but cannot draw a reliable conclusion on the third. We view our findings as generally supportive of the Fama-French model applied to Indian equities.

There are numerous questions left unanswered by our study. Are the size and value factors pervasive in explaining the risk of a wider range of portfolios (such as industry-sorted portfolios)? Is there evidence for any other pervasive factors in returns? Can the random returns on these equity return factors be related to corporate earnings shocks or other business cycle variables? Are our findings on a significant (negative) size premium and insignificant (positive) value premium robust to alternative samples and different estimation methods? India is a very large emerging market with a growing and fast maturing equity market. A better understanding of the risk and return characteristics of this market is an important research problem.

Notes

1. With 7 degrees of freedom (as in Table 7), the 95% confidence level for a t-statistic is 2.37; with 5 degrees of freedom (as in Table 8), it is 2.57. This assumes normality and no time-series autocorrelation of residuals.

Table 1

Summary statistics on the portfolio returns
(July 1989 – March 1999, 117 observations)

Portfolio	Mean	Standard deviation	skewness	Excess kurtosis	ρ_1	ρ_2	ρ_3
S/L	.0158	.1037	.5812	.9304	.114	.019	-.054
S/M	.0215	.0975	.5822	1.087	.215	.073	-.038
S/H	.0211	.1093	1.300	5.515	.206	.028	-.028
B/L	.0095	.0961	.9661	4.706	.161	-.032	-.089
B/M	.0081	.0976	.9000	5.280	.272	.018	-.143
B/H	.0034	.1131	1.691	7.853	.266	.039	-.073
MKT	.0107	.1026	.9714	2.718	.147	.045	-.140
SMB	.0120	.0329	.2580	1.494	-.046	-.100	.117
HML	.0003	.0450	.3474	1.494	.107	.131	.024

Table 2

Correlations between the factor portfolios

	MKT	SMB	HML
MKT		.1132	.1325
SMB			.2682
HML			

Table 3

Monthly seasonals in portfolio returns

Panel a: Estimated differences in mean returns

Portfolio	$\mu_{January}-\mu_{other}$	$\mu_{March}-\mu_{other}$	$\mu_{April}-\mu_{other}$	$\mu_{Festival}-\mu_{other}$
S/L	-.0162	.0319	-.0244	-.0661
S/M	-.0159	.0300	-.0173	-.0543
S/H	-.0067	.0250	-.0229	-.0574
B/L	-.0005	.0279	-.0175	-.0506
B/M	-.0100	.0272	-.0244	-.0580
B/H	.0006	.0323	-.0133	-.0457
MKT	-.0013	.0247	.0002	-.0636
SMB	-.0087	.0011	-.0021	-.0066
HML	.0063	.0008	.0045	.0057

Panel b: t-statistics for differences in mean returns

Portfolio	$t(\mu_{January}-\mu_{other})$	$t(\mu_{March}-\mu_{other})$	$t(\mu_{April}-\mu_{other})$	$\mu_{Festival}-\mu_{other}$
S/L	-.471	.930	-.675	-2.664
S/M	-.491	.931	-.510	-2.310
S/H	-.184	.691	-.602	-2.174
B/L	-.017	.877	-.523	-2.181
B/M	-.308	.842	-.720	-2.474
B/H	.017	.864	-.339	-1.660
MKT	-.037	.727	.004	-2.585
SMB	-.800	.103	-.186	-.815
HML	.420	.054	.289	.516

Table 4
Regressions of size and book-to-market sorted portfolio excess returns (R_t) on combinations of the market (MKT), size (SMB) and value (HML) factor portfolios

$$R_t = a + bMKT_t + sSMB_t + hHML_t + \varepsilon_t$$

Panel a: Coefficients estimates and R-squared statistics

Explanatory Variables	Dependent Variable	a	b	s	h	R^2
Market	S/L	0.007	0.865	-	-	0.731
	S/M	0.013	0.803	-	-	0.712
	S/H	0.012	0.884	-	-	0.686
	B/L	0.000	0.845	-	-	0.813
	B/M	-0.001	0.871	-	-	0.837
	B/H	-0.007	0.937	-	-	0.720
SMB and HML	S/L	0.006	-	0.781	0.156	0.040
	S/M	0.012	-	0.808	0.562	0.088
	S/H	0.011	-	0.833	1.096	0.192
	B/L	0.011	-	-0.103	0.131	-0.011
	B/M	0.011	-	-0.246	0.541	0.064
	B/H	0.005	-	-0.156	1.193	0.226
Mkt and SMB	S/L	-0.006	0.903	1.043	-	0.839
	S/M	0.002	0.836	0.897	-	0.802
	S/H	0.002	0.911	0.753	-	0.735
	B/L	-0.001	0.850	0.149	-	0.814
	B/M	0.001	0.866	-0.139	-	0.838
	B/H	-0.003	0.927	-0.266	-	0.724
Mkt and HML	S/L	0.006	0.881	-	-0.263	0.742
	S/M	0.013	0.794	-	0.164	0.715
	S/H	0.012	0.844	-	0.678	0.761
	B/L	0.000	0.851	-	-0.105	0.814
	B/M	-0.001	0.852	-	0.332	0.859
	B/H	-0.006	0.881	-	0.957	0.863
Mkt, SMB and HML	S/L	-0.006	0.906	1.018	-0.071	0.838
	S/M	0.000	0.820	1.022	0.357	0.825
	S/H	-0.001	0.871	1.061	0.878	0.856
	B/L	-0.001	0.854	0.120	-0.083	0.814
	B/M	-0.001	0.851	-0.023	0.328	0.858
	B/H	-0.007	0.883	0.075	0.971	0.862

Panel b: t-statistics of the estimated coefficients and Gibbons-Ross-Shanken statistics jointly testing the intercepts equal zero

Explanatory Variables	Dependent Variable	t(a)	t(b)	t(s)	t(h)
Market	S/L	1.960	9.432	-	-
	S/M	2.915	9.224	-	-
	S/H	2.484	8.852	-	-
	B/L	1.224	10.24	-	-
	B/M	1.010	10.77	-	-
	B/H	0.207	9.371	-	-
GRS statistic	3.8069	p-value		0.0017	
SMB and HML	S/L	0.640	-	2.623	0.718
	S/M	1.273	-	2.960	2.820
	S/H	1.117	-	2.895	5.214
	B/L	1.118	-	-0.364	0.635
	B/M	1.169	-	-0.888	2.677
	B/H	0.506	-	-0.534	5.601
GRS statistic	1.7999	p-value		0.1057	
Mkt and SMB	S/L	0.462	10.48	4.386	-
	S/M	1.560	10.05	3.862	-
	S/H	1.486	9.259	2.610	-
	B/L	1.115	10.17	0.083	-
	B/M	1.433	10.66	-1.392	-
	B/H	0.784	9.274	-1.701	-
GRS statistic	1.5174	p-value		0.1791	
Mkt and HML	S/L	1.962	9.477	-	-0.960
	S/M	2.933	9.074	-	1.708
	S/H	2.703	9.134	-	4.876
	B/L	1.219	10.15	-	-0.005
	B/M	1.039	10.79	-	3.151
	B/H	0.225	10.45	-	7.211
GRS statistic	4.1369	p-value		0.0009	
Mkt, SMB and HML	S/L	0.447	10.39	4.246	0.119
	S/M	1.316	10.11	4.644	3.007
	S/H	1.104	10.14	4.563	6.293
	B/L	1.103	10.09	0.084	0.017
	B/M	1.194	10.71	-0.635	2.867
	B/H	0.261	10.38	-0.143	6.891
GRS statistic	1.7478	p-value		0.1168	

Table 5
Constrained estimation of the three-factor model with an excess zero-beta return

$$R_{jt} = \gamma_0(1-b_j) + b_jMKT_t + s_jSMB_t + h_jHML_t + \varepsilon_{jt}$$

Panel A: Coefficient Estimates

Without an excess zero-beta return (from Table 3)		With a single-regime excess zero-beta return		With a two-regime excess zero-beta return		
	a	γ_0	ε	γ_{01}	γ_{02}	ε
S/L	0.003	0.012	-0.002	0.063	-0.005	-0.003
S/M	0.009		0.002			0.002
S/H	0.008		0.002			0.001
B/L	0.008		0.002			0.001
B/M	0.008		0.002			0.001
B/H	0.002		-0.003			-0.004

Panel B: t-statistics

Without an excess zero-beta return (from Table 3)		With a single-regime excess zero-beta return		With a two-regime excess zero-beta return		
	t(a)	t(γ_0)	t(ε)	t(γ_{01})	t(γ_{02})	T(ε)
S/L	0.447	0.962	-0.299	2.681	-0.343	-0.410
S/M	1.316		0.382			0.266
S/H	1.104		0.268			0.161
B/L	1.103		0.241			0.131
B/M	1.194		0.291			0.175
B/H	0.261		-0.508			-0.624

Table 6

Growth in earnings for the six size and value sorted portfolios (GE) regressed on contemporaneous market (GEMKT), size (GESMB) and value factors (GEHML) in the growth in earnings.

$$GE_t = a + bGEMKT_t + sGESMB_t + hGEHML_t + \varepsilon_t$$

Panel A: Coefficient Estimates and Adjusted R^2s

Portfolio	a	b	s	h	R^2
S/L	–.0520	1.72	.912	-.471	.967
S/M	–.0103	.964	.145	.267	.945
S/H	.0623	.316	.442	.204	.644
B/L	.0414	.554	-1.563	–1.165	.993
B/M	.0315	.490	1.156	1.005	.840
B/H	-.0729	1.957	–1.093	.160	.680

Panel B: t-statistics

Portfolio	t(a)	t(b)	t(s)	t(h)
S/L	–1.275	4.240	3.922	-3.971
S/M	–.723	6.784	1.781	6.413
S/H	1.836	.937	2.284	2.070
B/L	3.268	4.393	–21.620	–31.601
B/M	.535	.837	3.445	5.876
B/H	–1.114	3.007	–2.927	.838

Table 7

Annual portfolio excess returns (R) regressed on portfolio specific growth in earnings (GE) one year ahead.

$$R_t = a + bGE_{t+1} + \varepsilon_t$$

Portfolio	a	b	R^2	t(a)	t(b)
S/L	1.227	.549	−.004	7.721	.985
S/M	.995	2.043	−.060	3.228	.741
S/H	.236	8.694	.484	.682	2.918
B/L	1.324	−.0812	−.142	7.384	−.087
B/M	1.099	.952	.008	5.813	1.031
B/H	1.208	−1.919	.245	6.486	−1.896

Table 8

Annual portfolio excess returns (R) regressed on market (GEMKT) , size (GESMB) and value (GEHML) factors in the growth in earnings one year ahead.

$$R_t = a + bGEMKT_{t+1} + sGESMB_{t+} + hGEHML_{t+} + \varepsilon_t$$

Panel A: Coefficient Estimates and Adjusted R^2s

Portfolio	a	b	s	h	R^2
S/L	1.182	1.184	.771	-.321	-.241
S/M	1.190	.0691	2.349	-.169	-.014
S/H	1.029	.464	3.184	.247	-.173
B/L	1.356	.261	1.307	-.020	-.376
B/M	1.188	.248	1.224	-.107	-.340
B/H	.962	.391	.940	-.158	-.398

Panel B: t-statistics

Portfolio	t(a)	t(b)	t(s)	t(h)
S/L	2.989	.301	.342	-.279
S/M	2.561	.015	.885	-.125
S/H	1.423	.065	.772	.118
B/L	3.159	.061	.534	-.016
B/M	2.665	.056	.481	-.082
B/H	2.136	.087	.366	-.121

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