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Sanjay Shanbhag*
Indian Institute of Management, Ranchi

Kamran Quddus**
Indian Institute of Management, Ranchi

CROSS-SECTIONAL PREDICTABILITY OF INDIAN STOCK RETURNS: A FACTOR ANALYTICAL APPROACH

Keywords: asset pricing, return predictability, Fama-MacBeth regression, arbitrage pricing, principal components.

J E L Classification: C51, G0, G12.

Abstract: The core objective of this article is to analyze how firm characteristics collectively affect the risk-adjusted returns of Indian stocks. It aims to understand the simultaneous explanatory power of multiple variables that have been shown to predict the cross-sectional returns in prior studies. We include eight firm characteristics as determinants of expected returns: size, book-to-market equity, reciprocity of share price, volume traded, dividend yield, and three lagged returns. The data consists of monthly returns and firm characteristics for a sample of listed securities that constitute the National Stock Exchange's (NSE) NIFTY 100 Index. We use Arbitrage Pricing Theory, with Connor and Korajczyk's (1988) benchmark factors for risk-adjusting returns on individual securities. We conduct Fama-MacBeth regressions to determine the statistical

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* Contact information: sanjay.suresh20eph@iimranchi.ac.in, Indian Institute of Management, Prabandhan Nagar, Nayasarai Road, Ranchi, Jharkhand 835303, India, phone: +918408027817; ORCID ID: https://orcid.org/0009-0009-2809-1999.

** Contact information: kamran.quddus@iimranchi.ac.in, Indian Institute of Management, Prabandhan Nagar, Nayasarai Road, Ranchi, Jharkhand 835303, India, phone: +919007973996; ORCID ID: https://orcid.org/0000-0003-3365-381X.

significance of the firm characteristics. Furthremore, we find that lags of size, book-to-market, dividend yield, and momentum have strong residual pricing power and in-sample predictability of risk-adjusted returns. We also find that the intercepts are positive and highly significant. Thus, the average stock in the sample underperforms the risk model by a substantial amount. The results lead us to categorically reject the Arbitrage Pricing Model with Connor and Korajczyk's factors as a risk model for Indian stock returns.

Introduction

The understanding and measurement of the sources of fundamental, non-diversifiable macroeconomic risks underlying asset prices largely remain unanswered. The CAPM (Sharpe, 1964; Lintner, 1965; Black, Jensen & Scholes, 1972), a cross-sectional model, shows that expected excess security returns are a linear function of market beta only with an intercept of zero. However, over the past decades, numerous empirical asset pricing studies contradicting the CAPM have been documented. These CAPM "anomalies" that reject the zero intercept hypothesis have steadily increased.

Some of the more prominent anomaly research findings demonstrate the inability of CAPM to price portfolios formed by grouping securities based on firm characteristics. Basu (1983) finds that, on average, securities with low P/E earn higher risk-adjusted returns than securities with high P/E. Banz (1981) discovers the "size" effect, with small capitalization stocks earning higher risk-adjusted returns than large capitalization stocks. Rosenberg, Reid and Lanstein (1985) discover the "value" effect with high B/M (value) stocks earning higher risk-adjusted returns than low B/M (growth) stocks. Finally, Jegadeesh and Titman (2001) identify the momentum factor.

As the number of documented violations of CAPM grew, so did the research efforts to find possible explanations. Prominent among them were explanations based on deviations from perfect markets due to transaction and liquidity effects (Amihud & Mendelson, 1986; Pastor & Stambaugh, 2001); irrational investor behavior (such as overreaction) or market inefficiencies (Lakonishok, Shleifer & Vishny, 1994); momentum anomaly arising from investors behavioral and cognitive biases (Jegadeesh & Titman, 1993; Chan, Jegadeesh & Lakonishok, 1995; Daniel, Hirshleifer & Subrahmanyam, 1998; Hong & Stein, 1999); fundamental non-diversifiable risks such as missing risk factor(s) or improper proxy for market portfolio (Roll, 1977); and the biases in the empirical methodology (such as data-snooping).

Many theoretical equilibrium-based models (unrelated to the Linear Factor Model (LFM)) in literature offer non-CAPM-based explanations of asset returns. For example, Kraus and Litzenberger (1976) and Harvey and Siddique (2000) use co-skewness as a risk measure, Hwang and Satchell (1999) use co-kurtosis, while Bawa and Lindenberg (1977) propose a semi-variance, downside beta-based equilibrium model.

Theoretically motivated LFMs, such as Intertemporal CAPM (Merton, 1973) and Arbitrage Pricing Theory (APT) (Ross, 1976), assume rational investors and perfect markets. However, these models are quiet when it comes to which factors and how many of them should be included in the LFMs, making it largely an empirical issue. This "fishing license" (Fama, 1991) that apparently allows researchers to use just about any factor led to a rise in the number of potential factors. Harvey, Liu and Zhu (2015) document over 300 factors identified in empirical studies to explain asset cross-sectional returns. Cochrane (2011) calls this situation "a zoo of new factors". The large number of factors in literature is contrary to earlier empirical APT studies that have suggested the existence of not more than 10 factors.

The findings of a statistically significant non-zero CAPM intercept also led to the empirical testing of multiple beta asset pricing models. Connor (1995) lists 3 types of multiple beta models: macroeconomic, statistical, and fundamental factor models. Chen, Roll, and Ross (1986) find empirical evidence for 5 priced macroeconomic factors. Roll and Ross (1980) use a statistical procedure. Lehmann and Modest (1988) use maximum likelihood analysis to estimate the LFM. Connor and Korajczyk (1988) find empirical evidence for 5 to 10 principal component factors. The factors extracted through statistical procedures or principal components are not observable, and their economic interpretation is unclear. Additionally, these factors are conditional to sample assets and time periods, and they are likely unstable.

A different approach, not necessarily economically motivated, is based on creating factors from excess returns of portfolios formed from securities sorted on firm attributes such as size, B/M, etc., to explain assets' returns and reassessing the zero intercept hypothesis. There are no specific theories identified with these risk factors, and they are hypothesized as either proxies correlated to yet-to-be-known fundamental sources of risk, products of data snooping, or just redundant. Gibbons, Ross and Shanken (1989) posit that stock portfolios are used to test LFMs due to the limitations of the econometric techniques requiring a larger number of test periods than test assets. Fama and French

(1992) find that the three-factor model (FF3), with factor portfolios formed from excess market returns, size, and B/M, has an intercept not significantly different from zero. Besides the widely known FF3, other models in literature are the four-factor model by Carhart (1997), three-factor model by Chen and Zhang (2009), four-factor model by Hou, Xue and Zhang (2014), five-factor model by Fama and French (2015) (FF5), and six-factor model by Barillas and Shanken (2018).

Important considerations that are also present in literature include whether FF3 firm-characteristic factors are priced (MacKinlay, 1995; Lakonishok et al., 1994; Liew & Vassalou, 2000; Petkova, 2006), whether the factor portfolios that correlate well with anomalies are related to fundamental sources of risk (Lewellen, Nagel and Shanken, 2010), and which factors best explain asset returns.

The ability of characteristic-sorted portfolios to explain CAPM anomalies is viewed with caution. The factor portfolio formation process itself may make it difficult to reject the model (Roll, 1977) or the CAPM anomaly (Lo & MacKinlay, 1990; Ferson, Sarkissian & Simin, 1999; Berk, 2000) due to data snooping biases inherent in the characteristic-sorted test portfolios. Hwang and Satchell (2012) suggest an average F-test to get around this problem. Hou, Xue and Zhang (2018) and Chordia, Goyal and Saretto (2020) demonstrate that anomalies fail to replicate when adjusted for multiple hypothesis testing. Kothari, Shanken and Sloan (1995) provide evidence of CRSP and Compustat database sample selection biases to demonstrate FF3's ability to explain CAPM anomalies. Fama and French, however, provide evidence of the success of the FF3 model in other international markets to demonstrate that not all characteristic-related phenomena are spurious effects of data snooping or sample bias.

Literature Review

There is extensive literature focused on empirical testing of asset pricing models and uncovering anomalies in the Indian stock markets. Asset pricing models such as CAPM, Fama-French three-factor, APT, and Carhart four-factor have been tested extensively on various indices such as BSE and NSE for different sets of portfolios and different time periods. While CAPM has generally failed, the performance of Fama-French three-factor has been better and Carhart four-factor has been found to explain cross section of returns better than both these models. Basu and Chawla (2010), Ansari and Khan (2012), Sehgal and Balakrishnan (2013), and Das (2015) document the failure of CAPM. Basu and Chawla (2012) find selected macroeconomic variables in multi-factor APT to be good descriptors of asset returns. Zaremba (2015) demonstrates the January seasonal effect using several distinct value and momentum strategies on 78 markets and concludes that their findings are consistent with the tax loss selling and window dressing effects. Ansari and Khan (2012), Pandey and Sehgal (2015), Balakrishnan (2016), Vasishth, Sehgal and Sharma (2020), Sobti (2018), Harshita, Singh and Yadav (2018), Sharma, Subramaniam and Sehgal (2019), Balakrishnan, Maiti and Panda (2018), and Tripathi and Aggarwal (2020) confirm the existence of size, value, momentum, profitability, and investment effects. Das and Barai (2015) show the existence of time-varying portfolio beta. Sehgal and Balakrishnan (2013) and Das (2015) test the Fama-French three-factor model. Sehgal and Jain (2015) and Dutta (2019) find the Fama-French five-factor model more robust than the Fama-French three-factor model. Das and Barai (2016) test Carhart four-factor model. Roy's (2021) findings reveal that the six-factor model performs better than Carhart four-factor and Fama–French five-factor models. Khudoykulov (2020) evaluates the CAPM, Fama-French three-factor model, and Fama-French five-factor model. Veeravel (2023) tests the short-term persistence of equity mutual fund returns in Indian stock markets and finds that the three-factor Fama-French model consistently explains the persistence better than four-factor Carhart model. Keswani, Puri and Jha (2024) find significantly positive association between returns and GDP, disposable income, foreign institutional investor flows, and negative relationship with interest rates, government policies, exchange rates, and inflation.

The literature in the area of predictability, however, is sparse. Narayan and Ahmed (2014) test sectoral stock return predictability on the Indian stock exchange using P/B, dividend yield, and P/E and find evidence of predictability. Narayan and Bannigidadmath (2015) show predictability of B/M and size-sorted industry portfolios both in-sample and out-of-sample.

Objectives

In this article, our objective is to further study the cross-sectional predictability of returns for Indian stocks. We investigate whether the lags of firm characteristic variables that have been attributed with the power to predict in prior studies are cross-sectionally priced after adjusting for risk using the APT model Connor and Korajczyk (1988) benchmarks. Our sample consists of securities from the India's National Stock Exchange (NSE) NIFTY 100 Index. The firm characteristics that we include have found importance in several prior empirical studies and are backed by strong theoretical rationales (Lakonishok et al., 1994; Fama & French, 1988, 1992; Miller & Scholes, 1982; Pontiff & Schall, 1998; Goyal & Welch, 2003; Lewellen, 2004; Welch & Goyal, 2007).

Theoretical Framework

We base our analysis on Arbitrage Pricing Theory (Ross, 1976). For risk factors, we use the Connor and Korajczyk's (1988) (CK) approach to extract principal components risk factors from the covariance matrix of security returns. For a period spanning 1967–1991, Connor and Korajczyk (1993) document evidence for up to six factors underlying the returns on the NYSE and AMEX. The focus of our study is on testing the explanatory power or pricing lags of firm characteristics relative to CK benchmarks. Our model is based on risk adjustment of individual security returns. As discussed earlier, many studies show that characteristic-sorted test portfolios formed introduce data-snooping biases. The approach of using individual securities permits the consideration of joint effects of many firm characteristics and also mitigates the data-snooping biases of the portfolio-based methodology.

We include lags of eight firm level variables as determinants of expected returns: size (Banz, 1981), B/M (Fama & French, 1992), reciprocity of security price (Miller & Scholes, 1982), volume traded, dividend yield (Fama & French, 1988), and 3 lagged returns (Jegadeesh & Titman, 1993).

We investigate the persistence of statistical significance of these firm characteristics after accounting for risk factors. Equation (1) is the conditional K factor CK benchmark version of multifactor APT model of returns with M firm characteristics. Under the null hypothesis, c_q ($q = 1, \ldots, M$) is zero, implying that excess security returns are a linear function only of β_{ij} ($j = 1, \ldots, K$), the factor loadings. Thus, a violation of the null hypothesis would attribute predictive power to lagged values of firm characteristics.

$$\mathrm{E}(R_i) - R_F = c_0 + \sum_{j=1}^{K} \lambda_j \, \beta_{ij} + \sum_{q=1}^{M} c_q \, Z_{qi} \tag{1}$$

Research Methodology

The data consists of excess monthly returns and characteristics (as listed above) for a sample of listed securities which constitute the National Stock Exchange's (NSE) NIFTY 100 Index. 66 securities from the NIFTY 100 Index that had price data for all months for a period of 20 years from January 2004 to December 2023 were selected. The firm level sample data has been obtained from Prowess database. The one month risk-free rate is derived from 91-days treasury bills yield from the Reserve Bank of India's official website.

Table 1 displays the predetermined firm characteristic variables used in the conditional APT model. Table 2 displays the summary statistics that represent the sample period average of cross-sectional means, medians, and standard deviations of the firm characteristic variables for 66 securities over 240 months from January 2004 to December 2023 of the sample period. The variables display minor skewness; we nevertheless use logarithmic transformations for all variables in our analysis. Table 3 displays the matrix of averages of monthly cross-correlation of all natural logarithm transformed variables for all securities over the sample period. The largest correlation is between SIZE and VOL. The other correlations are fairly low.

Using Connor and Korajczyk's (1988) technique, the CK factors are estimated for the 66 listed securities of the NSE exchanges on NIFTY 100 that had price data for all months from 2004–2023 of the sample period. Connor and Korajczyk (1993) show evidence for 1 to 6 factors. We use 5 factors in our model.

The regression in Equation (2) is Fama-MacBeth estimation:

$$\tilde{R}_{it} - R_{Ft} = c_0 + \sum_{j=1}^{K} \beta_{ij} \tilde{CK}_{jt} + \sum_{q=1}^{M} c_q Z_{qit} + \tilde{e}_{it} \qquad (2)$$

Table 1. Predetermined Firm Characteristic Variables

Variable	Definition
SIZE	The natural logarithm of the firm's market capitalization ending month before the previous month.
BM	The natural logarithm B/M as of the previous month.
VOL	The natural logarithm of the rupee trading volume ending month before the previous month.

Table 1. Predetermined...

Variable	Definition
PRICE	The natural logarithm of the reciprocal of the security price ending month before the previous month.
YLD	The natural logarithm of the previous 12 month cumulative dividends divided by the security price as of month before the previous month.
RET 2-3	The natural logarithm of the two months cumulative return ending two months before the current month.
RET 4-6	The natural logarithm of the three months cumulative return ending three months before the current month.
RET 7-12	The natural logarithm of the 6 months cumulative return ending six months before the current month.

Source: authors hypothesis of the eight firm level variables as determinants of expected returns, based on existing literature size (Banz, 1981), B/M (Fama & French, 1992), reciproityc of security price (Miller & Scholes, 1982), volume traded, dividend yield (Fama & French, 1988), and 3 lagged returns (Jegadeesh & Titman, 1993).

Table 2. Summary Statistics

Variable	Mean	Median	Standard Deviation
Size (₹ billion)	0.791	0.643	0.569
BM	0.386	0.362	0.098
Trading Volume (₹ billion)	0.034	0.021	0.029
Share Price (₹)	1,374.937	1,340.738	586.043
Dividend Yield (%)	1.148%	1.100%	0.331%

Source: authors' analysis and calculations with data sourced from Prowess dx.

Table 3. Correlation Matrix for Firm Characteristics

	RETURN	SIZE	BM	VOL	PRICE	YLD	RET 2-3	RET 4-6	RET 7-12
RETURN	1.00								
SIZE	-0.08	1.00							
BM	0.03	-0.09	1.00						
VOL	-0.05	0.78	0.12	1.00					

Table 3. Correlation...

	RETURN	SIZE	BM	VOL	PRICE	YLD	RET 2-3	RET 4-6	RET 7-12
PRICE	0.05	-0.26	0.30	-0.13	1.00				
YLD	0.02	-0.04	0.32	-0.01	0.32	1.00			
RET 2-3	-0.05	0.01	-0.07	0.02	-0.10	-0.18	1.00		
RET 4-6	-0.02	0.00	-0.08	0.01	-0.12	-0.18	-0.05	1.00	
RET 7-12	0.00	0.01	-0.10	0.01	-0.16	-0.12	0.00	-0.03	1.00

Source: authors analysis and calculations with data sourced from Prowess dx.

The null hypothesis is tested by estimating equation (2) using the Fama-MacBeth technique. Stationarity is a key assumption in the estimation of the CK factors (Connor & Korajczyk, 1988) based on an equilibrium APT model. The relationship between risk and return is expected to be stable over time, with sensitivities to the underlying factors or factor loadings () remaining unchanged. However, stationarity may not be the ideal description of real-world market conditions, with factors and factor sensitivities changing over time. We therefore estimate the CK factors on subsamples to simulate non-stationarity in the data.

Results and Discussions

First, we conduct Fama-Macbeth regression (Equation (2)) of returns on a reduced set of variables and lagged variables. Table 4 below displays the results of Fama-MacBeth regression. The sample includes 66 securities over a period of 240 months from January 2004 to December 2023. Of the variables, SIZE, BM, and the three lagged returns are well-known for their predictability of returns. The complete sample period is further partitioned into sub-samples of 5 years each: 2004–2008, 2008–2012, 2013–2017, and 2018–2023. For each sub-sample, excess security returns and excess security returns risk-adjusted using the CK factors are calculated, respectively. The coefficients in the cross-sectional regressions are estimated using the Fama-MacBeth technique for the two separate regressions: one with the excess security returns as the dependent variable and the other with risk-adjusted excess security returns. The numbers in the first and second columns of each subsample are the p-values.

Table 4. Fama-MacBeth Regression Results of Equation (2)

	2004–2008		2009–2013		2014–2018		2019–2023		2004–2023	
Firm Characteristic	Excess Returns	Risk-Adjusted Returns	Excess Returns	Risk-Adjusted Returns	Excess Returns	Risk-Adjusted Returns	Excess Returns	Risk-Adjusted Returns	Excess Returns	Risk-Adjusted Returns
INTERCEPT	0.0499	0.1688	0.1011	0.1070	0.0852	0.1475	0.0974	0.1594	0.0852	0.1444
	(1.67)	(12.22)	(4.06)	(8.08)	(2.70)	(9.50)	(3.63)	(11.56)	(6.02)	(19.98)
SIZE	-0.0036	-0.0053	-0.0074	-0.0019	-0.0067	-0.0052	-0.0064	-0.0060	-0.0061	-0.0046
	-(1.67)	-(5.15)	-(3.84)	-(1.67)	-(2.98)	-(4.50)	-(3.62)	-(5.90)	-(6.08)	-(8.24)
BM	0.0020	0.0116	0.0007	0.0073	-0.0028	0.0080	0.0002	0.0070	-0.0001	0.0083
	(0.53)	(4.94)	(0.17)	(4.95)	-(0.91)	(6.72)	(0.07)	(6.37)	-(0.05)	(10.90)
RET 2-3	0.0036	0.0244	-0.0322	0.0054	-0.0166	0.0175	-0.0264	0.0326	-0.0190	0.0197
	(0.18)	(2.04)	-(1.98)	(0.61)	-(0.98)	(1.88)	-(1.34)	(3.30)	-(2.09)	(3.98)
RET 4-6	-0.0143	0.0261	-0.0015	0.0005	-0.0025	0.0108	0.0115	0.0283	-0.0010	0.0159
	-(0.96)	(3.50)	-(0.11)	(0.08)	-(0.29)	(1.55)	(0.82)	(3.62)	-(0.16)	(4.32)
RET 7-12	0.0099	0.0225	-0.0113	0.0029	0.0044	0.0054	0.0123	0.0070	0.0035	0.0088
	(1.29)	(4.57)	-(1.32)	(0.71)	(0.73)	(0.96)	(1.45)	(1.77)	(0.89)	(3.69)

S o u r c e : authors’ analysis and calculations with data sourced from Prowess dx.

We present the results for the full sample as well as for four subsamples of 5 years each. For regressions of excess returns, we observe that the coefficient of SIZE is negative and statistically significant in all periods, consistent with Fama and French (1992), whereas the coefficient of BM is statistically insignificant. The coefficients of all 3 lags are statistically insignificant. The intercept of the regression is highly significant. Next, we repeat the regressions for excess risk-adjusted returns using CK factors. We compare the results and find the coefficient of SIZE now to be negative, the coefficient of BM to be positive, and both statistically more significant for all periods. The lagged returns are now statistically significant for two periods – 2004–2008 and 2019–2023 – and for the full sample. Moreover, the sign of these lags changes after risk adjustment. An overarching observation is that regardless of the statistical significance, all coefficients except for that of the intercept are small and thus can be considered to be economically insignificant.

Next, we conduct Fama-MacBeth regressions using a complete set of variables and lagged variables. Table 5 displays the results of Fama-MacBeth regression (Equation (2)) of excess returns and risk-adjusted excess returns for all securities in the sample space on characteristics. As seen in Table 5, for excess returns and for the period of 2019–2023, coefficients of SIZE and YLD are negative and statistically significant, and PRICE is positive and statistically significant. For all other periods, all other variables are statistically insignificant. There is a distinct departure from these results, however, for regressions of excess returns risk-adjusted using CK factors. Coefficients of SIZE and YLD are negative, and BM and VOL are positive, and all four are now statistically more significant for all periods. With the introduction of PRICE, VOL, YLD, the coefficient of SIZE is more pronounced, and that of BM is slightly attenuated. The coefficient of PRICE is no longer significant. The lags show statistical importance in some periods, notably 2004–2008 and 2019–2023, as before. Moreover, the sign of these lags changes after risk adjustment, and lags become less significant after PRICE, VOL, and YLD are introduced. The intercept remains highly significant for all periods. But for the intercept, the economic significance of all coefficients remains small.

Table 5. Fama-MacBeth Regression Results of Equation (2)

	2004-2008		2009-2013		2014-2018		2019-2023		2004-2023	
Firm Characteristic	Excess Returns	Risk Adjusted Returns	Excess Returns	Risk Adjusted Returns	Excess Returns	Risk Adjusted Returns	Excess Returns	Risk Adjusted Returns	Excess Returns	Risk Adjusted Returns
INTERCEPT	0.0574	0.1982	0.1243	0.1307	0.0563	0.1472	0.1000	0.1568	0.0859	0.1561
	(1.61)	(9.82)	(4.07)	(9.05)	(1.65)	(8.46)	(3.88)	(10.11)	(5.45)	(18.44)
SIZE	-0.0007	-0.0143	-0.0060	-0.0115	-0.0017	-0.0111	-0.0078	-0.0127	-0.0042	-0.0123
	-(0.21)	-(6.21)	-(1.69)	-(5.93)	-(0.50)	-(6.46)	-(3.02)	-(8.36)	-(2.60)	-(13.30)
BM	0.0010	0.0097	-0.0011	0.0066	-0.0027	0.0073	-0.0012	0.0054	-0.0011	0.0071
	(0.24)	(4.00)	-(0.28)	(4.34)	-(0.94)	(5.64)	-(0.41)	(4.53)	-(0.64)	(8.93)
PRICE	0.0039	-0.0010	0.0026	0.0015	0.0011	-0.0017	0.0037	0.0013	0.0028	0.0001
	(1.08)	-(0.50)	(1.56)	(1.28)	(0.57)	-(1.44)	(2.10)	(1.52)	(2.51)	(0.11)
VOL	-0.0005	0.0072	-0.0006	0.0081	-0.0040	0.0058	0.0021	0.0082	-0.0008	0.0073
	-(0.24)	(4.47)	-(0.28)	(6.67)	-(1.63)	(4.46)	(0.88)	(6.49)	-(0.67)	(11.01)
YLD	0.0036	-0.0023	0.0048	-0.0080	-0.0015	-0.0023	-0.0042	-0.0032	0.0005	-0.0040
	(0.68)	-(0.85)	(1.63)	-(5.32)	-(0.65)	-(1.74)	-(2.38)	-(2.79)	(0.33)	-(4.79)
RET 2-3	0.0033	0.0172	-0.0201	0.0006	-0.0152	0.0102	-0.0286	0.0282	-0.0161	0.0139
	(0.17)	(1.40)	-(1.26)	(0.07)	-(0.92)	(1.13)	-(1.61)	(2.95)	-(1.87)	(2.87)
RET 4-6	-0.0137	0.0238	0.0037	0.0002	-0.0074	0.0065	0.0090	0.0247	-0.0015	0.0133
	-(0.94)	(3.14)	(0.27)	(0.03)	-(0.86)	(0.86)	(0.63)	(3.21)	-(0.23)	(3.56)
RET 7-12	0.0105	0.0220	-0.0092	0.0017	0.0054	0.0017	0.0076	0.0023	0.0032	0.0061
	(1.39)	(4.10)	-(1.09)	(0.41)	(0.88)	(0.32)	(0.78)	(0.58)	(0.79)	(2.57)

S o u r c e : authors' analysis and calculations with data sourced from Prowess dx.

Conclusions

In this article, we test the principal components approach of the APT model (Connor & Korajczyk, 1988) against firm characteristic variables such as SIZE, BM, YLD, VOL, PRICE, and several return lags using data on individual securities. We find strong evidence of risk-adjusted excess returns to be more strongly related to SIZE, BM, and lagged returns or momentum than unadjusted excess returns. The presence of YLD, PRICE, and VOL makes SIZE even more significant and BM less significant. YLD and VOL are significant in the overall sample, whereas PRICE is insignificant. All characteristics, except for PRICE, become highly statistically significant after risk adjustment. It is also worth noting that in both sets of regressions of risk-adjusted returns (Table 4 and Table 5), the intercepts are positive and highly significant. Thus, the average stock in the sample underperforms the risk model by a substantial amount. The results lead us to categorically reject the null hypothesis that returns are determined by the APT with CK factors as the risk model. The lags of SIZE, BM, YLD, and momentum have strong residual pricing power and in-sample predictability of risk-adjusted returns. The statistically and economically significant intercept suggests the presence of omitted risk factors.

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