Pricing of Equities in China: Evidence from the Shanghai Stock Exchange

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Abstract

In this paper we compare the performance of the traditional CAPM with the multifactor model of Fama and French (1996) for equities listed in the Shanghai Stock Exchange. We also investigate the explanatory power of idiosyncratic volatility and respond to the claim that multifactor model findings can be explained by the turn of the year effect. Our results show that firm size, book to market equity and idiosyncratic volatility are priced risk factors in addition to the theoretically well specified market factor. As far as the turn of the year effect is concerned we reject the claim that the findings are driven by seasonal factors.

Our findings have implications for both academic researchers and practitioners. This is because we demonstrate that by following the investment strategies investigated in this paper superior returns could be generated – returns in addition to those offered by the market. Of course this is only applicable to those investors who are willing to take additional risks in order to generate additional returns. In summary, our results show that a broader asset pricing model such as the one investigated in this paper does a much better job than the single index CAPM.

JEL Classification: G110, G120, G150

Keywords: Asset Pricing, CAPM, China, Small Firm Effect, Turn of the Year Effect.

1.0 Introduction

This paper examines a controversial area of financial economics that has provided a lively ongoing debate in the literature. The controversy relates to a number of studies that have investigated the cross-section of average stock returns on US common stocks and found little relationship with the betas of the traditional Capital Asset Pricing Model (henceforth CAPM). These studies show that variables such as firm size, earnings to price (E/P), book-to-market equity (BE/ME) and more recently idiosyncratic volatility[1] adequately explain the cross-section of average stock returns better than the beta of the CAPM. In addition, we also focus on the seasonality issue as controversy surrounds whether the three-factor model is explained by a January effect.

The development of the CAPM represented one of the most significant breakthrough in understanding risk and return in a market setting. The CAPM focuses on expected return on common stocks with return linearly related to the market betas of the security. However, in their groundbreaking paper, Fama and French (hereafter FF) (1992) observed that the cross-section of average equity returns in the US shows little or no relation to the betas of the traditional CAPM.

FF (1992) observed that firm size and book-to-market equity provide a simple and powerful explanation of the cross-sectional variation in the average returns on stocks. In essence, they suggest that if stocks are priced rationally, risks must be multidimensional. One dimension captured by the firm size effect and the other by the book-to-market equity ratio. Their bottom-line results are: (a) beta does not explain the cross-section of average stock returns and (b) the combination of the size

[1] For studies on Asian markets, see, Drew and Veeraraghavan (2001, 2002a, 2002b and 2002c) and Drew, Naughton and Veeraraghavan (2003).

effect and book-to-market equity absorbs the roles played by other variables such as leverage and E/P found in previous studies. In a similar vein, Miller (1999) states that although the single-beta CAPM managed to withstand more than three decades of intense scrutiny, the current consensus is that a single risk factor is not sufficient for describing the cross-section of expected stock returns[2]. Miller (1999:98) also states: "That a three-factor model has now been shown to describe the data somewhat better than the single factor CAPM should detract in no way, of course, from appreciation of the enormous influence of the original CAPM on the theory of asset pricing". Fama and French (2003, Abstract) state:

"The attraction of the CAPM is its powerfully simple logic and intuitively pleasing predictions about how to measure risk and about the relation between expected return and risk. Unfortunately, perhaps because of its simplicity, the empirical record of the model is poor – poor enough to invalidate the way it is used in applications. We argue, however, that if the market proxy problem invalidates tests of the model, it also invalidates most applications, which typically borrow the market proxies used in empirical tests".

Campbell, Lo and Mackinlay (1997, p251) state that "the usefulness of multifactor models will not be fully known until sufficient new data become available to provide a true out-of-sample check on their performance". Hence, in this paper we advance the debate by comparing the explanatory power of a single factor CAPM with the multifactor asset-pricing model of Fama and French (hereafter FF) (1996). In addition, we also investigate the role of idiosyncratic volatility in asset pricing for equities listed in Shanghai stock exchange.

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[2] See, for example, Basu (1983), Banz (1981), Black (1993), Daniel and Titman (1997), Daniel, Titman and Wei (2001), Davis, Fama and French (2000), Fama and French (1992, 1993, 1995, 1996 and 1998), Jagannathan and Wang (1996), Kothari, Shanken and Sloan (1995), Liew and Vassalou (2000), Mackinlay (1995), Malkiel and Xu (1997, 2000), Merton (1973), Narasimhan and Titman (1993), Roll (1977), Ross (1976) and Rosenberg, Reid and Lanstein (1985).

We investigate the following questions:

(a) Is beta risk the only risk needed to explain the variation in average stock returns?

(b) Does the multifactor model of FF (1996) explain the variation in average stock returns better than the CAPM? and,

(c) Does idiosyncratic volatility matter?

2.0 Data and Methods

A. Data

We obtain the monthly stock returns, market returns, market capitalization, book value of shareholders equity and the risk free rate from the Great China Database maintained by the Taiwan Economic Journal. In this paper we test the robustness of three asset-pricing models. Our first model is a single factor CAPM where we investigate the explanatory power of beta. This model takes the following form:

$$\mathbf{R_{pt} - R_{ft} = a_{pt} + \beta_p(R_{mt} - R_{ft}) + \varepsilon_{pt}} \qquad \textbf{[1]}$$

Note that if the CAPM describes expected returns the regression coefficient α_p should be equal to zero and β_p greater than zero. In our second model we investigate the relationship between the expected return of a portfolio, the overall market factor, firm size (ME) and book-to-market equity ratio (BE/ME). Our second model takes the following form:

$$\mathbf{R_{pt} - R_{ft} = a_{pt} + b_p (R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + \varepsilon_{pt}} \qquad \textbf{[2]}$$

In this model R_{pt} is the average return of a certain portfolio, R_{ft} is the risk-free rate observed at the end of each month and R_{mt} is the equal weight market return. We use the China 1-Year Time Deposit Rate as the risk-free rate of return. SMB is the monthly difference between the return on a portfolio of small stocks and a portfolio of big stocks; HML is the monthly difference between the return on a portfolio of high book-to-market equity stocks and the return on a portfolio of low book-to-market equity stocks. In our third model we investigate the relationship between the expected return of a portfolio, the overall market factor, firm size and idiosyncratic volatility. Our third model can be shown as:

$$R_{pt} - R_{ft} = a_{pt} + b_p (R_{mt}-R_{ft}) + s_p SMB_t + h_p HIVMLIV_t + \varepsilon_{it} \quad [3]$$

Note that in this model we drop the book-to-market equity and investigate the power of idiosyncratic volatility. That is, in this model our variables of interest are firm size and idiosyncratic volatility. We investigate the explanatory power of idiosyncratic volatility since Malkiel and Xu (1997 and 2000) and Xu and Malkiel (2003) suggest that idiosyncratic volatility may be relevant for asset pricing and that it may serve as a useful proxy for systematic risk. More importantly, Malkiel and Xu (1997 and 2000) also find that the portfolio with the highest idiosyncratic volatility generates superior returns.

B. Methods

B1. Portfolio Formation - Model 2

We follow FF (1993, 1996) in constructing portfolios on firm size and book-to-market equity. At the end of December of each year *t* stocks are assigned to two portfolios of size (Small and Big) based on whether their December market equity (ME) is above or below the median ME. The same stocks are allocated in an independent sort to three-book equity to market equity portfolios (Low, Medium, and High) based on the breakpoints for the bottom 33.33 percent and top 66.67 percent. Book equity (BE) is defined as the book value of common shareholder's equity plus the balance sheet deferred taxes (if any) and minus the book value of preferred stocks. The BE/ME ratio used to form portfolios in December of each year *t* is the book common equity for the fiscal year ending in calendar year *t-1* divided by the market equity at the end of December of *t-1*. Following FF (1996) we exclude negative book equity firms, as they do not have meaningful explanations. Our portfolio aggregation procedure results in six intersection portfolios. Monthly returns on the six portfolios are calculated from the following January to December. The explanatory variables R_M, SMB, and HML are defined as follows: R_M (market return) is the market return on all stocks in the six portfolios and includes the negative book equity stocks which were excluded from the sample while forming BE/ME portfolios. SMB is long small capitalization stocks and short big capitalization stocks. HML is long high book-to-market equity stocks and short low book-to-market equity stocks.

B2. Portfolio Formation - Model 3

As with Model 2 we follow the portfolio construction approach of FF (1993, 1996). However, in this model we form portfolios on size and idiosyncratic volatility whereas in Model 2 we formed portfolios on size and book to market equity. Note that we use the same approach as in Model 2 in forming size portfolios. All stocks are then allocated to three idiosyncratic volatility portfolios (Low, Medium, and High) based on the breakpoints for the bottom 33.33 percent and top 66.67 percent**.** We first compute the variance of returns for each stock in the sample. We define the variance of returns as the total risk of a stock. We then estimate the beta for each stock by using the covariance / variance approach. We define systematic risk as the beta of a stock multiplied by the variance of the index.

We define idiosyncratic volatility as the difference between total risk and the systematic risk of a stock. We require the previous 24 months of average returns to calculate the variance or beta of the stock. Stocks that do not have 24 months of continuous returns are excluded from the sample. Similarly, we use the previous 24 months of market returns to calculate the variance of the index. As with our previous model we construct six intersection and three zero investment portfolios.

The six intersection portfolios are S/L, S/M, S/H, B/L, B/M, and B/H. The three zero investment portfolios are RMRFT, SMB and HIVMLIV. RMRFT is long the overall market portfolio and short the risk free asset. SMB (Small minus Big) is long small capitalization stocks and short big capitalization stocks. HIVMLIV (High Idiosyncratic Volatility minus Low Idiosyncratic Volatility) is long high idiosyncratic volatility stocks and short low idiosyncratic volatility stocks.

3.0 Findings

A. Is beta priced?

In this section we report the findings for our first research question - whether beta alone is sufficient to explain the variation in average stock returns.

Table 1

Panel A: Summary Statistics
Mean Monthly Returns
Period: 12/95 to 12/01

Portfolio	RPTRFT	RMRFT
S/L	1.96 (9.59)[3]	1.53 (11.07)
S/M	2.38 (10.87)	1.53 (11.07)
S/H	2.12 (10.50)	1.53 (11.07)
B/L	1.39 (10.14)	1.53 (11.07)
B/M	1.64 (9.87)	1.53 (11.07)
B/H	1.04 (9.06)	1.53 (11.07)

Table 1, Panel A reports the average excess returns for the six portfolios. The table shows that all six portfolios generate positive returns. The table also shows that the broad market portfolio generates a monthly return of 1.53 per cent or 18.36 percent per annum. In Panel B we report the parameter estimates of our model.

[3] Standard Deviation in parentheses

Table 1-Continued
Panel B: R_{pt}-R_{ft} = a_{pt}+b_p(R_{mt}-R_{ft})+ε_{pt}

Portfolio	a	b	Adjusted R^2
S/L	0.815 (1.515)[4]	0.747 (15.435)	0.64
S/M	0.767 (1.371)	0.824 (19.283)	0.66
S/H	0.735 (1.142)	0.706 (14.364)	0.62
B/L	0.151 (0.290)	0.712 (17.403)	0.63
B/M	0.340 (1.077)	0.60 (13.203)	0.58
B/H	-0.09 (-0.237)	0.54 (11.722)	0.55

Table 1, Panel B reports the regression parameters. The results show that the intercept is not statistically significant for any of the six portfolios. It is also observed that the overall market factor, b coefficient, is significant at the 1-per cent level for all six portfolios. The average R^2 for the six portfolios is 0.61, which implies that the market factor explains 61% of the variation in the cross-section of average stock returns. We now proceed to present the findings for our second model – Fama and French (1996) multifactor model.

B. Are size and book-to-market equity priced?

In this section we report the findings of our multifactor model. Recall that in our second research question we investigate the explanatory power of firm size and book-to-market equity in addition to the overall market portfolio. In Panel A, we report the excess returns while in Panel B we report the parameter estimates.

[4] T-Statistics in parentheses

Table 2
Panel A: Summary Statistics
Mean Monthly Returns
Period: 12/95 to 12/01

PORTFOLIO	RPTRFT	RMRFT	SMB	HML
S/L	1.9614 (9.59)[5]	1.5342 (11.07)	0.7934 (3.37)	-0.0964 (3.62)
S/M	2.3819 (10.87)	1.5342 (11.07)	0.7934 (3.37)	-0.0964 (3.62)
S/H	2.1242 (10.50)	1.5342 (11.07)	0.7934 (3.37)	-0.0964 (3.62)
B/L	1.3967 (10.14)	1.5342 (11.07)	0.7934 (3.37)	-0.0964 (3.62)
B/M	1.6493 (9.87)	1.5342 (11.07)	0.7934 (3.37)	-0.0964 (3.62)
B/H	1.0412 (9.06)	1.5342 (11.07)	0.7934 (3.37)	-0.0964 (3.62)

In Table 2, Panel A, we report the average excess returns of the six portfolios. The table shows that all six portfolios generate positive returns. It is worth noting that the three small stock portfolios generate higher returns than the three big stock portfolios. The table also shows that the overall market factor generates a return of 1.53 per cent per month or 18.36 percent per annum while the mimic portfolio for size and book-to-market equity generate an annual return of 9.52 per cent and –1.15 per cent respectively. Note that the mimic portfolio for book-to-market equity generates negative returns.

In short, our findings show that small stocks and low book-to-market equity stocks generate higher returns than big and high book-to-market equity stocks. Since, small and low book-to-market equity stocks generate higher returns than big and high book-to-market equity stocks we suggest that such firms carry risk premia. Our findings are consistent with that of FF (1996) who argues that small stocks generate higher returns than big stocks because they are fundamentally riskier. However, with respect to book-to-market equity our findings are different in the sense that we find that the mimic portfolio for book-to-market equity generates negative returns

[5] Standard Deviation in parentheses

suggesting that high book-to-market firms are not riskier than low book-to-market equity firms. We now proceed to Panel B where we report the parameter estimates.

Table 2-Continued

Panel B: $R_{pt} – R_{ft} = a_{pt} + b_p (R_{mt}-R_{ft}) + s_pSMB_t + h_pHML_t + \varepsilon_{pt}$

Portfolio	a	b	s	h	Adjusted R^2	DW
S/L	0.399 (1.138)	0.771 (24.322)	0.360 (3.492)	-0.978 (-10.266)	0.90	1.90
S/M	0.489 (1.550)	0.909 (31.886)	0.583 (6.295)	-0.379 (-4.424)	0.93	1.96
S/H	0.346 (1.261)	0.872 (33.939)	0.559 (6.691)	-0.416 (5.539)	0.94	1.88
B/L	0.273 (0.869)	0.880 (30.963)	-0.409 (-4.427)	-1.010 (-11.813)	0.92	1.93
B/M	0.134 (1.523)	0.893 (39.304)	-0.479 (-6.493)	-0.275 (-4.033)	0.87	1.96
B/H	0.327 (0.889)	0.779 (23.467)	-0.609 (-5.642)	-0.003 (-0.302)	0.94	1.98

In Table 2, Panel B we report the parameter estimates of the three-factor model. The results show that the intercept is statistically insignificant for all six portfolios. We also observe that the overall market factor, *b* coefficient, is close to one and significant at the 1-percent level for all six portfolios. The *s* coefficient is positive and significant at the 1 per cent level for the three small portfolios. As far the three big stock portfolios are concerned the s coefficient is negative but significant at the 1-percent level. Our findings are consistent with that of FF (1996) who report that small firms load positively on SMB while big firms load negatively on SMB.

Our results also show that the *h* coefficient is negative for all six portfolios. Our results are interesting because FF (1996) show that high book to market equity firms load positively on HML factor while low book to market firms load negatively on the HML factor. Note that we document otherwise as the h coefficient is negative foe all six portfolios. Our findings show that the book to market equity effect is not as pervasive as was found with the US portfolios. As far as diagnostics are concerned we find no evidence of autocorrelation[6], multicollinearity or heteroscedasticity entering our regression model. The average R^2 is 0.91, which implies that the three independent variables explain at 91% per cent of the variation in the cross-section of average stock returns. Recall that the average R^2 was 0.61 when beta was the sole explanatory variable. Thus, we argue that the multifactor model explains the variation in average stock returns better than the one factor CAPM. As far as the turn of the year effect[7] is concerned our findings show that the multifactor model is robust throughout the sample period. We now present the findings of our third model where we substitute the book to market variable with idiosyncratic volatility.

C. Are size and idiosyncratic volatility priced?

Table 3
Panel A: Summary Statistics
Mean Monthly Returns
Period: 12/95 to 12/00

PORTFOLIO	RPTRFT	RMRFT	SMB	HIVMLIV
S/L	3.3661 (12.5651)	2.18 (4.62)	0.76 (3.37)	-0.58 (6.58)
S/M	2.6001 (9.3550)	2.18 (4.62)	0.76 (3.37)	-0.58 (6.58)
S/H	2.2823 (9.8576)	2.18 (4.62)	0.76 (3.37)	-0.58 (6.58)
B/L	1.9787 (11.5603)	2.18 (4.62)	0.76 (3.37)	-0.58 (6.58)
B/M	2.0775 (9.7818)	2.18 (4.62)	0.76 (3.37)	-0.58 (6.58)
B/H	1.8860 (10.2403)	2.18 (4.62)	0.76 (3.37)	-0.58 (6.58)

Table 3, Panel A, shows that all six portfolios generate positive returns. The table also shows that the broad market portfolio generates a monthly return of 2.18

[6] In this paper we employed the Durbin-Watson, d test, for detecting autocorrelation, Condition Index and the Variance inflation factors to detect multicollinearity and White's test to detect heteroskedasticity.

[7] For Models 2 and 3 we added a dummy for January and February to test for January and Chinese New Year effects. Our findings show that the coefficients for the two dummy variables are not statistically significant for any of the six portfolios. Thus, we reject the argument that the multifactor model findings can be explained by the turn of the year effect. We only report the coefficients of our main model for reasons of space.

percent. Our findings also show that the mimic portfolio for size generates an excess return of 0.76 percent per month while the mimic portfolio for idiosyncratic volatility generates a return of – 0.58 percent per month. It is interesting to note that investors perceive low idiosyncratic volatility firms to be more risky than high idiosyncratic volatility firms. As far as the size effect is concerned our findings are consistent with that of FF (1993, 1996, 1998) and Malkiel and Xu (1997) who document those small firms generate superior returns than big firms.

Thus, we offer a risk-based explanation for market and size effect. As far as idiosyncratic volatility is concerned our findings are different from that of Malkiel and Xu (1997) in the sense that the mimic portfolio generates negative returns whereas Malkiel and Xu (1997) document otherwise. It is equally interesting to note that in Model 2 we documented a size effect but found that the book to market effect was not as pervasive as was found for the US portfolios. That is, the mimic portfolio for the book to market effect, HML, generated negative returns whereas FF (1993, 1996, 1998) show otherwise. We now proceed to Panel B where we discuss the regression parameters.

Table 3-Continued

Panel B: $R_{pt} – R_{ft} = a_{pt} + b_p (R_{mt}-R_{ft}) + s_pSMB_t + h_pHIVMLIV_t + \varepsilon_{pt}$

Portfolio	a	b	s	h	Adjusted R^2	DW
S/L	0.422 (1.554)	0.963 (22.721)	0.875 (9.592)	-0.278 (-4.596)	0.95	1.96
S/M	0.494 (1.567)	0.847 (33.245)	0.752 (6.165)	0.556 (7.738)	0.90	1.91
S/H	0.083 (0.227)	0.877 (14.545)	0.929 (6.515)	0.742 (5.873)	0.89	1.88
B/L	-0.030 (-0.093)	0.856 (12.742)	-0.075 (-0.534)	-0.328 (-3.202)	0.91	1.98
B/M	0.723 (1.866)	0.890 (28.966)	-0.238 (-1.609)	0.698 (15.145)	0.89	1.96
B/H	0.308 (1.186)	0.941 (19.315)	-0.129 (-1.426)	0.651 (7.827)	0.91	1.95

Table 3, Panel B, shows that the intercept is statistically indistinguishable from zero for all portfolios. The table also shows that the overall market factor is close to one for most portfolios and is significant at the 1- percent level for all six portfolios. The s coefficient is positive and significant at the 1- percent level for the three small stock portfolios. As far the three big portfolios are concerned the s coefficient is negative but not significant. It is to be noted that our findings are consistent with prior research in this area. This is because FF (1993, 1996) and others show that small load positively on the SMB factor while big firm's load negatively on the SMB factor.

Note that our findings for Models 2 and 3 are identical in this respect in that we document a clear size effect. We document this after looking at the mimic portfolio returns and the behaviour of the coefficient both in terms of direction and magnitude. The behaviour of h coefficient is interesting. It is interesting because the coefficient is negative for low idiosyncratic volatility portfolios but becomes positive for medium and high portfolios. The behavior of the h coefficient is consistent with prior research in this area. However, what is not consistent is the behavior of the mimic portfolio, HIVMLIV. That is, the mimic portfolio for idiosyncratic volatility generated a return of –0.58 percent per month. The average adjusted R^2 is 0.91 which implies that the three independent variables help explain at least 91% of the variation in the dependent variable.

We also do not find any evidence of autocorrelation, multicollinearity or heteroscedasticity in our regression model. In summary, our findings clearly show that beta alone is insufficient to explain the variation in average stock returns. In this paper we show clear existence of small firm effect and also document that variables such as book to market equity and idiosyncratic volatility are priced. Our findings challenge the traditional CAPM, which states that beta alone, is sufficient to explain the variation in average stock returns.

4.0 Conclusion

In this paper we compare the performance of the traditional CAPM with the multifactor model of FF (1996) for equities listed in the Shanghai Stock Exchange. In addition, we also investigate the explanatory power of idiosyncratic volatility in a multifactor setting. Our results reveal that Chinese investors view small and low idiosyncratic volatility firms as more risky than big and high idiosyncratic volatility firms. This is an interesting finding because Drew and Veeraraghavan (2002) show those investors in Hong Kong, India, Malaysia and Philippines perceive firms with high idiosyncratic volatility to be more risky than those with low idiosyncratic risk.

We also test the claim that the multifactor model findings can be explained by the turn of the year effect. We respond to this argument by adding a dummy for both January and Chinese New Year effects. Our findings clearly show that variables such as firm size, book to market equity and idiosyncratic volatility are priced. We demonstrate that the multifactor model does a better job than the single factor CAPM. As far as the turn of the year effect is concerned we dismiss the claim that the multifactor model is not robust throughout the sample period. Our findings have implications not only for academic researchers in the area of asset pricing or corporate finance but also for practitioners. We say this because practitioners can generate superior returns from following strategies investigated in this paper. What will be more interesting is to see if these strategies continue to generate superior returns in the future. This is left for future research.

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