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International Business Review 14 (2005) 695–717

INTERNATIONAL BUSINESS REVIEW

www.elsevier.com/locate/ibusrev

# Common risk factors in returns in Asian emerging stock markets

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Received 17 February 2005; received in revised form 31 August 2005; accepted 9 September 2005

**Abstract**

This paper examines the application of the Fama and French's (1993) three-factor model in three Asian emerging markets (Hong Kong, Singapore and Taiwan). The empirical evidence is consistent with the US findings that the model can explain most of the variations in average returns. However, we find that the main contributing factor is the contemporaneous market excess returns. The impact of the size effect and book-to-market (BE/ME) factor is limited and in some cases insignificant. When the three-factor model is modified by using lagged market excess returns instead in order to check for the predictability of the market factor, the explanatory power of the model drops substantially but both the risk factors for size and BE/ME are now able to contribute significantly in explaining the cross-sectional variations of stock returns. Their explanatory powers are strongest for small-size with high BE/ME portfolios. The robustness of our results is also checked for the separation of up and down markets periods and January effect.


*JEL classification:* JEL Classification; G12/G15

*Keywords:* Three-factor model; Emerging markets; Size effect; BE/ME factor

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0969-5931/$ - see front matter 
doi:10.1016/j.ibusrev.2005.09.001

## 1. Introduction

Several studies documented that average return is related to firm size, book-to-market equity ratio (BE/ME), earnings to price ratio (E/P), cash flow to price ratio (C/P) and past sales growth. Banz (1981); Basu (1983); Cook and Rozeff (1984); Davis (1994); De Bondt and Thaler (1987); Keim (1983); Lakonishok and Shapiro (1984); Reinganum (1982); Rosenberg et al. (1985), and Lakonishok et al. (1994)) provided evidence on these firm characteristics in explaining the average stock returns. Since these patterns in the behavior of stock prices cannot be explained by the Capital Asset Pricing Model (CAPM) of Sharpe (1964); Lintner (1965), they are typically called anomalies. Fama and French (1992) found that size and BE/ME play dominant roles in explaining the cross-sectional variations in US stock returns. Fama and French (1993) showed that size and BE/ME proxy for the security's loadings in priced factors within a three-factor model. The three factors are the returns on the market portfolio and those on two zero net-investment portfolios: long in portfolio of small-size stocks and short in portfolio of big-size stocks (SMB) and long in portfolio of high BE/ME stocks and short in portfolio of low BE/ME stocks (HML). They found that the three factors provide a good job in explaining the cross-section of average stock returns. Fama and French (1996) further showed that the three-factor model captures returns regardless of the construction methods of portfolios, i.e. based on E/P, C/P, and past sales growth.

Daniel and Titman (1997) examined the irrational pricing against the three-factor model of Fama and French (1993, 1996). They argued that expected returns are not related to an asset's covariance with any economic risk factor but rather with firm specific characteristics. They rejected the three-factor model, but not the characteristic model. However, Davis et al. (2000) documented that the three-factor model explains the value premium, as measured by HML, better than the characteristic model of Daniel and Titman (1997). They argued that the results of Daniel and Titman (1997) are due to their short sample period. Daniel et al. (2001) replicated the tests of Daniel and Titman (1997) in the Japanese stock market and provided evidence rejecting the three-factor model but not rejecting the characteristic model.

Previous empirical work has discovered that US stock returns are largely explained by size and BE/ME effects. In Asian emerging markets, Chui and Wei (1998); Ho et al. (2000b), and Lam (2002) showed that significant size and BE/ME effects are observed in Hong Kong. In fact, Ho et al. (2000a) also suggested that the CAPM may indeed be misspecified as beta plays no role after examining the equilibrium risk-return relationships in the Hong Kong stock market. Wong and Lye (1990); Lau et al. (2002) found that Singaporean stock returns are related to firm size. Chui and Wei (1998) also found no significant firm size and BE/ME effects in Taiwan. However, it should be noted that the above articles did not employ the exact Fama and French (1993) three-factor model in their analysis in that no zero net-investment portfolios are formed for size and BE/ME factors. They simply employed the market capitalization and book-to-market ratio directly in their regression models. To the best of our knowledge, except those studies by Drew and Veeraraghavan (2001 and 2003), there is probably no study to test the robustness of the same model in the Asian emerging stock markets. Drew and Veeraraghavan (2003) investigated the robustness of the Fama and French (1993) three-factor model in Hong Kong, Korea, Malaysia and Philippines. They documented that size and value effects exist for all four markets under investigation and concluded that the multi-factor model approach provides a parsimonious description of the cross-section of returns for these Asian markets over the 1990s. This paper helps provide more empirical evidence of the model in three Asian markets.

This paper makes no attempt to provide any argument whether the three-factor model of Fama and French (1993, 1996) or characteristic model of Daniel and Titman (1997) is superior but has the following two purposes. The first one is to examine the fitness of the three-factor model in three Asian emerging equity markets (Hong Kong, Singapore and Taiwan). Besides adding evidence on two new markets (Singapore and Taiwan) as compared to the work of Drew and Veeraraghavan (2003, hereafter DV), our paper is also different from theirs in several ways even for the common market under study (i.e. Hong Kong). First, we use a longer sampling period (7/1986–12/1998) than DV (12/1993–12/1999). Second, we employ a different source of data from theirs (Pacific-Basin Capital Markets Databases vs. Datastream). These two points are important as noted by Campbell et al. (1997) because using different sampling periods, different data sources and different markets can help in checking the true out-of-sample performance of the mutli-factor model. Third, besides employing time-series regressions as DV did, we also perform time-pooled cross-sectional regression analysis. Fourth, we form 9 (3 sizes time 3 BE/ME values) portfolios instead of 6 (2 sizes time 3 BE/ME values) as in DV. Fifth, in running OLS regression, we adjust for the effects of heteroskedasticity and first-order autocorrelation which was not done in DV (DV only checked for the existence of autocorrelation and concluded that autocorrelation does not exist in their sample) and hence, our results are considered to be more reliable in terms of these potential errors.

The second objective of this paper is to investigate the three-factor model when the overall contemporaneous market factor is replaced by the lagged market factor. This extension of the model has not been examined in previous studies, but may provide new insight for us to better understand the role plays by the market factor. We all know that portfolios returns are highly correlated with the contemporaneous market returns and the relevance of other factors may be missed under statistical tests. Hence, the proposed extension helps check whether the market factor does have a dominant role in these Asian markets. Furthermore, by using the lagged market factor, we can see how large its predictive power is, if any, on portfolios returns. This investigation is more relevant to emerging markets when compared with those developed markets like US and UK, as previous studies have indicated that significant serial autocorrelation may exist in emerging markets returns. We further enhance our analysis by performing robustness check with respect to two effects: up and down markets separation and the January effect. The rest of the paper is organized as follows: Section 2 describes the data and methodologies. A sub-section on institutional features of the three markets is also included. Section 3 reports the empirical results while Section 4 concludes the paper.

## 2. Data and methodologies

### 2.1. Institutional features of markets

Among the three stock markets under studied, Hong Kong is the largest while Singapore is the smallest market in term of market capitalization. The Hong Kong stock market follows an order-driven system and has two trading session daily (Monday to Friday): the morning session starts from 10:00 a.m. to 12:30 p.m., and the afternoon session is from 2:30 p.m. to 4:00 p.m. During the continuous trading session, the system accepts limit, enhanced limit and special limit orders. Buy and sell orders are traded electronically via the Automatic Order Matching and Execution System (AMS). Transaction's settlement follows the T + 2 rule.

The Taiwan Stock Exchange also follows an order-driven system but has only one continuous trading session daily from 9:00 a.m. to 1:30 p.m., Monday through Friday. The Exchange operates an off-hour trading session from 2:00 to 2:30 p.m., Monday through Friday. Thirty minutes before the market opens, customers' orders can be entered by the personnel of the securities firm on first-come-first-serve basis. Buy and sell orders are traded electronically via a fully automated securities trading (FAST) system starting from 1993. The book-entry system of shares and payments settlement is administered centrally through the Taiwan Securities Central Depository Company (TSCD). Same as in Hong Kong, the settlement of shares and payments between securities firms and the Exchange works on a T+2 rule.

The Singapore Stock Exchange operates a fully electronic and floorless securities trading system. Two trading sessions are held daily from Mondays to Fridays between 9.00 a.m. and 12.30 p.m. and from 2.00 to 5.00 p.m. In addition, there is a Pre-Open Routine (8.30–9.00 a.m.) and Pre-Close Routine (5.00–5.06 p.m.). Shares are mainly traded in board lots of 1000 shares. Orders are traded electronically via the Central Limit Order Book (CLOB)—a screen-based computerized trading system. Under the CLOB System, workstations installed at brokers' offices are linked directly to the Exchange's computer system. Investors' orders are keyed in and matched by the system and confirmations sent to the brokers immediately. The CLOB system maintains an order book for every traded stock and matches buy and sell orders. Each order in the order book has a limit price. This is the highest (for a buy order) or lowest (for a sell order) price at which the order can be executed. Orders in the CLOB system are held according to price, then time priority. Clearing and settlement of trades are centrally administered by the Central Depository Limited.

From the above information, we can see that all three markets operate an electronic trading system. Besides, the individual investors in these markets are predominately Chinese. This makes it reasonable to study them at the same time in our analysis.

### 2.2. Data source

Monthly returns on non-financial companies, market returns and accounting data for the three emerging markets are collected from the Pacific-Basin Capital Markets (PACAP) Databases. Monthly returns of all stocks traded on the Hong Kong Stock Exchange (HKSE), Taiwan Stock Exchange (TSE) and the Stock Exchange of Singapore (SES) from July 1986 to December 1998 are employed.[1] Our sample excludes those stocks issued after 1993 and the sample covers all stocks that have been traded at least 72 months. Companies that are delisted are not deleted from the sample prior to their delisting in order to prevent the survivorship bias. Equally weighted as well as value-weighted market returns are employed as the market proxies, respectively. The one-month Hong Kong interbank offer rate (HIBOR), one-month Singapore interbank offer rate (SIBOR) and 30-day Taiwan money market rate are used as the risk-free interest rate respectively for each stock market.

In order to ensure the accounting information is known before the stock returns for which the accounting information is used to explain, we match stock returns for the period between July of year $t$ to June of year $t+1$ to accounting data of the company at the fiscal year-end that falls in year $t-1$.[2] Size is the market value of equity (ME) at the end of June in year $t$. The book-to-market equity (BE/ME) is defined as the firm's book equity (BE) for the fiscal year ending in

[1] Data for some companies are not available for some years. The selection criterion is that the listed stocks in each stock market must have no more than 10% per cent of missing values and zero returns out of the total returns of each individual stock.

[2] Fama and French (1992) pointed out that matching accounting data for all fiscal yearends in calendar year $t-1$ with returns for July of $t$ to June of $t+1$ creates a gap between accounting data and matching returns across firms since different firms have different fiscal yearends. However, similar results were generated when they used a smaller sample of firms with December fiscal yearends.

calendar year $t-1$ divided by its market equity (ME) at the end of December of $t-1$. We do not use negative-BE firms when calculating the BE/ME or forming the size-BE/ME portfolios. Hence, these accounting information of all firms are collected from December 1985 to December 1997 annually.

In each year, $t$, each firm is ranked by its market value of equity at the end of June in year $t$. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio in each of the three stock markets. SMB is the difference, each month, between the average returns on the three small-stock portfolios and the average returns on the three big-stock portfolios. HML is the difference, each month, between the average returns on the three high-BE/ME portfolios and the average returns on the three low-BE/ME portfolios.

### 2.3. Fama and French three-factor model

Fama and French (1993) proposed a three-factor model to capture the CAPM average-return anomalies. The model states that the expected return on a risky portfolio $p$, in excess of risk-free rate, i.e. $E(R_p)-R_f$ is explained by the sensitivity of its return to three factors: (i) the excess return on the market portfolio, $R_m-R_f$; (ii) the difference between the return on a portfolio covering small-size stocks and the return on a portfolio covering large-size 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). Hence, the expected excess return on portfolio $p$ can be written as

$$E(R_p)-R_f = b_p[E(R_m)-R_f] + s_pE(\text{SMB}) + h_pE(\text{HML}) \quad (1)$$

The previous empirical findings documented that smaller market value portfolios or higher book-to-market value portfolios generally produce higher average returns. SMB and HML, the two mimicking portfolios under the three-factor model, are tested whether they help explain the co-variations in returns on small stocks and high BE/ME stocks that are not captured by the market returns and are compensated in average returns.

The equilibrium relation of Fama and French (1993) three-factor model is stated in terms of the expected returns. In order to test the model with historical data, we transform Eq. (1) to

$$R_{p,t}-R_{f,t} = a_p + b_p(R_{m,t}-R_{f,t}) + s_p\text{SMB} + h_p\text{HML} + \tilde{\mu}_{p,t} \quad (2a)$$

and

$$R_{p,t}-R_{f,t} = a_p + b_p(R_{m,t-1}-R_{f,t-1}) + s_p\text{SMB} + h_p\text{HML} + \tilde{\mu}_{p,t} \quad (2b)$$

where $(R_{p,t}-R_{f,t})$ is portfolio $p$'s excess return at time $t$; $(R_{m,t}-R_{f,t})$ is market excess return at time $t$; $(R_{m,t-1}-R_{f,t\text{-}1})$ is market excess return at time $t-1$; SMB is the excess return on small stocks over large stocks; HML is the excess return on high-BE/ME stocks over low-BE/ME stocks; $\tilde{\mu}_{p,t}$ is a disturbance term assumed to have zero mean and to be uncorrelated with all other variables; and the factor sensitivities or loadings, $b_p$, $s_p$, and $h_p$, are the slope coefficients in the time-series regression. Besides the nine time-series regressions run for each size-BE/ME portfolios, we also run a single time-pooled cross-sectional regression for each market. Both regressions employ the standard OLS procedure.

In testing, the null hypotheses whether the regression coefficients are equal to zero, standard *t*-tests are applied. However, before running the regressions, some diagnostic checks are performed. We test for heteroskedasticity using the White test (White, 1980) and using the Durbin–Watson test (Durbin and Watson, 1950, 1951a,b) for autocorrelation. We find evidence (results are not reported here to save space) of significant heteroskedasticity and autocorrelation in the regressions disturbances in the models. This suggests that *t*-test results obtained from standard OLS procedure are unreliable and hence, we adjust the standard deviations to correct for the effects of heteroskedasticity and first-order autocorrelation using the method of Newey and West (1987) in running the *t*-tests. It should be noted that this correction procedure only alters the standard errors of the *t*-tests (i.e. the *t*-values in testing for statistical significance) without changing the regression estimates obtained from the OLS procedure. We also use the variance inflation factors to detect multicollinearity (results are not reported here to save spaces). Since all factors are less than 10, multicollinearity does not exist.

## 3. Empirical results

In all tables below, only the results on the equally weighted market proxy are reported. This is in line with Fama and French (1992). Results on the value-weighted market proxy are available from the authors.[3]

Table 1 presents the descriptive statistics for the nine equally weighted size-BE/ME sorted portfolios. Panel A shows that the mean return in the Hong Kong stock market tends to increase from low-BE/ME portfolios to high-BE/ME portfolios. Small firms outperform big firms. However, no monotonic pattern in mean return is observed from small firms to big firms, except for portfolios that contain high-BE/ME stocks. Panel B indicates that high-BE/ME portfolios earn higher returns than low-BE/ME portfolios in the Singaporean stock market. Portfolios contain small stocks capture higher returns than portfolios of big stocks. Finally, Panel C shows that the mean return in the Taiwan stock market tends to decrease from small-size portfolios to large-size portfolios. A similar monotonic pattern in mean return is observed from low BE/ME firms to high BE/ME firms, except for the small-size and low BE/ME portfolios. Results on the standard deviations are more consistent across the three markets. Standard deviation decreases from small-size portfolios to large-size portfolios. Table 1 also reports the coefficients of variations (CV) of the nine corresponding portfolios. In general, small-size portfolio or high BE/ME portfolio has smaller CV than large-size and low BE/ME portfolios, respectively. Besides the size and BE/ME sorted portfolios, zero-cost portfolios are produced by longing small-size and high BE/ME portfolios and shorting correspondingly the large-size and low BE/ME portfolios at the same time. Results show that all zero-cost portfolios in all three markets have positive mean returns, supporting previous findings in the US market.

Table 2 presents the average number of stocks in each of the nine equally weighted size-BE/ME sorted portfolios by year for all three markets. It shows that the number is largest in Hong Kong with a range of 11–26 while in Taiwan, the number ranges from 9 to 25. This number is

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[3] Basically, though regression coefficients differ when using equally weighted or valued-weighted market proxies, the conclusions drawn from the results are the same in general. In most cases, adjusted R-squared is larger with equally weighted market proxy.

Table 1
Summary statistics for equally weighted monthly excess returns on 9 portfolios formed on size and BE/ME in the Hong Kong, Singaporean and Taiwan stock markets

| Size | Book-to-Market Equity (BE/ME) | | | | | | | | | | Zero-cost Portfolios | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Low | Medium | High | Low | Medium | High | Low | Medium | High | | | |
| | Mean | | | Standard Deviation (S.D.) | | | Coefficient of Variation (C.V.) | | | | SMB | HML |
| *Panel A: Summary Statistics for Hong Kong* | | | | | | | | | | | | |
| Small | 0.0216 | 0.0229 | 0.0285 | 0.1168 | 0.1220 | 0.1154 | 5.4050 | 5.3271 | 4.0455 | Mean | 0.0142 | 0.0077 |
| Medium | 0.0034 | 0.0054 | 0.0136 | 0.1027 | 0.1107 | 0.1152 | 30.2854 | 20.4645 | 8.4812 | S.D. | 0.0683 | 0.0343 |
| Big | 0.0071 | 0.0104 | 0.0130 | 0.0775 | 0.1038 | 0.1097 | 10.9285 | 9.9720 | 8.4395 | C.V. | 4.8117 | 4.4718 |
| *Panel B: Summary Statistics for Singapore* | | | | | | | | | | | | |
| Small | 0.0163 | 0.0158 | 0.0196 | 0.1175 | 0.1092 | 0.1067 | 7.2239 | 6.9044 | 5.4330 | Mean | 0.0175 | 0.0180 |
| Medium | 0.0082 | 0.0143 | 0.0145 | 0.0977 | 0.1040 | 0.1177 | 11.8547 | 7.2477 | 8.1072 | S.D. | 0.1711 | 0.1057 |
| Big | 0.0074 | 0.0110 | 0.0157 | 0.0849 | 0.1016 | 0.1120 | 11.4948 | 9.1933 | 7.1115 | C.V. | 9.7619 | 5.8727 |
| *Panel C: Summary Statistics for Taiwan* | | | | | | | | | | | | |
| Small | 0.0252 | 0.0215 | 0.0289 | 0.1650 | 0.1619 | 0.1647 | 6.5557 | 7.5290 | 5.6978 | Mean | 0.0132 | 0.0043 |
| Medium | 0.0150 | 0.0170 | 0.0184 | 0.1483 | 0.1359 | 0.1448 | 9.8772 | 7.9813 | 7.8803 | S.D. | 0.0812 | 0.0479 |
| Big | 0.0095 | 0.0110 | 0.0155 | 0.1265 | 0.1205 | 0.1391 | 13.2567 | 10.9349 | 8.9941 | C.V. | 6.1595 | 11.0338 |

In each year, *t*, each firm is ranked by its market value of equity at the end of June in year *t*. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio in the Hong Kong, Singaporean and Taiwan stock markets. For zero-cost portfolios, SMB (HML) represents long small-size (high-BE/ME) portfolios and short large-size (low-BE/ME) portfolios.

smallest in Singapore and ranges from 7 to 12 only. Compared with previous studies using the US data, the number of stocks in each portfolio is small. However, this is a common limitation in using emerging market data. In view of the 'thinness' problem in the portfolio size, empirical results found in this study should be read cautiously.

### *3.1. Regression results in the Hong Kong stock market*

Results for the time-series regressions of nine size-BE/ME portfolios excess returns on the contemporaneous market excess returns and the SMB and HML factors are showed in Table 3. Six out of nine intercepts are positive and four intercepts are significant at the 5% level. Our results here are different from those of DV who found that none of the six intercepts is significantly different from zero. The difference may be due to different sampling periods, different sources of data and/or different methodologies in calculating the *t*-values in our and their studies. The nine slope coefficients on the market portfolio are all significantly positive and range from 0.82 (for portfolios of big size and low BE/ME) to 1.07 (for small-size and low BE/ME portfolios). However, no consistent pattern is found between size and market beta in the three BE/ME groups. The slopes on SMB are systematically related to size from small to big.

Table 2
The average number of stocks in each of the 9 size and BE/ME sorted portfolios by year

| Year[a] | Portfolio 1 *S/L* | Portfolio 2 *S/M* | Portfolio 3 *S/H* | Portfolio 4 *M/L* | Portfolio 5 *M/M* | Portfolio 6 *M/H* | Portfolio 7 *B/L* | Portfolio 8 *B/M* | Portfolio 9 *B/H* |
|---|---|---|---|---|---|---|---|---|---|
| *Panel A: Hong Kong* | | | | | | | | | |
| 1986 | 11 | 11 | 12 | 11 | 11 | 12 | 11 | 11 | 12 |
| 1987 | 12 | 13 | 13 | 12 | 13 | 13 | 13 | 13 | 13 |
| 1988 | 14 | 14 | 15 | 14 | 15 | 15 | 14 | 15 | 15 |
| 1989 | 17 | 17 | 18 | 17 | 17 | 18 | 17 | 18 | 18 |
| 1990 | 18 | 18 | 18 | 18 | 18 | 19 | 18 | 18 | 19 |
| 1991 | 18 | 18.92 | 19 | 18 | 19 | 19 | 18 | 19 | 19 |
| 1992 | 22 | 22 | 22 | 22 | 22 | 23 | 22 | 22 | 23 |
| 1993 | 26 | 26 | 26.42 | 26 | 26 | 27 | 26 | 26.25 | 27 |
| 1994 | 25.92 | 26.5 | 26.75 | 26 | 26.5 | 26.75 | 26 | 26.5 | 26.75 |
| 1995 | 25 | 26 | 26 | 25.17 | 26 | 26 | 25.5 | 26 | 26 |
| 1996 | 25 | 25.25 | 26 | 25 | 25.83 | 26 | 25 | 26 | 26 |
| 1997 | 25 | 25 | 25.83 | 25 | 25 | 26 | 25 | 25 | 26 |
| 1998 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 25 |
| *Panel B: Singapore* | | | | | | | | | |
| 1986 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 8 |
| 1987 | 7 | 7 | 8 | 7 | 7 | 8 | 7 | 7 | 8 |
| 1988 | 8 | 8 | 9 | 8 | 8 | 9 | 8 | 8 | 9 |
| 1989 | 8 | 9 | 9 | 8 | 9 | 9 | 8 | 9 | 9 |
| 1990 | 9 | 9 | 9 | 9 | 9 | 10 | 9 | 9 | 10 |
| 1991 | 10 | 10 | 11 | 10 | 10 | 11 | 10 | 10 | 11 |
| 1992 | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 1993 | 11 | 11 | 12 | 11 | 12 | 12 | 11 | 12 | 12 |
| 1994 | 11 | 11 | 12 | 11 | 12 | 12 | 11 | 12 | 12 |
| 1995 | 11 | 11 | 12 | 11 | 12 | 12 | 11 | 12 | 12 |
| 1996 | 11 | 11 | 12 | 11 | 11.92 | 12 | 11 | 12 | 12 |
| 1997 | 10.5 | 11 | 11 | 10.5 | 11 | 11 | 11 | 11 | 11.5 |
| 1998 | 10 | 10.67 | 11 | 10 | 11 | 11 | 10 | 11 | 11 |
| *Panel C: Taiwan* | | | | | | | | | |
| 1986 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| 1987 | 9 | 9 | 10 | 9 | 9 | 10 | 9 | 10 | 10 |
| 1988 | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 1989 | 13 | 13 | 14 | 13 | 13 | 14 | 13 | 14 | 14 |
| 1990 | 14 | 14 | 14 | 14 | 14 | 15 | 14 | 14 | 15 |
| 1991 | 17 | 17 | 17.58 | 17 | 17 | 18 | 17 | 17 | 18 |
| 1992 | 18 | 18 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |
| 1993 | 23 | 23 | 24 | 23 | 24 | 24 | 23 | 24 | 24 |
| 1994 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 25 |
| 1995 | 24 | 24 | 24 | 24 | 24 | 25 | 24 | 24 | 25 |
| 1996 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 25 |
| 1997 | 23 | 23 | 24 | 23 | 23 | 24 | 23 | 23.5 | 24 |
| 1998 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |

[a] Denotes the year starts from July and ends in the next June but the last year only ends in December 1998.

In each BE/ME group, the SMB slope decreases monotonically from strong positive value to strong negative value and all are significant at the 5% level except those for medium-size with medium and high BE/ME portfolios. The slopes on HML are systematically related to BE/ME from low to high. In each size group, the slope increases monotonically from strong negative

Table 3
Time-series regressions using equally weighted monthly contemporaneous market excess returns for 9 portfolios formed on size and BE/ME: 07/1986–12/1998, 150 months, in the Hong Kong stock market

| Book-to-Market Equity (BE/ME) | | | | | | |
|---|---|---|---|---|---|---|
| Size | Low | Medium | High | Low | Medium | High |
| Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t}-R_{f,t})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ | | | | | | |
| | $a$ | | | $t(a)$ | | |
| Small | 0.0053 | 0.0009 | 0.0047 | 1.72 | 0.30 | 1.88 |
| Medium | −0.0063 | −0.0096 | −0.0036 | −2.21 | −3.63 | −1.65 |
| Big | 0.0045 | 0.0039 | 0.0025 | 2.79 | 2.11 | 1.05 |
| | $b$ | | | $t(b)$ | | |
| Small | 1.0695 | 0.9529 | 0.8686 | 28.53 | 23.86 | 18.39 |
| Medium | 1.0522 | 1.0299 | 1.0495 | 16.64 | 25.24 | 19.79 |
| Big | 0.8207 | 1.0460 | 1.0243 | 25.69 | 40.41 | 29.54 |
| | $s$ | | | $t(s)$ | | |
| Small | 0.4331 | 0.5467 | 0.4426 | 7.01 | 5.63 | 11.48 |
| Medium | −0.1564 | −0.0869 | −0.0925 | −3.49 | −1.05 | −1.19 |
| Big | −0.4496 | −0.6050 | −0.5230 | −10.56 | −15.89 | −9.99 |
| | $h$ | | | $t(h)$ | | |
| Small | −0.6666 | 0.0802 | 0.6726 | −3.85 | 0.65 | 6.50 |
| Medium | −0.4092 | 0.2050 | 0.4579 | −4.72 | 1.86 | 6.91 |
| Big | −0.3622 | 0.0169 | 0.4315 | −5.65 | 0.25 | 2.53 |
| | Adj $R^2$ (1) | | | $s(e)$ | | |
| Small | 0.8160 | 0.7777 | 0.8469 | 0.0338 | 0.0458 | 0.0312 |
| Medium | 0.8759 | 0.8949 | 0.9203 | 0.0333 | 0.0351 | 0.0286 |
| Big | 0.7667 | 0.8066 | 0.8156 | 0.0228 | 0.0229 | 0.0275 |
| | Adj $R^2$ (3) | | | | | |
| Small | 0.9162 | 0.8593 | 0.9268 | | | |
| Medium | 0.8951 | 0.8996 | 0.9386 | | | |
| Big | 0.9132 | 0.9514 | 0.9372 | | | |

$t$( ) Indicates $t$-statistic. Adj $R^2$ (1) is the adjusted R-squared with market factor alone as independent variable. Adj $R^2$ (3) is the adjusted $R$-squared with all three factors as independent variables. In each year, $t$, each firm is ranked by its market value of equity at the end of June in year $t$. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio. SMB is the difference, each month, between the average returns on the three small-size portfolios and the average of the returns on the three big-size portfolios. HML is the difference, each month, between the average of the returns on the three high-BE/ME portfolios and the average of the returns on the three low-BE/ME portfolios. The $t$-statistics have been corrected for the effects of heteroskedasticity and autocorrelation of a 1-month lag using the method of Newey and West (1987).

value to strong positive value. All slope coefficients except those of medium-BE/ME portfolios are significant at the 5% level. Clearly, SMB and HML are able to capture shared variations in stock returns that are missed by the market. All adjusted $R^2$ are high with a range between 0.86 and 0.94. The adjusted $R^2$ with the market factor as the only independent variable is also reported for comparison. Results show that all adjusted $R^2$ are larger when all three factors are included, particularly in the cases of small-size and large-size portfolios. The average adjusted $R^2$ is 0.92 which is much higher than that reported by DV (0.625). Our findings support a better fitted model in the Hong Kong stock market than in the study of DV.

Table 4
Time-series regressions using equally weighted monthly lagged market excess returns for 9 portfolios formed on size and BE/ME: 08/1986–12/1998, 149 months, in the Hong Kong stock market

| | Book-to-Market Equity (BE/ME) | | | | | |
|---|---|---|---|---|---|---|
| Size | Low | Medium | High | Low | Medium | High |
| Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t-1}-R_{f,t-1})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ | | | | | | |
| | $a$ | | | $t(a)$ | | |
| Small | 0.0031 | −0.0004 | 0.0026 | 0.37 | −0.05 | 0.38 |
| Medium | −0.0084 | −0.0110 | −0.0054 | −1.03 | −1.38 | −0.67 |
| Big | 0.0030 | 0.0018 | 0.0005 | 0.49 | 0.23 | 0.06 |
| | $b$ | | | $t(b)$ | | |
| Small | −0.0054 | −0.0726 | 0.0130 | −0.06 | −0.88 | 0.18 |
| Medium | −0.0368 | −0.0907 | −0.0774 | −0.44 | −1.09 | −0.94 |
| Big | −0.0303 | −0.0265 | −0.0082 | −0.47 | −0.33 | −0.10 |
| | $s$ | | | $t(s)$ | | |
| Small | 0.8847 | 0.9932 | 0.7973 | 7.01 | 8.22 | 7.65 |
| Medium | 0.3061 | 0.4023 | 0.3940 | 2.47 | 3.29 | 3.24 |
| Big | −0.0864 | −0.1515 | −0.0869 | −0.90 | −1.27 | −0.73 |
| | $h$ | | | $t(h)$ | | |
| Small | 0.7557 | 1.3387 | 1.8331 | 3.25 | 6.01 | 9.54 |
| Medium | 0.9957 | 1.5694 | 1.8591 | 4.35 | 6.96 | 8.29 |
| Big | 0.7277 | 1.4128 | 1.7870 | 4.13 | 6.41 | 8.15 |
| | Adj $R^2$ (1) | | | $s(e)$ | | |
| Small | 0.0452 | 0.0323 | 0.0501 | 0.0978 | 0.0936 | 0.0808 |
| Medium | 0.0036 | 0.0015 | 0.0025 | 0.0962 | 0.0948 | 0.0943 |
| Big | 0.0032 | 0.0021 | 0.0000 | 0.0740 | 0.0926 | 0.0922 |
| | Adj $R^2$ (3) | | | | | |
| Small | 0.3020 | 0.4152 | 0.5133 | | | |
| Medium | 0.1283 | 0.2686 | 0.3329 | | | |
| Big | 0.0910 | 0.2067 | 0.2934 | | | |

$t(\ )$ Indicates $t$-statistic. Adj $R^2$ (1) is the adjusted $R$-squared with market factor alone as independent variable. Adj $R^2$ (3) is the adjusted $R$-squared with all three factors as independent variables. In each year, $t$, each firm is ranked by its market value of equity at the end of June in year $t$. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio. Using lagged market excess returns imply we have 149 observations in the regression. SMB is the difference, each month, between the average returns on the three small-size portfolios and the average of the returns on the three big-size portfolios. HML is the difference, each month, between the average of the returns on the three high-BE/ME portfolios and the average of the returns on the three low-BE/ME portfolios. The $t$-statistics have been corrected for the effects of heteroskedasticity and autocorrelation of a 1-month lag using the method of Newey and West (1987).

Table 4 demonstrates the same regression results but with the market excess returns are now replaced by the lagged market excess returns. The nine intercepts are small and insignificant at the 5% level. Also, all nine market betas are insignificant at the same level. Clearly, lagged market excess returns have no explanatory power on variations of stock returns. However, statistically significant (at the 5% level) loadings on SMB and HML are observed. The estimated loading on SMB monotonically decreases from small-size to big-size portfolios. Similarly, the estimated loading on HML systematically increases from low-BE/ME portfolios to high-BE/ME portfolios. The model adjusted $R^2$ lies between 0.09 for big-size with low-BE/ME portfolios and 0.51 for small-size and high-BE/ME portfolios.

The adjusted $R^2$ systematically increases with a decrease in size and with an increase in BE/ME.

Comparing the results from Tables 3 and 4, we find that the high explanatory power of the three-factor model largely comes from the contemporaneous market factor. The factors of SMB and HML capture comparatively little explanatory power in explaining average returns. The lagged market factor, however, is unable to explain variations of stock returns while SMB and HML significantly capture the variations of returns that are missed by the lagged market factor, particularly for the small-size with high BE/ME portfolios. This result is also indicated by looking at the changes in the adjusted $R^2$ with only the market factor and with all three factors as the independent variables.

Table 5 presents the time-pooled cross-sectional regression results. In Panel A, using the contemporaneous market excess returns, the market beta is 0.99 with a highly significant $t$-statistic. The adjusted $R^2$ is high (0.8213). When the mimicking factor for size is included as regressor, adjusted $R^2$ improves slightly to 0.8224. Similarly, when adding BE/ME as regressor, adjusted $R^2$ only increases by 0.0002. When either one or both factors are included simultaneously as the regressors, no estimated loading is significant at the 5% level.

In Panel B, the lagged market excess returns are employed and the market betas are found to be significantly positive in one-factor model only. However, adding SMB factor as regressor regardless of whether HML effect is presented, the explanatory power of beta vanishes. The estimated loading on SMB (or HML) in a two-factor model including beta is also significant. Combining the three factors substantially improves the explanatory power for the monthly

Table 5
Time-pooled cross-sectional regression for equally weighted monthly excess returns on 9 portfolios formed on size and BE/ME: 07/1986–12/1998, 150 months, in the Hong Kong stock market

| Explanatory variables | a | t(a) | b | t(b) | s | t(s) | h | t(h) | Adj $R^2$ |
|---|---|---|---|---|---|---|---|---|---|
| *Panel A: Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t}-R_{f,t})+s_pSMB+h_pHML+\tilde{\mu}_{p,t}$ (Contemporaneous market factor)* | | | | | | | | | |
| Excess market alone | −0.0001 | −0.07 | 0.9870 | 80.31 | | | | | 0.8213 |
| Excess market and SMB | 0.0006 | 0.46 | 0.9984 | 77.99 | −0.0578 | −3.08 | | | 0.8224 |
| Excess market and HML | −0.0004 | −0.35 | 0.9770 | 71.03 | | | 0.0647 | 1.61 | 0.8215 |
| All three (Excess Market, SMB and HML) | 0.0003 | 0.21 | 0.9904 | 68.33 | −0.0545 | −2.87 | 0.0474 | 1.17 | 0.8224 |
| *Panel B: Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t-1}-R_{f,t-1})+s_p\mathrm{SMB}+h_p\mathrm{HML}+\tilde{\mu}_{p,t}$ (Lagged market factor)* | | | | | | | | | |
| Excess market alone | 0.0130 | 4.40 | 0.0878 | 3.01 | | | | | 0.0058 |
| Excess market and SMB | 0.0093 | 3.18 | −0.0175 | −0.56 | 0.3842 | 8.41 | | | 0.0532 |
| Excess market and HML | 0.0021 | 0.78 | 0.0679 | 2.57 | | | 1.3649 | 17.46 | 0.1838 |
| All three (excess market, SMB and HML) | −0.0016 | −0.58 | −0.0372 | −1.33 | 0.3836 | 9.32 | 1.3644 | 17.98 | 0.2312 |

$t$( ) Indicates $t$-statistic. In each year, $t$, each firm is ranked by its market value of equity at the end of June in year $t$. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio. When lagged market excess returns are employed, we have 149 observations in the regression. SMB is the difference, each month, between the average returns on the three small-size portfolios and the average of the returns on the three big-size portfolios. HML is the difference, each month, between the average of the returns on the three high-BE/ME portfolios and the average of the returns on the three low-BE/ME portfolios. Here we run a single time-pooled cross-sectional regression. The $t$-statistics have been corrected for the effects of heteroskedasticity and autocorrelation of a 1-month lag using the method of Newey and West (1987).

returns though market beta plays no role in explaining returns while the factors on SMB and HML are both significant at the 5% level.

Results from Table 5 confirm those from Tables 3 and 4 in that the contemporaneous market factor is the most significant tool in explaining the cross-sectional average returns in the original three-factor model. Adding SMB and HML can only improve the explanatory power slightly. However, when the model is modified by using the lagged market factor, the explanatory power decreases tremendously but SMB and HML can now capture larger shared variations in stock returns that are missed by the market.

### *3.2. Regression results in the Singaporean stock market*

Results for the time-series regressions of nine size-BE/ME portfolios returns on the contemporaneous market excess returns and the SMB and HML factors are reported in Table 6. The intercepts for the size-BE/ME portfolios are small and not significant while the market betas are all significantly positive at the 5% level. No clear relation between market beta and size effect can be observed. Small-size portfolios which have comparatively higher average returns do not have the highest betas. Hence, the results are consistent with the previous empirical findings that CAPM is mis-specified. The slopes on SMB are systematically related to firm size. After controlling for BE/ME, the SMB slope decreases monotonically from strong positive values to strong negative values with an increase in size. Similarly, after controlling for the size effect, the slope on HML increases monotonically from strong negative values to strong positive values with an increase in BE/ME. As most of the slopes are significant at the 5% level, SMB and HML are able to capture shared variations in stock returns that are missed by the market factor. Adjusted $R^2$ is greater than 0.9 in 8 out of 9 portfolios. Comparing with those with the market factor alone, the increase in the adjusted $R^2$ is highest in large-size with low BE/ME portfolios and small-size with high BE/ME portfolios.

Table 7 presents the same results when the lagged market excess returns are employed in the time-series regressions. The intercepts for the size-BE/ME portfolios are not significant at the 5% level. Market betas are positive but only 2 are significant at the 5% level. In each BE/ME group, the slopes on SMB decrease monotonically from strong positive values for the smallest-size portfolios to strong negative values for the biggest-size portfolios. However, only the slopes of small-size with either medium or high BE/ME portfolios are significant at the 5% level. In each size group, the HML slopes increase monotonically with an increase in BE/ME though the *t*-statistics for the low-BE/ME portfolios are not significant at the 5% level. Adjusted $R^2$ varies from 0.0265 for the big-size and low-BE/ME portfolio to 0.4125 for the small-size and high BE/ME portfolio. Comparing with those with the market factor alone, the increase in the adjusted $R^2$ is highest in small-size portfolios and in high BE/ME portfolios.

Table 8 shows the time-pooled cross-sectional regression results. Using the contemporaneous market excess returns (Panel A), the market beta is 1.05 and is significant at the 5% level. Adjusted $R^2$ is high (0.846). Adding SMB or HML or both virtually do not change the adjusted $R^2$ and all the corresponding slopes on SMB and HML are not significant at the 5% level.

In Panel B, when lagged market excess returns are employed, the market beta is still positive and significant at the 5% level with adjusted $R^2$ of 0.0228. Adding SMB (HML) alone with the market factor increases the adjusted $R^2$ to 0.0409 (0.0868). The slopes on SMB and HML, respectively are significantly positive at the 5% level. In a three-factor model, only the slope coefficient of beta and HML are significant at the 5% level with adjusted $R^2$ of 0.0908.

Table 6
Time-series regressions using equally weighted monthly contemporaneous market excess returns for 9 portfolios formed on size and BE/ME: 07/1986–12/1998, 150 stmonths, in the Singaporean stock market

| Book-to-Market Equity (BE/ME) | | | | | | |
|---|---|---|---|---|---|---|
| Size | Low | Medium | High | Low | Medium | High |
| *Regression:* $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t}-R_{f,t})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ | | | | | | |
| | $a$ | | | $t(a)$ | | |
| Small | 0.0022 | −0.0002 | 0.0011 | 0.77 | −0.06 | 0.45 |
| Medium | −0.0031 | 0.0014 | −0.0033 | −1.32 | 0.50 | −1.23 |
| Big | 0.0007 | 0.0004 | 0.0020 | 0.37 | 0.15 | 0.54 |
| | $b$ | | | $t(b)$ | | |
| Small | 1.1829 | 1.0083 | 0.8601 | 37.95 | 29.96 | 31.59 |
| Medium | 1.0318 | 1.0795 | 1.1749 | 40.00 | 36.72 | 39.80 |
| Big | 0.9011 | 1.0695 | 1.1592 | 41.05 | 38.36 | 43.28 |
| | $s$ | | | $t(s)$ | | |
| Small | 0.2353 | 0.3781 | 0.6044 | 5.35 | 7.96 | 15.73 |
| Medium | −0.1335 | −0.1212 | 0.0040 | −3.67 | −2.92 | 0.10 |
| Big | −0.4302 | −0.4153 | −0.4382 | −13.88 | −10.55 | −11.59 |
| | $h$ | | | $t(h)$ | | |
| Small | −0.2759 | 0.1761 | 0.6188 | −4.37 | 2.58 | 11.21 |
| Medium | −0.1996 | −0.0817 | 0.3016 | −3.82 | −1.37 | 5.04 |
| Big | −0.4339 | −0.2174 | 0.0953 | −9.75 | −3.85 | 1.76 |
| | Adj $R^2$ (1) | | | $s(e)$ | | |
| Small | 0.8839 | 0.8370 | 0.7531 | 0.0344 | 0.0371 | 0.0301 |
| Medium | 0.9034 | 0.8986 | 0.9118 | 0.0285 | 0.0324 | 0.0326 |
| Big | 0.7861 | 0.8401 | 0.8638 | 0.0242 | 0.0308 | 0.0296 |
| | Adj $R^2$ (3) | | | | | |
| Small | 0.9143 | 0.8842 | 0.9207 | | | |
| Medium | 0.9152 | 0.9026 | 0.9234 | | | |
| Big | 0.9186 | 0.9083 | 0.9303 | | | |

$t(\,)$ Indicates $t$-statistic. Adj $R^2$ (1) is the adjusted $R$-squared with market factor alone as independent variable. Adj $R^2$ (3) is the adjusted $R$-squared with all three factors as independent variables. In each year, $t$, each firm is ranked by its market value of equity at the end of June in year $t$. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio. SMB is the difference, each month, between the average returns on the three small-size portfolios and the average of the returns on the three big-size portfolios. HML is the difference, each month, between the average of the returns on the three high-BE/ME portfolios and the average of the returns on the three low-BE/ME portfolios. The $t$-statistics have been corrected for the effects of heteroskedasticity and autocorrelation of a 1-month lag using the method of Newey and West (1987).

Comparing with results from Panel A, when using contemporaneous market excess returns, the explanatory power for the average returns mainly comes from the market factor and the contributions from the other two factors are very limited. However, when lagged market excess returns are used instead, the explanatory power of the market factor decreases tremendously while SMB and HML factors can add significant contributions. Since Fama and French's (1993) three-factor model is based on contemporaneous market excess returns, it explains why the model's explanatory power on stock return variations is so high. Under our modified version, SMB and HML do help explaining the cross-sectional variations of average returns though the explanatory power is still low.

Table 7
Time-series regressions using equally weighted monthly lagged market excess returns for 9 portfolios formed on size and BE/ME: 08/1986 - 12/1998, 149 months, in the Singaporean stock market

| Book-to-Market Equity (BE/ME) | | | | | | |
|---|---|---|---|---|---|---|
| Size | Low | Medium | High | Low | Medium | High |
| *Regression:* $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t-1}-R_{f,t-1})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ | | | | | | |
| | $a$ | | | $t(a)$ | | |
| Small | 0.0099 | 0.0060 | 0.0065 | 1.07 | 0.74 | 0.95 |
| Medium | 0.0032 | 0.0089 | 0.0045 | 0.40 | 1.05 | 0.50 |
| Big | 0.0068 | 0.0066 | 0.0090 | 0.98 | 0.82 | 1.03 |
| | $b$ | | | $t(b)$ | | |
| Small | 0.1690 | 0.1718 | 0.1405 | 1.74 | 2.03 | 1.96 |
| Medium | 0.1775 | 0.1152 | 0.1524 | 2.11 | 1.30 | 1.61 |
| Big | 0.1100 | 0.2077 | 0.1636 | 1.50 | 2.46 | 1.80 |
| | $s$ | | | $t(s)$ | | |
| Small | 0.6261 | 0.5877 | 0.7457 | 3.77 | 4.06 | 6.10 |
| Medium | 0.1102 | 0.0528 | 0.1134 | 0.77 | 0.35 | 0.70 |
| Big | −0.2781 | −0.3616 | −0.4008 | −2.22 | −2.51 | −2.58 |
| | $h$ | | | $t(h)$ | | |
| Small | 0.1205 | 0.7547 | 1.1883 | 0.45 | 3.23 | 6.02 |
| Medium | 0.3339 | 0.6527 | 1.2550 | 1.44 | 2.66 | 4.81 |
| Big | 0.1625 | 0.7274 | 1.1736 | 0.80 | 3.12 | 4.68 |
| | Adj $R^2$ (1) | | | $s(e)$ | | |
| Small | 0.0217 | 0.0297 | 0.0256 | 0.1114 | 0.0972 | 0.0820 |
| Medium | 0.0318 | 0.0137 | 0.0208 | 0.0963 | 0.1018 | 0.1083 |
| Big | 0.0138 | 0.0390 | 0.0224 | 0.0840 | 0.0968 | 0.1041 |
| | Adj $R^2$ (3) | | | | | |
| Small | 0.1032 | 0.2091 | 0.4125 | | | |
| Medium | 0.0354 | 0.0478 | 0.1589 | | | |
| Big | 0.0265 | 0.0965 | 0.1399 | | | |

$t(\,)$Indicates $t$-statistic. Adj $R^2$ (1) is the adjusted $R$-squared with market factor alone as independent variable. Adj $R^2$ (3) is the adjusted $R$-squared with all three factors as independent variables. In each year, $t$, each firm is ranked by its market value of equity at the end of June in year $t$. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio. Using lagged market excess returns imply we have 149 observations in the regression. SMB is the difference, each month, between the average returns on the three small-size portfolios and the average of the returns on the three big-size portfolios. HML is the difference, each month, between the average of the returns on the three high-BE/ME portfolios and the average of the returns on the three low-BE/ME portfolios. The $t$-statistics have been corrected for the effects of heteroskedasticity and autocorrelation of a 1-month lag using the method of Newey and West (1987).

### *3.3. Regression results in the Taiwan stock market*

Results for the time-series regressions of nine size-BE/ME portfolios returns on the contemporaneous market excess returns and the SMB and HML factors are showed in Table 9. The intercepts of the nine size-BE/ME portfolios are all negative but 7 of them are not significant at the 5% level. Same as the other two markets, the coefficients on the excess market return are all significantly positive at the 5% level. The portfolio beta ranges from 0.93 to 1.06. After controlling for BE/ME, the SMB slope decreases monotonically from strong positive values to strong negative values with an increase in size. Six coefficients are significant at the 5% level.

Table 8
Time-pooled cross-sectional regression for equally weighted monthly excess returns on 9 portfolios formed on size and BE/ME: 07/1986–12/1998, 150 Months, in the Singaporean stock market

| Explanatory variables | a | t(a) | b | t(b) | s | t(s) | h | t(h) | Adj $R^2$ |
|---|---|---|---|---|---|---|---|---|---|
| Panel A: Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t}-R_{f,t})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ (Contemporaneous market factor) | | | | | | | | | |
| Excess market alone | −0.0000 | −0.03 | 1.0475 | 86.95 | | | | | 0.8460 |
| Excess market and SMB | 0.0000 | 0.04 | 1.0517 | 86.10 | −0. 0350 | −2.00 | | | 0.8463 |
| Excess market and HML | −0.0001 | −0.06 | 1.0469 | 85.13 | | | 0.0064 | 0.25 | 0.8459 |
| All three (excess market, SMB and HML) | 0.0001 | 0.05 | 1.0519 | 83.87 | −0. 0352 | −1.99 | −0.0019 | −0.07 | 0.8462 |
| Panel B: Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t-1}-R_{f,t-1})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ (Lagged market factor) | | | | | | | | | |
| Excess market alone | 0.0115 | 4.02 | 0.1748 | 5.73 | | | | | 0.0228 |
| Excess market and SMB | 0.0100 | 3.50 | 0.1690 | 5.59 | 0.2566 | 5.18 | | | 0.0409 |
| Excess market and HML | 0.0073 | 2.59 | 0.1581 | 5.36 | | | 0.7683 | 9.84 | 0.0868 |
| All three (excess market, SMB and HML) | 0.0068 | 2.43 | 0.1564 | 5.31 | 0.1328 | 2.64 | 0.7076 | 8.71 | 0.0908 |

*t*( ) Indicates *t*-statistic. In each year, *t*, each firm is ranked by its market value of equity at the end of June in year *t*. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio. When lagged market excess returns are employed, we have 149 observations in the regression. SMB is the difference, each month, between the average returns on the three small-size portfolios and the average of the returns on the three big-size portfolios. HML is the difference, each month, between the average of the returns on the three high-BE/ME portfolios and the average of the returns on the three low-BE/ME portfolios. Here we run a single time-pooled cross-sectional regression. The *t*-statistics have been corrected for the effects of heteroskedasticity and autocorrelation of a 1-month lag using the method of Newey and West (1987).

The insignificant coefficients on SMB are the medium-size portfolios. After controlling for size effect, the slope on HML increases monotonically from strong negative values to strong positive values with an increase in BE/ME. Seven coefficients are significant at the 5% level and the insignificant coefficients are of small-size and medium-size with medium-BE/ME portfolios. SMB and HML are able to capture shared variations in time-series stock returns that are missed by the market. The adjusted $R^2$ is very high and varies between 0.9323 and 0.9752. Comparing with those with the market factor alone, the increase in the adjusted $R^2$ is highest in large-size portfolios.

Table 10 presents the same results when lagged market excess returns are used. The intercepts and the market betas for all size-BE/ME portfolios are small and insignificant at the 5% level. However, statistically significant loadings on the SMB and BE/ME factors are observed though BE/ME effect is significant at the 5% level in high-BE/ME portfolios only and size effect is not significant for the big-size portfolios. Same as results from Table 9, the estimated loading on the SMB (HML) factor monotonically decreases (increases) with an increase in size (BE/ME). Adjusted $R^2$ is small and ranges from 0.0251 to 0.0752 for big-size portfolios but increases inversely with size and reaches 0.4444 for portfolios containing small firms with high BE/ME. Comparing with those with the market factor alone, the increase in the adjusted $R^2$ is substantially large in all sorted portfolios except in the large-size portfolios.

Table 11 shows the time-pooled cross-sectional regressions results. Using the contemporaneous market excess returns (Panel A), the market beta is 1.00 and is significant at the 5% level. Adjusted

Table 9
Time-series regressions using equally weighted monthly contemporaneous market excess returns for 9 portfolios formed on size and BE/ME: 07/1986–12/1998, 150 months, in the Taiwan stock market

| Book-to-Market Equity (BE/ME) | | | | | | |
|---|---|---|---|---|---|---|
| Size | Low | Medium | High | Low | Medium | High |
| Regression: $R_{p,t} - R_{f,t} = a_p + b_p(R_{m,t} - R_{f,t}) + s_p\mathrm{SMB} + h_p\mathrm{HML} + \tilde{\mu}_{p,t}$ | | | | | | |
| | *a* | | | *t*(*a*) | | |
| Small | −0.0011 | −0.0058 | −0.0021 | −0.53 | −1.91 | −0.87 |
| Medium | −0.0058 | −0.0028 | −0.0055 | −2.20 | −0.94 | −2.56 |
| Big | −0.0031 | −0.0035 | −0.0025 | −1.56 | −1.51 | −1.09 |
| | *b* | | | *t*(*b*) | | |
| Small | 1.0138 | 0.9974 | 0.9604 | 58.57 | 41.19 | 49.85 |
| Medium | 1.0266 | 0.9685 | 1.0104 | 49.24 | 41.15 | 59.45 |
| Big | 0.9860 | 0.9300 | 1.0556 | 61.46 | 50.83 | 58.74 |
| | *s* | | | *t*(*s*) | | |
| Small | 0.4957 | 0.4616 | 0.5795 | 16.79 | 11.17 | 17.63 |
| Medium | 0.0643 | −0.0644 | 0.0241 | 1.81 | −1.60 | 0.83 |
| Big | −0.4812 | −0.4571 | −0.5249 | −17.58 | −14.64 | −17.12 |
| | *h* | | | *t*(*h*) | | |
| Small | −0.4368 | −0.0231 | 0.6527 | −9.72 | −0.37 | 13.05 |
| Medium | −0.4682 | −0.0152 | 0.4415 | −8.65 | −0.25 | 10.01 |
| Big | −0.4766 | 0.1452 | 0.5242 | −11.44 | 3.06 | 11.24 |
| | Adj $R^2$ (1) | | | *s*(*e*) | | |
| Small | 0.9046 | 0.9071 | 0.8809 | 0.0260 | 0.0364 | 0.0290 |
| Medium | 0.9312 | 0.9325 | 0.9486 | 0.0313 | 0.0354 | 0.0255 |
| Big | 0.8683 | 0.8653 | 0.8422 | 0.0241 | 0.0275 | 0.0270 |
| | Adj $R^2$ (3) | | | | | |
| Small | 0.9752 | 0.9495 | 0.9691 | | | |
| Medium | 0.9554 | 0.9323 | 0.9689 | | | |
| Big | 0.9637 | 0.9479 | 0.9623 | | | |

*t*( ) Indicates *t*-statistic. Adj $R^2$ (1) is the adjusted *R*-squared with market factor alone as independent variable. Adj $R^2$ (3) is the adjusted *R*-squared with all three factors as independent variables. In each year, *t*, each firm is ranked by its market value of equity at the end of June in year *t*. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio. SMB is the difference, each month, between the average returns on the three small-size portfolios and the average of the returns on the three big-size portfolios. HML is the difference, each month, between the average of the returns on the three high-BE/ME portfolios and the average of the returns on the three low-BE/ME portfolios. The *t*-statistics have been corrected for the effects of heteroskedasticity and autocorrelation of a 1-month lag using the method of Newey and West (1987).

$R^2$ is very high (0.887). When either SMB or HML or both is included as regressor, adjusted $R^2$ virtually remains constant, indicating these two factors are not priced and the slope coefficients are not significant at the 5% level. Using lagged market excess returns in the regressions (Panel B), the market beta is insignificant at the 5% level in all cases. In a two-factor model, the estimated loading on SMB is significant while that on HML is insignificant at the 5% level. Combining the three factors substantially improves the explanatory power for the monthly returns in the cross-sectional regressions. The slope coefficients of SMB and HML in the three-factor model are both statistically significant. In fact, the results indicate that the main contributing factor is SMB.

Table 10
Time-series regressions using equally weighted monthly lagged market excess returns for 9 portfolios formed on size and BE/ME: 08/1986–12/1998, 149 months, in the Taiwan stock market

| Book-to-Market Equity (BE/ME) | | | | | | |
|---|---|---|---|---|---|---|
| Size | Low | Medium | High | Low | Medium | High |
| Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t-1}-R_{f,t-1})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ | | | | | | |
| | $a$ | | | $t(a)$ | | |
| Small | 0.0111 | 0.0053 | 0.0086 | 1.03 | 0.49 | 0.83 |
| Medium | 0.0055 | 0.0091 | 0.0060 | 0.50 | 0.86 | 0.56 |
| Big | 0.0079 | 0.0071 | 0.0099 | 0.75 | 0.71 | 0.88 |
| | $b$ | | | $t(b)$ | | |
| Small | −0.0562 | −0.0317 | −0.0297 | −0.71 | −0.40 | −0.39 |
| Medium | −0.0304 | −0.0810 | −0.0396 | −0.38 | −1.05 | −0.50 |
| Big | −0.0339 | −0.0325 | −0.0513 | −0.44 | −0.45 | −0.62 |
| | $s$ | | | $t(s)$ | | |
| Small | 1.2901 | 1.2359 | 1.3248 | 9.85 | 9.35 | 10.54 |
| Medium | 0.8601 | 0.6977 | 0.8105 | 6.39 | 5.46 | 6.19 |
| Big | 0.2847 | 0.2665 | 0.2996 | 2.23 | 2.19 | 2.19 |
| | $h$ | | | $t(h)$ | | |
| Small | −0.1570 | 0.2357 | 0.9013 | −0.69 | 1.03 | 4.15 |
| Medium | −0.2037 | 0.2680 | 0.7087 | −0.88 | 1.21 | 3.13 |
| Big | −0.2192 | 0.3889 | 0.8102 | −0.99 | 1.85 | 3.43 |
| | Adj $R^2$ (1) | | | $s(e)$ | | |
| Small | 0.0000 | 0.0016 | 0.0072 | 0.1284 | 0.1295 | 0.1232 |
| Medium | 0.0000 | 0.0007 | 0.0025 | 0.1318 | 0.1253 | 0.1284 |
| Big | 0.0015 | 0.0001 | 0.0005 | 0.1252 | 0.1190 | 0.1340 |
| | Adj $R^2$ (3) | | | | | |
| Small | 0.3974 | 0.3643 | 0.4444 | | | |
| Medium | 0.2156 | 0.1553 | 0.2189 | | | |
| Big | 0.0251 | 0.0288 | 0.0752 | | | |

$t$( ) Indicates $t$-statistic. Adj $R^2$ (1) is the adjusted $R$-squared with market factor alone as independent variable. Adj $R^2$ (3) is the adjusted $R$-squared with all three factors as independent variables. In each year, $t$, each firm is ranked by its market value of equity at the end of June in year $t$. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio. Using lagged market excess returns imply we have 149 observations in the regression. SMB is the difference, each month, between the average returns on the three small-size portfolios and the average of the returns on the three big-size portfolios. HML is the difference, each month, between the average of the returns on the three high-BE/ME portfolios and the average of the returns on the three low-BE/ME portfolios. The $t$-statistics have been corrected for the effects of heteroskedasticity and autocorrelation of a 1-month lag using the method of Newey and West (1987).

Comparing results from both panels, only the market factor has explanatory power for the variations in the average returns when employing contemporaneous market excess returns and the estimated loadings on SMB and HML are not significant. Using lagged market excess returns, on the other hand, reduce the explanatory power tremendously but empirical results also indicate that SMB and HML can capture shared variations in stock returns that are missed by the market factor.

### *3.4. Up and down markets periods*

Recent studies on asset pricing models have found that the results are conditional on the state of the markets. Using US stock market data, Pettengill et al. (1995) re-confirmed the reliability

Table 11
Time-pooled cross-sectional regressions for equally weighted monthly excess returns on 9 portfolios formed on size and BE/ME: 07/1986–12/1998, 150 months, in the Taiwan Stock Market

| Explanatory variables | a | t(a) | b | t(b) | s | t(s) | H | t(h) | Adj $R^2$ |
|---|---|---|---|---|---|---|---|---|---|
| *Panel A: Regression:* $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t}-R_{f,t})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ *(Contemporaneous market factor)* | | | | | | | | | |
| Excess market alone | −0.0033 | −2.47 | 0.9976 | 102.91 | | | | | 0.8870 |
| Excess market and SMB | −0.0034 | −2.49 | 0.9957 | 92.00 | 0.0076 | 0.41 | | | 0.8869 |
| Excess market and HML | −0.0035 | −2.57 | 0.9972 | 102.81 | | | 0.0360 | 1.29 | 0.8871 |
| All Three (Excess Market, SMB and HML) | −0.0036 | −2.62 | 0.9943 | 91.51 | 0.0109 | 0.59 | 0.0382 | 1.35 | 0.8870 |
| *Panel B: Regression:* $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t-1}-R_{f,t-1})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ *(Lagged market factor)* | | | | | | | | | |
| Excess market alone | 0.0179 | 4.44 | 0.0186 | 0.64 | | | | | −0.0004 |
| Excess market and SMB | 0.0089 | 2.41 | −0.0200 | −0.76 | 0.7641 | 17.09 | | | 0.1781 |
| Excess market and HML | 0.0176 | 4.34 | 0.0086 | 0.29 | | | 0.1383 | 1.62 | 0.0008 |
| All three (Excess Market, SMB and HML) | 0.0078 | 2.12 | −0.0429 | −1.59 | 0.7855 | 17.53 | 0.3037 | 3.92 | 0.1869 |

*t*( ) Indicates *t*-statistic. In each year, *t*, each firm is ranked by its market value of equity at the end of June in year *t*. Firms are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, we sort stocks into 3 book-to-market portfolios based on individual stocks' BE/ME in ascending order. Nine size-BE/ME portfolios are then formed and are rebalanced yearly. The equally weighted monthly returns on portfolios are computed each month from July to the following June. Repeating this procedure for every year results in 150 equally weighted monthly returns from July 1986 to December 1998 for each size-BE/ME portfolio. When lagged market excess returns are employed, we have 149 observations in the regression. SMB is the difference, each month, between the average returns on the three small-size portfolios and the average of the returns on the three big-size portfolios. HML is the difference, each month, between the average of the returns on the three high-BE/ME portfolios and the average of the returns on the three low-BE/ME portfolios. Here we run a single time-pooled cross-sectional regression. The *t*-statistics have been corrected for the effects of heteroskedasticity and autocorrelation of a 1-month lag using the method of Newey and West (1987).

of market beta in measuring risk when the sampling period is divided into up and down markets. As in reality, it is possible that the realized market return can be lower than the risk-free return, they showed that when the realized market returns exceed the risk-free rate (i.e. up markets), there is a significant positive relationship between beta and realized returns. When the realized market excess returns are negative (down markets), a significant negative relationship between beta and realized returns is found. Using the same model, Tang and Shum (2003) applied it to international stock markets for the period 1991–2000, they found strong supportive evidence for beta as the relevant risk factor under this conditional framework.

In order to check the robustness of our results, we conduct tests to see if the same results hold at times when the markets are falling as when the markets are rising. Following Tang and Shum (2003), we divide our sampling period into up (market excess returns are positive) and down (market excess returns are negative) markets periods and we add a dummy variable which has a value equal to 1 during up markets and a value of zero during down markets in the time-pooled cross-sectional regression model for each of the three factors: market, SMB, and HML. Table 12 presents the results for the three markets with Panels A and B for the model using, respectively contemporaneous and lagged market factor. Comparing results reported in Tables 5, 8, and 11, respectively for the three markets, several interesting results are found. First, in all cases, the regression intercept is not different from zero at the 5% level. This is the same as in the unconditional regression analysis except for the Taiwan stock market and for the Singaporean market when lagged market factor is used. Our results may imply that the conditional model could be a better fit in explaining average stock returns. Second, the market beta is significant

Table 12
Time-pooled cross-sectional regression for equally weighted monthly excess returns on 9 portfolios formed on size and BE/ME: 07/1986–12/1998, 150 months, under up and down markets periods

| Stock Market | $a$ | $b_1$ | $b_2$ | $s_1$ | $s_2$ | $h_1$ | $h_2$ | Adj $R^2$ |
|---|---|---|---|---|---|---|---|---|
| Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t}-R_{f,t})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ | | | | | | | | |
| *Panel A: Contemporaneous market factor* | | | | | | | | |
| Hong | 0.0018 | −0.1019 | 1.0352 | 0.1481 | −0.1646 | 0.1861 | −0.0561 | 0.8241 |
| Kong | (1.06) | (−1.79) | (29.07) | (1.66) | (−2.16) | (1.48) | (−0.73) | |
| Singapore | −0.0002 | 0.0076 | 1.0461 | 0.0215 | −0.0452 | −0.0124 | −0.0015 | 0.8459 |
| | (−0.09) | (0.11) | (22.34) | (0.29) | (−0.84) | (−0.13) | (−0.03) | |
| Taiwan | −0.0025 | −0.0253 | 1.0107 | 0.0098 | 0.0028 | −0.0612 | 0.0911 | 0.8869 |
| | (−1.14) | (−0.55) | (43.45) | (0.12) | (0.05) | (−0.67) | (1.42) | |
| *Panel B: Lagged market factor* | | | | | | | | |
| Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t-1}-R_{f,t-1})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ | | | | | | | | |
| Hong | 0.00723 | −0.3340 | 0.1528 | 0.4010 | 0.0747 | −0.8762 | 2.0012 | 0.2593 |
| Kong | (0.89) | (−1.23) | (1.04) | (1.53) | (0.30) | (−1.72) | (4.49) | |
| Singapore | 0.0039 | −0.0380 | 0.2211 | 1.2622 | −0.5574 | −0.1730 | 0.8377 | 0.1962 |
| | (0.54) | (−0.17) | (1.28) | (3.36) | (−1.82) | (−0.37) | (1.99) | |
| Taiwan | 0.0192 | −0.2602 | 0.1003 | −0.0163 | 0.8135 | 0.7272 | −0.1820 | 0.2010 |
| | (1.63) | (−1.11) | (0.73) | (−0.06) | (4.02) | (1.52) | (−0.58) | |

$t$( ) Indicates $t$-statistic. Below are the results of the time-pooled cross-sectional regression in the Hong Kong, Singaporean, and Taiwan stock markets. The factor sensitivities or loadings, $b_1$, $b_2$, $s_1$, $s_2$, $h_1$ and $h_2$, are the slope coefficients in the time-pooled cross-sectional regression, where subscript 1 represents the loadings obtained in up-market periods (market excess returns $>0$) and subscript 2 represents the loadings obtained in down-market periods (market excess returns $<0$). Panel A shows the regression results using the contemporaneous market factor, whereas Panel B displays the regression results using the lagged market factor.

and close to one only during the down market periods when the contemporaneous market factor is used. When lagged market factor is used, none of the beta coefficients is significant at the 5% level no matter during up or down markets.

Third, for the slope coefficient on SMB when compared with the unconditional results, mixed findings are observed for the three markets. When the contemporaneous market factor is used, it is significant at the 5% level in Hong Kong only during down markets but it loses its significance in the Singaporean stock market but remains insignificant in the Taiwan stock market. In the model with lagged market factor, different results are also found. The slope coefficient loses its significance during both up and down markets in Hong Kong while keeps its significance only in up market periods in Singapore, but only in down market periods in Taiwan. Our results suggest that stock returns may react differently to the size factor during up and down markets in different stock markets. Fourth, for the slope coefficient on HML, the findings are more consistent across the three markets. The coefficient remains insignificant at the 5% level in all three markets when the contemporaneous market factor is used. When the lagged market factor is used, the coefficient is significant at the 5% level during down market only except in the Taiwan stock market, where it is insignificant during both market periods.

Fifth, comparing the value of the adjusted $R^2$ of the unconditional and conditional models, we notice that when the contemporaneous market factor is used, the value virtually remains unchanged in all three markets, suggesting that employing conditional model based on up and down markets does not help in improving the explanatory power of the three-factor model. However, when the lagged market factor is used, the adjusted $R^2$ increases in all three markets

(0.2312–0.2593 in Hong Kong, 0.091–0.1962 in Singapore, and 0.1869–0.201 in Taiwan). Our results suggest that employing the conditional model can improve the explanatory power of the modified three-factor model, particularly in the Singaporean stock market. In summary, though our results provide new insights on the Fama and French three-factor model conditional on the state of the market, it should be noted that as, to the best of our knowledge, no similar studies have been carried on the US market or other well developed markets, we are not sure that our findings are common features or just due to special characteristics of the Asian emerging markets under study. More empirical studies should be performed using data from other markets in order to confirm and/or reject our results.

### *3.5. January effect*

The January effect is one of the most well documented anomalies in literature. Previous studies (e.g. Keim, 1983; Roll, 1983) have found that a significant portion of the size premium to small firms occurs in January. Hence, we further extend our analysis to examine the existence of January effect. Unlike the study by DV who added a dummy variable, which takes a value of 1 in January, in the three-factor model, we study the effect by running two separate regression models, one with all January months data and the other with all non-January months data. By doing so, we can compare the slope coefficients on the risk factors between January months and non-January months.

Table 13 presents the results for the three markets. Panels A and B show the regression results using the contemporaneous and lagged market factor respectively. For the Hong Kong stock market, Panel A shows that only the market beta is significant at the 5% level and the value is

Table 13
Test for seasonality in the three-factor model for equally weighted monthly excess returns

| Stock market | $b$ (Jan) | $b$ (Non-Jan) | $s$ (Jan) | $s$ (Non-Jan) | $h$ (Jan) | $h$ (Non-Jan) |
|---|---|---|---|---|---|---|
| Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t}-R_{f,t})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ | | | | | | |
| *Panel A: Contemporaneous market factor* | | | | | | |
| Hong Kong | 0.9519 | 0.9923 | −0.0638 | −0.0603 | −0.0638 | 0.1067 |
| | (15.62) | (36.41) | (−0.70) | (−1.55) | (−0.54) | (1.65) |
| Singapore | 1.1271 | 1.0549 | 0.0648 | −0.0470 | −0.0219 | −0.0176 |
| | (12.90) | (43.24) | (0.58) | (−1.49) | (−0.17) | (−0.50) |
| Taiwan | 0.9205 | 1.0004 | 0.0823 | 0.0023 | −0.0887 | 0.0471 |
| | (16.86) | (67.35) | (1.04) | (0.05) | (−0.63) | (0.79) |
| *Panel B:Lagged market factor* | | | | | | |
| Regression: $R_{p,t}-R_{f,t}=a_p+b_p(R_{m,t-1}-R_{f,t-1})+s_p\text{SMB}+h_p\text{HML}+\tilde{\mu}_{p,t}$ | | | | | | |
| Hong Kong | −0.0131 | −0.0347 | 0.6283 | 0.3350 | 1.0626 | 1.5230 |
| | (−0.03) | (−0.36) | (1.78) | (3.69) | (1.98) | (6.02) |
| Singapore | 0.1819 | 0.1245 | −0.7650 | 0.2553 | 1.0881 | 0.8249 |
| | (0.97) | (1.74) | (−3.33) | (1.10) | (2.08) | (3.75) |
| Taiwan | −0.4974 | −0.0197 | 0.2819 | 0.8045 | −0.4068 | 0.3598 (1.21) |
| | (−3.84) | (−0.23) | (1.00) | (6.12) | (−1.12) | |

$t$( )Indicates $t$-statistic. Below are the results of testing the seasonality effect in the Hong Kong, Singaporean, and Taiwan stock markets. We use two separate regressions for each model to test for seasonality effect. The factor sensitivities or loadings, $b$, $s$ and $h$, are the slope coefficients in the time-pooled cross-sectional regression, where subscript (Jan) represents the loadings obtained in January months and subscript (Non-Jan) represents the loadings obtained in non-January months. Panel A shows the regression results using the contemporaneous market factor, whereas Panel B displays the regression results using the lagged market factor.

roughly the same in both January and non-January. Panel B shows that the slope coefficient on SMB is significant at the 5% level in non-January only while that on HML is significant in both January and non-January with the value in non-January is roughly 50% more than that in January. Our results do not support a January effect in Hong Kong, which is consistent with the findings of DV.

Same as in Hong Kong, Panel A shows that only the market beta is significant at the 5% level in the two other markets with the beta is slightly higher (lower) in January in Singapore (Taiwan) . However, when lagged market factor is used in the model, some interesting results are found. The slope coefficient on SMB is significant at the 5% level in January only in Singapore. Unfortunately, the risk premium is negative. While the slope coefficient on HML is significant in both January and non-January, the value is 30% higher in January than in non-January. Our results suggest a January effect exists in the BE/ME premium in the Singaporean stock market. For the Taiwan stock market, Panel B shows that the slope coefficient on SMB is significantly positive at the 5% level in non-January only while those on HML is insignificant. However, the beta on the lagged market factor shows a reverse January effect. The value is significantly negative at the 5% level in January, indicating that January returns of the portfolios are negatively related to the previous year December market returns.

## 4. Conclusions

This paper has examined the relations between a market factor together with two proxies for the risk factors related to size and book-to-market equity ratio and stock portfolios' returns using the three-factor model of Fama and French (1993, 1996) over the period July 1986 to December 1988 in three Asian emerging markets: Hong Kong, Singapore and Taiwan. The empirical evidence is consistent with the US findings reported by Fama and French (1993, 1996) and with those of four Asian markets studied by DV (2003) that the model largely explains the variations in average returns when using the contemporaneous market factor. However, the impact of the size effect and BE/ME factor is very limited and insignificant in most cases. When the three-factor model is modified by using lagged market factor instead, the explanatory ability of the model drops substantially but both SMB and HML are now able to contribute significantly in explaining the time-pooled cross-sectional variations in stock returns. Our results provide some insights on the three-factor model. When the contemporaneous market factor is employed, it is the dominate factor over the other two factors: SMB and HML. Only when lagged market factor is used that SMB and HML can reflect their importance in explaining the stock returns variations. Furthermore, their explanatory powers are strongest for small-size with high BE/ME portfolios.

This paper also checks the robustness of the model on two effects: separation of up and down markets periods and the January effect. Our results find that the conditional model based on up and down markets does not help in improving the explanatory power of the three-factor model when the contemporaneous market factor is employed. However, when the lagged market factor is used in the model, the conditional extension does help in increasing the explanatory power, particularly in the Singaporean stock market. We find no evidence of January effect in the Hong Kong stock market but our results indicate a January effect exists in the BE/ME premium in Singapore and a reverse January effect exists in the market risk premium when the lagged market factor is used in the model.

The results found in the paper are interesting and should provide new insights to our understanding of the Fama and French three-factor model. The results also have implications to portfolio managers as investing in small firm size and/or high book-to-market ratio stocks should be rewarded by generating higher average returns. However, they should also be aware that though the traditional CAPM could be mis-specified as size and BE/ME are important additional risk factors, the market factor is still the dominating factor in these Asian emerging markets.

## Acknowledgements

An earlier version of this paper was presented at the 2004 Academy of International Business Annual Meeting held in July at Stockholm, Sweden. The authors thank the participants' comments. Valuable comments from two anonymous referees are also acknowledged.

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