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# The Limits of Standard Risk and Macroeconomic Factors in Explaining the Return Premia: Evidence from the Tokyo Stock Exchange

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**Abstract**

This paper examines whether various factors suggested in standard finance can explain the excess returns of portfolios formed on size and book-equity-to-market equity (BE/ME) in Japan. First, we find that, unlike for the US, five risk factors, comprising the three Fama−French factors and the momentum and reversal factors of Chan et al. (1998, 2001), cannot adequately explain the return premia in Japan. Namely, statistically significant positive alphas were observed for the excess returns of all 25 Fama−French (1996) type portfolios, formed on the basis of size and BE/ME ratios. Second, the representative macroeconomic factors of Chen et al. (1986) cannot explain the positive alphas left unexplained by the five risk factors. Third, not only is there little contemporaneous relationship between the alphas left unexplained by the five risk factors and the representative macroeconomic factors of Chen et al. (1986) but also there is little evidence of any causal relationship between these macroeconomic factors and the alphas. Thus, for Japan, unlike for the US, well-known risk factors and macroeconomic factors cannot adequately explain the return premia.

**Keywords:** Book-to-market effect, Fama−French model, Jensen's alpha, Macroeconomic factors, Momentum, reversal, Size effect

## 1. Introduction

The behavioral finance literature, including Lakonishok et al. (1994), Daniel and Titman (1997), and Daniel et al. (2001) attacked the Fama and French (FF) (1993; 1996) model (Note 1), which is categorized as one of the standard finance models. This categorization reflects FF's (1993; 1996) explanation that because in their model, high-minus-low (*HML*) and small-minus-big (*SMB*) are the standard finance risk factors, which explain the risk premia uncaptured by the simplest traditional capital asset pricing model (CAPM), they should be the standard factors that explain equity returns within the field of standard finance.

In contrast to the above insistence, however, we should point out that the effectiveness of *SMB* and *HML* seems to be anomalous because they are derived from two kinds of anomalies, namely, the size and book-equity-to-market equity (BE/ME) anomalies.

Using US data, FF (1996) demonstrated that FF's three-factor model explains much of the cross-sectional return variation in portfolios formed on the basis of size and BE/ME. Subsequently, Chan et al. (2001) proposed a risk adjustment based on five risk factors, adding to the three FF factors the momentum factor of Jegadeesh and Titman (1993) and the reversal factor of DeBondt and Thaler (1985). Therefore, it appears that the three FF factors, when combined with the momentum and reversal factors, explain almost all excess return dispersion of common stock or equity portfolios in the US. On the basis of the evidence from FF (1996, 2006) and Chan et al. (2001), when the above five risk factors are applied, the Jensen's (1968) alphas of the excess returns of 25 FF (1996) type size- and BE/ME-sorted stock portfolios are zero in the US. (Note 2)

Why then is Jensen's alpha important here and should be focused on in our context of analysis? This is because FF (2006, p. 2174) themselves posited that "*In a CAPM world, the true intercepts in these regressions are zero*.", and FF (1996) also repeatedly tested whether alphas are zero in their model.

However, in contrast to the US evidence and FF's results, from an international perspective, (Note 3) in this paper, we demonstrate that the return premia dispersions of 25 size and BE/ME portfolios in Japan cannot be fully explained. That is, for Japan, one cannot remove the positive alphas from the excess returns of 25 size and BE/ME portfolios, contrary to the findings of FF (1996) for the US.

This finding is robust even if we use not only the five risk factors mentioned above but also the representative macroeconomic factors suggested by Chen et al. (1986). (Note 4) Regarding this point, in another standard finance model, the arbitrage pricing model (APM) suggested by Ross (1976), stock returns are assumed to be generated from multiple unidentified factors. Then if a number of macroeconomic factors cannot contribute to explain the alphas unexplained by FF, momentum, and the reversal factors, then this situation also demonstrates the limits of the standard finance asset pricing models.

Based on the above introductory discussions, the objective of this paper is to examine the explanatory power of traditional risk and macroeconomic factors for the return premia of size and BE/ME portfolios in Japan. We note here that, in this paper, we do not intend to search for other effective explanatory factors for the Japanese stock market. Furthermore, we are unaware of any published international study that investigated common stock portfolios' alphas as comprehensively as ours for Japan.

The new findings contributed by this paper are summarized as follows. First, unlike the US evidence, for Japan, the five risk factors comprising the three FF factors and the momentum and reversal factors of Chan et al. (1998, 2001) cannot fully explain the excess stock portfolio returns in Japan. Namely, statistically significant positive alphas were observed for all 25 FF (1996) type portfolios, formed on size and BE/ME. More precisely, the above five risk factor model has a positive alpha of 876 basis points per year (73 basis points per month), and this value is economically significant.

Second, for Japan, the representative macroeconomic factors of Chen et al. (1986) also exhibit difficulty in capturing the positive alphas left unexplained by the five risk factors.

Third, not only is there little contemporaneous relationship between the alphas left unexplained by the five risk factors and the representative macroeconomic factors of Chen et al. (1986) but also there is little evidence of any causal relationship between these macroeconomic factors and the alphas. Hence, it also seems to be difficult to explain the return premia of portfolios formed on size and BE/ME in Japan by conditioning on macroeconomic information.

The rest of this paper is organized as follows. In Section 2, we describe the testing models and methodology. In Section 3, we describe the data used. In Section 4, we discuss the empirical results, and Section 5 provides an interpretation and implications. Section 6 concludes the paper.

## 2. Models and Methodology

We use four testing models in this paper. The first is the following FF (1993, 1996) model (1):

$$R_{i,t} - R_{f,t} = \alpha_i + b_i(R_{M,t} - R_{f,t}) + s_i SMB_t + h_i HML_t + e_{i,t}, \tag{1}$$

where $R_{M,t}-R_{f,t}$ is the market factor, $SMB_t$ is the small-minus-big factor, and $HML_t$ is the high-minus-low factor of FF (1993, 1996).

The second model is the following risk adjusted model used by Chan et al. (2001):

$$R_{i,t} - R_{f,t} = \alpha_i + b_i(R_{M,t} - R_{f,t}) + s_i SMB_t + h_i HML_t + w_i WML_t + d_i UMD_t + e_{i,t}, \tag{2}$$

where $UMD_t$ and $WML_t$ are the momentum and reversal factors constructed and used by Chan et al. (1998). They insisted that risk adjustment should be carefully conducted based on five factors in model (2).

The next two testing models use the macroeconomic factors of Chen et al. (1986). Namely, Model (3) is as follows:

$$ALPHA_{i,t} = \mu_i + \beta_i MPSA_t + \gamma_i UI_t + \delta_i DEI_t + \varsigma_i URP_t + \eta_i UTS_t + \varepsilon_{i,t}, \tag{3}$$

where $ALPHA_{i,t} \equiv R_{i,t} - R_{f,t} - b_i(R_{M,t} - R_{f,t}) - s_i SMB_t - h_i HML_t - w_i WML_t - d_i UMD_t$. Following Chen et al. (1986), the following variables are constructed by using Japanese data: macroeconomic factors of *MPSA*, the monthly growth rate of seasonally adjusted industrial production; *UI*, unanticipated inflation; *DEI*, the change in expected inflation; *URP*, the series for the risk premium (credit spreads); and *UTS*, the series for the term structure. (Details are provided in the next section.)

Finally, the fourth model is as follows:

$$ALPHA_{i,t} = \nu_i + \beta_i MPSA_t + \gamma_i UI_t + \delta_i DEI_t + \varsigma_i URP_t + \eta_i UTS_t + \vartheta_i CG_t + \kappa_i OG_t + \omega_{i,t}, \tag{4}$$

where the definition of $ALPHA_{i,t}$ is the same as that in model (3), and following Chen et al. (1986), the following variables are constructed by using Japanese data: *CG*, the growth rate in real per capita consumption; and *OG*, the growth rate in oil prices. (Details are also provided in the next section.)

## 3. Data

The data analyzed in this paper cover the sample period from October 1981 to April 2005 (Note 5) in Japan. Individual data series are described below, and their glossaries and definitions are summarized in Table 1.

*3.1 Fama-French factors and momentum and reversal factors*

First, we construct and use the three FF (1993) factors, Jegadeesh and Titman's (1993) momentum factor, and DeBondt and Thaler's (1985) reversal factor. The notation is as follows: risk-free percentage rate: $R_f$; market portfolio percentage return: $R_M$; FF's (1993) small-minus-big factor percentage return: *SMB*; FF's (1993) high-minus-low factor percentage return: *HML*; the momentum factor percentage return, constructed by following the method of Chan et al. (1998): *UMD*; the reversal factor percentage return, constructed by following the method of Chan et al. (1998): *WML*. (Note 6)

Following FF (1993, 1996), we also use the returns of 25 portfolios formed based on size and BE/ME ratios. Complete explanations of data sources and the methods used to construct the five factors, comprising the three FF factors and the momentum and reversal factors are in Appendix A.

*3.2 Macroeconomic factors*

Regarding the macroeconomic factors, we construct the factors of Chen et al. (1986) using Japanese data. First, by seasonally adjusting the monthly index of industrial production, which is from the Ministry of Economy, Trade, and Industry, we construct the seasonally adjusted series of industrial production, $IPSA(t)$. Then we construct the innovations (growth rates) (Note 7) of industrial production $MPSA(t)$ by computing the first difference of $IPSA(t)$ in logarithms: $MPSA(t) = \ln IPSA(t) - \ln IPSA(t-1)$.

For inflation, to derive an expected inflation series, we used the Fama and Gibbons (1984) methodology as used by Chen et al. (1986) and Hamao (1988). First, we define $I(t)$ as the monthly first-order log of the realized consumer price index (CPI), obtained from the Ministry of Internal Affairs and Communications, and define $E[\cdot\,|t]$ as the expectations operator, conditional on information held at the end of month $t$. Then, following Chen et al. (1986) and Hamao (1988), we define unanticipated inflation *UI* and the change in expected inflation *DEI* as follows: $UI(t) = I(t) - E[I(t)|t-1]$, $DEI(t) = E[I(t+1)|t] - E[I(t)|t-1]$. Constructing the series for $UI(t)$ and $DEI(t)$ requires the risk-free rate, $R_f$, for which we use the gensaki rate, obtained from the Japan Securities Dealers Association, for the period from October 1981 to May 1984, and use the one-month median rate of negotiable time certificates of deposit (CD), obtained from the Bank of Japan, for the period from June 1984 to April 2005. (Note 8)

Third, for the risk premiums (credit spreads), (Note 9) as did Chen et al. (1986), we use the spread between corporate bond yields and long-term government bond yields. However, because so few ‘BAA and under’ bonds have been issued in Japan, we calculate the series for this risk premium, *URP*, as $URP(t) = BD(t) - GB(t)$, where *BD* denotes the yield of the Nikkei Bond Index (long term) from Nikkei, Inc. and *GB* denotes the Japanese 10-year government bond yield from the Bank of Japan.

Fourth, for the term structure, also following Chen et al. (1986), we use the yield spread between long-term bonds and the risk-free rate, $UTS(t) = GB(t) - R_f(t-1)$.

Fifth, for consumption, we use time-series data on real consumption changes, *CG*, following Chen et al. (1986). *CG* is the innovation (growth rate) in real per capita seasonally adjusted private consumption and is constructed by dividing data on seasonally adjusted real consumption from the Government of Japan by the corresponding population estimates from the Ministry of Internal Affairs and Communications.

Following Chen et al. (1986), we measure innovations in oil prices, *OG*, by constructing the first difference in the logarithm of the domestic corporate goods price index (petroleum coal products) from the Bank of Japan. Summary statistics for the above risk factors and macroeconomic factors are in Appendix B.

## 4. Empirical Results

*4.1 The limits of risk factors in explaining the return premia*

With regard to the explanatory power of their three-factor model, FF (1996) insisted that the three-factor model captures much of the anomalous cross-sectional variation in average stock returns. To justify this, using US data, FF (1996) showed that, when applied to the excess returns of 25 portfolios formed by size and BE/ME ratios, the intercepts of model (1), were not statistically significantly different from zero.

To test the effectiveness of the FF model for Japan, we perform a parallel test by using Japanese data from October 1981 to April 2005. The results are shown in Table 2, and they are very different from those for the US. The 25 intercepts are all positive and statistically significant at the 1% level, except one, which is significant at the 5% level in a size-4 and BE/ME-2 portfolio. Furthermore, the average absolute value of the 25 intercepts is 0.72 percent (72 basis points) per month, and this figure is substantially larger than that for the US reported in Table I of FF (1996). In addition, the average adjusted $R$-squared from the 25 regressions is 0.83 for Japan, which is below the corresponding US value reported in Table I of FF (1996). Thus, unlike in the case of the US, the three-factor model of FF (1993) has unexplained positive excess returns; i.e., there are positive alphas for Japan, which average 8.64 percent (864 basis points) per year.

To examine the robustness of these estimated positive alphas for Japan, we incorporate into our analysis the momentum and reversal factors of Chan et al. (1998, 2001), *UMD* and *WML*. That is, we estimate regression (2) by using the 25 portfolio returns formed by size and BE/ME. The results reported in Table 3 are similar to the results from the three-factor model (1). All 25 intercepts are positive and statistically significant at the 1% level, except one that is significant at the 5% level, in a size-4 and BE/ME-2 portfolio. Furthermore, the average value of the 25 intercepts is 0.73 percent (73 basis points) per month. The average adjusted *R*-squared from the 25 regressions of 0.84 indicates that model (2) has little more explanatory power than the three-factor model (1). Hence, the momentum and reversal factors, *UMD* and *WML*, hardly contribute to eliminating the alphas that are left unexplained by the FF model for Japan.

Thus, our rigorous analysis shows that there are positive alphas for Japan. This suggests that Japan's dynamics in return premia differ from those of the US.

*4.2 The limits of macroeconomic factors in explaining the return premia*

In the preceding subsections, we obtained robust evidence of positive alphas in Japan. Hence, we here test the explanatory power of the macroeconomic factors used by Chen et al. (1986) on $ALPHA_{i,t} \equiv R_{i,t} - R_{f,t} - b_i(R_{M,t} - R_{f,t}) - s_i SMB_t - h_i HML_t - w_i WML_t - d_i UMD_t$. Specifically, we first estimate regression (3) using the five macroeconomic factors of Chen et al. (1986).

The regression results are reported in Table 4. There are slightly fewer statistically significant positive alphas than in models (1) and (2). Nevertheless, 24 positive alphas remain. In addition, only four of the coefficients of the five macroeconomic factors are statistically significant for *MPSA*, only two are statistically significant for *DEI*, only four are significant for *URP*, and only one is significant for *UTS*; the other cases of five macroeconomic factors explain none of the dynamics of the positive alphas in Japan. Furthermore, the adjusted *R*-squared values of the 25 regressions are quite low, as Table 4 shows. Thus, overall, there is little contemporaneous relation between the alphas and the five Japanese macroeconomic factors.

Next, for further analysis, by adding two factors for *CG* and *OG*, we estimate regression (4) by using the seven macroeconomic factors of Chen et al. (1986). The results are shown in Table 5. Again, there are slightly fewer statistically significant positive alphas than in models (1) to (3). However, as in model (3), 24 positive alphas remain. Also similarly to model (3), only four of the coefficients of the seven macroeconomic factors are statistically significant for *MPSA*, only two are statistically significant for *DEI*, only four are significant for *URP*, and only one is significant for *UTS* and *CG*. Therefore, neither of the two added macroeconomic factors can explain the dynamics of the positive alphas, except in only one case in which there is a weak statistically significant effect of *CG*. Furthermore, the adjusted *R*-squared values of the 25 regressions are again quite low, as Table 5 shows. Thus, overall, there is little contemporaneous relation between the alphas left unexplained by the risk factors and the seven Japanese macroeconomic factors.

What is then the nature of the intertemporal relationships between the macroeconomic factors and the positive alphas in Japan? To investigate the intertemporal relationships, in Table 6 we report the results for Granger causality from the seven macroeconomic factors to the average value of alphas left unexplained by the three FF factors, momentum factor, and reversal factor. As Table 6 shows, for the seven Chen et al. (1986) macroeconomic factors, there is evidence of only one causal relation from *MPSA* to the average alpha. This causality is recognized in all cases for lags 1 to 5 (Panel A to E).

On the basis of the results, to check the response direction of the shocks from *MPSA* to the average values of the 25 alphas, we show the impulse responses of the alpha to shocks from *MPSA* in Figure 1. Figure 1 shows that, in general, response directions from *MPSA* to the alphas are unstable for all lags and thus it is difficult to judge whether the effects of *MPSA* are positive or negative. Therefore, although a causal relation from *MPSA* to the alphas is apparent in Table 6, it would be difficult to use this information on the *MPSA* to forecast the direction of the movements in the alphas in Japan.

Therefore, given the results in Table 6 and Figure 1, we suggest that even if intertemporal relations are considered, macroeconomic information does not adequately explain the return premia of portfolios formed on size and BE/ME in Japan.

**5. Interpretation and Implications**

This section discusses the interpretation and implications of our results. First are the arguments regarding risk adjustments. As mentioned before, in the US, as Chan et al. (2001) suggested, when the five risk factors (three FF, momentum, and reversal factors) are applied, the risk adjustment for the excess stock returns is generally completed. However, as our evidence demonstrates, risk adjustment by the above five factors does not operate in Japan. Thus, as an important implication, if the returns of portfolios, sorted according to certain firm characteristics or accounting measures, exhibit the positive alphas after risk adjustment by the five factors as in Chan et al. (2001), we cannot judge that it is the evidence of the special additional return premia linked to those firm characteristics or accounting measures in Japan.

Second, as far as we can judge by monthly data as in Chen et al. (1986), return premia show autonomous dynamics that are not strongly affected by the innovations of macroeconomic factors. Of course, we did not test all macroeconomic factors other than the traditional seven factors suggested by Chen et al. (1986); however, in a general sense, the evidence that numerous factors, namely five risk factors and seven macroeconomic factors, cannot explain the return premia in Japan contradicts the assumption of arbitrage pricing theory (APT) in standard finance theory. This is because in APT, stock returns are assumed to be generated by unidentified factors such as risk factors and/or macroeconomic factors.

Third, regarding *HML* and *SMB*, their economic meaning and roles are still unclear. Regarding this matter, FF (1996, p.77) wrote that "*FF (1993) interpret the average HML returns as a premium for a state-variable risk related to relative distress*". However, the economic meaning of *SMB* was not discussed in any existing studies. Furthermore, Lakonishok et al. (1994, p.1574) explained that "*value strategies appear to be no riskier than glamour strategies.*" This means that low-risk value premia, such as *HML*, do not fluctuate highly with the dynamics of the business cycle. If so, in bad times, *HML* does not behave badly like the distress risk factor but rather somewhat defensively against economic stagnation. If, as Lakonishok et al. (1994, p.1574) suggested, value premia have generally low risk, then high *HML* premia and their low risk are inconsistent with the risk-return trade-off paradigm, and this also contradicts standard finance theory.

## 6. Conclusions

In this paper, we examined whether one can explain the return premia of portfolios formed on size and BE/ME in Japan. We tested four models by using the five risk factors and the seven macroeconomic factors used by Chen et al. (1986). The three new findings obtained for Japan in this study are summarized as follows.

First, unlike in the US, the five risk factors, comprising the three FF factors and the momentum and reversal factors of Chan et al. (1998), cannot fully explain the return premia of portfolios formed on size and BE/ME in Japan. Statistically significant positive alphas were observed for all 25 FF (1996) type portfolios, which are formed on size and BE/ME.

Second, we found that the representative macroeconomic factors of Chen et al. (1986) also cannot adequately explain the positive alphas left unexplained by the five risk factors. Our results imply that, contemporaneously, economic forces do not seem to influence strongly the return premia of portfolios formed on size and BE/ME in Japan.

Third, not only is there little contemporaneous relationship between the alphas left unexplained by the five risk factors and the representative macroeconomic factors of Chen et al. (1986) but also there is little evidence of any causal relationship between these macroeconomic factors and the alphas. Thus, it seems difficult to explain the positive alphas in Japan by conditioning on macroeconomic information as well.

These empirical results represent new findings for Japan, which are surprisingly different from existing findings for the US. The fact that well-known risk factors and macroeconomic factors cannot fully explain the return premia of size and BE/ME-ranked portfolios in Japan clearly suggests the limits of standard asset pricing models in Japan. In future work, we should find different factors to explain the return premia in Japan; however, we emphasize that it is not our aim in this paper. Instead, we believe that a more important matter for us is to recognize the limits of standard asset pricing models in Japan.

Furthermore, our results imply that one must assess the existing evidence more carefully, including studies of international markets, to deepen our knowledge of interesting, but sometimes puzzling, financial market characteristics from a more international viewpoint.

## Appendix A. Construction of Fama−French, Momentum, and Reversal Factors

The sample period of data for factor constructions is from October 1981 to April 2005. The individual data series are: the risk-free percentage rate, $R_f$; the market portfolio percentage return, $R_M$; Fama and French (FF)'s (1993) small-minus-big factor percentage return, *SMB*; FF's (1993) high-minus-low percentage return, *HML*; Chan et al.'s (1998) momentum factor percentage return, *UMD*; and Chan et al.'s (1998) reversal factor percentage return, *WML*.

First, $R_f$ is the gensaki rate from the Japan Securities Dealers Association from October 1981 to May 1984 and the one-month median rate on negotiable-time certificates of deposit (CD) from the Bank of Japan from June 1984 to April 2005. This is because before June 1984, one-month CD rates are not available. Thus, following Hamao (1988), we specified the gensaki rate as the risk-free rate before June 1984.

Second, the market return $R_M$ is the value-weighted return of all stocks in the Tokyo Stock Exchange (TSE) First Section, provided by the Japan Securities Research Institute (JSRI).

Third, the factor returns of *SMB* and *HML* for Japan are formed following FF (1993). Individual stock return data for the constructions of *SMB* and *HML* are the returns of stocks listed in the TSE First Section, and they are from JSRI. At the end of September each year $t$ (from 1981 to 2004), TSE First Section stocks are first allocated to two groups, small

(S) or big (B), based on whether their September market equity (ME, stock price times shares outstanding) is below or above the median of ME for TSE First Section stocks. Next, TSE First Section stocks are allocated in an independent sort to three book-to-market equity (BE/ME) groups (low, medium, or high; L, M, or H) based on breakpoints for the bottom 30 percent, middle 40 percent, and top 30 percent of values of BE/ME for TSE First Section stocks, where BE is the book value of equity. The BE/ME ratio used to form portfolios in September of year $t$ is the book common equity for the fiscal year $t-1$, divided by the market equity at the end of March in calendar year $t$. Following FF (1993), we do not use negative BE firms when calculating the breakpoints for BE/ME or when forming the size-BE/ME portfolios; and only firms with ordinary common equity are included in the tests. This means that Real Estate Investment Trusts (REITs) and units of beneficial interest are excluded. By these procedures, six size-BE/ME portfolios (S/L, S/M, S/H, B/L, B/M, B/H) are defined as the intersections of the two ME and three BE/ME groups. Value-weighted monthly returns on the portfolios are then calculated from the following October to the next September. We rebalance the portfolios every September following FF's (1993) suggestion: "*We calculate returns beginning in July of year t to be sure that book equity for year t−1 is known* (FF 1993, p.9)." In Japan, the fiscal year for most companies closes not at the end of December as in the US but at the end of March; that is, the end of the fiscal year in Japan is three months later than in the US. Thus, we calculate returns not from July but from October of year $t$ to September of year $t$+1, after rebalancing portfolios in every September of year $t$, to be sure that book equity for the most recent fiscal year is known in the Japanese market. *SMB* is the difference, each month, between the average of the returns on the three small-stock portfolios (S/L, S/M, and S/H) and the average of the returns on the three big-stock portfolios (B/L, B/M, and B/H), while *HML* is the difference between the average of the returns on the two high-BE/ME portfolios (S/H and B/H) and the average of the returns on the two low-BE/ME portfolios (S/L and B/L). The 25 size-BE/ME portfolios also used for the analysis in this paper, are formed in a similar manner as the six size-BE/ME portfolios used to construct the *SMB* and *HML* factors.

Finally, regarding the momentum factor return, *UMD*, and the reversal factor return, *WML*, we followed Chan et al. (1998) for the construction using the Japanese data. In particular, for the construction of *UMD*, we first reformed portfolios every six months beginning in July of each year according to the attributes of the past seven months' returns, from seven months before to one month before (Chan et al. (1998) denoted this attribute $R(-7, -1)$), while for the construction of *WML*, we reformed portfolios every July, according to the attributes of the past 49 months' returns, from 60 months before to 12 months before (Chan et al. (1998) denoted this attribute $R(-60, -12)$). We note that Chan et al. (1998) formed portfolios every April to be sure that the information of the attributes (past returns, here) are known in the US market. As with the construction of *HML* and *SMB* above, we delayed the portfolio formation time by three months in our case, taking into consideration the above mentioned fact that the fiscal year in Japan generally ends three months later than in the US. In our portfolio construction, following Chan et al. (1998), we formed five portfolios by allocating the stocks with the lowest and highest values of the attributes to Portfolios 1 and 5, respectively. Using the above procedure, we obtain five portfolios ranked by the attribute $R(-7, -1)$ and five portfolios ranked by $R(-60, -12)$, respectively. The quintile breakpoints are obtained from the distribution of the attributes for the TSE First Section-listed stocks. Next, we compute the equally weighted return on each quintile portfolio; for $R(-7, -1)$-ranked portfolios, we calculate the subsequent six-month return, and for $R(-60, -12)$-ranked portfolios, we calculate the subsequent 12-month return. The mimicking portfolio returns, *UMD* and *WML* here, are then calculated each month: *UMD* is computed by deducting the calculated subsequent return of the lowest-$R(-7, -1)$ portfolio 1 from the return of the highest-$R(-7, -1)$ portfolio 5, and *WML* is calculated each month by deducting the subsequent return of the lowest-$R(-60, -12)$ portfolio 1 from the return of the highest-$R(-60, -12)$ portfolio 5, respectively.

**Appendix B. Summary Statistics for Risk Factors and Macroeconomic Factors**

| | $R_{M,t}-R_{f,t}$ | *SMB* | *HML* | *WML* | *UMD* | *MPSA* |
|---|---|---|---|---|---|---|
| Mean | 0.221897 | 0.744121 | 0.661034 | −0.591074 | −0.107534 | 0.001292 |
| Median | 0.207750 | 0.931108 | 0.614312 | −0.546000 | 0.367000 | 0.001063 |
| Maximum | 16.83492 | 20.72886 | 15.20494 | 14.10300 | 17.39500 | 0.041536 |
| Minimum | −20.49162 | −14.34414 | −11.71550 | −13.36600 | −31.69700 | −0.043788 |
| Std. Dev. | 5.475107 | 4.603124 | 3.329509 | 3.593877 | 5.046707 | 0.014068 |
| Skewness | −0.013767 | −0.235526 | 0.025603 | 0.037204 | −1.033234 | −0.106523 |
| Kurtosis | 3.933067 | 4.531289 | 5.358265 | 5.693192 | 9.556846 | 3.518973 |
| | *UI* | *DEI* | *URP* | *UTS* | *CG* | *OG* |
| Mean | 0.000124 | −1.25E−05 | 0.300908 | 0.993287 | 0.172340 | 0.000438 |
| Median | 0.000187 | −5.00E−06 | 0.266500 | 1.206000 | −0.020252 | 0.000000 |
| Maximum | 0.016583 | 0.001057 | 1.366095 | 2.788182 | 3.274185 | 0.084518 |
| Minimum | −0.009269 | −0.000889 | −0.280000 | −2.092000 | −3.681645 | −0.116187 |
| Std. Dev. | 0.002796 | 0.000268 | 0.287258 | 0.942647 | 0.627371 | 0.020215 |
| Skewness | 0.783865 | 0.019108 | 0.667123 | −0.785135 | 0.626256 | −1.215999 |
| Kurtosis | 8.046193 | 4.604435 | 3.670478 | 3.602963 | 12.67757 | 12.27387 |

**References**


Avramov, D. (2002). Stock return predictability and model uncertainty. *Journal of Financial Economics*, 64, 423-458

Avramov, D. (2004). Stock Return Predictability and Asset Pricing Models. *Review of Financial Studies*, 17, 699-738

Baks, K. P., Metric, A. & Wachter, J. (2001). Should investors avoid all actively managed mutual funds? A study in Bayesian performance evaluation. *Journal of Finance*, 56, 45-85

Becht, M., Bolton, P. & Röell, A. (2003). Corporate Governance and Control, in: Constantinides, G. M., Harris, M., and Stulz, R. M. Ed., *Handbook of the Economics of Finance*, Elsevier, Amsterdam, Netherlands, 1-109

Berk, J. B. & Green, R. C. (2004). Mutual fund flows and performance in rational markets. *Journal of Political Economy*, 112, 1269-95

Bollen, N. & Busse, J. A. (2005). Short-term persistence in mutual fund performance. *Review of Financial Studies*, 18, 569-597

Box, G. E. P. & Jenkins, G. M. (1976). *Time series analysis: Forecasting and control*, San Francisco, Holden-Day

Brealey, R., Myers, S., & Allen, F. (2006). *Principles of Corporate Finance*, The McGraw-Hill Companies, Inc., New York, NY

Brown, S. J., Goetzmann, W. N., Ibbotson, R. G. & Ross, S. A. (1992). Survivorship bias in performance studies. *Review of Financial Studies*, 5, 553-580

Busse, J. A. & Irvine, P. J. (2006). Bayesian Alphas and Mutual Fund Persistence. *Journal of Finance*, 61, 2251-2288

Carhart, M. M. (1997). On persistence in mutual fund performance. *Journal of Finance*, 52, 57-82

Carhart, M. M., Carpenter, J. N., Lynch, A. W., & Musto, D. K. (2002). Mutual fund survivorship. *Review of Financial Studies*, 15, 1439-1463

Chan, L. K. C., Karceski, J., & Lakonishok, J. (1998). The Risk and Return from Factors. *Journal of Financial and Quantitative Analysis*, 33, 159-188

Chan, L. K. C., Lakonishok, J. & Sougiannis, T. (2001). The Stock Market Valuation of Research and Development Expenditures. *Journal of Finance*, 56, 2431-2456

Chelley-Steeley, P. & Siganos, A. (2004). Momentum profits and macroeconomic factors. *Applied Economics Letters*, 11, 433-6

Chen, H. L., Jegadeesh, N. & Wermers, R. (2000). The value of active mutual fund management: An examination of the stockholdings and trades of fund managers. *Journal of Financial and Quantitative Analysis*, 35, 343-368

Chen, N. (1991). Financial Investment Opportunities and the Macroeconomy. *Journal of Finance*, 46, 529-554

Chen, N., Roll, R., & Ross, S. (1986). Economic Forces and the Stock Market. *Journal of Business*, 59, 383-403

Chevalier, J. A., & Ellison, G. (1997). Risk taking by mutual funds as a response to incentives. *Journal of Political Economy*, 105, 1167-1200

Christopherson, J. A., Ferson, W. E. & Glassman, D. A. (1998). Conditioning manager alphas on economic information: Another look at the persistence of performance. *Review of Financial Studies*, 11, 111-142

Cohen, R., Coval, J. & Pastor, L. (2005). Judging fund managers by the company they keep. *Journal of Finance*, 60, 1057-1096

Conrad, J., Cooper, M. & Kaul, G. (2003). Value versus glamour. *Journal of Finance*, 58, 1969-95

Daniel, K., Grinblatt, M., Titman, S. & Wermers, R. (1997). Measuring mutual fund performance with characteristic-based benchmarks. *Journal of Finance*, 52, 1035-1058

Daniel, K. & Titman, S. (1997). Evidence on the characteristic of cross sectional variation in stock return. *Journal of Finance*, 52, 1-33

Daniel, K., Titman, S. & Wei, K. C. J. (2001). Explaining the cross-section of stock returns in Japan: factors or characteristics? *Journal of Finance*, 56, 743-766

DeBondt, W. F. M. & Thaler, R. (1985). Does the Stock Market Overreact? *Journal of Finance*, 40, 793-805

Ewing, B. T., Forbes, S. M. & Payne, J. E. (2003). The effects of macroeconomic shocks on sector-specific returns. *Applied Economics*, 35, 201-207

Fama, E. & and French, K. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, 33, 3-56

Fama, E. & French, K. (1996). Multifactor explanations of asset pricing anomalies. *Journal of Finance*, 51, 55-84

Fama, E. & French, K. (2006). The Value Premium and the CAPM. *Journal of Finance*, 61, 2163-2185

Fama, E. & Gibbons, M. (1984). A comparison of inflation forecasts. *Journal of Monetary Economics*, 13, 327-348

Ferson, W. E. & Harvey, C. R. (1991). The valuation of economic risk premiums. *Journal of Political Economy*, 90, 385-415

Ferson, W. E. & Schadt, R. W. (1996). Measuring Fund Strategy and Performance in Changing Economic Conditions. *Journal of Finance*, 51, 425-461

Fifield, S. G. M., Power, D. M. & Sinclair, C. D. (2002). Macroeconomic factors and share returns: an analysis using emerging market data. *International Journal of Finance & Economics*, 7, 51-62

Fisher, I. (1965). *The theory of interest*, A. M. Kelley, Clifton, NJ

Flannery, M. J. & Protopapadakis, A. A. (2002). Macroeconomic Factors *Do* Influence Aggregate Stock Returns. *Review of Financial Studies*, 15, 751-782

Goyal, A. & Santa-Clara, P. (2003). Idiosyncratic risk matters! *Journal of Finance*, 58, 975-1007

Griffin, J. M., Ji, X. & Martin, J. S. (2003). Momentum Investing and Business Cycle Risk: Evidence from Pole to Pole. *Journal of Finance*, 58, 2515-2547

Grinblatt, M., Titman, S. & Wermers, R. (1995). Momentum investment strategies, portfolio performance, and herding: A study of mutual fund behavior. *American Economic Review*, 85, 1088-1105

Gruber, M. J. (1996). Another puzzle: The growth of actively managed mutual funds. *Journal of Finance*, 51, 783-810

Hamao, Y. (1988). An empirical examination of the arbitrage pricing theory. *Japan and the World Economy*, 1, 45-61

Hoshi, T. & Kashyap, A. K. (2004). *Corporate Financing and Governance in Japan: The Road to the Future*, MIT Press, Cambridge, M.A

Jagannathan, R. & Wang, Z. (2002). Empirical Evaluation of Asset-Pricing Models: A Comparison of the SDF and Beta Methods. *Journal of Finance*, 57, 2337-2367

Jegadeesh, N. & Titman, S. (1993). Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. *Journal of Finance*, 48, 65-91

Jensen, M. C. (1968). The performance of mutual funds in the period 1945-1964. *Journal of Finance*, 23, 389-416

Jones, C. S. & Shanken, J. (2005). Mutual fund performance with learning across funds. *Journal of Financial Economics*, 78, 507-552

Kosowski, R., Timmermann, A., Wermers, R. & White, H. (2006). Can Mutual Fund “Stars” Really Pick Stocks? New Evidence from a Bootstrap Analysis. *Journal of Finance*, 61, 2551-2595

Lakonishok, J., Shleifer, A. & Vishny, R. (1994). Contrarian investment, extrapolation. and risk. *Journal of Finance*, 49, 1541-1578

Lamont, O. A. (2001). Economic tracking portfolios. *Journal of Econometrics*, 105, 161-84

Lioui, A. & Poncet, P. (2003). International asset allocation: a new perspective. *Journal of Banking & Finance*, 27, 2203-30

Lundblad, C. (2007). The risk return trade off in the long run: 1836-2003. *Journal of Financial Economics*, 85, 123-150

Maringer, D. G. (2004). Finding the relevant risk factors for asset pricing. *Computational Statistics & Date Analysis*, 47, 339-52

Merville, L. J., Hayes-Yelken, S. & Xu, Y. X. (2001). Identifying the factor structure of equity returns. *Journal of Portfolio Management*, 27, 51-61

Mixon, S. (2002). Factors explaining movements in the implied volatility surface. *Journal of Futures Markets*, 22, 915-37

Newey, W. K. & West, K. D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica*, 55, 703-708

Pastor, L. & Stambaugh, R. F. (2002a). Investing in equity mutual funds. *Journal of Financial Economics*, 63, 351-380

Pastor, L. & Stambaugh, R. F. (2002b). Mutual fund performance and seemingly unrelated assets. *Journal of Financial Economics*, 63, 313-349

Payne, J. E. (2003). Shocks to macroeconomic state variables and the risk premium of REITs. *Applied Economics*

*Letters*, 10, 671-7

Petkova, R. (2006). Do the Fama-French Factors Proxy for Innovations in Predictive Variables? *Journal of Finance*, 61, 581-612

Poitras, M. (2004). The impact of macroeconomic announcements on stock prices: in search of state dependence. *Southern Economic Journal*, 70, 549-65

Priestley, R. & Odegaard, B. A. (2004). Exchange rate regimes and the price of exchange rate risk. *Economics Letters*, 82, 181-8

Qi, M. & Maddala, G. S. (1999). Economic factors and the stock market: a new perspective. *Journal of Forecasting*, 18, 151-66

Resnick, B. G. & Shoesmith, G. L. (2002). Using the yield curve to time the stock market. *Financial Analysts Journal*, 58, 82-90

Ross, S. A. (1976). The Arbitrage Theory of Capital Asset Pricing. *Journal of Economic Theory*, 13, 341-360

Scruggs, J. T. & Glabadanidis, P. (2003). Risk premia and the dynamic covariance between stock and bond returns. *Journal of Financial and Quantitative Analysis*, 38, 295-316

Siddique, A. R. (2003). Common asset pricing factors in volatilities and returns in futures markets. *Journal of Banking & Finance*, 27, 2347-68

Smith, P. & Wickens, M. (2002). Asset pricing with observable stochastic discount factors. *Journal of Economic Surveys*, 16, 397-446

Vassalou, M. & Xing, Y. (2004). Default Risk in Equity Returns. *Journal of Finance*, 59, 831-868

**Notes**

Note 1. Lakonishok et al. (1994) questioned the risk-return trade-off of value stocks, and Daniel and Titman (1997) and Daniel et al. (2001) insisted that firm characteristics, rather than risk, are priced.

Note 2. Studies of the alphas of the excess returns of common stocks or equity portfolios are rare, mainly because when the FF model is applied to excess returns, the alphas of these assets are often close to zero for the US. Generally, therefore, most of the existing literature considers the alphas of mutual funds. This literature includes the studies of Brown et al. (1992), Grinblatt et al. (1995), Ferson and Schadt (1996), Gruber (1996), Carhart (1997), Chevalier and Ellison (1997), Daniel et al. (1997), Christopherson et al. (1998), Chen et al. (2000), Baks et al. (2001), Carhart et al. (2002), Pastor and Stambaugh (2002a, 2002b), Berk and Green (2004), Bollen and Busse (2005), Cohen et al. (2005), Jones and Shanken (2005), Busse and Irvine (2006), and Kosowski et al. (2006).

Note 3. The structure of the economy and of financial markets, the characteristics of investors' preferences, the pertinent degree of knowledge of monetary and financial issues, and the characteristics or creditworthiness of the financial systems differ between countries. For example, Hamao (1988) explained the differences in the US and Japanese bond markets. Brealey et al. (2006) argued that financial asset allocations generally differ in the US and Japan. Furthermore, Hoshi and Kashyap (2004) and Becht et al. (2003) discussed differences in the US and Japanese financial systems. Hence, we argue that these differences directly or indirectly produce different stock return structures in the US and Japan.

Note 4. Because Chen et al. (1986) is a very influential study on the macroeconomy and stock market, and their macroeconomic factors are considered to be important, their study was followed by a large number of related studies. These include Chen (1991), Ferson and Harvey (1991), Qi and Maddala (1999), Lamont (2001), Merville et al. (2001), Fifield et al. (2002), Flannery and Protopapadakis (2002), Mixon (2002), Griffin et al. (2003), Avramov (2002, 2004), Jagannathan and Wang (2002), Resnick and Shoesmith (2002), Smith and Wickens (2002), Conrad et al. (2003), Ewing et al. (2003), Goyal and Santa-Clara (2003), Lioui and Poncet (2003), Payne (2003), Scruggs and Glabadanidis (2003), Siddique (2003), Chelley-Steeley and Siganos (2004), Maringer (2004), Poitras (2004), Priestley and Odegaard (2004), Vassalou and Xing (2004), and Petkova (2006).

Note 5. This sample period is the longest period available for our analysis for Japan. Many researchers, such as Brealey et al. (2006) and Lundblad (2007) suggested that a longer sample period is better for deriving robust empirical results. Hence, in this paper we neither divide our sample period nor analyze the structural breaks in the portfolios.

Note 6. The *UMD* and *WML* factors were used by Chan et al. (2001) for a rigorous risk adjustment.

Note 7. Chen et al. (1986) used the term 'innovations' to mean (unanticipated) changes in, or growth rates of, economic variables. We also use the term 'innovations' in this sense.

Note 8. Data before June 1984 on one-month CD rates are not available. Thus, following Hamao (1988), we used the gensaki rate (yields on bonds traded with repurchase agreements) for the period before June 1984. The series for

$E[I(t)|t-1]$ (and $E[I(t+1)|t]$) were constructed as follows. First, according to Fisher (1965), $R_f(t-1)$ can be decomposed into two series, one for the expected real return for month $t$, $E[\rho(t)|t-1]$, and the other for the expected inflation rate, $E[I(t)|t-1]$, as follows: $R_f(t-1) = E[\rho(t)|t-1] + E[I(t)|t-1]$. Then, following Hamao (1988), we assume the following relationship, based on a first-order moving average process: $[R_f(t-1) - I(t)] - [R_f(t-2) - I(t-1)] = u(t) - \theta \cdot u(t-1)$. Given an estimate of $\theta$, obtained by using the standard Box and Jenkins (1976) methodology, and given that $R_f(t-1) - I(t) = E[\rho(t)|t-1] + u(t)$, we obtain $E[\rho(t)|t-1] = [R_f(t-2) - I(t-1)] - \hat{\theta} \cdot u(t-1)$. Then, by using this series for $E[\rho(t)|t-1]$, we can obtain the series for $E[I(t)|t-1]$ (and that for $E[I(t+1)|t]$) from the equation $R_f(t-1) = E[\rho(t)|t-1] + E[I(t)|t-1]$.(See Hamao (1988), p.50 for details.)

Note 9. Although Chen et al. (1986) termed this variable the 'risk premium', it is in fact the so-called credit spread.

Table 1. Glossary and definition of variables

| Notations | Contents and sources |
|---|---|
| **Basic series** | |
| $I$ [Inflation] | Log relative of seasonally adjusted Japanese consumer price index (Statistics Bureau, Ministry of Internal Affairs and Communications) |
| $R_f$ [Risk-free rate] | Yields of bond trade with repurchase agreement (Japan Securities Dealers Association, Hamao (1988), from October 1981 to May 1984) and the one-month median rate of the negotiable time certificate of deposit (CD) (Bank of Japan, from June 1984 to April 2005) |
| $GB$ [Long-term government bond yield] | Japanese 10-year government bond yield (in percent) (Bank of Japan) |
| $IPSA$ [Industrial production] | Industrial production index during month, seasonally adjusted (Ministry of Economy, Trade and Industry) |
| $BD$ [Bond index yield] | Yields of Nikkei Bond Index (long-term) in percent (Nikkei, Inc.) |
| $R_M$ [Value-weighted equities] | Monthly return in percent of a value-weighted portfolio of the first section of TSE-listed stocks (Japan Securities Research Institute) |
| **Derived series** | |
| *Panel A. Macroeconomic innovations* | |
| $MPSA(t)$ [Industrial production monthly growth] | $\log [IPSA(t) / IPSA(t-1)]$ |
| $E[I(t)]$ [Expected inflation] | Expected inflation in the sense of Fama and Gibbons (1984) |
| $UI(t)$ [Unexpected inflation] | $I(t)-E[I(t)|t-1]$ ($E[I(t)|t-1]$ was calculated in accordance with Hamao (1988), Fama and Gibbons (1984), and Chen et al. (1986)) |
| $DEI(t)$ [Expected inflation change] | $E[I(t+1)|t] - E[I(t)|t-1]$ ($E[I(t+1)|t]$ and $E[I(t)|t-1]$ were calculated in accordance with Hamao (1988), Fama and Gibbons (1984), and Chen et al. (1986)) |
| $URP(t)$ [Risk premium] | $BD(t) - GB(t)$ (yield difference in percent) |
| $UTS(t)$ [Term structure] | $GB(t) - R_f(t-1)$ (yield difference in percent) |
| $CG(t)$ [Consumption] | Growth rate in percent of real per capita seasonally adjusted private consumption (Real seasonally adjusted private consumption is from the Cabinet Office of the Government of Japan, and population estimates are from the Statistics Bureau, Ministry of Internal Affairs and Communications) |
| $OG(t)$ [Oil prices] | First difference in the logarithm of domestic corporate goods price index (petroleum coal products) (Bank of Japan) |
| *Panel B. Fama and French's (1993) factors* | |
| $R_M - R_f(t)$ [Market factor] | Monthly excess return in percent of a value-weighted portfolio of the first section of TSE-listed stocks |
| $SMB(t)$ [Small-minus-big factor] | Fama and French's (1993) small-minus-big factor percentage return |
| $HML(t)$ [High-minus-low factor] | Fama and French's (1993) high-minus-low factor percentage return |
| *Panel C. Technical factors constructed by Chan et al. (1998)* | |
| $UMD(t)$ [Momentum factor] | Momentum factor of Jegadeesh and Titman (1993) following the construction method of Chan et al. (1998) |
| $WML(t)$ [Reversal factor] | Reversal factor of DeBondt and Thaler (1985) following the construction method of Chan et al. (1998) |

Table 2. Summary statistics and the results of the three-factor regressions for simple monthly percentage excess returns on 25 portfolios formed on size and BE/ME: the case of Japan, from October 1981 to April 2005 (283 months)

| | Book-to-market equity (BE/ME) quintiles | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Size | Low | 2 | 3 | 4 | High | Low | 2 | 3 | 4 | High |
| | | | | | **Panel A Summary statistics** | | | | | |
| | Means | | | | | Standard Deviations | | | | |
| Small | 2.37 | 2.09 | 1.94 | 2.33 | 2.60 | 9.79 | 8.38 | 8.02 | 7.87 | 8.35 |
| 2 | 1.63 | 1.61 | 1.49 | 1.42 | 1.67 | 8.21 | 7.41 | 7.30 | 7.26 | 7.50 |
| 3 | 1.21 | 1.19 | 1.29 | 1.45 | 1.62 | 7.22 | 6.79 | 6.62 | 6.53 | 6.97 |
| 4 | 0.88 | 0.93 | 1.10 | 1.23 | 1.57 | 6.44 | 6.30 | 6.01 | 5.86 | 6.41 |
| Big | 0.25 | 0.57 | 0.76 | 1.05 | 1.33 | 6.36 | 6.04 | 5.39 | 5.77 | 5.67 |

| | Book-to-market equity (BE/ME) quintiles | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Size | Low | 2 | 3 | 4 | High | Low | 2 | 3 | 4 | High |
| | **Panel B Regression: $R_{i,t} - R_{f,t} = \alpha_i + b_i(R_{M,t} - R_{f,t}) + s_i SMB_t + h_i HML_t + e_{i,t}$** | | | | | | | | | |
| | $\alpha$ | | | | | $t(\alpha)$ | | | | |
| Small | 1.26** | 0.98** | 0.88** | 1.21** | 1.27** | 5.65 | 5.34 | 4.53 | 6.12 | 5.49 |
| 2 | 0.86** | 0.70** | 0.54** | 0.41** | 0.46** | 4.47 | 4.22 | 3.49 | 2.92 | 3.17 |
| 3 | 0.76** | 0.52** | 0.52** | 0.57** | 0.55** | 4.55 | 3.16 | 2.67 | 3.88 | 3.69 |
| 4 | 0.65** | 0.41* | 0.52** | 0.59** | 0.72** | 3.69 | 2.36 | 3.32 | 3.61 | 4.58 |
| Big | 0.57** | 0.74** | 0.68** | 0.88** | 0.74** | 3.60 | 4.68 | 4.79 | 5.59 | 4.99 |
| | $b$ | | | | | $t(b)$ | | | | |
| Small | 1.05** | 0.91** | 0.88** | 0.94** | 0.96** | 21.93 | 19.25 | 21.46 | 21.19 | 17.26 |
| 2 | 0.91** | 0.92** | 0.90** | 0.93** | 0.92** | 16.15 | 22.14 | 18.03 | 26.04 | 17.00 |
| 3 | 0.93** | 0.90** | 0.85** | 0.91** | 0.90** | 17.67 | 18.88 | 20.91 | 22.98 | 16.55 |
| 4 | 0.90** | 0.94** | 0.90** | 0.87** | 0.94** | 16.51 | 17.30 | 16.70 | 16.57 | 19.16 |
| Big | 0.90** | 0.94** | 0.88** | 0.95** | 0.91** | 22.09 | 27.57 | 24.69 | 23.88 | 24.91 |
| | $s$ | | | | | $t(s)$ | | | | |
| Small | 1.38** | 1.22** | 1.13** | 0.99** | 1.05** | 13.22 | 29.19 | 21.36 | 18.01 | 18.64 |
| 2 | 1.11** | 0.93** | 0.95** | 0.92** | 0.93** | 13.66 | 24.99 | 25.68 | 30.52 | 22.05 |
| 3 | 0.73** | 0.73** | 0.75** | 0.64** | 0.75** | 12.99 | 16.46 | 17.66 | 15.45 | 18.57 |
| 4 | 0.42** | 0.45** | 0.41** | 0.41** | 0.48** | 9.21 | 11.31 | 7.98 | 9.98 | 11.40 |
| Big | −0.08 | −0.19** | −0.17** | −0.37** | −0.14** | −1.81 | −5.02 | −4.53 | −6.40 | −2.66 |
| | $h$ | | | | | $t(h)$ | | | | |
| Small | −0.24* | 0.00 | 0.03 | 0.26** | 0.51** | −2.51 | −0.04 | 0.41 | 3.48 | 6.26 |
| 2 | −0.40** | 0.01 | 0.05 | 0.19* | 0.48** | −3.28 | 0.17 | 0.77 | 2.43 | 8.03 |
| 3 | −0.45** | −0.12 | 0.05 | 0.29** | 0.46** | −5.36 | −1.32 | 0.72 | 4.61 | 6.64 |
| 4 | −0.43** | −0.03 | 0.11 | 0.21** | 0.44** | −4.28 | −0.35 | 1.87 | 3.03 | 6.01 |
| Big | −0.70** | −0.36** | 0.02 | 0.36** | 0.74** | −12.02 | −6.05 | 0.24 | 4.15 | 9.28 |
| | Adj.$R^2$ | | | | | $s(e)$ | | | | |
| Small | 0.82 | 0.86 | 0.84 | 0.84 | 0.83 | 4.11 | 3.12 | 3.21 | 3.19 | 3.44 |
| 2 | 0.82 | 0.86 | 0.87 | 0.90 | 0.88 | 3.49 | 2.79 | 2.59 | 2.33 | 2.59 |
| 3 | 0.81 | 0.83 | 0.81 | 0.85 | 0.85 | 3.18 | 2.83 | 2.85 | 2.51 | 2.73 |
| 4 | 0.79 | 0.81 | 0.79 | 0.79 | 0.83 | 2.98 | 2.76 | 2.74 | 2.68 | 2.62 |
| Big | 0.83 | 0.83 | 0.80 | 0.82 | 0.81 | 2.59 | 2.45 | 2.43 | 2.46 | 2.46 |

*Notes*: *HML* denotes the high-minus-low factor, which is calculated using the Japanese data, of the Fama–French (1993) model, and *SMB* denotes the small-minus-big factor, which is calculated using the Japanese data, of the Fama–French (1993) model, respectively. $t$ (coefficient) denotes the $t$-value of the coefficient, and the $t$-values are adjusted using the Newey–West (1987) heteroskedasticity and autocorrelation consistent covariance matrix. Adj.$R^2$ denotes adjusted $R$-squared value, and $s(e)$ denotes standard error of the regression. ** and * attached to the coefficients denote the statistical significance of the coefficient at the 1% and 5% levels, respectively. The sample period is from October 1981 to April 2005.

Table 3. Five-factor regressions for simple monthly percentage excess returns on 25 portfolios formed on size and BE/ME: the case of Japan, from October 1981 to April 2005 (283 months)

| | Book-to-market equity (BE/ME) quintiles | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Size | Low | 2 | 3 | 4 | High | Low | 2 | 3 | 4 | High |
| | **Regression: $R_{i,t} - R_{f,t} = \alpha_i + b_i(R_{M,t} - R_{f,t}) + s_iSMB_t + h_iHML_t + w_iWML_t + d_iUMD_t + e_{i,t}$** | | | | | | | | | |
| | | | $\alpha$ | | | | | $t(\alpha)$ | | |
| Small | 1.32** | 0.99** | 0.89** | 1.23** | 1.30** | 5.68 | 5.36 | 4.50 | 6.14 | 5.61 |
| 2 | 0.90** | 0.71** | 0.56** | 0.41** | 0.48** | 4.78 | 4.21 | 3.69 | 3.00 | 3.31 |
| 3 | 0.76** | 0.52** | 0.52** | 0.57** | 0.56** | 4.70 | 3.27 | 2.79 | 3.89 | 3.78 |
| 4 | 0.64** | 0.42* | 0.53** | 0.60** | 0.73** | 3.84 | 2.56 | 3.52 | 3.67 | 4.74 |
| Big | 0.58** | 0.76** | 0.69** | 0.89** | 0.76** | 3.58 | 4.74 | 4.92 | 5.71 | 5.26 |
| | | | $b$ | | | | | $t(b)$ | | |
| Small | 1.05** | 0.92** | 0.89** | 0.94** | 0.95** | 22.57 | 19.68 | 23.11 | 21.58 | 18.73 |
| 2 | 0.90** | 0.93** | 0.91** | 0.94** | 0.92** | 17.35 | 23.17 | 19.21 | 27.63 | 17.97 |
| 3 | 0.95** | 0.91** | 0.85** | 0.92** | 0.92** | 19.94 | 20.24 | 21.84 | 23.48 | 17.69 |
| 4 | 0.92** | 0.95** | 0.90** | 0.87** | 0.95** | 17.74 | 18.82 | 18.03 | 17.12 | 20.10 |
| Big | 0.91** | 0.95** | 0.89** | 0.95** | 0.91** | 24.28 | 28.65 | 27.05 | 25.01 | 26.89 |
| | | | $s$ | | | | | $t(s)$ | | |
| Small | 1.23** | 1.21** | 1.12** | 0.95** | 0.96** | 16.39 | 27.32 | 17.48 | 18.87 | 17.65 |
| 2 | 1.01** | 0.93** | 0.95** | 0.94** | 0.89** | 13.21 | 20.98 | 25.88 | 31.03 | 19.15 |
| 3 | 0.79** | 0.78** | 0.76** | 0.65** | 0.77** | 13.67 | 17.29 | 17.75 | 15.40 | 19.16 |
| 4 | 0.49** | 0.46** | 0.40** | 0.40** | 0.48** | 9.47 | 10.21 | 7.49 | 8.23 | 10.63 |
| Big | −0.09 | −0.23** | −0.18** | −0.40** | −0.17** | −1.54 | −4.80 | −4.53 | −7.03 | −3.20 |
| | | | $h$ | | | | | $t(h)$ | | |
| Small | −0.41** | 0.05 | 0.14 | 0.23* | 0.41** | −3.56 | 0.66 | 1.40 | 2.04 | 4.41 |
| 2 | −0.51** | 0.09 | 0.18** | 0.31** | 0.50** | −3.58 | 1.02 | 2.80 | 4.07 | 6.67 |
| 3 | −0.19* | 0.08 | 0.14 | 0.36** | 0.64** | −2.13 | 0.85 | 1.65 | 4.94 | 9.32 |
| 4 | −0.17 | 0.13 | 0.22** | 0.26** | 0.54** | −1.47 | 1.08 | 2.91 | 3.03 | 6.88 |
| Big | −0.63** | −0.33** | 0.09 | 0.34** | 0.81** | −6.08 | −4.13 | 1.04 | 3.48 | 10.19 |
| | | | $w$ | | | | | $t(w)$ | | |
| Small | −0.24* | 0.08 | 0.15 | −0.04 | −0.15 | −2.52 | 1.17 | 1.60 | −0.41 | −1.58 |
| 2 | −0.16 | 0.11 | 0.18** | 0.17** | 0.03 | −1.79 | 1.38 | 3.20 | 2.94 | 0.45 |
| 3 | 0.38** | 0.28** | 0.14 | 0.09 | 0.25** | 4.12 | 3.83 | 1.88 | 1.39 | 4.26 |
| 4 | 0.37** | 0.23** | 0.15* | 0.06 | 0.15* | 4.15 | 2.86 | 2.15 | 0.90 | 2.06 |
| Big | 0.11 | 0.04 | 0.11 | −0.03 | 0.10 | 1.29 | 0.68 | 1.47 | −0.44 | 1.57 |
| | | | $d$ | | | | | $t(d)$ | | |
| Small | −0.26** | −0.05 | −0.08 | −0.08 | −0.15* | −2.99 | −1.52 | −1.97 | −1.69 | −2.24 |
| 2 | −0.15** | −0.06 | −0.10* | −0.04 | −0.11* | −2.95 | −1.21 | −2.04 | −0.97 | −2.16 |
| 3 | −0.02 | −0.01 | −0.04 | −0.02 | −0.06 | −0.51 | −0.32 | −0.78 | −0.42 | −1.25 |
| 4 | 0.00 | −0.07 | −0.08 | −0.05 | −0.05 | −0.07 | −1.74 | −1.56 | −1.32 | −1.49 |
| Big | −0.06 | −0.12** | −0.08 | −0.07 | −0.10* | −1.44 | −2.94 | −1.89 | −1.78 | −2.05 |
| | | | Adj.$R^2$ | | | | | $s(e)$ | | |
| Small | 0.84 | 0.86 | 0.84 | 0.84 | 0.84 | 3.93 | 3.11 | 3.17 | 3.18 | 3.38 |
| 2 | 0.83 | 0.86 | 0.88 | 0.90 | 0.88 | 3.42 | 2.76 | 2.51 | 2.28 | 2.55 |
| 3 | 0.82 | 0.84 | 0.82 | 0.85 | 0.86 | 3.04 | 2.75 | 2.83 | 2.50 | 2.64 |
| 4 | 0.81 | 0.82 | 0.80 | 0.79 | 0.84 | 2.84 | 2.68 | 2.69 | 2.67 | 2.58 |
| Big | 0.84 | 0.84 | 0.80 | 0.82 | 0.82 | 2.57 | 2.39 | 2.39 | 2.45 | 2.40 |

*Notes*: *HML* denotes the high-minus-low factor, which is calculated using the Japanese data, of the Fama–French (1993) model, and *SMB* denotes the small-minus-big factor, which is calculated using the Japanese data, of the Fama–French (1993) model, respectively. *WML* denotes the reversal factor, which is calculated using the Japanese data, of Chan et al. (1998), and *UMD* denotes the momentum factor, which is calculated using the Japanese data, of Chan et al. (1998), respectively. *t* (coefficient) denotes the *t*-value of the coefficient, and the *t*-values are adjusted using the Newey–West (1987) heteroskedasticity and autocorrelation consistent covariance matrix. Adj.$R^2$ denotes adjusted *R*-squared value, and $s(e)$ denotes standard error of the regression. ** and * attached to the coefficients denote the statistical significance of the coefficient at the 1% and 5% levels, respectively. The sample period is from October 1981 to April 2005.

Table 4. Five-macroeconomic-factor regressions for the monthly percentage alphas of 25 portfolios based on size and BE/ME: the case of Japan, from October 1981 to April 2005 (283 months)

| | Book-to-market equity (BE/ME) quintiles | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Size | Low | 2 | 3 | 4 | High | Low | 2 | 3 | 4 | High |
| **Regression: $ALPHA_{i,t} = \mu_i + \beta_i MPSA_t + \gamma_i UI_t + \delta_i DEI_t + \zeta_i URP_t + \eta_i UTS_t + \varepsilon_{i,t}$** | | | | | | | | | | |
| | | | $\mu$ | | | | | $t(\mu)$ | | |
| Small | 0.94** | 1.03** | 0.70* | 0.75* | 0.74 | 2.69 | 3.17 | 2.28 | 2.46 | 1.62 |
| 2 | 0.85* | 0.58* | 0.88** | −0.01 | 0.30 | 2.54 | 2.11 | 2.95 | −0.03 | 1.12 |
| 3 | 0.66* | 0.00 | 0.30 | 0.62* | 0.29 | 2.46 | 0.00 | 1.12 | 1.99 | 1.12 |
| 4 | 0.54 | 0.42 | 0.63* | 0.57* | 0.53 | 1.80 | 1.61 | 2.54 | 2.12 | 1.87 |
| Big | 0.09 | 0.84** | 0.67** | 0.73** | 0.39 | 0.44 | 2.64 | 2.80 | 3.02 | 1.59 |
| | | | $\beta$ | | | | | $t(\beta)$ | | |
| Small | 7.47 | 7.98 | 14.52 | 15.35 | 10.31 | 0.65 | 0.79 | 1.57 | 1.44 | 0.96 |
| 2 | −3.73 | 11.47 | 13.03 | 16.15 * | 15.62* | −0.47 | 1.65 | 1.68 | 2.47 | 2.30 |
| 3 | 17.97 | 9.65 | 11.41 | −4.20 | 12.89 | 1.91 | 1.15 | 0.96 | −0.61 | 1.54 |
| 4 | 17.76 * | 9.76 | 6.24 | 2.34 | 12.05 | 2.26 | 1.31 | 0.89 | 0.31 | 1.53 |
| Big | 10.74 | 9.45 | 5.19 | 12.69 * | 6.28 | 1.29 | 1.51 | 0.87 | 2.11 | 0.90 |
| | | | $\gamma$ | | | | | $t(\gamma)$ | | |
| Small | −97.51 | −84.34 | −60.47 | −114.68 | −54.80 | −1.10 | −1.06 | −0.57 | −1.64 | −0.66 |
| 2 | 132.65 | −0.24 | −5.37 | −103.15 | 33.47 | 1.54 | 0.00 | −0.07 | −1.75 | 0.43 |
| 3 | 25.35 | 36.98 | −60.10 | −28.68 | 118.14 | 0.28 | 0.38 | −0.65 | −0.36 | 1.28 |
| 4 | 87.52 | 119.05 | −15.87 | 76.77 | 114.39 | 0.95 | 1.43 | −0.18 | 0.83 | 1.28 |
| Big | 50.81 | −17.45 | 29.96 | −85.98 | −9.70 | 0.70 | −0.25 | 0.48 | −1.09 | −0.15 |
| | | | $\delta$ | | | | | $t(\delta)$ | | |
| Small | 1203.37 | 641.03 | −198.17 | −426.07 | −853.90 | 1.21 | 0.65 | −0.13 | −0.59 | −0.75 |
| 2 | −731.14 | −114.86 | −334.68 | 253.86 | 21.09 | −1.02 | −0.13 | −0.42 | 0.38 | 0.03 |
| 3 | 996.23 | −631.29 | 85.48 | −714.28 | −1639.73 | 1.24 | −0.68 | 0.11 | −0.75 | −1.83 |
| 4 | −1160.08 | −1846.74* | −857.97 | −826.84 | −1303.61 | −1.21 | −2.53 | −0.96 | −0.83 | −1.34 |
| Big | −1564.75* | 481.93 | −691.69 | 498.74 | 341.23 | −2.05 | 0.55 | −0.93 | 0.75 | 0.49 |
| | | | $\zeta$ | | | | | $t(\zeta)$ | | |
| Small | 0.14 | 0.19 | 1.02 | 1.17 | 2.18* | 0.17 | 0.24 | 1.52 | 1.77 | 2.45 |
| 2 | −0.08 | 0.58 | −0.19 | 1.17* | 0.48 | −0.14 | 0.97 | −0.31 | 2.48 | 0.74 |
| 3 | 0.33 | 1.74* | 0.94 | 0.08 | 0.63 | 0.59 | 2.52 | 1.49 | 0.15 | 1.24 |
| 4 | 0.37 | 0.09 | −0.18 | 0.16 | 0.38 | 0.60 | 0.15 | −0.34 | 0.26 | 0.69 |
| Big | 1.30* | 0.14 | 0.17 | 0.60 | 0.93 | 2.32 | 0.31 | 0.31 | 1.09 | 1.86 |
| | | | $\eta$ | | | | | $t(\eta)$ | | |
| Small | 0.36 | −0.08 | −0.13 | 0.11 | −0.11 | 1.74 | −0.49 | −0.74 | 0.67 | −0.49 |
| 2 | 0.05 | −0.06 | −0.28* | 0.06 | 0.01 | 0.32 | −0.37 | −2.01 | 0.51 | 0.10 |
| 3 | −0.01 | −0.03 | −0.07 | −0.06 | 0.03 | −0.04 | −0.20 | −0.52 | −0.44 | 0.21 |
| 4 | −0.06 | −0.07 | −0.07 | −0.04 | 0.04 | −0.51 | −0.54 | −0.48 | −0.34 | 0.29 |
| Big | 0.05 | −0.13 | −0.05 | −0.02 | 0.08 | 0.47 | −0.71 | −0.39 | −0.19 | 0.62 |
| | | | Adj.$R^2$ | | | | | $s(\varepsilon)$ | | |
| Small | −0.01 | −0.01 | 0.00 | 0.02 | 0.03 | 3.91 | 3.10 | 3.14 | 3.12 | 3.30 |
| 2 | −0.01 | −0.01 | 0.00 | 0.03 | 0.00 | 3.41 | 2.75 | 2.48 | 2.23 | 2.53 |
| 3 | 0.01 | 0.02 | 0.00 | −0.01 | 0.01 | 3.00 | 2.70 | 2.81 | 2.49 | 2.61 |
| 4 | 0.00 | 0.00 | −0.01 | −0.01 | 0.00 | 2.81 | 2.65 | 2.68 | 2.67 | 2.56 |
| Big | 0.03 | −0.01 | −0.01 | 0.00 | 0.00 | 2.51 | 2.38 | 2.38 | 2.42 | 2.38 |

*Notes*: $ALPHA_{i,t}$ is defined as $R_{i,t} - R_{f,t} - b_i(R_{M,t} - R_{f,t}) - s_i SMB_t - h_i HML_t - w_i WML_t - d_i UMD_t$. Macroeconomic factors are *MPSA*: monthly growth rate of seasonally adjusted industrial production; *UI*: unanticipated inflation; *DEI*: the change in expected inflation; *URP*: the series for the risk premium (credit spreads); and *UTS*: the series for the term structure. These variables were constructed by following Chen et al. (1986) from Japanese data. *t* (coefficient) denotes the *t*-value of the coefficient, and the *t*-values are adjusted by using the Newey−West (1987) heteroskedasticity and autocorrelation consistent covariance matrix. Adj.$R^2$ denotes the adjusted *R*-squared value, and $s(\varepsilon)$ denotes the standard error of the regression. ** and * denote the statistical significance of the coefficient at the 1% and 5% levels, respectively. The sample period is from October 1981 to April 2005.

Table 5. Seven-macroeconomic-factor regressions for the monthly percentage alphas of 25 portfolios based on size and BE/ME: the case of Japan, from October 1981 to April 2005 (283 months)

| | Book-to-market equity (BE/ME) quintiles | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Size | Low | 2 | 3 | 4 | High | Low | 2 | 3 | 4 | High |
| **Regression: $ALPHA_{i,t} = \nu_i + \beta_i MPSA_t + \gamma_i UI_t + \delta_i DEI_t + \zeta_i URP_t + \eta_i UTS_t + \theta_i CG_t + \kappa_i OG_t + \omega_{i,t}$** | | | | | | | | | | |
| | | | $\nu$ | | | | | $t(\nu)$ | | |
| Small | 1.01** | 1.05** | 0.79** | 0.81* | 0.80 | 2.88 | 3.23 | 2.66 | 2.40 | 1.69 |
| 2 | 0.72* | 0.61* | 0.91** | −0.07 | 0.32 | 2.07 | 2.10 | 3.05 | −0.28 | 1.17 |
| 3 | 0.63* | 0.14 | 0.36 | 0.67* | 0.33 | 2.22 | 0.51 | 1.28 | 2.13 | 1.24 |
| 4 | 0.52 | 0.49 | 0.74** | 0.64* | 0.61* | 1.71 | 1.71 | 2.82 | 2.17 | 2.09 |
| Big | 0.04 | 0.89** | 0.67** | 0.80** | 0.35 | 0.19 | 2.70 | 2.66 | 3.30 | 1.45 |
| | | | $\beta$ | | | | | $t(\beta)$ | | |
| Small | 7.32 | 7.45 | 14.48 | 15.72 | 9.76 | 0.63 | 0.73 | 1.57 | 1.47 | 0.90 |
| 2 | −5.31 | 12.23 | 13.35 | 15.66 * | 16.14 * | −0.67 | 1.74 | 1.63 | 2.38 | 2.33 |
| 3 | 17.01 | 10.94 | 11.98 | −3.80 | 13.68 | 1.76 | 1.30 | 0.98 | −0.54 | 1.66 |
| 4 | 18.00 * | 10.28 | 7.13 | 2.88 | 13.34 | 2.25 | 1.34 | 1.00 | 0.38 | 1.67 |
| Big | 10.18 | 9.96 | 5.46 | 12.36 * | 5.61 | 1.20 | 1.58 | 0.95 | 1.98 | 0.80 |
| | | | $\gamma$ | | | | | $t(\gamma)$ | | |
| Small | −104.05 | −86.94 | −68.61 | −119.27 | −61.14 | −1.17 | −1.08 | −0.68 | −1.68 | −0.77 |
| 2 | 141.80 | −1.83 | −7.61 | −98.38 | 32.25 | 1.51 | −0.02 | −0.10 | −1.57 | 0.41 |
| 3 | 25.67 | 26.53 | −64.43 | −33.30 | 116.01 | 0.28 | 0.30 | −0.72 | −0.44 | 1.28 |
| 4 | 89.74 | 113.92 | −24.21 | 71.88 | 109.12 | 0.96 | 1.44 | −0.30 | 0.81 | 1.29 |
| Big | 54.64 | −20.92 | 30.78 | −92.33 | −7.16 | 0.72 | −0.30 | 0.48 | −1.23 | −0.10 |
| | | | $\delta$ | | | | | $t(\delta)$ | | |
| Small | 1279.31 | 833.29 | −154.92 | −537.72 | −641.59 | 1.25 | 0.84 | −0.11 | −0.74 | −0.60 |
| 2 | −215.78 | −373.08 | −435.62 | 406.32 | −152.80 | −0.29 | −0.42 | −0.47 | 0.58 | −0.19 |
| 3 | 1327.55 | −1039.52 | −97.88 | −838.42 | −1906.76* | 1.54 | −1.10 | −0.12 | −0.84 | −2.10 |
| 4 | −1251.47 | −2009.53* | −1136.02 | −995.60 | −1733.43 | −1.24 | −2.37 | −1.23 | −1.00 | −1.61 |
| Big | −1383.19 | 316.96 | −787.64 | 635.12 | 563.49 | −1.83 | 0.35 | −1.00 | 0.86 | 0.77 |
| | | | $\zeta$ | | | | | $t(\zeta)$ | | |
| Small | 0.05 | 0.12 | 0.92 | 1.14 | 2.07* | 0.07 | 0.16 | 1.37 | 1.66 | 2.28 |
| 2 | −0.09 | 0.61 | −0.20 | 1.20* | 0.51 | −0.14 | 1.01 | −0.33 | 2.54 | 0.77 |
| 3 | 0.26 | 1.70* | 0.93 | 0.05 | 0.66 | 0.47 | 2.52 | 1.47 | 0.10 | 1.29 |
| 4 | 0.41 | 0.07 | −0.22 | 0.14 | 0.40 | 0.69 | 0.11 | −0.41 | 0.22 | 0.77 |
| Big | 1.31* | 0.14 | 0.20 | 0.50 | 0.92 | 2.35 | 0.30 | 0.36 | 0.97 | 1.84 |
| | | | $\eta$ | | | | | $t(\eta)$ | | |
| Small | 0.37 | −0.06 | −0.12 | 0.10 | −0.08 | 1.89 | −0.36 | −0.77 | 0.62 | −0.37 |
| 2 | 0.11 | −0.09 | −0.29* | 0.08 | −0.01 | 0.67 | −0.57 | −2.02 | 0.64 | −0.06 |
| 3 | 0.04 | −0.07 | −0.09 | −0.08 | 0.00 | 0.24 | −0.51 | −0.70 | −0.53 | −0.03 |
| 4 | −0.08 | −0.09 | −0.09 | −0.06 | −0.01 | −0.62 | −0.65 | −0.70 | −0.47 | −0.08 |
| Big | 0.07 | −0.14 | −0.06 | 0.00 | 0.11 | 0.65 | −0.82 | −0.49 | −0.02 | 0.85 |
| | | | $\theta$ | | | | | $t(\theta)$ | | |
| Small | −0.29 | −0.09 | −0.37 | −0.23 | −0.26 | −0.93 | −0.35 | −1.25 | −0.67 | −0.84 |
| 2 | 0.51 | −0.12 | −0.12 | 0.25 | −0.09 | 1.27 | −0.40 | −0.51 | 1.17 | −0.33 |
| 3 | 0.07 | −0.56* | −0.23 | −0.24 | −0.14 | 0.20 | −2.03 | −0.95 | −1.23 | −0.56 |
| 4 | 0.09 | −0.27 | −0.44 | −0.26 | −0.32 | 0.37 | −1.02 | −1.69 | −1.12 | −1.27 |
| Big | 0.21 | −0.19 | 0.02 | −0.27 | 0.16 | 0.80 | −0.75 | 0.09 | −1.01 | 0.71 |
| | | | $\kappa$ | | | | | $t(\kappa)$ | | |
| Small | −10.68 | −11.33 | −11.04 | −0.27 | −16.41 | −0.79 | −1.03 | −0.91 | −0.03 | −1.14 |
| 2 | −12.25 | 9.51 | 1.90 | −1.30 | 6.24 | −1.58 | 1.19 | 0.17 | −0.31 | 0.89 |
| 3 | −14.13 | 6.11 | 3.15 | 0.24 | 9.28 | −1.78 | 0.76 | 0.34 | 0.03 | 1.25 |
| 4 | 6.50 | 1.35 | 2.78 | 1.88 | 12.88 | 0.82 | 0.14 | 0.38 | 0.24 | 1.74 |
| Big | −3.63 | 3.31 | 5.11 | −13.11 | −6.86 | −0.52 | 0.49 | 0.68 | −1.19 | −0.80 |
| | | | Adj.$R^2$ | | | | | $s(\omega)$ | | |
| Small | −0.01 | −0.01 | 0.01 | 0.01 | 0.04 | 3.91 | 3.10 | 3.13 | 3.13 | 3.29 |
| 2 | 0.00 | −0.01 | 0.00 | 0.03 | 0.00 | 3.40 | 2.75 | 2.49 | 2.23 | 2.53 |
| 3 | 0.01 | 0.03 | 0.00 | −0.01 | 0.01 | 3.00 | 2.69 | 2.81 | 2.49 | 2.61 |
| 4 | 0.00 | 0.00 | 0.00 | −0.02 | 0.01 | 2.82 | 2.66 | 2.67 | 2.67 | 2.55 |
| Big | 0.02 | −0.01 | −0.02 | 0.01 | 0.00 | 2.52 | 2.38 | 2.39 | 2.41 | 2.38 |

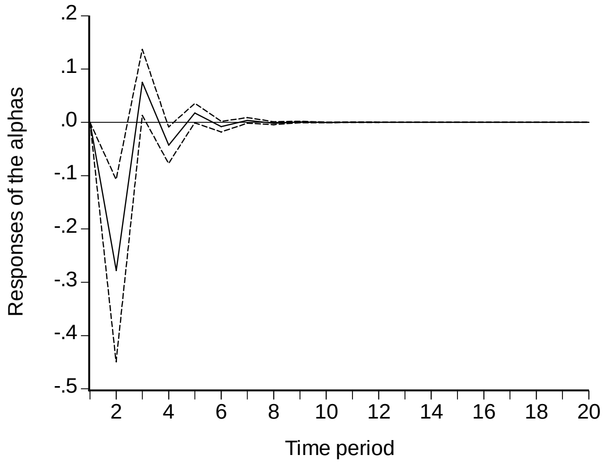
*Notes*: $ALPHA_{i,t}$ is defined as $R_{i,t}-R_{f,t}-b_i(R_{M,t}-R_{f,t})-s_iSMB_t-h_iHML_t-w_iWML_t-d_iUMD_t$. Macroeconomic factors are *MPSA*: monthly growth rate of seasonally adjusted industrial production; *UI*: unanticipated inflation; *DEI*: the change in expected inflation; *URP*: the series for the risk premium (credit spreads); *UTS*: the series for the term structure; *CG*: growth rate in real per capita consumption; and *OG*: growth rate in oil prices. These variables were constructed by following Chen et al. (1986) from Japanese data. *t* (coefficient) denotes the *t*-value of the coefficient, and the *t*-values are adjusted by using the Newey−West (1987) heteroskedasticity and autocorrelation consistent covariance matrix. Adj.$R^2$ denotes the adjusted *R*-squared value, and $s(\omega)$ denotes the standard error of the regression. ** and * denote the statistical significance of the coefficient at the 1% and 5% levels, respectively. The sample period is from October 1981 to April 2005.

Table 6. Test results for Granger causality from seven macroeconomic factors to the alphas left unexplained by the three Fama−French factors, momentum factors, and reversal factors

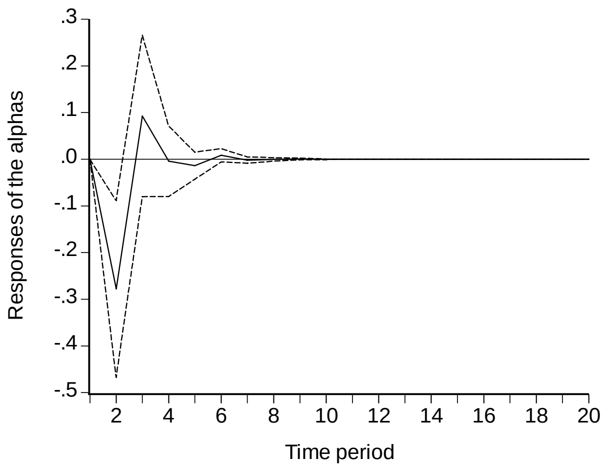
| | *MPSA* | *UI* | *DEI* | *URP* | *UTS* | *CG* | *OG* |
|---|---|---|---|---|---|---|---|
| Panel A Lag=1 | | | | | | | |
| *F*-statisitc | 10.761** | 1.474 | 2.340 | 0.067 | 0.000 | 0.106 | 0.498 |
| *p*-value | 0.001 | 0.226 | 0.127 | 0.795 | 0.986 | 0.746 | 0.481 |
| Panel B Lag=2 | | | | | | | |
| *F*-statisitc | 5.367** | 1.115 | 1.253 | 0.276 | 0.172 | 0.688 | 0.277 |
| *p*-value | 0.005 | 0.329 | 0.287 | 0.759 | 0.842 | 0.503 | 0.758 |
| Panel C Lag=3 | | | | | | | |
| *F*-statisitc | 3.898** | 0.877 | 0.948 | 0.237 | 0.286 | 0.714 | 2.615 |
| *p*-value | 0.009 | 0.454 | 0.418 | 0.871 | 0.835 | 0.545 | 0.052 |
| Panel D Lag=4 | | | | | | | |
| *F*-statisitc | 2.944* | 1.108 | 0.926 | 0.283 | 0.263 | 0.556 | 1.927 |
| *p*-value | 0.021 | 0.353 | 0.449 | 0.889 | 0.901 | 0.695 | 0.106 |
| Panel E Lag=5 | | | | | | | |
| *F*-statisitc | 3.132** | 1.260 | 1.047 | 0.122 | 0.241 | 0.486 | 1.453 |
| *p*-value | 0.009 | 0.282 | 0.391 | 0.987 | 0.944 | 0.786 | 0.206 |

*Notes*: $ALPHA_{i,t}$ is defined as $R_{i,t}-R_{f,t}-b_i(R_{M,t}-R_{f,t})-s_iSMB_t-h_iHML_t-w_iWML_t-d_iUMD_t$. The *F*-statisitc for testing for Granger causality, with the null hypothesis being that there is no causal relationship between the two variables, is displayed. ** and * denote statistically significant rejection of the null hypothesis at the 1% and 5% levels, respectively. The tests were conducted for the sample period from October 1981 to April 2005. Macroeconomic factors are *MPSA*: monthly growth rate of seasonally adjusted industrial production; *UI*: unanticipated inflation; *DEI*: the change in expected inflation; *URP*: the series for the risk premium (credit spreads); *UTS*: the series for the term structure; *CG*: growth rate in real per capita consumption; and *OG*: growth rate in oil prices. These variables were constructed by following the methodology of Chen et al. (1986) from Japanese data.

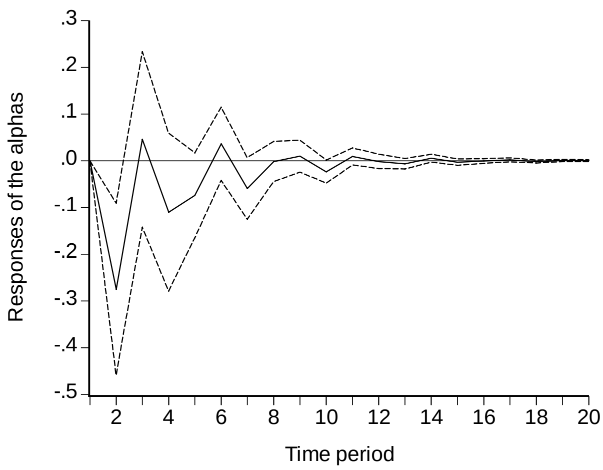
Panel A. Responses of the alphas to a shock to MPSA: derived from the VAR(1) model



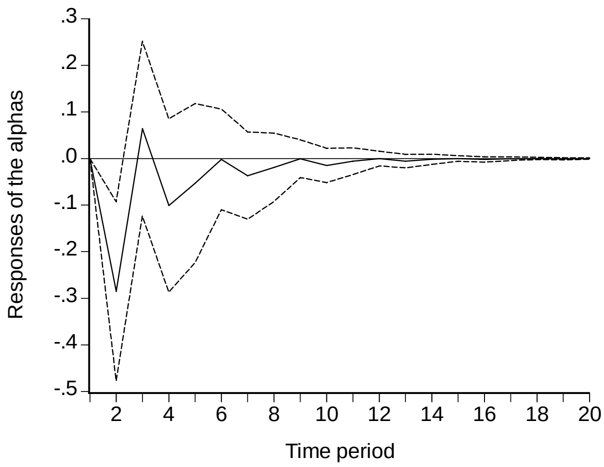

Panel B. Responses of the alphas to a shock to MPSA: derived from the VAR(2) model



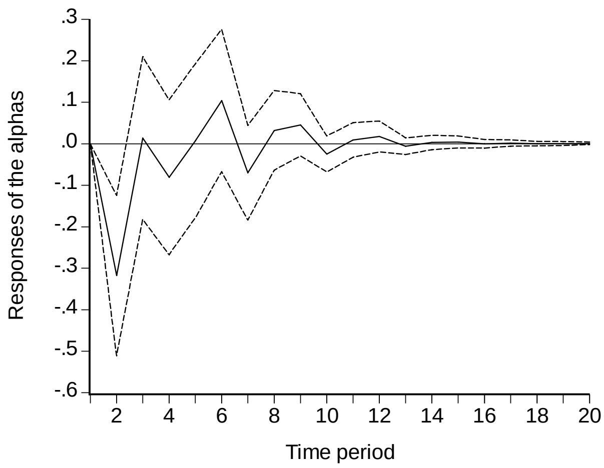

Panel C. Responses of the alphas to a shock to MPSA: derived from the VAR(3) model



Panel D. Responses of the alphas to a shock to MPSA: derived from the VAR(4) model




Panel E. Responses of the alphas to a shock to MPSA: derived from the VAR(5) model




Panel F. Responses of the alphas to a shock to MPSA: derived from the VAR(6) model

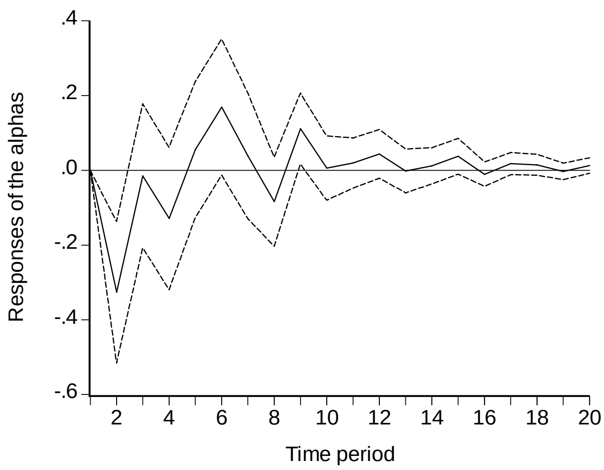



Figure 1. Impulse responses of the alphas left unexplained by the three Fama−French factors and momentum and reversal factors to a shock to industrial production in Japan