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Can We Resurrect the CAPM in Japan? Evaluating Conditional Asset Pricing Models by Incorporating Time-varying Price of Risk

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Abstract

This paper evaluates conditional asset pricing models for the Japanese stock market by examining time-varying risk pricing. Using a multivariate generalized autoregressive conditional heteroskedasticity (GARCH) model, we tested the conditional versions of the Sharpe (1964)−Lintner (1965)−Mossin (1966) capital asset pricing model (CAPM), the consumption CAPM (CCAPM), and the CAPM with a constant term. The empirical results demonstrate that the price of risk in the conditional CAPM is generally positive and significant. Moreover, our formal panel data tests reveal that the conditional CAPM is never rejected in the case of the 25 book-equity-to-market equity (BE/ME)-ranked portfolios. Furthermore, in the conditional version of the CAPM with a constant term, positive alphas are generally seen in Japan; however, our statistical test of the hypothesis that the average value of the alphas of the conditional CAPM equals zero is never rejected for the 25 BE/ME-ranked portfolios in Japan. This evidence demonstrates that the CAPM can be adequately represented by using the multivariate GARCH model to explain the value premia in Japan.

Keywords: Conditional CAPM, Conditional consumption CAPM, Jensen's alpha, Multivariate GARCH model, Panel data analysis, Time-varying price of risk, Time-varying alpha

1. Introduction

The time-varying characteristics of both covariance risk and the price of risk are clearly crucial for asset pricing. There is substantial empirical evidence that the level of risk varies over time (Bollerslev et al. (1988), Harvey (1989), Ng (1991), and Zhou (1994), amongst others). However, in many earlier studies, covariance risk is focused on and regarded as time-varying, but not much attention is paid to the price of risk.(Note 1) Thus, the dynamics of the risk price and the degree of pricing of the risk from a time-series viewpoint appears to be unclear in existing work.(Note 2) Price of risk is important because the risk price of the capital asset pricing model (CAPM) has the economic meaning of the relative risk aversion and also the risk price generally means the reward for taking risks in practical investments. Therefore, research on asset pricing focusing on the time-varying risk *price* rather than on time-varying risk is required. This will contribute to a wider body of research in the field of finance, and this is the first motive of this research.

Our second motive relates to the ongoing debate regarding the conditional CAPM and the conditional consumption-based CAPM (CCAPM). Some authors, such as Jagannathan and Wang (1996), Lettau and Ludvigson (2001), Ang and Chen (2007), and Petkova and Zhang (2005), find that conditional models help explain the cross-section of stock returns. However, other authors, such as Lewellen and Nagel (2006) and Fama and French (2006), argue that the conditional models have had very limited success. It is also pointed out that the testing methodologies that the above studies employ are not always the same, however, the Generalized Method of Moments (GMM) approach is typical. This situation requires additional research as to the effectiveness of conditional asset pricing models using methods other than the typical GMM approach.

Thus, in this paper, we attempt to participate in the ongoing debate by testing the conditional versions of the Sharpe (1964)−Lintner (1965)−Mossin (1966) CAPM, the CCAPM (Breeden (1979), Merton (1973), and Rubinstein (1976)), and the CAPM with a constant term (Hereafter, we call this model the alpha CAPM.) by focusing on the risk prices. We also employ a different methodology by using the multivariate generalized autoregressive conditional heteroskedasticity (GARCH) model, which enables us to incorporate a time-varying risk price into our empirical tests. Furthermore, the use of this multivariate GARCH model in asset pricing seems to be limited.(Note 3)

More directly, this paper has two goals. The first is to clarify the degree of statistical significance of the monthly time-varying price of risk in the conditional version of CAPM, alpha CAPM, and CCAPM in Japan. The second is to judge the empirical validity of the above three conditional models in Japan using a multivariate GARCH model.(Note 4)

To achieve the above goals, we construct two sets of 25 portfolios, which are formed by BE/ME (book-equity-to-market equity) and by size following Fama and French (1993).(Note 5) We then use a multivariate GARCH model(Note 6) to derive the time-varying covariance risk. By exploiting the covariances and performing monthly cross-sectional regressions for Japan, we examine the monthly time-varying risk *prices*. Furthermore, in addition to a monthly analysis, we also test risk pricing and compare models using panel data analysis.

Moreover, we also test whether the averages of the time-varying alphas(Note 7) are zero in the conditional CAPM. The above latter two tests attempt to answer the criticisms of the testing methodologies of Lewellen and Nagel (2006) and Fama and French (2006).(Note 8)

On the basis of our motives, goals, and approach, the findings derived in this paper are as follows. First, from the viewpoint of risk pricing, we demonstrate that the conditional covariance risk from a multivariate GARCH model is generally positively priced in the conditional CAPM in Japan.

Second, our monthly test of the time-varying risk price revealed that the conditional CCAPM is not supported in Japan.

Third, from the viewpoint of model evaluation, again, our formal *F*-test rejects the traditional conditional CCAPM against the conditional CAPM and the conditional alpha CAPM in Japan.

Fourth, in our model evaluation tests, in Japan, we find that the positive alpha is generally recognized. In our panel data analysis, mainly because of the effects of a positive alpha, the conditional CAPM is sometimes rejected and the conditional alpha CAPM is supported in explaining the size effect in Japan. However, the conditional CAPM is never rejected and the conditional alpha CAPM is rejected in all cases in explaining the value effect in Japan. This evidence is very similar to the results for the US of Ang and Chen (2007), and is different from the results for the US of Fama and French (2006).(Note 9)

Fifth, we also test the existence of a non-zero alpha in the conditional CAPM, which is often criticized (e.g. Lewellen and Nagel (2006) and Fama and French (2006)). We confirm that the non-zero alpha hypothesis is not supported in the tests used for the BE/ME portfolios in Japan. Thus, we suggest that when the time-varying risk price, derived using the multivariate GARCH model, is incorporated into the tests, the performance of the conditional CAPM adequately explains the value effect in Japan.

The remainder of this paper is organized as follows. Section 2 describes the models we test in this paper. Section 3 documents the economic background of our research. Section 4 presents the methodology and Section 5 describes the data. The empirical results and their interpretation are supplied in Sections 6 and 7. Comparisons with other influential studies are performed in Section 8. Section 9 presents our conclusions.

2. Model

As mentioned, we focus on three traditional conditional models in this article. The first is the conditional CAPM. The model for period t is an equilibrium relation for the conditional expected return of an asset in excess of the risk-free rate when agents use the information available at the end of period $t-1$:

$$E\left[\left(r_{i,t}-r_{f,t}\right)\middle|\Omega_{t-1}\right]=\frac{E\left[\left(r_{m,t}-r_{f,t}\right)\middle|\Omega_{t-1}\right]}{Var\left[r_{m,t}\middle|\Omega_{t-1}\right]}Cov\left[r_{i,t},r_{m,t}\middle|\Omega_{t-1}\right] \tag{1}$$

$$= \beta_{i,t} E\left[\left(r_{m,t} - r_{f,t}\right) | \Omega_{t-1}\right].$$

$$\beta_{i,t} \equiv \frac{Cov\left[r_{m,t}, r_{i,t} | \Omega_{t-1}\right]}{Var\left[r_{m,t} | \Omega_{t-1}\right]}, \tag{2}$$

where $r_{i,t}$ and $r_{m,t}$ are the one-period returns on an asset and the market portfolio, respectively, $r_{f,t}$ is the one-period risk-free rate, and $\mathbf{\Omega}_{t-1}$ is the information available in markets at time $t-1$.(Note 10)

The conditional CAPM is a static one-period model that holds period by period. It is also a generalization of the one-period CAPM developed by Sharp−Lintner−Mossin. In this paper, we do not assume that the market price of risk is stable over time, but rather assume that it is time varying:

$$\delta_t \equiv \frac{E\left[\left(r_{m,t} - r_{f,t}\right) | \Omega_{t-1}\right]}{Var\left[r_{m,t} | \Omega_{t-1}\right]}. \tag{3}$$

Thus, different from other studies, we have the following conditional version of the Sharp−Lintner−Mossin CAPM for a single asset i:

$$E\left[\left(r_{i,t} - r_{f,t}\right) | \Omega_{t-1}\right] = \delta_t Cov\left[r_{i,t}, r_{m,t} | \Omega_{t-1}\right]. \tag{4}$$

In this formulation, the estimation of the time-varying covariance, $Cov[r_{i,t}, r_{m,t} | \mathbf{\Omega}_{t-1}]$, is necessary for evaluating this model and, by inspecting the statistical significance of δ_t using these covariances, we can judge whether the covariance risk is priced. Thus, testing using this model is the first method of analysis for our empirical work. Model (4) allows us to statistically implement the intertemporal capital asset pricing model (ICAPM), and we provide more economic foundations and background for our tests in Section 3.

Our second model for analysis is model (5) below, which could be interpreted as the conditional version of the CAPM with a constant term (the conditional alpha CAPM):

$$E\left[\left(r_{i,t} - r_{f,t}\right) | \Omega_{t-1}\right] = \alpha_t + \delta_t Cov\left[r_{i,t}, r_{m,t} | \Omega_{t-1}\right], \tag{5}$$

where α_t, the time-varying alpha, is a common intercept for all portfolios and again, we assume a time-varying risk price, δ_t.

The third model is the following conditional version of the consumption CAPM:

$$E\left[\left(r_{i,t} - r_{f,t}\right) | \Omega_{t-1}\right] = \lambda_t Cov\left[r_{i,t}, \Delta c_t | \Omega_{t-1}\right]. \tag{6}$$

Again, we assume that the price of consumption covariance risk, λ_t, is time varying. Here, $Cov[r_{i,t}, \Delta c_t | \mathbf{\Omega}_{t-1}]$ is the covariance between the return of an asset i and changes in consumption.

3. Economic Background

As we emphasized in Sections 1 and 2, our focus is the time-varying risk *price* in this paper. Apart from the viewpoint of econometrics or model evaluation, how then is it economically important?

As Merton (1973, 1980) and Cochrane (2005) suggest, the price of risk from the CAPM can be interpreted as the coefficient of relative risk aversion of investors. Specifically, Cochrane (2005) expresses the ICAPM as:

$$E_t\left(R_{t+1}^i\right)-R_t^f \approx rra_t cov_t\left(R_{t+1}^i,\Delta W_{t+1}/W_t\right)+\lambda_{zt} cov_t\left(R_{t+1}^i,\Delta z_{t+1}\right), \qquad (7)$$

where $E_t(R_{t+1}^i)$ is the conditional expected return of asset i, R_t^f is the risk-free rate, rra_t is the relative risk aversion coefficient, $cov_t(R_{t+1}^i,\Delta W_{t+1}/W_t)$ is the conditional covariance between the return of asset i and the change in wealth (or return on the market portfolio), $cov_t(R_{t+1}^i,\Delta z_{t+1})$ is the conditional covariance between the return of asset i and the change in state variable z, and λ_{zt} is the risk price for the state variable.

Thus, in the context of our research, in particular, the time-varying price of risk δ_t from the conditional CAPM (4) and the conditional alpha CAPM (5) can be interpreted as the time-varying risk aversion of the market participants as per Cochrane's (2005) δ_t as rra_t in equation (7).

This notion of time-varying risk aversion is used for example by Abel (1990), Constantinides (1990), Campbell and Cochrane (1999), and Li (2007). Recently, this concept has received increasing attention, and is important to research in both finance and economics.

Furthermore, from a practical viewpoint, we assume that the time-varying risk *price* is more important than time-varying covariance risk. Because if the time-varying risk is not priced, the risks taken by investors are never rewarded by a premium in asset returns. Therefore, as mentioned above, the time-varying *price* of risk is crucial for both academic researchers and practitioners in that 1) it has significant economic interpretation, and 2) it helps investors decide whether the risks are worth taking or are meaningless in actual equity investment situations.

4. Methodology

As the excellent survey by Bauwens et al. (2006) argues, the multivariate GARCH model is crucially important in the context of asset pricing because the model is useful for calculating the time-varying covariances or factor loadings (Lundblad (2007) and Bali (2008), amongst others).

To evaluate the time-varying risk prices, δ_t and λ_t above, we first estimate the time-varying covariances, $Cov[r_{i,t},r_{m,t}|\Omega_{t-1}]$ and $Cov[r_{i,t},\Delta c_t|\Omega_{t-1}]$, by the multivariate BEKK GARCH

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model (Engle and Kroner (1995), Kroner and Ng (1998)). The BEKK model ensures that the **H** matrix is always positive definite, and is specified by:

$$\mathbf{H_t} = \mathbf{W} + \mathbf{B}'\mathbf{H_{t-1}}\mathbf{B} + \mathbf{A}'\mathbf{\Xi_{t-1}}\mathbf{\Xi'_{t-1}}\mathbf{A}, \tag{8}$$

where **W**, **A**, and **B** are 2 × 2 matrices of parameters, and **W** is assumed to be symmetric and positive definite.

For the purpose of clarity, in the case of two assets, we define the matrices as follows:

$$\mathbf{H_t} = \begin{bmatrix} h_{11,t} & h_{12,t} \\ h_{12,t} & h_{22,t} \end{bmatrix}, \ \mathbf{W} = \begin{bmatrix} w_{11} & w_{12} \\ w_{12} & w_{22} \end{bmatrix}, \ \mathbf{A} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix},$$

$$\mathbf{B} = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}, \ \mathbf{\Xi_t} = \begin{bmatrix} u_{1,t} \\ u_{2,t} \end{bmatrix};$$

the model is then written in full as:

$$\begin{aligned} h_{11,t} = {} & w_{11} + a_{11}^2 u_{1,t-1}^2 + a_{21}^2 u_{2,t-1}^2 + 2a_{11}a_{21}u_{1,t-1}u_{2,t-1} \\ & + b_{11}^2 h_{11,t-1} + b_{21}^2 h_{22,t-1} + 2b_{11}b_{21}h_{12,t-1}, \end{aligned} \tag{9}$$

$$\begin{aligned} h_{22,t} = {} & w_{22} + a_{12}^2 u_{1,t-1}^2 + a_{22}^2 u_{2,t-1}^2 + 2a_{12}a_{22}u_{1,t-1}u_{2,t-1} \\ & + b_{12}^2 h_{11,t-1} + b_{22}^2 h_{22,t-1} + 2b_{12}b_{22}h_{12,t-1}, \end{aligned} \tag{10}$$

$$\begin{aligned} h_{12,t} = {} & w_{12} + a_{11}a_{12}u_{1,t-1}^2 + a_{21}a_{22}u_{2,t-1}^2 + \left(a_{12}a_{21} + a_{11}a_{22}\right)u_{1,t-1}u_{2,t-1} \\ & + b_{11}b_{12}h_{11,t-1} + b_{21}b_{22}h_{22,t-1} + \left(b_{11}b_{22} + b_{12}b_{21}\right)h_{12,t-1}. \end{aligned} \tag{11}$$

Regarding the estimation of model (8), the parameters can be estimated by maximizing the log-likelihood function:

$$l(\theta) = -\frac{TN}{2}\log 2\pi - \frac{1}{2}\sum_{t=1}^{T}\left(\log\left|\mathbf{H_t}\right| + \mathbf{\Xi'_t}\mathbf{H_t^{-1}}\mathbf{\Xi_t}\right), \tag{12}$$

where θ denotes all of the unknown parameters to be estimated, N is the number of assets, T is the number of observations, and $\mathbf{H_t}$ and $\mathbf{\Xi}_t$ are as defined earlier.

After deriving the time-varying covariances, $Cov[r_{i,t},r_{m,t}|\Omega_{t-1}]$ and $Cov[r_{i,t},\Delta c_t|\Omega_{t-1}]$, from the multivariate GARCH model, we first estimate regressions (4), (5), and (6) using monthly cross-sections. Then, the time-varying prices of risk δ_t and λ_t can be evaluated monthly. Furthermore, to evaluate and compare the effectiveness of models (4), (5), and (6) by taking both the cross-sectional and the time-series aspects into account, we undertake panel data analysis. By pooling the monthly data on 25 size-ranked portfolios (size portfolios) and 25 BE/ME-ranked portfolios (BE/ME portfolios), we can conduct a balanced panel data analysis in several time spans. The details of the empirical results are provided in Sections 6, 7, and 8. As above, in our context of testing three conditional asset pricing models, the use of the multivariate GARCH model enables us to implement the direct test of the time-varying risk pricing and the less restrictive test that no assumption is put on the state variable in the model conditioning, which is different from Shanken (1990), Ferson and Schadt (1996), or Lettau and Ludvigson (2001), for example. This is an advantage of our methodology in this paper (also see note 6).

5. Data

Our whole data sample period is from October 1981 to July 2004. We note that because of the data availability, this is the longest period to investigate as to Japan in our context. The individual data series are the risk-free percentage rate, $r_{f,t}$, the market portfolio percentage return, $r_{m,t}$, the growth rate in real per-capita seasonally adjusted private consumption, Δc_t, and $r_{i,t}$ is the returns of 25 portfolios constructed using the Tokyo Stock Exchange (TSE) First Section listed stocks.

More concretely, $r_{f,t}$ 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 July 2004.(Note 11) The market return $r_{m,t}$ is the value-weighted return of all stocks in the TSE First Section from the Japan Securities Research Institute (JSRI). Δc_t is constructed by dividing seasonally adjusted real consumption from the Government of Japan by the population estimates from the Ministry of Internal Affairs and Communications.

As $r_{i,t}$, we computed 25 value-weighted returns of size portfolios and 25 value-weighted returns of BE/ME portfolios, following Fama and French (1993). All TSE First Section listed stocks' return data from the JSRI are used to compute the portfolio returns.

6. The Time-varying Risk Pricing

This section examines the degree of the time-varying risk *pricing* of three asset pricing models. We also pay attention to the situation of the positiveness of the time-varying alphas in the conditional alpha CAPM.

6.1 Portfolio Return Characteristics

First, Table 1 presents sample statistics of the returns of the 25 size and BE/ME portfolios from October 1981 to July 2004. The mean returns of the size portfolios show a rather clear pattern of a monotonic increase from the largest to the smallest portfolio. The mean returns of the BE/ME portfolios also exhibit evidence of a monotonic increase, from the lowest to the highest BE/ME portfolio, although the pattern is not as strong as that found in the size portfolios. Therefore, at this point, we find both a size effect and a BE/ME effect in Japan; however, the former seems to be stronger than the latter at the TSE First Section in Japan.

6.2 The Time-varying Risk Pricing of the Conditional CAPM

Applying equations (4), (5), and (6) to the cross-sectional data, we obtained the monthly time-varying risk prices.(Note 12) Figure 1 displays the monthly time-varying risk prices from the conditional CAPM of size portfolios for the period from January 1982 to December

2003.(Note 13) Although not shown as tables,(Note 14) the monthly time-varying risk prices from the conditional CAPM were statistically significant in general; significant risk prices with theoretically consistent positive signs at the 5% level equalled 135 of the 264 cases. Figure 2 also exhibits the monthly time-varying risk prices from the conditional CAPM for the BE/ME portfolios. Again, the time-varying risk prices were generally statistically significant for the BE/ME portfolios; the number of significant risk prices with positive signs at the 5% level equalled 123 of the 264 cases. The above results suggest that, from the viewpoint of risk *pricing*, in Japan, the conditional CAPM demonstrates better performance than the suggestions by Lewellen and Nagel (2006) and Fama and French (2006), amongst others.

6.3 The Time-varying Risk Pricing and the Time-varying Alphas

Next, Figures 3 and 5 present the monthly time-varying risk prices and time-varying alphas from the conditional alpha CAPM for the 25 size portfolios, respectively. Regarding the risk pricing, in general, the monthly time-varying risk prices for size portfolios were not statistically significant; in only 42 of 264 cases were the prices positive and significant at the 5% level. In contrast, the monthly time-varying alphas were positive and statistically significant at the 5% level in 68 of 264 cases. Furthermore, there existed 152 cases of positive alphas, regardless of their statistical significance, in the 264 cases. Figures 4 and 6 display the monthly time-varying risk prices and alphas from the conditional alpha CAPM for BE/ME portfolios, respectively. Again, the time-varying risk prices were not statistically significant in the BE/ME portfolios; only 30 of 264 cases showed 5% significance and positive signs. In contrast, the monthly time-varying alphas for the BE/ME portfolios were positive and statistically significant at the 5% level in 41 of 264 cases; this increased to 146 cases if all positive alphas were included regardless of statistical significance. Therefore, the application of the conditional alpha CAPM using the time-varying covariances from the multivariate GARCH model suggests that, as far as we can judge from our monthly analysis, positive alphas exist for Japan, although the alphas are not always statistically significant. It is also pointed out by Lewellen and Nagel (2006) and Fama and French (2006) that the effect of the alphas in evaluating the conditional asset pricing models is crucial, and this point is examined in more detail in Section 8.

6.4 The Time-varying Risk Pricing of the Conditional CCAPM

Figure 7 shows the monthly time-varying risk prices from the conditional CCAPM for the 25 size portfolios. In CCAPM, theoretically, the risk premium of an asset should be proportional to the covariance between the return of an asset and consumption growth (Mehra and Prescott (1985) and Mankiw and Zeldes (1991), amongst others). However, the number of statistically significant time-varying risk prices from the conditional CCAPM were far less than that from the conditional CAPM; the number of statistically significant risk prices with positive signs at the 5% level occurred in 54 of the 264 cases for the 25 size portfolios. Furthermore, Figure 8 depicts the monthly time-varying risk prices from the conditional CCAPM for the 25 BE/ME portfolios. Again, the number of statistically significant risk prices was much less than those in the conditional CAPM for the 25 BE/ME portfolios. Significant consumption risk prices with positive signs at the 5% level occurred in 46 of the 264 cases. Therefore, for the traditional CCAPM, from the monthly risk pricing viewpoint, the conditional CCAPM is less supported than the conditional CAPM, even if the multivariate GARCH model is applied.

7. Evaluation of the Conditional Asset Pricing Models

This section attempts to more formally evaluate the empirical performance of three conditional asset pricing models. For the evaluation, we implement three types of formal *F*-tests on a monthly basis.(Note 15) For the three *F*-tests, the tested period is from January 1982 to December 2003, the conditional time-varying covariances derived from the multivariate GARCH model are used, and the same data set of 25 size and BE/ME portfolios are again used.

Table 1. Sample statistics of the value-weighted returns on 25 portfolios formed on the basis of size and BE/ME: October 1981 to July 2004

	Size-ranked portfolios					BE/ME-ranked portfolios			
Portfolio	Mean	Variance	Skewness	Kurtosis	Portfolio	Mean	Variance	Skewness	Kurtosis
Biggest	0.880	34.806	0.334	0.826	Highest	2.032	69.049	0.571	2.107
Size 2	1.245	30.193	0.216	1.183	BE/ME 2	1.838	45.395	0.147	1.006
Size 3	1.341	29.942	0.171	1.669	BE/ME 3	1.861	45.686	0.267	1.718
Size 4	1.396	33.943	−0.014	1.533	BE/ME 4	1.746	48.948	0.608	1.510
Size 5	1.279	35.505	0.168	1.758	BE/ME 5	1.707	48.172	0.548	0.863
Size 6	1.373	37.241	0.108	1.755	BE/ME 6	1.778	42.823	0.144	0.609
Size 7	1.521	33.475	0.249	2.946	BE/ME 7	1.950	44.786	0.246	0.447
Size 8	1.448	39.028	0.100	1.765	BE/ME 8	1.550	44.244	0.442	1.332
Size 9	1.334	42.063	0.113	1.819	BE/ME 9	1.537	40.285	−0.013	0.814
Size 10	1.587	43.404	0.068	1.272	BE/ME 10	1.881	45.487	0.350	1.349
Size 11	1.502	42.696	0.131	1.806	BE/ME 11	1.719	39.362	0.500	0.983
Size 12	1.786	47.146	0.334	1.435	BE/ME 12	1.207	35.977	0.098	1.588
Size 13	1.601	46.298	0.069	0.930	BE/ME 13	1.600	38.687	0.408	1.601
Size 14	1.596	45.948	0.133	0.826	BE/ME 14	1.308	36.352	0.219	0.980
Size 15	1.782	51.738	0.301	1.599	BE/ME 15	1.297	33.159	−0.021	0.740
Size 16	1.812	55.766	0.279	1.116	BE/ME 16	1.288	34.835	0.406	2.994
Size 17	1.626	54.122	0.196	1.207	BE/ME 17	1.350	39.235	0.748	4.757
Size 18	1.904	57.538	0.402	1.410	BE/ME 18	1.153	38.323	0.605	3.220
Size 19	2.168	65.859	0.915	4.109	BE/ME 19	1.045	37.947	0.708	2.993
Size 20	1.719	58.811	0.522	2.349	BE/ME 20	1.001	33.143	0.314	1.585
Size 21	2.170	61.365	0.309	0.967	BE/ME 21	1.079	41.158	0.467	2.477
Size 22	2.092	66.998	0.302	1.645	BE/ME 22	1.117	41.062	0.344	1.337
Size 23	2.546	72.813	0.400	0.588	BE/ME 23	0.811	42.155	0.562	2.689
Size 24	2.775	80.312	0.596	1.847	BE/ME 24	0.565	43.652	0.182	1.171
Smallest	3.762	111.198	1.055	2.935	Lowest	0.545	47.542	0.105	2.233

Note: The sample statistics of the value-weighted returns of 25 portfolios formed on the basis of size or BE/ME (book equity to market equity) ratios are displayed. The sample period is from October 1981 to July 2004. The size- and BE/ME-ranked portfolios are constructed following Fama and French (1993). In constructing the size-ranked portfolios, TSE (Tokyo Stock Exchange) First Section stocks were allocated to one of 25 groups based on their market equity (ME, stock price times shares outstanding) at the end of September of each year t (1981-2003). Value-weighted monthly returns on the 25 portfolios were then calculated from the following October to the next September. When constructing the BE/ME portfolios, the BE/ME ratio used to form the 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. Negative BE firms were not used in forming the BE/ME portfolios. The value-weighted monthly returns on the portfolios are then calculated from October to the following September like the size-ranked portfolios. Only firms with ordinary common equity are included. REITs (Real Estate Investment Trusts) and units of beneficial interest are excluded.

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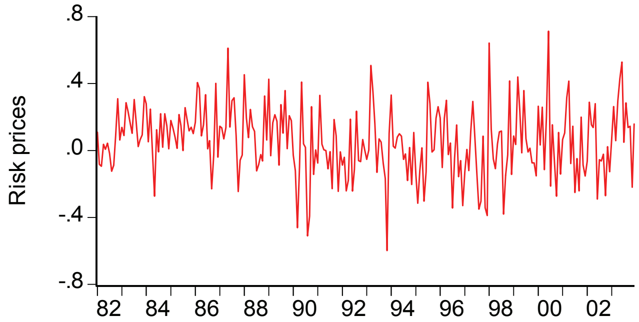

Figure 1. Time-varying risk prices of the conditional CAPM from size portfolios

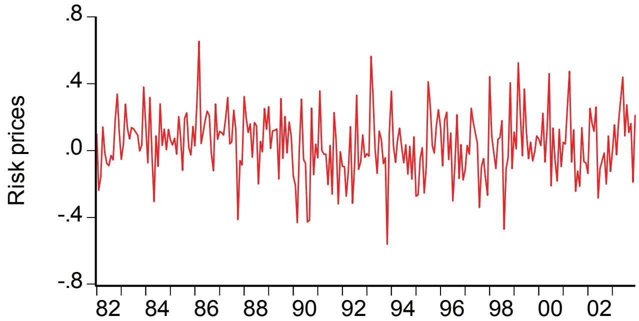

Figure 2. Time-varying risk prices of the conditional CAPM from BE/ME portfolios

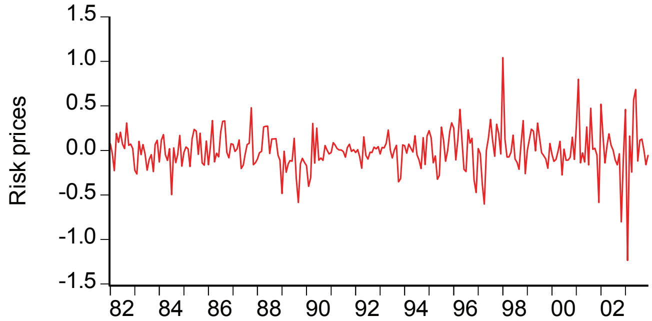

Figure 3. Time-varying risk prices of the conditional alpha CAPM from size portfolios

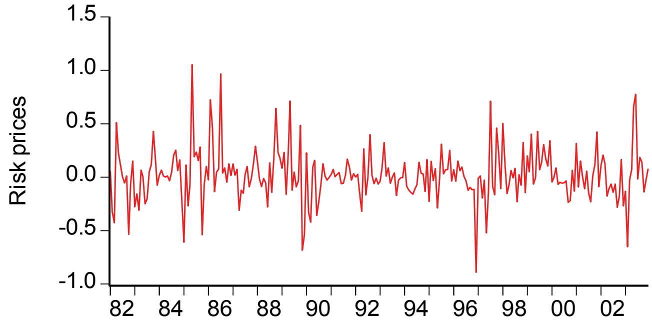

Figure 4. Time-varying risk prices of the conditional alpha CAPM from BE/ME portfolios

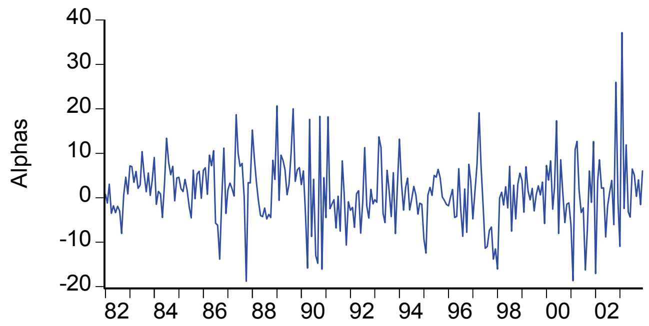

Figure 5. Time-varying alphas of alpha CAPM from size portfolios

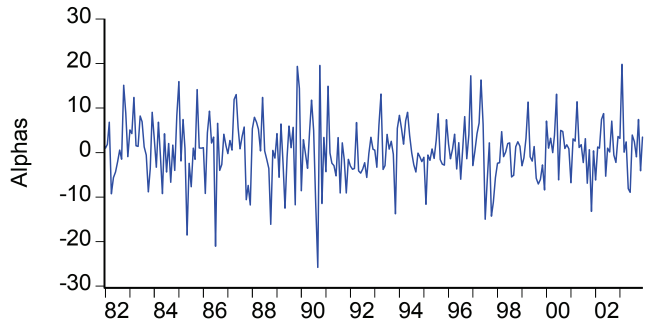

Figure 6. Time-varying alphas of alpha CAPM from BE/ME portfolios

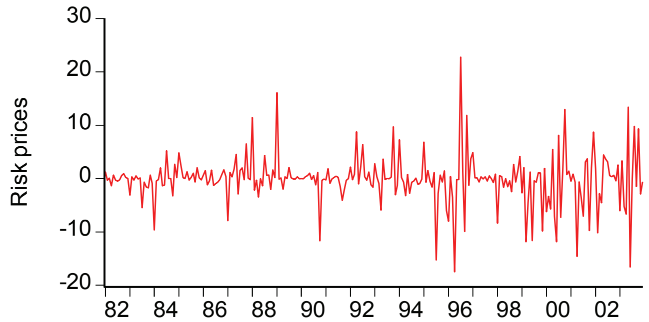

Figure 7. Time-varying risk prices of the conditional CCAPM from size portfolios

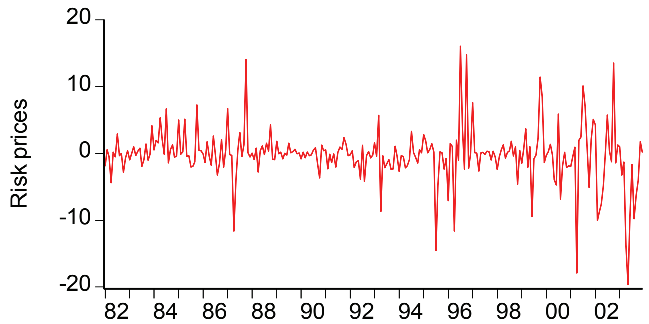

Figure 8. Time-varying risk prices of the conditional CCAPM from BE/ME portfolios

7.1 The Conditional CAPM versus the Conditional CCAPM

The first test procedure is as follows. Because the conditional CAPM (4) and the conditional CCAPM (6) are non-nested models of each other, following Maddala (1992), we combine the two models as the following model (13):

$$E\left[\left(r_{i,t}-r_{f,t}\right)|\Omega_{t-1}\right]=\delta_t Cov\left[r_{i,t},r_{m,t}\middle|\Omega_{t-1}\right]+\lambda_t Cov\left[r_{i,t},\Delta c_t\middle|\Omega_{t-1}\right]. \tag{13}$$

By using model (13), we implement the first monthly F-test. In model (13), the null hypothesis is H_0: $\lambda_t = 0$ and the alternative hypothesis is H_1: $\delta_t = 0$. Under H_0 and H_1, the F-statistic (14) follows an F-distribution with r and $n - k$ degrees of freedom.

$$F_{Test1}=\frac{\left(RRSS-URSS\right)/r}{URSS/\left(n-k\right)}. \tag{14}$$

$RRSS$ is the sum of squared residuals of the restricted model (4) or (6),(Note 16) $URSS$ is the sum of squared residuals of the unrestricted model (13), r is the number of restrictions, n is the number of samples, and k is the number of explanatory variables in the unrestricted model (13). In the model evaluation, when H_0 is not rejected, the conditional CAPM is supported, whilst when H_1 is not rejected, the conditional CCAPM is supported.(Note 17)

Regarding the first test, Table 2 shows the results for the conditional CAPM versus the conditional CCAPM in the case of the 25 size portfolios. In Table 2, H_0 is rejected in 40 of 264 cases, whilst H_1 is rejected in 218 of 264 cases. Therefore, in this first monthly F-test, out of 264 cases, the conditional CAPM is rejected only 40 times, while the conditional CCAPM is rejected in 218 cases. Hence, the evidence implies that the conditional CAPM is, by far, superior to the conditional CCAPM for the 25 size portfolios in Japan. Furthermore, Table 3 displays the results of the first F-test for the 25 BE/ME portfolios. The table indicates that H_0 is rejected in 19 of 264 cases, whilst H_1 is rejected 214 times. Therefore, the results suggest that out of 264 cases, the conditional CAPM is rejected only 19 times, whilst the conditional CCAPM is rejected in 214 cases. Thus, we can judge that again, the conditional CAPM outperforms the conditional CCAPM in the case of the 25 BE/ME portfolios in Japan.

7.2 The Conditional Alpha CAPM Versus the Conditional CCAPM

As for the second test procedure, the conditional alpha CAPM (5) and the conditional CCAPM (6) are again non-nested models of each other. Thus, again following Maddala (1992), we combine the two models as model (15):

$$E\left[\left(r_{i,t}-r_{f,t}\right)|\Omega_{t-1}\right]=\alpha_t+\delta_t Cov\left[r_{i,t},r_{m,t}\middle|\Omega_{t-1}\right]+\lambda_t Cov\left[r_{i,t},\Delta c_t\middle|\Omega_{t-1}\right]. \tag{15}$$

By exploiting this model (15), we implement the second monthly F-test. In model (15), the null hypothesis is H_0: $\lambda_t = 0$ and the alternative hypothesis is H_1: $\alpha_t = 0$ and $\delta_t = 0$. Under H_0 and H_1, the F-statistic (16) follows the F-distribution, whose degrees of freedom are r and $n - k - 1$.

$$F_{Test2,3} = \frac{(RRSS - URSS)/r}{URSS/(n-k-1)}. \quad (16)$$

RRSS is the sum of squared residuals of the restricted model (5) or (6),(Note 18) *URSS* is the sum of squared residuals of the unrestricted model (15), r and n are the same as in (14), and k is the number of explanatory variables in the unrestricted model (15).

When H_0 is not rejected, the conditional alpha CAPM is supported, whilst when H_1 is not rejected, the conditional CCAPM is supported.(Note 19)

Table 4 shows the second F-test results; the conditional alpha CAPM versus the conditional CCAPM in the case of the 25 size portfolios. In Table 4, H_0 is rejected in 31 of 264 cases, whilst H_1 is rejected in 222 of 264 cases. Therefore, out of 264 cases, the conditional alpha CAPM is rejected only 31 times, while the conditional CCAPM is rejected in 222 cases. Hence, we understand that the conditional alpha CAPM outperforms the conditional CCAPM in the case of the 25 size portfolios in Japan. Furthermore, Table 5 exhibits the second F-test results for the 25 BE/ME portfolios. In the table, H_0 is rejected in 16 of 264 cases, whilst H_1 is rejected in 211 of 264 cases. The results mean that out of 264 cases, the conditional alpha CAPM is rejected only 16 times, whilst the conditional CCAPM is rejected in 211 cases. Therefore, we can conclude that in Japan, the conditional alpha CAPM is by far superior to the conditional CCAPM in the case of the 25 BE/ME portfolios as well.

7.3 The Conditional CAPM versus the Conditional Alpha CAPM

Regarding our third test, the conditional CAPM (4) is a nested model of the conditional alpha CAPM (5); therefore, by setting a restriction on the conditional alpha CAPM (5), we can implement the third monthly F-test. Namely, in model (5), we set the null hypothesis as H_0: $\alpha_t = 0$ and set the alternative hypothesis as H_1: $\alpha_t \neq 0$. Under H_0, the above mentioned F-statistic (16) follows an F-distribution with r and $n - k - 1$ degrees of freedom as in the second test. *RRSS* is the sum of squared residuals of the restricted model (4), *URSS* is the sum of squared residuals of the unrestricted model (5), r and n are the same as in (14), and k is the number of explanatory variables in the unrestricted model (5).

Here, when H_0 is rejected, the conditional CAPM is rejected and the conditional alpha CAPM is supported, whilst when H_0 is not rejected, the conditional CAPM is supported and the conditional alpha CAPM is rejected.

Table 6 shows the third F-test results; the conditional CAPM versus the conditional alpha CAPM in the case of the 25 size portfolios. In Table 6, H_0 is rejected in 109 of 264 cases; this means that out of 264 cases, the conditional CAPM is rejected against the conditional alpha CAPM 109 times (the rejection rate is 41.3%). Hence, we conclude that the conditional CAPM is slightly better than the conditional alpha CAPM in the case of the 25 size portfolios in Japan. Furthermore, Table 7 displays the third test results for the 25 BE/ME portfolios. The table indicates that H_0 is rejected in 74 of 264 cases, and this means that out of 264 cases, the conditional CAPM is rejected against the conditional alpha CAPM only 74 times (the rejection rate is 28.0%). Hence, we conclude that the conditional CAPM is clearly superior to the conditional alpha CAPM in the case of the 25 BE/ME portfolios in Japan.

8. Comparisons and Discussions with Other Studies

Finally, based on the arguments of other existing influential studies, such as Chen et al. (1986), Lewellen and Nagel (2006), Fama and French (1996, 2006), Lettau and Ludvigson (2001), amongst others, we conduct additional tests and discussions below. These tests are also worthwhile for checking the robustness of our previous results.

The most critical issues regarding the conditional asset pricing models argued by Lewellen and Nagel (2006) are that 1) the conditioning methods using observable variables, seen in existing works such as Harvey (1989), Shanken (1990), Jagannathan and Wang (1996), Lettau and Ludvigson (2001), amongst others, limit the information set; therefore, through such a conditioning method, we can only test the implications conditioned by several observable variables; 2) the main focus of most existing studies is cross-sectional regressions; thus, they ignore time-series characteristics; and 3) the direct test of the conditional CAPM is to examine whether the conditional alphas are zero.

Regarding the first point, because we use the multivariate GARCH model, which enables us to derive the conditional covariances for tests without using any state variables, our research is not subject to this critique. Therefore, below, we only discuss the latter two points. As to the second point, to further evaluate our three conditional models by taking into consideration both the time-series and the cross-sectional aspects, we perform a balanced panel data analysis. Furthermore, as for the third point, we additionally test the conditional alphas, as suggested by Lewellen and Nagel (2006) and Fama and French (2006).

8.1 Panel Data Analysis

First, Table 8 displays the results of the pooled regressions for the entire sample period from October 1981 to July 2004 and for four subsample periods. Table 8 indicates that the risk price from the conditional CAPM is statistically significant for all testing periods and for both the size and the BE/ME portfolios, with only one exception in the case of the BE/ME portfolios over the subperiod from January 1987 to December 1992. For example, Chen et al. (1986) show that the unconditional CAPM pricing is weakly statistically significant in the entire period of 1958−1984 and in only one subperiod of 1978−1984 in the cases of 20 size-ranked portfolios (Chen et al. (1986), Table 5, p. 398). Therefore, we suggest that the statement "*the conditional CAPM performs nearly as poorly as the unconditional CAPM*" (Lewellen and Nagel 2006, p. 291) does not hold in the case of Japan.

In contrast to this result, Table 8 also shows that the risk price from the conditional CCAPM is never statistically significant with the theoretically consistent positive sign. Once again, the conditional CCAPM is not supported from the viewpoint of risk pricing in Japan.(Note 20)

Furthermore, regarding the conditional alpha CAPM, the intercepts, the alphas, are statistically significant with positive signs in seven of 10 cases; thus, we need more formal tests especially for the conditional CAPM versus the conditional alpha CAPM using the panel data. Thus, we again perform the three types of formal tests by using panel data below.

8.1.1 The Conditional CAPM Versus the Conditional CCAPM

The first test using the panel data is the conditional CAPM versus the conditional CCAPM. The null hypothesis is H_0: $\lambda_t = 0$ and the alternative hypothesis is H_1: $\delta_t = 0$ in model (13). As before, under H_0 (the conditional CAPM holds) and H_1 (the conditional CCAPM holds), the F-statistic (17) follows an F-distribution with r and $nT - k$ degrees of freedom.(Note 21)

$$F_{Test1}^{Panel} = \frac{(RRSS - URSS)/r}{URSS/(nT - k)}. \tag{17}$$

The left section of Table 9 shows the results for the 25 size portfolios in Panel A and for the 25 BE/ME portfolios in Panel B. In Table 9, H_0 is never rejected in all 10 cases in Panels A and B; this means that, in this first panel F-test, in all 10 cases, the conditional CAPM is never rejected for the panel data. However, H_1 (CCAPM holds) is rejected in six out of 10 cases in Panels A and B, and the six rejection cases include the entire sample period cases for both the size and the BE/ME portfolios. Therefore, as with the monthly results, we conclude that, for the panel data, the conditional CAPM is again superior to the conditional CCAPM in Japan.

8.1.2 The Conditional Alpha CAPM Versus the Conditional CCAPM

In the second additional panel data test, the null hypothesis is H_0: $\lambda_t = 0$ and the alternative hypothesis is H_1: $\alpha_t = 0$ and $\delta_t = 0$ in model (15). Under H_0 (the conditional alpha CAPM holds) and H_1 (the conditional CCAPM holds), the F-statistic (18) follows the F-distribution whose degrees of freedom are r and $nT - k - n$.(Note 22)

$$F_{Test2,3}^{Panel} = \frac{(RRSS - URSS)/r}{URSS/(nT - k - n)}. \tag{18}$$

The middle section of Table 9 displays the results for the 25 size portfolios in Panel A and for the 25 BE/ME portfolios in Panel B. The table indicates that H_0 is not rejected for all 10 cases in Panels A and B. Therefore, this second panel F-test suggests that in all 10 cases, the conditional alpha CAPM is never rejected. On the other hand, it is shown that H_1 (CCAPM holds) is rejected eight out of 10 times in Panels A and B; the rejection cases are seen in the entire sample period analysis for both the size and the BE/ME portfolios. Therefore, from this second panel F-test, we understand, again like the results of the monthly tests, that the conditional alpha CAPM outperforms the traditional conditional CCAPM in Japan.

8.1.3 The Conditional Alpha CAPM versus the Conditional CAPM

The third additional panel data test is the conditional alpha CAPM versus the conditional CAPM. In model (5), as before, we set the null hypothesis as H_0: $\alpha_t = 0$ and the alternative hypothesis as H_1: $\alpha_t \neq 0$. Under H_0 (the conditional CAPM holds), the F-statistic (18) follows an F-distribution with r and $nT - k - n$ degrees of freedom.(Note 23)

The right section of Table 9 displays the results for the 25 size portfolios in Panel A and the results for the 25 BE/ME portfolios in Panel B. The table indicates that, in Panel A, H_0 is rejected in three of the five cases, and these three cases involve the entire sample period test case. In Panel B, H_0 is never rejected in the five cases. Therefore, this third additional panel F-test demonstrates that, in the case of the size portfolios, in all five cases, the conditional CAPM is supported in only two subperiod cases. However, contrary to this, in the BE/ME portfolios, the conditional CAPM is supported against the conditional alpha CAPM in all five cases in Japan. We note that the above results for the BE/ME portfolios are consistent with the results of Ang and Chen (2007), who insist that the CAPM can explain US value premiums from 1926 to 1963, and are inconsistent with the suggestion of Fama and French (1996, 2006) that the CAPM cannot explain the value premiums in the US.(Note 24)

8.2 Testing the Time-varying Alpha

Finally, we move to the third sceptical view of conditioning by Lewellen and Nagel (2006): the test of the conditional alphas is essential for judging the validity of the conditional CAPM. To investigate this matter in Japan, we further test the time-varying alphas derived from our previous analysis. We also consider that this test serves as a robustness check of our previous results between the conditional CAPM and the conditional alpha CAPM.

Regarding the test, more precisely, using the average values of the time-varying alphas exhibited in Figures 5 and 6, we implement the following t-test for the entire sample period from January 1982 to December 2003 and for four subperiods. The null hypothesis is H_0: $Avg[\alpha_t] = \mu_0 = 0$, and the alternative hypothesis is H_1: $Avg[\alpha_t] \neq 0$, where $Avg[\alpha_t]$ is the average value of the time-series alphas.(Note 25) The test t-statistic is $T = [\bar{\alpha} - \mu_0]/[s/\sqrt{n}]$, where $\bar{\alpha}$ is the sample average of the time-varying alphas, $\mu_0 = 0$ under the null hypothesis, s is the standard deviation of the time-varying alphas, and n is the number of samples. Under H_0, $T = [\bar{\alpha} - \mu_0]/[s/\sqrt{n}]$ follows a t-distribution with $n-1$ degrees of freedom. Thus, in the test, if $|T| > t_{p/200}(n-1)$, H_0 is rejected at the p% significance level, where $t_k(n-1)$ denotes the $100k$% point value of the t-distribution, with $n-1$ degrees of freedom.

Panel A of Table 10 shows the results for the 25 size portfolios, while Panel B displays the results for the 25 BE/ME portfolios. Panel A shows that for three out of five cases, the null hypothesis H_0: $Avg[\alpha_t] = 0$ is supported; however, the two rejections involve the entire sample period test case. On the other hand, in Panel B of Table 10, it is demonstrated that in all five cases, the null H_0 is not rejected. Therefore, from the viewpoint of the conditional alphas, the conditional CAPM is supported in explaining the value effect in Japan, although it is again of limited effectiveness in explaining the size effect in Japan.

Table 2. Monthly *F*-tests for model evaluation using 25 portfolios formed on the basis of size: the conditional CAPM versus conditional Consumption CAPM in Japan from January 1982 to December 2003

Year	Hypotheses	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1982	H_0: $\lambda_t = 0$ (CAPM holds)	0.065	0.000	0.064	1.016	28.454**	1.095	0.059	0.003	4.753*	3.808	2.609	0.341
	H_1: $\delta_t = 0$ (CCAPM holds)	39.736**	8.555**	27.415**	2.526	1.722	1.096	0.571	51.326**	13.653**	13.373**	163.831**	12.309**
1983	H_0: $\lambda_t = 0$ (CAPM holds)	4.371*	0.678	1.212	0.092	0.180	0.549	0.405	3.988	19.067**	0.606	0.853	0.736
	H_1: $\delta_t = 0$ (CCAPM holds)	15.194**	5.023*	163.972**	49.432**	31.950**	11.820**	18.980**	35.516**	0.028	4.090	32.945**	154.115**
1984	H_0: $\lambda_t = 0$ (CAPM holds)	0.978	0.016	3.098	1.154	0.012	2.840	0.252	13.640**	0.043	0.108	3.570	0.129
	H_1: $\delta_t = 0$ (CCAPM holds)	23.912**	3.444	50.210**	0.016	88.839**	56.650**	0.011	50.865**	1.144	23.496**	22.431**	0.283
1985	H_0: $\lambda_t = 0$ (CAPM holds)	0.720	18.992**	1.264	0.039	0.906	0.050	0.016	0.354	0.044	3.232	0.115	3.807
	H_1: $\delta_t = 0$ (CCAPM holds)	35.408**	6.297*	17.042**	0.291	31.899**	25.342**	0.003	86.791**	77.224**	21.977**	14.026**	23.226**
1986	H_0: $\lambda_t = 0$ (CAPM holds)	0.594	3.266	0.021	0.002	1.916	0.316	0.126	2.837	0.090	0.032	0.086	0.074
	H_1: $\delta_t = 0$ (CCAPM holds)	23.205**	63.548**	37.101**	3.126	15.918**	38.427**	0.026	3.183	9.367**	1.486	121.852**	4.538*
1987	H_0: $\lambda_t = 0$ (CAPM holds)	0.708	0.664	0.485	0.786	3.354	3.985	0.641	0.286	0.161	3.978	8.372**	0.492
	H_1: $\delta_t = 0$ (CCAPM holds)	23.650**	18.102**	7.774**	40.735**	59.505**	9.588**	12.022**	47.951**	17.799**	23.883**	33.687**	2.101
1988	H_0: $\lambda_t = 0$ (CAPM holds)	4.458*	9.951**	0.001	0.026	0.751	3.314	2.002	9.913**	2.442	0.012	0.117	1.376
	H_1: $\delta_t = 0$ (CCAPM holds)	62.281**	250.475**	53.162**	94.479**	19.374**	29.018**	11.929**	26.359**	0.747	7.107*	173.022**	13.591**
1989	H_0: $\lambda_t = 0$ (CAPM holds)	1.422	2.089	3.633	18.477**	3.847	0.364	0.745	1.770	0.023	0.017	33.248**	0.047
	H_1: $\delta_t = 0$ (CCAPM holds)	104.451**	2.120	48.235**	92.737**	37.298**	29.740**	331.831**	8.984**	70.921**	0.374	251.264**	61.471**
1990	H_0: $\lambda_t = 0$ (CAPM holds)	0.069	0.314	7.546*	0.156	4.623*	1.668	0.569	0.116	0.207	0.476	3.113	0.073
	H_1: $\delta_t = 0$ (CCAPM holds)	0.548	17.039**	812.138**	8.873**	157.813**	5.797*	0.568	688.966**	991.129**	258.357**	286.215**	0.115
1991	H_0: $\lambda_t = 0$ (CAPM holds)	0.700	1.644	0.289	0.047	6.007*	0.332	0.037	0.025	0.515	0.329	0.869	0.936
	H_1: $\delta_t = 0$ (CCAPM holds)	83.611**	225.415**	28.906**	0.671	1.369	108.721**	0.722	280.371**	170.644**	74.377**	214.129**	4.623*
1992	H_0: $\lambda_t = 0$ (CAPM holds)	0.061	0.773	0.366	0.901	0.132	0.120	0.404	3.449	7.634*	0.041	2.855	5.712*
	H_1: $\delta_t = 0$ (CCAPM holds)	79.635**	28.520**	422.333**	230.133**	290.340**	509.235**	93.254**	215.854**	38.585**	84.816**	57.998**	0.002
1993	H_0: $\lambda_t = 0$ (CAPM holds)	0.756	9.952**	0.070	2.459	12.152**	6.092*	0.432	12.606**	0.349	0.818	3.929	4.052
	H_1: $\delta_t = 0$ (CCAPM holds)	22.208**	0.901	504.243**	642.755**	32.921**	262.586**	52.992**	138.110**	61.036**	79.549**	932.566**	427.950**
1994	H_0: $\lambda_t = 0$ (CAPM holds)	5.874*	9.180**	1.536	0.981	0.407	7.697*	0.828	7.454*	1.042	0.016	0.553	7.556*
	H_1: $\delta_t = 0$ (CCAPM holds)	461.045**	36.015**	0.684	53.994**	176.301**	21.250**	77.675**	1.337	404.595**	1.439	275.171**	173.049**
1995	H_0: $\lambda_t = 0$ (CAPM holds)	0.441	0.354	0.329	0.150	1.282	0.536	0.135	0.215	2.740	0.560	1.312	7.478*
	H_1: $\delta_t = 0$ (CCAPM holds)	30.190**	367.940**	77.911**	3.731	780.715**	226.352**	837.092**	644.854**	0.176	0.007	136.611**	292.214**
1996	H_0: $\lambda_t = 0$ (CAPM holds)	0.851	1.306	0.057	0.074	0.382	2.446	0.069	0.000	12.657**	0.302	0.292	0.128
	H_1: $\delta_t = 0$ (CCAPM holds)	186.901**	188.614**	256.154**	124.381**	4.729*	13.593**	453.820**	8.264**	52.077**	74.358**	12.202**	147.410**
1997	H_0: $\lambda_t = 0$ (CAPM holds)	1.553	2.120	1.051	7.683*	2.818	6.531*	1.583	0.373	0.861	0.204	2.920	0.556
	H_1: $\delta_t = 0$ (CCAPM holds)	121.942**	0.021	64.144**	31.800**	116.403**	39.077**	15.497**	274.535**	64.357**	6.610*	44.828**	107.073**
1998	H_0: $\lambda_t = 0$ (CAPM holds)	1.853	0.966	0.927	4.395*	1.466	17.364**	2.304	3.581	4.289*	6.036*	2.583	0.550
	H_1: $\delta_t = 0$ (CCAPM holds)	126.609**	113.615**	23.490**	90.404**	17.077**	39.781**	45.115**	325.631**	128.535**	13.209**	614.768**	109.370**
1999	H_0: $\lambda_t = 0$ (CAPM holds)	0.863	5.459*	2.406	2.526	0.211	0.097	0.069	0.352	0.802	0.138	4.290*	0.369
	H_1: $\delta_t = 0$ (CCAPM holds)	79.249**	7.281*	157.733**	137.158**	0.121	256.243**	34.036**	0.570	0.836	14.048**	4.088	5.890*
2000	H_0: $\lambda_t = 0$ (CAPM holds)	0.626	2.218	0.138	1.659	2.040	0.861	0.690	0.976	0.000	5.074*	0.262	0.278
	H_1: $\delta_t = 0$ (CCAPM holds)	27.584**	0.283	21.507**	5.912*	18.361**	61.669**	46.164**	32.734**	23.946**	172.101**	64.021**	99.835**
2001	H_0: $\lambda_t = 0$ (CAPM holds)	0.060	0.001	0.016	4.183	0.832	0.019	2.314	0.948	2.137	0.503	0.350	6.462*
	H_1: $\delta_t = 0$ (CCAPM holds)	36.398**	14.014**	64.620**	132.248**	41.328**	35.463**	394.018**	1.585	262.417**	112.807**	19.097**	18.919**
2002	H_0: $\lambda_t = 0$ (CAPM holds)	0.144	0.179	0.315	0.011	0.523	0.219	0.099	10.319**	0.069	5.501*	0.016	0.050
	H_1: $\delta_t = 0$ (CCAPM holds)	6.659*	200.387**	108.235**	99.536**	209.142**	481.678**	5.566*	60.482**	3.111	496.278**	0.850	148.624**
2003	H_0: $\lambda_t = 0$ (CAPM holds)	2.570	2.541	3.725	0.772	3.884	1.993	0.008	0.514	0.045	0.068	0.705	3.722
	H_1: $\delta_t = 0$ (CCAPM holds)	1.089	45.756**	2.614	44.480**	83.179**	105.809**	6.099*	125.436**	45.269**	35.670**	289.222**	175.883**

Note: Monthly *F*-tests are performed for model evaluation. Figures in the table are *F*-statistics. The null hypothesis is H_0: $\lambda_t = 0$ and the alternative hypothesis is H_1: $\delta_t = 0$ in the model: $E[(r_{i,t} - r_{f,t}) \mid \Omega_{t-1}] = \delta_t \, Cov[r_{i,t}, r_{m,t} \mid \Omega_{t-1}] + \lambda_t \, Cov[r_{i,t}, \Delta c_t \mid \Omega_{t-1}]$. ** and * attached to the *F*-statistic denote that the hypothesis is rejected at the 1% and 5% statistical significance level, respectively. When H_0 is not rejected, the conditional CAPM is supported, whilst when H_1 is not rejected, the conditional Consumption CAPM is supported. The test period of the monthly *F*-tests is from January 1982 to December 2003. The conditional time-varying covariances derived from the multivariate GARCH model are used for the tests. The 25 size portfolios used for the tests are formed following the procedures in Fama and French (1993). That is, at the end of September of each year *t* (1981-2003), TSE (Tokyo Stock Exchange) First Section stocks are allocated to one of 25 groups based on their September market equity (ME, stock price times shares outstanding). Value-weighted monthly returns on the 25 portfolios are then calculated from the following October to the next September. Only firms with ordinary common equity are included. REITs (Real Estate Investment Trusts) and units of beneficial interest are excluded.

Table 3. Monthly *F*-tests for model evaluation using 25 portfolios formed on the basis of BE/ME: the conditional CAPM versus conditional Consumption CAPM in Japan from January 1982 to December 2003

Year	Hypotheses	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1982	H_0: $\lambda_t = 0$ (CAPM holds)	0.420	0.199	0.149	0.444	0.470	1.680	3.737	3.321	0.768	0.064	6.610*	1.516
	H_1: $\delta_t = 0$ (CCAPM holds)	19.888**	36.998**	51.475**	21.091**	0.241	15.053**	12.923**	4.431*	14.927**	30.519**	190.890**	36.772**
1983	H_0: $\lambda_t = 0$ (CAPM holds)	1.697	0.093	0.216	0.007	2.341	0.304	0.520	0.748	3.087	0.577	0.049	8.682**
	H_1: $\delta_t = 0$ (CCAPM holds)	4.965*	2.347	87.250**	54.080**	8.529**	23.150**	19.837**	19.088**	13.684**	0.058	2.131	236.884**
1984	H_0: $\lambda_t = 0$ (CAPM holds)	4.361*	1.047	1.518	9.346**	0.273	0.002	1.984	0.106	0.416	0.992	0.293	0.517
	H_1: $\delta_t = 0$ (CCAPM holds)	30.129**	7.730*	151.487**	0.361	129.140**	32.984**	20.078**	261.704**	2.234	28.432**	0.002	8.470**
1985	H_0: $\lambda_t = 0$ (CAPM holds)	10.123**	0.117	0.056	4.651*	0.000	2.151	1.053	0.929	1.401	20.311**	5.533*	0.444
	H_1: $\delta_t = 0$ (CCAPM holds)	9.247**	2.524	3.556	0.680	9.873**	12.776**	3.842	56.108**	17.205**	9.296**	0.206	31.832**
1986	H_0: $\lambda_t = 0$ (CAPM holds)	0.065	0.430	0.026	0.114	3.040	2.868	1.445	2.196	2.593	0.085	1.613	0.173
	H_1: $\delta_t = 0$ (CCAPM holds)	1.936	35.087**	164.918**	2.641	30.112**	45.700**	11.866**	9.843**	0.566	25.175**	102.788**	14.338**
1987	H_0: $\lambda_t = 0$ (CAPM holds)	0.648	0.039	0.495	1.802	7.166*	0.113	0.911	0.050	1.033	1.503	0.095	0.407
	H_1: $\delta_t = 0$ (CCAPM holds)	6.373*	9.339**	4.927*	12.220**	55.463**	0.812	5.682*	92.534**	6.022*	60.556**	15.311**	6.144*
1988	H_0: $\lambda_t = 0$ (CAPM holds)	0.019	0.086	0.022	13.687**	0.379	0.106	0.017	0.018	0.062	2.056	0.308	2.587
	H_1: $\delta_t = 0$ (CCAPM holds)	274.577**	168.229**	31.855**	182.852**	3.346	12.834**	9.522**	83.296**	3.012	0.018	204.948**	8.920**
1989	H_0: $\lambda_t = 0$ (CAPM holds)	2.872	0.045	0.000	0.491	0.381	0.207	1.294	0.637	0.107	1.497	0.088	0.059
	H_1: $\delta_t = 0$ (CCAPM holds)	131.248**	0.135	14.713**	37.800**	21.825**	89.281**	233.509**	3.703	74.244**	0.540	35.943**	9.152**
1990	H_0: $\lambda_t = 0$ (CAPM holds)	2.228	0.909	0.086	0.558	0.977	0.108	0.087	0.037	2.922	0.116	0.091	0.777
	H_1: $\delta_t = 0$ (CCAPM holds)	33.671**	172.137**	146.935**	1.656	311.623**	3.728	24.635**	559.905**	605.861**	218.973**	313.842**	36.241**
1991	H_0: $\lambda_t = 0$ (CAPM holds)	3.616	0.004	0.332	2.187	0.704	0.259	0.009	1.518	1.510	3.888	0.013	1.505
	H_1: $\delta_t = 0$ (CCAPM holds)	45.117**	240.550**	0.193	3.543	6.236*	152.743**	9.332**	151.158**	298.376**	18.639**	275.503**	0.685
1992	H_0: $\lambda_t = 0$ (CAPM holds)	1.845	0.429	0.461	2.584	0.158	0.066	0.830	0.002	3.853	0.281	3.501	0.198
	H_1: $\delta_t = 0$ (CCAPM holds)	76.602**	80.059**	286.814**	46.156**	95.011**	516.399**	80.186**	484.736**	119.667**	56.256**	134.869**	11.753**
1993	H_0: $\lambda_t = 0$ (CAPM holds)	1.898	5.794*	3.635	0.020	0.628	1.758	1.041	0.549	4.481*	2.607	3.061	1.558
	H_1: $\delta_t = 0$ (CCAPM holds)	2.482	9.619**	229.107**	221.658**	0.704	205.761**	138.971**	41.441**	18.755**	7.583*	659.109**	96.659**
1994	H_0: $\lambda_t = 0$ (CAPM holds)	0.230	0.007	0.032	0.522	0.396	2.460	0.815	1.883	1.719	0.643	0.195	5.643*
	H_1: $\delta_t = 0$ (CCAPM holds)	365.494**	4.641*	67.526**	24.110**	72.155**	3.747	31.091**	11.082**	157.576**	5.159*	249.183**	88.249**
1995	H_0: $\lambda_t = 0$ (CAPM holds)	0.003	1.195	0.656	1.766	0.075	2.432	0.337	1.533	0.281	0.149	0.447	1.804
	H_1: $\delta_t = 0$ (CCAPM holds)	124.070**	178.915**	16.407**	4.837*	380.195**	44.198**	614.750**	217.379**	5.832*	2.228	74.405**	107.519**
1996	H_0: $\lambda_t = 0$ (CAPM holds)	0.231	0.021	0.270	0.714	0.612	0.419	2.178	0.019	0.822	1.020	2.030	1.860
	H_1: $\delta_t = 0$ (CCAPM holds)	100.223**	60.007**	206.393**	230.641**	15.749**	58.076**	599.596**	67.275**	311.447**	421.860**	1.169	50.255**
1997	H_0: $\lambda_t = 0$ (CAPM holds)	4.490*	1.850	0.562	1.886	0.719	1.022	0.206	2.349	6.215*	5.204*	0.196	0.007
	H_1: $\delta_t = 0$ (CCAPM holds)	23.959**	5.793*	2.215	79.517**	28.707**	34.683**	1.484	261.910**	13.704**	1.304	14.027**	41.126**
1998	H_0: $\lambda_t = 0$ (CAPM holds)	0.997	0.345	14.354**	3.361	2.959	0.322	0.566	0.010	0.456	0.254	0.079	0.126
	H_1: $\delta_t = 0$ (CCAPM holds)	119.504**	45.477**	3.731	31.290**	11.109**	25.739**	120.056**	562.021**	49.786**	4.718*	313.170**	70.525**
1999	H_0: $\lambda_t = 0$ (CAPM holds)	0.002	1.481	0.111	0.738	0.070	3.040	0.360	0.599	1.014	8.740**	2.038	0.593
	H_1: $\delta_t = 0$ (CCAPM holds)	54.542**	1.112	520.361**	46.980**	3.614	363.704**	28.543**	7.010*	3.088	3.460	0.111	1.513
2000	H_0: $\lambda_t = 0$ (CAPM holds)	0.670	0.007	0.035	0.037	0.937	0.177	0.009	4.175	2.981	0.635	0.090	0.172
	H_1: $\delta_t = 0$ (CCAPM holds)	4.373*	0.219	17.885**	3.125	2.864	28.420**	49.108**	28.070**	9.242**	45.457**	18.001**	7.015*
2001	H_0: $\lambda_t = 0$ (CAPM holds)	0.086	0.006	0.008	2.641	0.576	0.945	1.029	1.571	3.872	1.479	0.069	2.451
	H_1: $\delta_t = 0$ (CCAPM holds)	3.364	0.691	139.765**	72.039**	10.190**	15.458**	95.779**	5.951*	60.058**	79.288**	4.310*	9.073**
2002	H_0: $\lambda_t = 0$ (CAPM holds)	0.312	0.375	2.186	0.019	0.002	1.053	0.013	1.355	0.933	0.151	0.404	0.755
	H_1: $\delta_t = 0$ (CCAPM holds)	46.356**	105.103**	29.919**	36.060**	61.863**	372.757**	20.740**	55.293**	0.188	66.491**	10.713**	51.265**
2003	H_0: $\lambda_t = 0$ (CAPM holds)	0.071	2.334	1.060	0.067	0.292	0.149	5.820*	0.897	0.739	2.362	0.279	0.001
	H_1: $\delta_t = 0$ (CCAPM holds)	0.074	18.882**	2.066	21.441**	54.304**	108.39**	35.733**	157.306**	13.062**	33.628**	66.819**	170.326**

Note: Monthly *F*-tests are performed for model evaluation. Figures in the table are *F*-statistics. The null hypothesis is H_0: $\lambda_t = 0$ and the alternative hypothesis is H_1: $\delta_t = 0$ in the model: $E[(r_{i,t} - r_{f,t}) \mid \Omega_{t-1}] = \delta_t \, Cov[r_{i,t}, r_{m,t} \mid \Omega_{t-1}] + \lambda_t \, Cov[r_{i,t}, \Delta c_t \mid \Omega_{t-1}]$. ** and * attached to the *F*-statistic denote that the hypothesis is rejected at the 1% and 5% statistical significance level, respectively. When H_0 is not rejected, the conditional CAPM is supported, whilst when H_1 is not rejected, the conditional Consumption CAPM is supported. The test period of the monthly *F*-tests is from January 1982 to December 2003. The conditional time-varying covariances derived from the multivariate GARCH model are used for the tests. The 25 BE/ME portfolios used for the tests are formed following the procedures in Fama and French (1993). That is, the BE/ME ratio used to form the 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*. We do not use negative BE firms when forming the BE/ME portfolios. The value-weighted monthly returns on the 25 portfolios are then calculated from October to the following September. Only firms with ordinary common equity are included. REITs (Real Estate Investment Trusts) and units of beneficial interest are excluded.

Table 4. Monthly *F*-tests for model evaluation using 25 portfolios formed on the basis of size: the conditional alpha CAPM versus conditional Consumption CAPM in Japan from January 1982 to December 2003

Year	Hypotheses	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1982	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.034	0.002	0.042	1.127	31.527**	0.862	0.084	0.054	11.348**	4.077	4.169	0.460
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	19.014**	4.117*	14.561**	1.774	1.974	0.620	0.604	27.799**	25.479**	6.713**	103.003**	6.180**
1983	H_0: $\lambda_t = 0$ (alpha CAPM holds)	7.562*	0.054	2.962	0.007	0.359	0.811	0.052	3.652	17.469**	1.252	0.764	0.994
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	13.660**	5.061*	101.342**	30.837**	16.369**	6.812**	12.907**	23.396**	0.013	5.441*	15.920**	90.608**
1984	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.590	0.000	2.793	1.531	1.439	1.251	0.279	4.065	1.496	2.315	4.625*	0.004
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	18.332**	1.853	24.015**	0.572	73.614**	31.877**	1.852	192.668**	10.915**	26.590**	11.822**	3.643*
1985	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.385	18.507**	0.562	0.202	1.197	0.234	0.569	0.314	0.037	2.188	0.197	3.725
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	19.408**	3.189	8.151**	1.661	16.054**	12.836**	1.072	69.091**	36.952**	16.883**	10.346**	11.183**
1986	H_0: $\lambda_t = 0$ (alpha CAPM holds)	1.320	2.386	0.018	1.232	4.296*	0.222	0.242	3.356	0.897	0.022	0.621	0.020
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	20.665**	39.069**	17.784**	37.197**	48.264**	35.802**	1.982	4.084*	68.142**	0.715	229.467**	5.555*
1987	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.689	0.665	0.643	0.663	0.981	3.467	0.560	1.714	0.243	0.421	6.248*	0.274
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	11.634**	12.972**	5.422*	19.486**	142.218**	26.390**	7.191**	55.654**	8.601**	35.759**	17.079**	1.502
1988	H_0: $\lambda_t = 0$ (alpha CAPM holds)	2.494	2.264	1.147	0.027	3.177	1.247	1.732	5.990*	3.785	0.069	0.256	0.879
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	34.846**	192.529**	31.053**	45.235**	11.841**	13.926**	5.708**	12.672**	1.945	4.710*	135.708**	7.331**
1989	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.270	2.180	0.635	11.397**	3.572	0.452	0.024	0.552	0.112	0.003	31.305**	0.052
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	95.725**	1.120	26.985**	44.379**	23.501**	14.455**	182.768**	9.813**	130.748**	1.197	158.264**	39.615**
1990	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.066	0.003	3.452	0.086	2.659	2.599	0.179	0.373	1.326	0.127	0.006	0.054
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	0.373	12.811**	421.128**	23.193**	186.637**	7.253**	0.759	564.355**	871.405**	388.740**	870.599**	3.490*
1991	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.102	2.632	0.156	0.030	5.857*	0.204	0.025	1.291	0.001	0.220	3.095	0.757
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	53.125**	308.914**	14.834**	1.557	0.885	245.874**	0.375	451.072**	165.027**	35.824**	618.726**	2.559
1992	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.030	0.483	0.015	0.863	0.139	0.063	0.616	5.959*	11.185**	0.019	3.257	5.578*
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	50.014**	17.321**	530.810**	110.719**	143.266**	766.609**	45.666**	244.411**	23.019**	98.552**	31.545**	0.208
1993	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.674	9.208**	0.350	1.636	15.711**	5.211*	0.210	11.080**	0.074	1.068	1.645	2.806
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	10.645**	0.574	693.632**	470.593**	19.226**	193.221**	47.244**	72.980**	38.954**	45.782**	494.687**	222.778**
1994	H_0: $\lambda_t = 0$ (alpha CAPM holds)	4.232	4.964*	1.414	2.020	1.181	7.204*	0.778	6.921*	1.402	0.078	0.412	9.528**
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	685.302**	19.943**	0.892	31.682**	185.297**	10.817**	37.192**	1.479	198.463**	1.974	132.650**	92.780**
1995	H_0: $\lambda_t = 0$ (alpha CAPM holds)	2.081	0.667	0.412	0.033	1.202	0.082	0.019	0.080	3.438	0.597	1.262	6.919*
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	21.454**	451.020**	37.527**	2.813	373.681**	127.028**	467.962**	383.020**	2.408	0.045	65.450**	140.228**
1996	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.983	1.331	0.000	0.294	1.366	0.166	0.015	0.061	14.374**	0.374	0.028	0.006
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	91.941**	90.597**	126.746**	62.516**	5.002*	11.792**	225.684**	10.474**	27.553**	48.073**	6.631**	71.363**
1997	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.744	2.288	0.514	8.655**	3.789	6.816*	0.249	0.002	0.630	0.596	2.419	2.094
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	76.587**	0.241	36.970**	34.839**	62.565**	19.589**	8.719**	276.355**	31.367**	4.545*	33.367**	107.189**
1998	H_0: $\lambda_t = 0$ (alpha CAPM holds)	1.458	1.196	0.105	2.529	0.032	16.771**	1.432	0.282	3.166	1.709	3.391	0.103
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	69.493**	55.116**	11.937**	43.584**	11.984**	20.737**	93.797**	246.486**	64.667**	9.865**	324.843**	69.752**
1999	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.086	3.604	3.774	3.236	0.193	0.436	0.590	0.374	0.147	0.228	3.797	0.613
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	58.887**	5.482*	91.287**	68.612**	0.061	127.837**	19.668**	0.384	0.733	6.858**	1.976	3.859*
2000	H_0: $\lambda_t = 0$ (alpha CAPM holds)	3.584	0.536	0.071	1.312	1.662	0.261	0.290	0.122	0.000	3.211	0.377	0.369
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	36.493**	0.885	18.933**	3.352	8.862**	202.931**	276.153**	31.678**	11.646**	93.046**	31.314**	48.433**
2001	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.143	2.277	0.036	1.244	0.716	0.435	1.927	2.287	2.586	0.001	0.309	3.078
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	28.230**	15.876**	33.351**	178.557**	20.099**	18.087**	190.393**	7.260**	162.148**	59.884**	9.140**	11.556**
2002	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.000	0.080	0.266	0.014	0.487	5.864*	0.119	9.634**	0.072	4.625*	0.366	0.004
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	22.471**	99.327**	60.643**	49.125**	100.876**	558.479**	2.746	28.927**	1.787	260.284**	8.205**	71.553**
2003	H_0: $\lambda_t = 0$ (alpha CAPM holds)	1.500	1.706	3.641	3.287	3.474	0.967	0.045	0.104	0.145	2.604	0.017	0.115
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	0.875	30.859**	1.472	27.469**	39.860**	51.244**	26.844**	88.614**	21.830**	25.833**	141.816**	136.489**

Note: Monthly *F*-tests are performed for model evaluation. Figures in the table are *F*-statistics. The null hypothesis is H_0: $\lambda_t = 0$ and the alternative hypothesis is H_1: $\alpha_t = 0$ and $\delta_t = 0$ in the model: $E[(r_{i,t} - r_{f,t}) \mid \Omega_{t-1}] = \alpha_t + \delta_t \mathrm{Cov}[r_{i,t}, r_{m,t} \mid \Omega_{t-1}] + \lambda_t \mathrm{Cov}[r_{i,t}, \Delta c_t \mid \Omega_{t-1}]$. ** and * attached to the *F*-statistic denote that the hypothesis is rejected at the 1% and 5% statistical significance level, respectively. When H_0 is not rejected, the conditional alpha CAPM is supported, whilst when H_1 is not rejected, the conditional Consumption CAPM is supported. The test period of the monthly *F*-tests is from January 1982 to December 2003. The conditional time-varying covariances derived from the multivariate GARCH model are used for the tests. The 25 size portfolios used for the tests are formed following the procedures in Fama and French (1993). That is, at the end of September of each year *t* (1981-2003), TSE (Tokyo Stock Exchange) First Section stocks are allocated to one of 25 groups based on their September market equity (ME, stock price times shares outstanding). Value-weighted monthly returns on the 25 portfolios are then calculated from the following October to the next September. Only firms with ordinary common equity are included. REITs (Real Estate Investment Trusts) and units of beneficial interest are excluded.

Table 5. Monthly F-tests for model evaluation using 25 portfolios formed on the basis of BE/ME: the conditional alpha CAPM versus conditional Consumption CAPM in Japan from January 1982 to December 2003

Year	Hypotheses	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1982	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.416	0.186	0.064	0.093	0.090	1.812	3.486	3.157	0.883	0.000	3.344	1.705
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	9.564**	17.735**	29.890**	15.966**	1.773	8.400**	6.226**	2.122	7.424**	23.179**	107.566**	17.995**
1983	H_0: $\lambda_t = 0$ (alpha CAPM holds)	1.595	0.234	0.007	0.003	2.766	0.009	1.362	0.612	3.522	0.085	0.015	6.050*
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	2.903	1.769	52.543**	26.214**	4.440*	12.765**	11.710**	9.129**	6.959**	3.943*	1.617	130.363**
1984	H_0: $\lambda_t = 0$ (alpha CAPM holds)	3.954	0.328	0.695	9.542**	0.507	0.004	2.141	0.203	1.165	1.145	0.521	0.708
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	14.615**	4.275*	77.924**	0.618	158.343**	22.494**	12.262**	127.741**	2.707	13.896**	0.329	4.681*
1985	H_0: $\lambda_t = 0$ (alpha CAPM holds)	2.236	0.266	0.432	4.696*	0.005	1.383	0.642	0.877	1.231	11.657**	5.331*	0.369
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	6.766**	1.549	2.968	0.451	6.711**	6.304**	2.117	27.076**	8.252**	5.235*	0.220	15.353**
1986	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.034	0.722	0.007	0.801	2.280	2.899	0.901	2.079	1.322	0.533	0.418	0.007
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	1.017	21.441**	82.488**	8.439**	14.578**	23.954**	11.204**	6.912**	0.279	14.901**	52.139**	7.342**
1987	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.620	0.356	0.565	1.926	2.955	0.124	0.584	0.057	0.715	2.432	0.278	0.036
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	3.050	5.728**	2.433	18.354**	40.883**	1.373	2.755	56.367**	3.762*	49.383**	18.073**	5.556*
1988	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.016	0.434	0.574	12.667**	0.346	0.384	0.013	0.082	0.140	3.582	0.318	2.475
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	146.819**	164.179**	22.984**	101.579**	1.600	8.972**	4.554*	40.753**	1.714	3.254	98.226**	4.274*
1989	H_0: $\lambda_t = 0$ (alpha CAPM holds)	1.202	0.027	0.004	0.476	0.238	0.163	0.691	0.724	0.000	5.597*	1.144	0.345
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	63.972**	0.547	7.696**	18.859**	15.557**	42.887**	122.166**	1.874	37.926**	5.136*	31.898**	9.717**
1990	H_0: $\lambda_t = 0$ (alpha CAPM holds)	1.693	0.597	0.083	1.268	1.863	1.081	0.123	0.105	0.127	0.561	3.347	1.030
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	19.525**	86.314**	70.283**	3.968*	195.185**	8.449**	15.338**	665.954**	694.056**	148.001**	558.016**	20.640**
1991	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.855	1.935	0.316	2.283	0.192	0.598	0.101	0.951	1.416	3.048	0.432	2.308
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	35.037**	330.546**	0.092	3.525*	6.330**	137.365**	9.246**	168.084**	148.876**	8.981**	322.109**	1.184
1992	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.554	1.002	0.104	1.140	0.216	1.289	0.000	0.013	3.082	0.455	3.363	0.255
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	39.400**	50.474**	148.095**	25.540**	55.217**	388.126**	46.204**	239.391**	116.039**	27.265**	91.371**	5.770**
1993	H_0: $\lambda_t = 0$ (alpha CAPM holds)	2.160	4.508*	4.610*	4.959*	1.374	1.512	0.446	0.570	3.751	2.502	1.516	2.559
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	1.435	6.336**	123.131**	271.611**	1.902	108.297**	73.953**	20.062**	9.161**	3.640*	408.916**	61.785**
1994	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.598	0.696	0.046	0.000	0.007	1.710	0.780	3.074	0.726	0.657	0.119	7.141*
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	221.743**	6.011**	35.190**	32.883**	97.119**	2.885	14.871**	7.784**	96.007**	2.493	119.639**	47.468**
1995	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.001	1.786	0.658	1.825	0.088	2.547	0.380	0.117	0.486	0.027	0.499	1.883
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	59.455**	151.415**	7.914**	2.784	182.363**	21.584**	300.822**	167.061**	3.192	1.550	36.629**	57.687**
1996	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.722	0.012	0.255	0.543	0.554	0.363	1.811	0.007	0.799	0.818	1.631	1.382
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	50.982**	29.164**	98.939**	117.379**	8.726**	28.271**	329.485**	32.617**	195.944**	204.310**	0.569	28.129**
1997	H_0: $\lambda_t = 0$ (alpha CAPM holds)	3.789	1.813	0.664	1.569	2.038	0.348	1.213	2.071	5.927*	8.450**	0.013	0.162
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	11.459**	2.813	1.565	39.757**	21.394**	39.493**	3.177	149.915**	6.649**	9.485**	8.988**	24.190**
1998	H_0: $\lambda_t = 0$ (alpha CAPM holds)	1.252	0.952	15.445**	3.366	2.829	0.534	0.393	0.000	0.278	0.234	0.135	0.164
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	58.859**	27.844**	8.242**	15.477**	5.315*	13.769**	59.245**	311.341**	31.582**	2.370	152.225**	34.474**
1999	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.004	1.419	0.093	0.058	0.173	2.927	0.269	0.875	0.768	8.253**	1.916	0.001
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	28.085**	0.616	252.700**	28.779**	1.867	176.047**	13.723**	5.584*	2.164	2.063	0.069	2.410
2000	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.260	0.054	1.169	0.037	0.521	0.055	0.114	3.184	4.824*	0.490	0.081	0.194
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	17.872**	0.207	11.507**	1.495	1.785	64.336**	107.493**	15.125**	9.262**	21.754**	8.959**	3.413
2001	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.002	0.013	0.001	3.581	0.340	0.972	1.180	1.712	2.105	1.452	0.053	2.388
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	7.009**	0.492	72.423**	48.075**	4.967*	7.533**	47.026**	3.168	32.060**	38.224**	7.142**	4.376*
2002	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.170	0.331	2.591	0.366	0.006	1.478	0.016	1.307	1.271	0.148	0.309	0.373
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	28.802**	50.330**	14.863**	24.166**	31.991**	196.234**	9.976**	26.473**	1.064	31.828**	5.163*	25.466**
2003	H_0: $\lambda_t = 0$ (alpha CAPM holds)	0.060	1.476	1.019	0.159	0.462	0.677	0.223	0.219	0.587	1.252	0.171	0.108
	H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)	0.222	18.441**	0.991	10.661**	32.737**	72.922**	28.022**	77.515**	6.255**	17.459**	38.118**	85.877**

Note: Monthly F-tests are performed for model evaluation. Figures in the table are F-statistics. The null hypothesis is H_0: $\lambda_t = 0$ and the alternative hypothesis is H_1: $\alpha_t = 0$ and $\delta_t = 0$ in the model: $E[(r_{i,t} - r_{f,t}) \mid \Omega_{t-1}] = \alpha_t + \delta_t \text{Cov}[r_{i,t}, r_{m,t} \mid \Omega_{t-1}] + \lambda_t \text{Cov}[r_{i,t}, \Delta c_t \mid \Omega_{t-1}]$. ** and * attached to the F-statistic denote that the hypothesis is rejected at the 1% and 5% statistical significance level, respectively. When H_0 is not rejected, the conditional alpha CAPM is supported, whilst when H_1 is not rejected, the conditional Consumption CAPM is supported. The test period of the monthly F-tests is from January 1982 to December 2003. The conditional time-varying covariances derived from the multivariate GARCH model are used for the tests. The 25 BE/ME portfolios used for the tests are formed following the procedures in Fama and French (1993). That is, the BE/ME ratio used to form the 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. We do not use negative BE firms when forming the BE/ME portfolios. The value-weighted monthly returns on the 25 portfolios are then calculated from October to the following September. Only firms with ordinary common equity are included. REITs (Real Estate Investment Trusts) and units of beneficial interest are excluded.

Table 6. Monthly F-tests for model evaluation using 25 portfolios formed on the basis of size: the conditional CAPM versus conditional alpha CAPM in Japan from January 1982 to December 2003

Year	Hypotheses	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1982	H_0: $\alpha_t = 0$ (CAPM holds)	0.037	0.037	1.404	0.905	0.206	0.378	0.644	2.045	15.101**	0.028	4.468*	0.260
1983	H_0: $\alpha_t = 0$ (CAPM holds)	4.498*	5.305*	3.809	4.880*	0.752	1.292	4.803*	5.447*	0.448	5.343*	0.194	4.241
1984	H_0: $\alpha_t = 0$ (CAPM holds)	7.529*	0.390	0.159	0.739	11.168**	4.520*	3.813	155.296**	17.949**	12.342**	0.061	7.407*
1985	H_0: $\alpha_t = 0$ (CAPM holds)	2.377	0.095	0.659	2.948	0.363	0.513	1.619	12.121**	0.015	7.927**	4.617*	0.002
1986	H_0: $\alpha_t = 0$ (CAPM holds)	8.894**	5.663*	0.034	61.023**	43.372**	13.773**	3.966	4.004	90.429**	0.017	54.936**	5.977*
1987	H_0: $\alpha_t = 0$ (CAPM holds)	0.321	5.012*	2.459	0.093	74.963**	32.925**	2.039	19.434**	0.011	32.204**	2.306	1.163
1988	H_0: $\alpha_t = 0$ (CAPM holds)	4.722*	23.491**	2.239	0.018	0.392	1.951	0.181	2.941	1.742	2.029	12.760**	1.551
1989	H_0: $\alpha_t = 0$ (CAPM holds)	19.243**	0.028	5.862*	4.336*	4.632*	0.103	4.082	9.877**	49.286**	2.110	6.957*	5.807*
1990	H_0: $\alpha_t = 0$ (CAPM holds)	0.227	5.985*	5.566*	28.739**	33.325**	6.239*	1.389	15.408**	16.822**	46.339**	132.621**	7.168*
1991	H_0: $\alpha_t = 0$ (CAPM holds)	6.669*	36.269**	1.066	2.529	0.361	71.262**	0.071	46.262**	21.692**	0.223	93.193**	0.750
1992	H_0: $\alpha_t = 0$ (CAPM holds)	5.626*	3.738	36.399**	0.123	0.662	47.428**	0.204	23.531**	0.457	25.910**	1.734	0.336
1993	H_0: $\alpha_t = 0$ (CAPM holds)	0.076	0.520	40.457**	12.842**	0.176	12.167**	14.196**	2.810	5.925*	3.299	4.724*	3.006
1994	H_0: $\alpha_t = 0$ (CAPM holds)	49.838**	5.784*	1.204	2.458	22.748**	0.840	0.035	1.837	0.151	2.459	0.290	0.600
1995	H_0: $\alpha_t = 0$ (CAPM holds)	4.322*	33.012**	0.025	1.976	0.041	4.141	3.914	5.533*	3.928	0.025	0.028	0.259
1996	H_0: $\alpha_t = 0$ (CAPM holds)	0.411	0.007	0.789	0.748	3.565	9.892**	0.927	9.942**	0.156	6.069*	1.362	0.366
1997	H_0: $\alpha_t = 0$ (CAPM holds)	7.008*	0.230	4.050	15.513**	1.303	0.230	3.034	24.196**	0.524	1.799	8.939**	17.862**
1998	H_0: $\alpha_t = 0$ (CAPM holds)	3.221	0.001	1.565	1.728	6.296*	1.209	53.426**	17.529**	1.908	9.463**	1.406	6.900*
1999	H_0: $\alpha_t = 0$ (CAPM holds)	10.971**	4.830*	2.662	0.129	0.015	0.545	2.259	0.189	1.336	0.081	0.311	1.449
2000	H_0: $\alpha_t = 0$ (CAPM holds)	16.883**	3.275	9.431**	1.153	0.377	101.579**	179.974**	15.177**	0.199	4.317*	0.252	0.161
2001	H_0: $\alpha_t = 0$ (CAPM holds)	8.639**	8.646**	1.319	42.683**	0.331	0.482	0.503	10.688**	5.532*	2.649	0.034	6.079*
2002	H_0: $\alpha_t = 0$ (CAPM holds)	31.611**	0.849	3.295	0.593	0.190	20.254**	0.116	0.172	0.544	2.724	15.119**	0.178
2003	H_0: $\alpha_t = 0$ (CAPM holds)	1.674	7.172*	0.345	1.653	0.253	1.189	39.437**	9.840**	0.020	4.076	1.241	18.220**

Note: Monthly F-tests are performed for model evaluation. Figures in the table are F-statistics. The null hypothesis is H_0: $\alpha_t = 0$ and the alternative hypothesis is H_1: $\alpha_t \neq 0$ in the model: $E[(r_{i,t} - r_{f,t}) \mid \Omega_{t-1}] = \alpha_t + \delta_t \, Cov[r_{i,t}, r_{m,t} \mid \Omega_{t-1}]$. ** and * attached to the F-statistic denote that the null hypothesis is rejected at the 1% and 5% statistical significance level, respectively. When H_0 is rejected, the conditional CAPM is rejected and the conditional alpha CAPM is supported, whilst when H_0 is not rejected, the conditional CAPM is supported and the conditional alpha CAPM is rejected. The test period of the monthly F-tests is from January 1982 to December 2003. The conditional time-varying covariances derived from the multivariate GARCH model are used for the tests. The 25 size portfolios used for the tests are formed following the procedures in Fama and French (1993). That is, at the end of September of each year t (1981-2003), TSE (Tokyo Stock Exchange) First Section stocks are allocated to one of 25 groups based on their September market equity (ME, stock price times shares outstanding). Value-weighted monthly returns on the 25 portfolios are then calculated from the following October to the next September. Only firms with ordinary common equity are included. REITs (Real Estate Investment Trusts) and units of beneficial interest are excluded.

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Table 7. Monthly F-tests for model evaluation using 25 portfolios formed on the basis of BE/ME: the conditional CAPM versus conditional alpha CAPM in Japan from January 1982 to December 2003

Year	Hypotheses	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1982	H_0: $\alpha_t = 0$ (CAPM holds)	0.044	0.038	3.499	6.853*	3.860	1.306	0.142	0.024	0.211	7.798*	6.792*	0.078
1983	H_0: $\alpha_t = 0$ (CAPM holds)	0.937	1.068	4.968*	0.222	0.049	2.082	1.552	0.105	0.018	8.825**	1.179	5.262*
1984	H_0: $\alpha_t = 0$ (CAPM holds)	0.380	1.625	2.326	0.461	29.945**	5.770*	2.708	0.329	2.259	0.081	0.433	0.738
1985	H_0: $\alpha_t = 0$ (CAPM holds)	11.636**	0.479	1.869	0.039	2.904	0.932	0.879	0.158	0.136	6.757*	0.218	0.171
1986	H_0: $\alpha_t = 0$ (CAPM holds)	0.205	3.492	0.945	12.353**	0.759	1.315	8.270**	3.251	1.161	2.338	2.351	0.795
1987	H_0: $\alpha_t = 0$ (CAPM holds)	0.002	1.522	0.038	16.742**	13.769**	1.970	0.356	5.029*	1.755	10.339**	13.187**	4.757*
1988	H_0: $\alpha_t = 0$ (CAPM holds)	2.507	20.364**	6.064*	3.623	0.017	3.465	0.004	0.346	0.419	4.899*	0.020	0.011
1989	H_0: $\alpha_t = 0$ (CAPM holds)	1.931	1.019	0.837	0.611	5.654*	0.118	2.568	0.068	1.307	4.989*	10.397**	7.587*
1990	H_0: $\alpha_t = 0$ (CAPM holds)	3.382	1.272	0.002	5.275*	5.479*	10.512**	3.542	32.676**	37.419**	7.971**	47.791**	2.366
1991	H_0: $\alpha_t = 0$ (CAPM holds)	13.205**	34.294**	0.002	3.110	6.124*	16.969**	6.988*	27.531**	0.953	0.695	29.662**	0.855
1992	H_0: $\alpha_t = 0$ (CAPM holds)	2.641	4.949*	2.072	3.873	3.905	10.711**	4.622*	0.704	20.854**	0.025	8.167**	0.138
1993	H_0: $\alpha_t = 0$ (CAPM holds)	0.134	3.555	1.497	22.371**	2.309	2.261	2.842	0.136	0.703	0.012	8.383**	4.979*
1994	H_0: $\alpha_t = 0$ (CAPM holds)	5.329*	5.697*	1.520	22.813**	32.567**	2.643	0.001	2.159	6.650*	0.002	0.153	0.763
1995	H_0: $\alpha_t = 0$ (CAPM holds)	0.040	14.638**	0.052	0.677	0.046	0.109	0.453	14.797**	0.442	1.049	0.441	2.142
1996	H_0: $\alpha_t = 0$ (CAPM holds)	0.657	0.278	0.052	1.491	1.516	0.333	3.601	0.247	6.740*	0.437	0.322	3.124
1997	H_0: $\alpha_t = 0$ (CAPM holds)	0.452	0.029	0.831	1.047	5.436*	20.283**	3.627	4.359*	0.139	12.912**	3.167	3.205
1998	H_0: $\alpha_t = 0$ (CAPM holds)	0.273	3.541	10.033**	0.313	0.004	1.194	0.771	3.510	5.335*	0.206	0.287	0.336
1999	H_0: $\alpha_t = 0$ (CAPM holds)	1.238	0.166	0.354	5.140*	0.139	0.244	0.145	3.224	1.482	0.827	0.065	3.985
2000	H_0: $\alpha_t = 0$ (CAPM holds)	28.593**	0.161	2.176	0.000	1.169	47.823**	55.649**	2.392	5.001*	0.129	0.415	0.062
2001	H_0: $\alpha_t = 0$ (CAPM holds)	9.971**	0.320	1.656	5.661*	0.354	0.107	0.294	0.327	3.586	0.106	8.966**	0.014
2002	H_0: $\alpha_t = 0$ (CAPM holds)	4.758*	0.053	0.026	5.190*	1.359	1.678	0.059	0.007	1.614	0.012	0.136	0.983
2003	H_0: $\alpha_t = 0$ (CAPM holds)	0.396	11.895**	0.001	0.339	3.988	6.993*	16.635**	1.288	0.133	2.215	3.414	0.982

Note: Monthly F-tests are performed for model evaluation. Figures in the table are F-statistics. The null hypothesis is H_0: $\alpha_t = 0$ and the alternative hypothesis is H_1: $\alpha_t \neq 0$ in the model: $E[(r_{i,t} - r_{f,t}) \mid \Omega_{t-1}] = \alpha_t + \delta_t \, Cov[r_{i,t}, r_{m,t} \mid \Omega_{t-1}]$. ** and * attached to the F-statistic denote that the null hypothesis is rejected at the 1% and 5% statistical significance level, respectively. When H_0 is rejected, the conditional CAPM is rejected and the conditional alpha CAPM is supported, whilst when H_0 is not rejected, the conditional CAPM is supported and the conditional alpha CAPM is rejected. The test period of the monthly F-tests is from January 1982 to December 2003. The conditional time-varying covariances derived from the multivariate GARCH model are used for the tests. The 25 BE/ME portfolios used for the tests are formed following the procedures in Fama and French (1993). That is, the BE/ME ratio used to form the 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. We do not use negative BE firms when forming the BE/ME portfolios. The value-weighted monthly returns on the 25 portfolios are then calculated from October to the following September. Only firms with ordinary common equity are included. REITs (Real Estate Investment Trusts) and units of beneficial interest are excluded.

Table 8. Panel data analysis of the time-varying price of risk and the alphas on 25 portfolios formed on the basis of size and BE/ME: the case of the conditional CAPM, the conditional alpha CAPM, and the conditional Consumption CAPM in Japan from October 1981 to July 2004

Conditional CAPM		Conditional alpha CAPM				Conditional Consumption CAPM	
Risk price	*p*-value	Intercept	*p*-value	Risk price	*p*-value	Risk price	*p*-value
Panel A Results of 25 portfolios formed on the basis of size							
From October 1981 to July 2004							
0.0382**	0.0000	1.7165**	0.0000	−0.0073	0.1995	0.0443	0.2401
From October 1981 to December 1986							
0.0952**	0.0000	3.0591 **	0.0000	−0.0322*	0.0352	0.0820	0.3020
From January 1987 to December 1992							
0.0146**	0.0015	2.0492**	0.0000	−0.0263 **	0.0028	0.0885	0.1379
From January 1993 to December 1997							
0.0205**	0.0002	−7.0302 **	0.0000	0.2256**	0.0000	0.0377	0.5643
From January 1998 to July 2004							
0.0687**	0.0000	1.4424**	0.0033	0.0264	0.0850	−0.4907 **	0.0075
Panel B Results of 25 portfolios formed on the basis of BE/ME							
From October 1981 to July 2004							
0.0351**	0.0000	1.0170**	0.0000	0.0038	0.5850	−0.0222	0.5853
From October 1981 to December 1986							
0.0756**	0.0000	1.2600**	0.0076	0.0279	0.1343	−0.1185	0.2928
From January 1987 to December 1992							
0.0074	0.1278	0.5413	0.1799	−0.0060	0.5897	−0.0548	0.3911
From January 1993 to December 1997							
0.0222**	0.0000	−3.4998**	0.0000	0.1366 **	0.0000	0.0802	0.2050
From January 1998 to July 2004							
0.0619**	0.0000	0.9485*	0.0367	0.0299	0.0638	−0.2335	0.2715

Note: Monthly time-varying price of risk and alphas on 25 portfolios formed on the basis of size and BE/ME (book equity to market equity) ratios are evaluated, for the period from October 1981 to July 2004 using panel data. The evaluation is performed for the whole sample period and for four subsample periods. The risk price of the several versions of conditional asset pricing models is calculated using the conditional time-varying covariances derived from the multivariate GARCH model. The size- and BE/ME-ranked portfolios are formed following Fama and French (1993). That is, in constructing the size portfolios, at the end of September of each year *t* (1981-2003), TSE (Tokyo Stock Exchange) First Section stocks are allocated to one of 25 groups based on their September market equity (ME, stock price times shares outstanding). Value-weighted monthly returns on the size portfolios are then calculated from the following October to the next September. When constructing the BE/ME portfolios, the BE/ME ratio used to form the portfolios in September of year *t* is the book common equity for the fiscal year *t*–1, divided by market equity at the end of March in calendar year *t*. We do not use negative BE firms when forming the BE/ME portfolios. The value-weighted monthly returns on the BE/ME portfolios are then calculated from October to the following September. Only firms with ordinary common equity are included. This means that REITs (Real Estate Investment Trusts) and units of beneficial interest are excluded. ** and * attached to the coefficients denote statistical significance at the 1% and 5% level, respectively.

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Table 9. Panel data F-tests for model evaluation using 25 portfolios formed on the basis of size and BE/ME: the case of the conditional CAPM, the conditional alpha CAPM, and the conditional Consumption CAPM in Japan from October 1981 to July 2004

Test 1 Conditional CAPM versus conditional Consumption CAPM				**Test 2** Conditional alpha CAPM versus conditional Consumption CAPM				**Test 3** Conditional CAPM versus conditional alpha CAPM	
H_0: $\lambda_t = 0$ (CAPM holds)		H_1: δ_t=0 (CCAPM holds)		H_0: $\lambda_t = 0$ (alpha CAPM holds)		H_1: $\alpha_t = 0$ and $\delta_t = 0$ (CCAPM holds)		H_0: $\alpha_t = 0$ (CAPM holds)	
F-statistic	p-value	F-statistic	p-value	F-statistic	p-value	F-statistic	p-value	F-statistic	p-value
Panel A Results of 25 portfolios formed on the basis of size									
From October 1981 to July 2004									
0.0805	1.0000	8.7082**	0.0000	0.0369	1.0000	11.8707**	0.0000	3.1508**	0.0000
From October 1981 to December 1986									
0.0180	1.0000	11.7098**	0.0000	0.0111	1.0000	15.1089**	0.0000	3.0700**	0.0000
From January 1987 to December 1992									
0.0947	1.0000	0.4010	0.9965	0.0517	1.0000	1.4916	0.0560	1.1487	0.2779
From January 1993 to December 1997									
0.0124	1.0000	0.5289	0.9731	0.0809	1.0000	5.5751**	0.0000	5.0217**	0.0000
From January 1998 to July 2004									
0.1223	1.0000	6.4740**	0.0000	0.1144	1.0000	6.7435**	0.0000	0.3368	0.9992
Panel B Results of 25 portfolios formed on the basis of BE/ME									
From October 1981 to July 2004									
0.0021	1.0000	7.1743**	0.0000	0.0034	1.0000	8.0851**	0.0000	0.9151	0.5846
From October 1981 to December 1986									
0.0008	1.0000	7.4860**	0.0000	0.0020	1.0000	7.6708**	0.0000	0.2772	0.9999
From January 1987 to December 1992									
0.0281	1.0000	0.0898	1.0000	0.0298	1.0000	0.1597	1.0000	0.0701	1.0000
From January 1993 to December 1997									
0.0596	1.0000	0.7007	0.8608	0.0728	1.0000	2.1097**	0.0011	1.4139	0.0846
From January 1998 to July 2004									
0.0177	1.0000	5.3299**	0.0000	0.0144	1.0000	5.4375**	0.0000	0.1706	1.0000

Note: F-tests are performed for model evaluation using the panel data analysis. ** and * attached to the F-statistic denote the hypothesis is rejected at the 1% and 5% statistical significance level, respectively. In Test 1, the null hypothesis is H_0: $\lambda_t = 0$ and the alternative hypothesis is H_1: $\delta_t = 0$ in the model: $E[(r_{i,t} - r_{f,t}) \mid \Omega_{t-1}] = \delta_t \, Cov[r_{i,t}, r_{m,t} \mid \Omega_{t-1}] + \lambda_t \, Cov[r_{i,t}, \Delta c_t \mid \Omega_{t-1}]$. When H_0 is not rejected, the conditional CAPM is supported, whilst when H_1 is not rejected, the conditional Consumption CAPM is supported. In Test 2, the null hypothesis is H_0: $\lambda_t = 0$ and the alternative hypothesis is H_1: $\alpha_t = 0$ and $\delta_t = 0$ in the model: $E[(r_{i,t} - r_{f,t}) \mid \Omega_{t-1}] = \alpha_t + \delta_t \, Cov[r_{i,t}, r_{m,t} \mid \Omega_{t-1}] + \lambda_t \, Cov[r_{i,t}, \Delta c_t \mid \Omega_{t-1}]$. When H_0 is not rejected, the conditional alpha CAPM is supported, whilst when H_1 is not rejected, the conditional Consumption CAPM is supported. In Test 3, the null hypothesis is H_0: $\alpha_t = 0$ and the alternative hypothesis is H_1: $\alpha_t \neq 0$ in the model: $E[(r_{i,t} - r_{f,t}) \mid \Omega_{t-1}] = \alpha_t + \delta_t \, Cov[r_{i,t}, r_{m,t} \mid \Omega_{t-1}]$. When H_0 is rejected, the conditional CAPM is rejected and the conditional alpha CAPM is supported. Whilst when H_0 is not rejected, the conditional CAPM is supported and the conditional alpha CAPM is rejected. The tests are performed for the entire sample period from October 1981 to July 2004 and for four subsample periods. All conditional time-varying covariances used in the tests are derived from the multivariate GARCH model.

Table 10. Tests of the alphas for the conditional CAPM using 25 portfolios formed on the basis of size and BE/ME: the case in Japan from January 1982 to December 2003

H_0: $Avg[\alpha_t] = 0$ (CAPM holds)
H_1: $Avg[\alpha_t] \neq 0$ (CAPM is rejected)

t-statistic	*p*-value	*t*-statistic	*p*-value
Panel A Results of 25 portfolios formed on size		**Panel B Results of 25 portfolios formed on BE/ME**	
From January 1982 to December 2003		*From January 1982 to December 2003*	
2.8384**	0.0049	1.2667	0.2064
From January 1982 to December 1986		*From January 1982 to December 1986*	
3.4558**	0.0010	0.9278	0.3573
From January 1987 to December 1992		*From January 1987 to December 1992*	
1.8659	0.0662	0.0847	0.9328
From January 1993 to December 1997		*From January 1993 to December 1997*	
0.1453	0.8850	0.7747	0.4416
From January 1998 to December 2003		*From January 1998 to December 2003*	
1.1039	0.2734	0.9574	0.3416

Note: *t*-tests on the alphas of the conditional CAPM are performed using the time-varying alphas. The *t*-test has the null hypothesis of H_0: $Avg\ [\alpha_t] = 0$, and the alternative hypothesis is H_1: $Avg\ [\alpha_t] \neq 0$. ** and * attached to the *t* -statistic denote the hypothesis is rejected at the 1% and 5% statistical significance level, respectively. In the test, when H_0 is rejected, the conditional CAPM is rejected, whilst when H_0 is not rejected, the conditional CAPM is supported. The evaluation is performed for the entire sample period from January 1982 to December 2003 and for four subsample periods.

9. Conclusions

Considering all the results above, we conclude that our empirical results in Japan offer an interesting case for reconciling the current disputes on the effects of conditioning asset pricing models. Our evidence demonstrates that the conditioning improves model performance in Japan (except for the traditional conditional CCAPM), even if not as dramatically as suggested by Jagannathan and Wang (1996), Lettau and Ludvigson (2001), Santos and Veronesi (2006), and Lustig and Van Nieuwerburgh (2005). The significant facts and implications derived from our analysis are summarized as follows.

- First, from the viewpoint of the risk pricing, we demonstrated that the conditional covariance risk in the CAPM, which is derived from a multivariate GARCH model, is generally positively priced in Japan. We examine the situation in regard to the time-varying risk price, rather than the time-varying covariance risk analysed in many other studies, which is one of our primary contributions in this article.

- Second, our monthly tests for time-varying risk pricing revealed that the conditional CCAPM is not supported in the Japanese stock market. As far as can be judged by the effectiveness of the traditional simple CCAPM, actual Japanese data do not support the model, even if the time-varying nature of both consumption risk and its price are taken into account.

- Third, positive time-varying alphas are confirmed by our tests of the conditional alpha CAPM. In particular, positive alphas are observed in the tests of the size portfolios rather than in the tests of the BE/ME portfolios.

- Fourth, from the viewpoint of model evaluation, our formal *F*-test indicates that the conditional CCAPM is inferior to the conditional CAPM and the conditional alpha CAPM, not only with respect to the time-varying risk pricing, but also with respect to model evaluation.

- Fifth, in our panel data analysis, the conditional CAPM is not strongly supported and the conditional alpha CAPM is relatively well supported in explaining the size effect in Japan; however, in all cases in explaining the value effect in Japan, the conditional CAPM is always supported and the conditional alpha CAPM is rejected.

- Sixth, we also examined the statistical significance of the non-zero alphas in the conditional CAPM, which is often controversial (e.g. Lewellen and Nagel (2006) and Fama and French (2006)). We confirm that the hypothesis of zero alphas is never rejected for the BE/ME portfolios. Thus, when a time-varying risk price is incorporated using the effective multivariate GARCH model, the conditional CAPM explains the value effect in Japan.

Overall, our paper has several noteworthy characteristics, such as 1) a detailed examination of risk pricing, the alphas, and model evaluation; 2) incorporation of both time-varying risks and a time-varying price of risk to analyse the conditional asset pricing model; 3) consideration of both time-series and cross-sectional aspects in evaluating the conditional asset pricing model by panel data analysis; 4) implementation of more direct tests of the effectiveness of the time-varying covariance risk by using a multivariate GARCH model; and 5) detailed discussions and comparisons with the other influential studies.

As the results of this paper suggest, when the time-varying risk price is incorporated into the asset pricing tests by using the multivariate GARCH model, the performance of the conditional CAPM is vastly improved. That is, we conclude that appropriate conditioning of the CAPM by sophisticated methods or models is rather effective for Japan, although such a conditioning does not make the simple CAPM a perfect asset pricing model that competently explains all anomalies in world equity markets.

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Notes

1. For example, interesting papers that deal with the price of risk include Harvey (1989), Ferson and Harvey (1994), Campbell (1996), and Hansson and Hördahl (1998). However, in these studies, the price of risk is not their main concern.

2. Polk et al. (2006) also perform an interesting empirical analysis by exploiting the price of risk; however, both their aim and their approach are different from those of our study.

3. Bollerslev et al. (1988) perform one of the first multivariate analyses in a test of CAPM. Other studies that use the multivariate GARCH model in the context of asset pricing include Chan et al. (1992), Braun et al. (1995), Kroner and Ng (1998), Scruggs (1998), and Bali (2008); however, the focus of the above interesting studies is not on the price of risk. On the other hand, many studies on the variation of financial asset prices using univariate GARCH models exist; those include Engle (1982), Bollerslev (1986), French et al. (1987), Nelson (1991), Campbell and Hentchel (1992), Glosten et al. (1993), and Lundblad (2007).

4. The time-varying price of risk in the CAPM is, in particular, economically important, because it is interpreted as time-varying risk aversion. We discuss this point in Section 3.

5. Because we investigate the size effect and value effect separately, we employed size and BE/ME-ranked portfolios in this paper.

6. In our tests, we use the multivariate GARCH model for two reasons. First, the model enables us to perform a direct test to judge whether the time-varying covariance risk is priced. That is, we can inspect the relationship between risk and risk price by using the time-varying covariance via the multivariate GARCH model. Second, this multivariate GARCH-asset pricing approach does not place any assumptions on the state variables, unlike the approaches of Shanken (1990), Ferson and Schadt (1996), and Lettau and Ludvigson (2001), for example. This is also one of the advantages of our approach because placing any assumptions on the state variables is a restricted way of conditioning asset pricing models. Despite these advantages of the multivariate GARCH model, as we mentioned previously, research into asset pricing using the multivariate GARCH models is limited.

7. The term alpha is used in this paper in the sense of Jensen (1968).

8. Lewellen and Nagel (2006) criticize Jagannathan and Wang (1996), Lettau and Ludvigson (2001), Santos and Veronesi (2006), and Lustig and Van Nieuwerburgh (2005) for not providing a full, quantitative test of the conditional CAPM. Fama and French (2006) insist that in a CAPM world, the true intercept is zero. We provide a detailed discussion on these points in Section 8.

9. Ang and Chen (2007) find that the CAPM can explain US value premiums from 1926 to

1963, whilst Fama and French (2006) reject CAPM pricing for 1928−1963, as well as for 1963−2004.

10. From a cross-sectional perspective, the model implies that the conditional expected excess returns vary with the different conditional beta values or different conditional covariances. From a time-series perspective, the model has the implication that the conditional expected excess returns change over time with three time-varying components: the conditional market risk premium, the market conditional variance, and the conditional covariance between an asset's return and the market's return.

11. 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.

12. Because each regression comprises a cross-section, White's (1980) heteroskedasticity-consistent covariance matrix was used to calculate the *p*-values. We employed White's (1980) covariance matrix throughout the paper when cross-sectional regressions were implemented.

13. From Figures 1 to 8, the time span is always from January 1982 to December 2003.

14. To save space, we did not attach tables of the values of risk prices with their *p*-values. However, they are available from the authors upon request.

15. Because this paper does not employ the GMM approach as in Harvey (1989), Cochrane (1996), and Guo (2006), amongst others, but employs the multivariate GARCH approach, we do not implement the *J*-test, the most typical test for the GMM approach, but perform the *F*-test.

16. Under H_0: $\lambda_t = 0$, the restricted model is the conditional CAPM (4), and under H_1: $\delta_t = 0$, the restricted model is the conditional CCAPM (6).

17. It is possible that both models are rejected or both models are supported.

18. Under H_0: $\lambda_t = 0$, the restricted model is the conditional alpha CAPM (5), and under H_1: $\alpha_t = 0$ and $\delta_t = 0$, the restricted model is the conditional CCAPM (6).

19. Again, it is possible that both models are rejected or both models are supported.

20. This paper does not test the consumption-wealth ratio, *cay*, of Lettau and Ludvigson (2001). Because *cay* is a quarterly variable, incorporation of *cay* is inconsistent with our research design of monthly tests and panel data model evaluation by pooling monthly data. Therefore, our empirical denegation on the conditional CCAPM in Japan is limited to the traditional standard version. The validity of the conditional CCAPM that incorporates *cay* in Japan is an open question.

21. Similarly to the previous test, *RRSS* is the sum of squared residuals of the restricted model (4) or (6). *URSS* is the sum of squared residuals of the unrestricted model (13), *r* is the number of restrictions, *n* is the number of samples in each month, *T* is the number of months in the sample period tested, and *k* is the number of explanatory variables in the unrestricted

model (13).

22. Similarly to the previous test, *RRSS* is the sum of squared residuals of the restricted model (5) or (6), *URSS* is the sum of squared residuals of the unrestricted model (15), r is the number of restrictions, n is the number of samples in each month, T is the number of months in the period tested, and k is the number of explanatory variables in the unrestricted model (15).

23. Similarly to the previous test, *RRSS* is the sum of squared residuals of the restricted model (4), *URSS* is the sum of squared residuals of the unrestricted model (5), r is the number of restrictions, n is the number of samples in each month, T is the number of months in the period tested, and k is the number of explanatory variables in the unrestricted model (5).

24. However, because our evidence indicates that the conditional CAPM cannot successfully explain the return dispersion of the size portfolios, we cannot fully support the conditional CAPM in Japan.

25. Our alphas are the time-varying alphas α_t, and not the time-invariant alpha α, which is like that obtained from a single time-series regression as in Fama and French (1996). Therefore, we do not implement the famous F-test of Gibbons et al. (1989) because it is not suitable for our context of analysis in this paper.