

AN EMPIRICAL STUDY ON THE INTEGRATION OF CAPITAL MARKETS: IN ASIAN EQUITY MARKETS SETTING

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This research tests the international arbitrage pricing model(IAPM) between Asian country equity markets. Factor analyses are used to estimate the Asian common risk factors. And cross-sectional regression analyses are used to test the validity of the IAPM and Chow test is used to examine the integration hypotheses between Asian country equity markets. Factor analysis results show that the number of common factors between Asian country equity markets ranges from three to six. The cross-sectional regression and Chow test results lead us not to reject the joint hypotheses that Japan and Hong Kong stock markets are integrated and that the IAPM is valid.

JEL Classification: G3

Keywords: International Diversification Effect, International Arbitrage Pricing Model(IAPM), International Equity Market Segmentation, Integration

I. INTRODUCTION

Portfolio selection theory starts at the logic that non-systematic risk can be reduced if a portfolio is composed of the assets with low correlation. Solnik(1974) showed that the effect of this diversification investment theory can be magnified when it is applied to international investment. This theory, however, constitutes only when it is assumed that international equity markets are integrated, as a result, domestic stocks and international stocks can be analyzed with same risk measurement and risk price. Therefore, whether international equity market is integrated should be verified before discussion of the international asset pricing models and the effect of international diversifi-

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cation investment.

Most of the previous studies on the international equity markets are based on a segmented market approach. This approach treats the different national equity markets as separated entities, hardly related to each other. Market segmentation is widely accepted as the only possible structure of the international equity market. Different currency areas, separated political organizations and trade barriers have been given as a priori evidence for the segmentation of the international equity markets.(Stulz(1981), Errunza and Losq(1985))

But recently, many researchers insist that the extent of integration has been grown up since each equity market's worldwide globalization trends.(Campbell and Hamao(1992), Chan, Karolyi, and Stulz(1992)) Most of the previous studies, however, made little contribution to testing the hypothesis on international equity market integration as they had mainly focused on developed countries such as between U.S. and Japanese equity markets.(Cho, Eun, and Senbet(1986), Gultekin, Gultekin, and Penati(1989), Campbell and Hamao(1992)).

Thus, in this paper, the empirical studies on the integration of equity markets between developing country and developed country based on Asian countries are performed. The test of this integration hypothesis might be possible through analyzing the common factors which affect the stock prices between two country markets in Asian equity markets, and then through verifying the existence of same risk measurement and risk price between two country markets in Asian equity markets.

While there is a rich body of theoretical research on international market integration, only a few studies have tried to test this important question empirically.

A first group of empirical tests on the integration has generally adopted an international single index asset pricing model of Sharpe-Lintner-Mossin. These studies have examined whether a purely domestic factor - usually the part of the return on the domestic market portfolio that is orthogonal to the world portfolio -has explanatory power in a regression of stock returns on a world market index. The finding that the stock return is often determined by domestic systematic risk is then taken to support market segmentation. The interpretation of this empirical evidence, however, is not so clear-cut because a single index (ICAPM ; international capital asset pricing model) can only be obtained under the restrictive assumptions of either a universal logarithmic utility function or purchasing power parity.(Adler and Dumas(1983)) Single index models also do not address the question of whether segmentation arises from government policies or from market inefficiency.

A second group of studies have used an international version of the Arbitrage Pricing Model(IAPM). Cho, Eun, and Senbet(1986) and Karajczyk and Viallet (1989) used an IAPM to test the integration of international capital markets. Because the pricing in this model is based on an arbitrage condition of nominal returns, IAPM has the advantage of eluding the problem of purchasing power

parity deviations.¹

Therefore, in this paper, we try to test IAPM in order to examine the integration between two country markets in Asian equity markets. Specifically, we address various issues as outline in the following procedure:

- (i) Extracting the number of common risk factors between two country markets in Asian equity markets
- (ii) Testing the asset pricing relationship implied by the IAPM between two country markets in Asian equity markets; and
- (iii) Examining whether the factor structure and the asset pricing relationship between two country markets in Asian equity markets are invariant to the numeraire chosen by using the U.S. dollar.

As will be discussed in detail, our test involves the joint hypotheses of the IAPM between two country markets in Asian equity markets being valid and two country markets in Asian equity markets being integrated.

II. THE INTERNATIONAL ARBITRAGE PRICING MODEL : A REVIEW

Suppose there exist k factors in the world economy which generate the random returns on a set of n international assets in terms of a given numeraire currency, say, the U.S. dollar :

$$\tilde{R}_i = E(R_i) + b_{i1} \tilde{\theta}_1 + b_{i2} \tilde{\theta}_2 + \cdots + b_{ik} \tilde{\theta}_k + \tilde{\varepsilon}_i, \quad i=1, 2, \cdots, n \quad (1)$$

where $E(R_i)$ is the expected return on the i th asset, $\tilde{\theta}_j$'s are zero mean international common factors, b_{ij} is the sensitivity of the i th asset to the j th factor, and $\tilde{\varepsilon}_i$'s are the residual terms of the assets. As usual, it is assumed that $E(\tilde{\varepsilon}_i | \theta_j) = 0$ for $i=1, 2, \cdots, n, j=1, 2, \cdots, k, n > k$ and $E(\tilde{\varepsilon}_i)^2 = \sigma_i^2 < \infty$.

Assuming that investors have homogeneous expectations concerning the k factors generating process of Equation (1), we can derive the IAPM in terms of the U.S. dollar in the usual manner. Suppose that there is a sufficient number of assets so that a portfolio with the following characteristics can be formed:

$$x^n 1 = 0, \quad x^n b_j = 0, \quad j=1, 2, \cdots, k \quad (2)$$

where x^n is an n -dimensional row vector of portfolio weights; 1 is an n -dimensional vector of ones; b_j is an n -dimensional vector of factor loadings

¹ CAPM and APM assert that every asset must be compensated only according to its systematic risk. One of the major differences is that, in the CAPM, the systematic risk of an asset is defined to be the covariability of asset with the market portfolio, whereas, in the APM, the systematic risks are defined to be the covariability with not only one factor but also possibly with several economic factors. Another difference is that the CAPM requires the economy to be in equilibrium whereas the APM requires only that the economy has no arbitrage opportunities.

b_{ij} 's. These portfolios entail neither net investment nor systematic risk. Further, the idiosyncratic risk of these portfolios should become negligible as the number of securities grows large. Consequently, in order to preclude arbitrage opportunities, these portfolios must earn zero profits, which in return implies the following relationship.

$$E(R_j) = \lambda_0 + \sum_{i=1}^k \lambda_i b_{ji} \quad (3)$$

The k weights, $\lambda_1, \dots, \lambda_k$, can be viewed as risk premia. It is well known in the APM literature that the IAPM of equation (3) holds only as an approximation, particularly in a finite economy, as shown by Ross and others. In a large economy with infinitely many assets, the model holds as an exact equality under certain conditions.² However, the magnitude of mispricing due to the approximation should be mitigated in the international context by the fact that there are more assets in the world economy than in any particular national economy. Although equation (3) applies to a set of international assets, rather than a set of local assets as in the domestic APM, its structure is identical to the standard APM of Ross.

III. TESTING PROCEDURES AND HYPOTHESES

In this section, we discuss the sample data used in this study, the testing procedures and the hypotheses to be tested. We shall begin with a discussion of the data, the joint nature of the hypothesis.

3.1. Data

The Data are described in Table 1. Our total sample consists of 158 stocks representing four Asian countries, 50 stocks in Korean market, 48 stocks in Japanese market, 30 stocks in Hong Kong market, in Singapore market respec-

[Table 1] Data Description: Sample Stocks of Asian Countries

| Nations | Sectors | Financial | Consumer goods | Capital goods | Wholesale | Public | Total |
|-----------|---------|-----------|----------------|---------------|-----------|--------|-------|
| | | | | | | | |
| Korea | | 10 | 10 | 18 | 9 | 3 | 50 |
| Japan | | 10 | 10 | 10 | 8 | 10 | 48 |
| Hong Kong | | 6 | 6 | 6 | 6 | 6 | 30 |
| Singapore | | 6 | 6 | 6 | 6 | 6 | 30 |

² See Dybvig and Ross(1985), for instance.

tively, dollar based weekly returns of which are available for the entire period of January 1994 through December 1996. Data were obtained from International Data Stream.

3.2. IAPM and Integration Hypothesis

Our test involves a joint hypothesis like any other test of the asset pricing models. In the domestic setting, for example, most of the studies test the joint hypothesis of the market being efficient and the underlying asset pricing model being valid. In an international setting, there is one additional hypothesis, i.e., the markets being integrated. Two country markets in Asian equity markets can be viewed as integrated if the stocks of two countries in Asian equity markets are traded as though their prices are determined in a unified market so as to yield the same price expressed in one currency.

Two country markets in Asian equity markets can be segmented due to severe imperfections resulting from discriminatory border taxes, possibilities of expropriation, exchange controls, information gaps, etc. The existence of exchange rate uncertainty per se does not cause segmentation. Indeed, as we saw earlier, the IAPM was developed in an environment characterized by exchange rate fluctuations.

We can not evaluate the extent of the integration between two country markets in Asian equity markets simply by looking at the number of common factors. A strong single common factor may depict more integration than several weak factors. We can not infer the integration between two country markets in Asian equity markets from factor structure or correlation analysis. We must test if the factors are priced identically between two country markets in Asian equity markets, which should be the case if the IAPM between two countries is valid and two country markets in Asian equity markets are integrated. In this sense we try to test a joint hypothesis.

3.3. Estimating Factor Model

Testing of the IAPM will be carried out in two parts. The first part involves estimation of the systematic risks, i.e., factor loadings for each assets, while the second part involves testing the pricing implications of the IAPM using cross-sectional regression analysis. We adopted the group approach used by Roll and Ross(1980) with following relationship..

$$\begin{bmatrix} R_i \\ R_j \end{bmatrix} = \begin{bmatrix} E_i \\ E_j \end{bmatrix} + \begin{bmatrix} b_i \\ b_j \end{bmatrix} \delta + \begin{bmatrix} \varepsilon_i \\ \varepsilon_j \end{bmatrix} \quad (4)$$

where R is individual stock returns, i, j are Asian countries ($i \neq j$) and E is average vector of individual stock returns.

$$\hat{B} = \begin{bmatrix} \hat{b}_i \\ \hat{b}_j \end{bmatrix} = \text{factor loading matrix}, \quad \hat{\varepsilon} = \begin{bmatrix} \hat{\varepsilon}_i \\ \hat{\varepsilon}_j \end{bmatrix} = \text{residual vector}$$

The analysis proceeds in the following stages:

- i) For two country stocks in Asian equity markets, a sample product-moment covariance matrix is computed from a time series of returns.
- ii) A principal component factor analysis is performed on the covariance matrix. This estimates the number of common factors and the matrix of factor loadings between two country markets in Asian equity markets.
- iii) The individual-asset factor loading estimates from the previous step are used to explain the cross-sectional variation of individual estimated expected returns. The procedure here is similar to a cross-sectional ordinary least squares regression.
- iv) Estimates from the cross-sectional regression model are used to measure the size and statistical significance of risk premia associated with the estimated factors.

3.4. Hypotheses Testing

Once we obtain estimates of Asian factor loadings, we can test the basic cross-sectional pricing relationship of the IAPM in equation (3). Cross-sectional regression analyses are performed to test the significance of the risk-free rate and risk premia and then Chow test same as Brown and Weinstein(1983) was conducted to examine the consistence of risk-free rate and risk premia between two different Asian country groups. Specifically, we test the following null hypotheses.

- (H1) the risk-free rate is the same between two country markets in Asian equity markets. $\lambda_o^i = \lambda_o^j$
- (H2) the risk premia are the same between two country markets in Asian equity markets. $\lambda^i = \lambda^j$
- (H3) both the risk-free rates and risk premia are the same between two country markets in Asian equity markets.

$$\lambda^i = \lambda^j, \lambda_o^i = \lambda_o^j \quad (5)$$

where λ_o is risk-free rate, λ is risk premia, i, j are individual stocks in Asian country equity markets ($i \neq j$). Each of the above hypotheses will be tested using the U.S. dollar as the numeraire currency.

As previously mentioned, our test involves a joint hypothesis that the IAPM between two country markets is valid and that two markets are integrated. If the IAPM between two country markets holds and two markets are integrated, then none of the above hypotheses, (H1), (H2), and (H3), should be rejected.

The Chow test entails comparison of the whole regressed residual sum of squares (ESS_w) with the each country regressed residual sum of squares (ESS_e). A given hypothesis is not rejected when the two residual sum of squares are close in value. Furthermore, if df_w and df_e denote the degrees of freedom for the regressions, respectively, then

$$F = \frac{(ESS_w - ESS_e) / (df_w - df_e)}{ESS_e / df_e} \quad (6)$$

has an F -distribution with $(df_w - df_e)$ and df_e degrees of freedom.

IV. EMPIRICAL RESULTS

In this section, the factor analyses are conducted to estimate the common factors between two markets. Then, cross-sectional regression analyses are performed in order to examine the validity of the IAPM between two markets. Finally, Chow tests are executed to evaluate the integration between two country markets in Asian equity markets. First, we analyzed the correlation between returns of two countries in Asian equity markets.

4.1. Results of Correlation Analysis

We summarize the result of correlation analysis of stock returns in Asian equity markets in Table 2. The correlation coefficient between Japanese and Singapore equity markets is 0.27 and between Hong Kong and Singapore equity markets is 0.38. These results show that the movement of stock returns between Japan and Singapore, and between Hong Kong and Singapore are statistically significant.

The correlation coefficients, however, between Korean and Japanese equity market, between Korean and Hong Kong market, between Korean and Singapore market, and between Japanese and Hong Kong market are 0.04, -0.02, 0.06, and 0, respectively. It means that these coefficients are not statistically important.

[Table 2] Correlation Matrix of Asian Stock Returns

| | Korea | Japan | Hong Kong |
|-----------|-------|--------|-----------|
| Japan | 0.04 | 1 | |
| Hong Kong | -0.02 | 0.00 | 1 |
| Singapore | 0.06 | 0.27** | 0.38*** |

Significant at 5%, *Significant at 1%.

[Table 3] Number of Common Factors

| | Korea | Japan | Hong Kong |
|-----------|-------|-------|-----------|
| Japan | 6 | | |
| H.K. | 3 | 6 | |
| Singapore | 6 | 6 | 3 |

4.2. Results of Factor Analysis

All samples between two markets in Asian equity markets were conducted to get common factors. Generally, number of common factors is determined by eigen values of factors which are greater than one. But in this test, scree plot approach of principal component factor analysis was used to select number of common factors and factor loading matrix since eigen value approach produced too many factors.³ This procedure allows us to generate the optimal common factors and test the validity of the IAPM between two country markets.⁴ Results of the factor analyses between two country markets in Asian equity markets are summarized in Table 3.

Table 3 presents the number of common factors between Asian countries. In the result of factor analysis, three through six common factors were obtained between Asian countries group.

Next, we examine if there are some pricing common factors or not by using cross-sectional regression analysis.

4.3. Results of Cross-sectional OLS

We investigate the validity of the IAPM between two country markets in Asian equity markets by cross-sectional regression. To conduct these tests, we regressed average returns of each stocks as dependent variables into each factor loadings between two countries as independent variables. If there are statistically significant common factors, pricing factors, in each regression equation, IAPM between two country markets could be valid.

We summarize the cross-sectional regression results in Table 4s.

The result of cross-sectional regression between Korea and Japan is presented in Table 4-1. According to the t-test, intercept, factor 1, 2, 4, 5, and 6 were

³ Many factors which were obtained by eigen value approach might give us problem to execute cross-sectional regression such as multicollinearity and a lot of computation cost.

⁴ The tests of APM based on the traditional factor analysis might have the problem of factor structure. Cho, Eun, and Senbet(1986) recommended to use the inter-battery factor analysis for the factor structure stability. In this paper, however, the validity of IAPM is not determined by the number of common factor, but is determined by the pricing common factors. Thus, the number of common factor might not be important in this paper.

[Table 4-1] Cross-Sectional OLS between Korea and Japan

| | λ_0 | factor 1 | factor 2 | factor 3 | factor 4 | factor 5 | factor 6 | R^2 | F |
|-------|---------------------|----------------------|-----------------------|----------------------|----------------------|-----------------------|----------------------|-------|-------|
| Whole | 0.0037*** (5.42) | -0.0034** (-2.56) | -0.0091*** (-7.64) | -0.002 (-1.54) | -0.005*** (-4.75) | -0.003** (-2.12) | -0.0028** (-2.02) | 0.47 | 13.54 |
| Korea | 0.0075*** (6.91) | 0.0083** (2.13) | -0.013*** (-8.72) | -0.009*** (-0.48) | -0.0021 (-0.69) | -0.0041* (-1.89) | -0.003* (-1.73) | 0.70 | 16.65 |
| Japan | -0.00016 (-0.16) | 0.0017 (1.02) | -0.0055* (-1.69) | -0.0053 (-1.35) | -0.0012 (-0.99) | -0.0051*** (-2.81) | -0.0007 (-0.32) | 0.25 | 2.35 |

* Significant at the 10% level, **Significant at 5%, ***Significant at 1%
t-statistics are presented in parentheses.

very significant for pricing in the whole market. In Korean market, intercept, factor 1, 2, 3, 5, and 6 and in Japanese market, factor 2, and 5 were significant for pricing. Thus, we concluded that the IAPM between Korean and Japanese equity markets were valid.

Table 4-2 shows the result of cross-sectional regression analysis between Korean and Hong Kong equity markets. Neither whole market nor each national markets had any significant factors for pricing. It led us to reject the validity of the IAPM between Korean and Hong Kong equity markets.

The result of cross-sectional regression analysis between Korean and Singapore equity market is presented in Table 4-3. All six factors including intercept in the whole market and intercept, factor 1, 3, 4, and 5 in Korean market were statistically significant for pricing. In Singapore market, however, there did not exist any pricing common factors.

[Table 4-2] Cross-Sectional OLS between Korea and Hong Kong

| | λ_0 | factor 1 | factor 2 | factor 3 | R^2 | F |
|-------|--------------------|--------------------|--------------------|--------------------|-------|------|
| Whole | 0.0026 (1.37) | -0.0053 (-1.31) | -0.0004 (-0.07) | -0.0027 (-0.74) | 0.05 | 1.14 |
| Korea | -0.0009 (-0.32) | 0.0028 (0.45) | 0.0011 (0.19) | 0.00032 (0.08) | 0.01 | 0.08 |
| H.K. | 0.0058 (1.44) | -0.0026 (-0.26) | -0.0074 (-0.73) | -0.0046 (-0.61) | 0.03 | 0.27 |

* Significant at the 10% level, **Significant at 5%,
*** Significant at 1%. t-statistics are presented in parentheses.

[Table 4-3] Cross-Sectional OLS between Korea and Singapore

| | λ_0 | factor 1 | factor 2 | factor 3 | factor 4 | factor 5 | factor 6 | R ² | F |
|-----------|--------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|--------------------|----------------|-----------|
| Whole | 0.004*** (4.74) | -0.0078*** (-5.09) | -0.0061*** (-3.23) | -0.0034~ (-1.95) | -0.0047*** (-2.81) | -0.0056** * (-2.95) | 0.0038** (2.08) | 0.44 | 9.32 |
| Korea | 0.007*** (6.94) | -0.01*** (-7.37) | 0.0036 (0.86) | -0.0068*** (-4.07) | -0.007*** (-4.34) | -0.008*** (-4.71) | 0.0011 (0.58) | 0.71 | 17.7 1 |
| Singapore | 0.0028 (1.32) | -0.0035 (-0.38) | -0.0048 (-1.15) | 0.003 (0.48) | 0.0012 (0.25) | 0.0014 (0.17) | 0.0066 (1.24) | 0.10 | 0.36 |

* Significant at the 10% level, **Significant at 5%, ***Significant at 1%.
t-statistics are presented in parentheses.

Table 4-4 presents the result of cross-sectional regression analysis between Japanese and Hong Kong equity markets. The result shows that no factors are statistically significant for pricing in the whole market but factor 4 in Japanese market and the intercept in Hong Kong market are significant for pricing.

In Table 4-5, the result of cross-sectional regression between Japanese and Singapore equity market is presented. According to the result, there were not any significant common factors for pricing in the whole market and individual equity markets. It led us to reject the validity of the IAPM between Japanese and Singapore equity markets.

[Table 4-4] Cross-Sectional OLS between Japan and Hong Kong

| | λ_0 | factor 1 | factor 2 | factor 3 | factor 4 | factor 5 | factor 6 | R ² | F |
|-------|---------------------|--------------------|--------------------|--------------------|-------------------|---------------------|--------------------|----------------|------|
| Whole | 0.0012 (1.04) | -0.0027 (-1.01) | -0.0014 (-0.58) | 0.0036 (1.28) | 0.0015 (0.68) | 0.00041 (0.14) | -0.0007 (-0.24) | 0.08 | 0.99 |
| Japan | -0.00005 (-0.06) | 0.0005 (0.29) | -0.0006 (-0.34) | 0.003 (1.00) | 0.0028* (1.73) | -0.00024 (-0.13) | -0.001 (-0.44) | 0.14 | 1.13 |
| H.K. | 0.0055* (1.64) | 0.012 (0.86) | -0.0053 (-0.86) | -0.0054 (-0.73) | 0.0078 (1.00) | 0.013 (1.37) | 0.00008 (0.01) | 0.17 | 0.68 |

* Significant at the 10% level, ** Significant at 5%, *** Significant at 1%
t-statistics are presented in parentheses.

[Table 4-5] Cross-Sectional OLS between Japan and Singapore

| | λ_0 | factor 1 | factor 2 | factor 3 | factor 4 | factor 5 | factor 6 | R^2 | F |
|-----------|--------------------|--------------------|--------------------|--------------------|--------------------|-------------------|--------------------|-------|------|
| Whole | 0.0012 (1.33) | -0.0012 (-0.90) | -0.0013 (-0.76) | -0.0017 (-1.12) | 0.0001 (0.06) | 0.0006 (0.34) | -0.0008 (-0.44) | 0.04 | 0.51 |
| Japan | -0.0003 (-0.29) | 0.00047 (0.26) | -0.0033 (-0.86) | -0.0011 (-0.87) | 0.0025 (1.42) | 0.0016 (1.02) | 0.00055 (0.24) | 0.15 | 1.25 |
| Singapore | 0.0015 (0.73) | 0.0065 (0.72) | -0.0026 (-0.63) | 0.0062 (0.69) | -0.0031 (-0.51) | 0.00016 (0.03) | -0.0029 (-0.86) | 0.08 | 0.31 |

* Significant at the 10% level, ** Significant at 5%, *** Significant at 1%.
t-statistics are presented in parentheses.

Table 4-6 shows the result of cross-sectional regression analysis between Hong Kong and Singapore equity markets. In the result of the t-test, intercept, factor 2, and 3 were very significant for pricing in the whole market. In Singapore market, intercept and factor 2 are statistically significant. Hong Kong market, however, did not have any pricing risk factors.

4.4. Chow Test Results

We summarize Chow test results for the consistence of risk premia between two country markets in Asian equity markets in Table 5. The null hypotheses of Chow test are (H1), (H2), and (H3) in equation (5). The F -values for Chow test are computed by equation (6). Thus, we could test the hypotheses to compare F -values for the Chow test with F -statistics.

[Table 4-6] Cross-Sectional OLS between Hong Kong and Singapore

| | λ_0 | factor 1 | factor 2 | factor 3 | R^2 | F |
|-----------|--------------------|------------------|---------------------|---------------------|-------|------|
| Whole | 0.004*** (3.75) | 0.0007 (0.22) | -0.007** (-2.25) | -0.009** (-2.51) | 0.13 | 3.40 |
| H. K. | 0.00012 (0.03) | 0.0075 (0.88) | 0.0024 (0.22) | 0.0015 (0.17) | 0.04 | 0.32 |
| Singapore | 0.0037** (2.08) | 0.0016 (0.31) | -0.007* (-1.67) | -0.01 (-2.35) | 0.25 | 2.82 |

* Significant at the 10% level, ** Significant at 5%,
*** Significant at 1%. t-statistics are presented in parentheses.

[Table 5] Chow Test Results for Risk Premia Consistence

| Countries \ Statistic | <i>F</i> -Value | <i>F</i> -Statistic |
|-----------------------|---------------------|---|
| Korea · Japan | 4.43 ^{***} | $F_{0.95}(7,85) = 2.09$, $F_{0.99}(7,85) = 2.79$ |
| Korea · Singapore | 2.28 ^{**} | $F_{0.95}(7,65) = 2.09$, $F_{0.99}(7,65) = 2.79$ |
| Japan · Hong Kong | 2.07 | $F_{0.95}(7,62) = 2.09$, $F_{0.99}(7,62) = 2.79$ |
| Hong Kong · Singapore | 9.15 ^{***} | $F_{0.95}(4,62) = 2.53$, $F_{0.99}(4,62) = 3.65$ |

* Significant at the 10% level, **Significant at 5%, ***Significant at 1%
degree of freedoms are presented in parentheses.

According to the result of Chow test, the *F*-value between Korean and Japanese regression equations was 4.43. This result implies that null hypotheses are rejected at 5% significance level. It means that two equity markets is segmented.

Since the *F*-value between Korea and Singapore was 2.28, we could not reject null hypotheses at 1% significance level but reject at 5% significance level. This result showed that Korean and Singapore equity markets were at least partially integrated. And *F*-value between Japan and Hong Kong equity markets was 2.07. Thus, we could not reject the hypothesis of integration between two equity markets at 5% significant level. It showed that two equity markets were integrated. But the result of Hong Kong and Singapore equity markets revealed that two markets were segmented.

V. CONCLUSIONS

The effect of diversification investment theory can be magnified when it is applied to international investment. This logic, however, constitutes only when it is assumed that international equity markets are integrated, as a result, domestic stocks and international stocks can be analyzed with same risk measurement and risk price. Therefore, whether international equity market is integrated should be verified before discussion of the international asset pricing models and the effect of international diversification investment. Most of the previous studies made little contribution to testing the hypothesis on international equity market integration as they had mainly focused on developed countries such as between U.S. and Japanese equity markets. Thus, in this paper, the empirical studies on the integration of equity markets between developing country and developed country based on Asian countries are performed.

As for the empirical analysis which examined integration between two country markets in Asian equity markets, IAPMs between Korea and Japan, between Korea and Singapore, between Japan and Hong Kong, and between Hong Kong

and Singapore were valid.

We examined the consistence of risk premia between two country markets in Asian equity markets. According to Chow test, Korean and Singapore equity markets were partially integrated and Japanese and Hong Kong equity markets were integrated.

The results of this paper have significant implications in terms of international diversification investment effect and establishment of international asset pricing model in international financial theory, and in practice, for international stock investment and international listings on the foreign equity markets by the financial staff in multinational companies and by individual investors. For instance, we can discuss the effect of international diversification investment in the integrated market such as between Korean and Singapore, and between Japanese and Hong Kong in Asian equity markets. In the segmented equity markets, we should discuss not in terms of international diversification but in term of the capital budgeting, when we consider international investment.

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