EQUITY PRICE VARIATION IN PACIFIC BASIN COUNTRIES

Yin-Wong Cheung and Lilian Ng

ABSTRACT

This paper uses a multivariate procedure to measure two sources of real return variation in the Pacific Basin equity markets: the expected-return variables and shocks to expected future cash flows. While the global instrumental variables that proxy for these two sources of variation explain individual stock index real returns reasonably well, their explanatory power for portfolio real returns is much stronger. Our evidence thus suggests market rationality of stock price movements in the Pacific Basin countries. We further find that expected future cash flow shocks are better at explaining quarterly real returns than do expected-return variables. Results also show that U.S. future industrial growth rates have a significantly stronger impact on the Pacific Basin stock return movements than do the Japanese.

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INTRODUCTION

In recent years the world has witnessed rapid economic and financial developments in the Pacific Basin countries. For instance, the 1993 World Bank report, "The East Asian Miracle," documented that the East Asian "superstars," such as Hong Kong, Japan, Malaysia, and Singapore, have consistently outperformed the rest of the world, and their per capita income growth rates are more than twice the world average. Asia's share of the world market capitalization is estimated to have doubled between 1987 and 1992. The sustained growth in these equity markets not only reflects an impressive economic performance, but also attracts increasing investment interests from the rest of the world. Indeed the astonishing achievement of these countries has stimulated considerable research interests in the Pacific Basin equity markets.[1]

This paper further pursues that topic with two main objectives. A simple valuation model suggests that there are two primary sources of variation in equity returns: (1) shocks to expected future cash flows, and (2) the expected-return variables, namely the time-variation in expected returns and shocks to expected returns. Thus, our first objective is to construct global variables that proxy for sources of equity variation and to investigate whether these variables explain real returns on a wide diversity of country stock market indexes. Specifically, we investigate whether shocks to expected future cash flows and expected-return variables can explain variation in monthly and quarterly real equity returns in Australia, Hong Kong, Japan, and Malaysia/Singapore. The interaction between real stock returns and these global information variables provides a way to gauge the rationality of stock prices (Fama 1990). The choice of global variables is motivated by the observed strong economic linkages between these countries and is also drawn from the existing empirical literature.

Our second objective is to assess the relative influence of the U.S. and Japanese economic activities on the Pacific Basin stock markets. We use future growth rates of the U.S. and Japanese industrial production indexes as proxies for shocks to expected future cash flows in the Pacific Basin region. The choice of industrial production is consistent with existing empirical studies which show that industrial production is a good measure of economic activity. The extent of the economic impact of the United States and Japan on this region will therefore be evaluated by examining the abilities of their industrial production indexes to explain the Pacific Basin real stock market movements.

In this analysis we employ both univariate regressions and a multivariate technique, the maximum-latent-root test procedure, to investigate the maximum and marginal explanatory powers of the selected proxy variables for real equity return variability. The maximum-latent-root test procedure is a generalization of the Lo and MacKinlay (1992) maximal R^2 methodology. The advantage of the proposed procedure is that it allows us to evaluate the incremental explanatory power of the two measures of return variation. For instance, we can test whether shocks to expected future cash flows provide any significant additional explanatory power in the presence of the other. The ability to evaluate the marginal contribution facilitates the comparison of the information contents of the different proxy variables employed. The multivariate maximum-latent-root procedure therefore represents a more flexible approach to study the explanatory power of the selected global information variables. Further, the interpretation of its statistic is similar to that of the coefficient of determination R^2 obtained from the standard regression analysis. In essence, our evaluation of the explainable component in real stock returns is in the spirit of Roll (1988).

The next section describes the data and their sample statistics. The models and methodology are discussed in the third section. Analyses of individual country returns are presented in the fourth section. The fifth section reports the maximal explanatory power of different combinations of the global information variables. The marginal contribution of the selected variables and the relative importance of the U.S. and Japanese industrial production data to the Pacific Basin stock markets are evaluated in the sixth section. The last section summarizes the paper.

DATA DESCRIPTION

The data on the national stock equity indexes of Australia, Hong Kong, Japan, and Singapore/Malaysia are available from Morgan Stanley Capital International (MSCI).[2] These indexes are: (1) value-weighted, (2) calculated with dividend reinvestment, and (3) in U.S. dollar-denominated currency. In constructing these indexes, MSCI excludes the market value of investment companies and of foreign domiciled companies to avoid double-counting. These stock returns are then converted to real returns using inflation rates computed from the U.S. consumer price index. The sample period is from January 1970 to December 1991.

Global information variables that proxy for time-varying expected returns, global shocks to expected returns, and global shocks to expected future cash flows are drawn from both theoretical and empirical consideration. These variables are also representative of those used in the existing studies on international capital markets (e.g., Harvey 1991; Bekaert and Hodrick 1992; Campbell and Hamao 1992; Ferson and Harvey 1992; Cheung, He, and Ng 1993; Solnik 1993). The proxies for time-varying expected returns are: (1) the dividend yield of the MSCI Pacific index (PDY), (2) the Eurodollar-Treasury yield spread (TED), which is the difference between the three-month Eurodollar rate and the 90-day yield on the U.S. Treasury Bill, and (3) the term spread (TERM), which is given by the difference between the CRSP long-term government bond return and the short-term 30-day U.S. Treasury Bill rate. Following Fama (1990), residuals from first-order autoregressions fitted to TED and TERM are interpreted as proxies for shocks to expected returns and are labeled SHD and SHM, respectively.[3]

Table 1. Descriptive Statistics of the Country Real Stock Returns and Global Proxies for Expected Returns, Expected Return Shocks, and Shocks to Expected Future Cash Flows

	MEAN	*STD DEV*	ρ(1)	ρ(2)	ρ(3)	ρ(4)	ρ(5)
Monthly Data							
AUR	0.01	0.08	–.01	–.06	–.00	0.01	–.02
HKR	0.02	0.12	0.06	–.04	–.01	–.05	–.02
JPR	0.02	0.07	0.08	0.01	0.07	0.03	0.07
SMR	0.02	0.09	0.16	–.01	–.08	0.05	0.02
PDY	0.18	0.08	0.98	0.96	0.95	0.93	0.91
TED	0.15	0.10	0.66	0.50	0.49	0.40	0.38
TERM	0.15	3.32	0.05	–.02	–.16	0.04	0.07
SHD	0.00	0.08	–0.10	–.09	0.19	–.02	0.08
SHM	–.02	3.32	–0.00	–.02	–.16	0.05	0.06
JPIP	1.03	2.14	0.73	0.66	0.43	0.40	0.33
USIP	0.65	2.06	0.85	0.61	0.35	0.21	0.11
Quarterly Data							
AUR	0.03	0.14	–.01	–.09	0.08	0.00	–.00
HKR	0.07	0.23	–.04	–.12	0.13	–.06	–.10
JPR	0.05	0.13	0.03	0.15	0.10	0.16	–0.15
SMR	0.05	0.20	–.00	–.11	0.12	–.00	–.14
PDY	0.56	0.26	0.92	0.86	0.80	0.73	0.63
TED	0.45	0.26	0.67	0.52	0.42	0.42	0.31
TERM	0.42	6.46	–0.12	0.05	0.09	0.08	–.18
SHD	0.00	0.19	–0.13	0.05	–.07	0.20	0.12
SHM	–.13	6.42	0.01	0.05	0.11	0.07	–.17
JPIPG	1.01	2.05	0.44	0.30	0.17	–.16	–.31
USIPG	0.66	2.05	0.40	0.05	0.06	0.01	–.15

Note: AUR, HKR, JPR, and SMR are U.S. dollar-denominated real returns on the Australia, Hong Kong, Japan, and Singapore/Malaysia stock indexes. PDY is the dividend yield on the MSCI Pacific Index, TED is the Eurodollar-Treasury yield spread, TERM is the term structure of interest rates, and SHD and SHM are the respective residuals from the first-order autoregressions fitted to TED and TERM. JPIPG and USIPG are the growth rates of the Japanese and U.S. industrial production indexes. The mean and standard deviation of each series are reported under "MEAN" and "STD DEV." ρ(k) represents the k-th lag autocorrelation coefficient estimate.

In this study we employ quarterly future growth rates in industrial production (IPGs) up to four quarters ahead as a measure of shocks to expected future cash flows in the Pacific Basin financial markets. This is consistent with recent studies such as Fama (1990) and Chen (1991) who find that IPGs are an important determinant of real stock return variation and have better explanatory power than other measures of real economic activity such as GNP and gross private investment. Because of their close trading and investment interactions, it is conceivable that the economic activity in the United States and Japan can have a considerable influence on the Pacific Basin stock markets. Thus, the Japanese and United States IPGs are employed as two different proxies for expected future cash flow shocks. This approach also allows us to determine the relative importance of the U.S. and Japan economies in this region. Data on the industrial production indexes are obtained from CITIBASE.

Table 1 presents summary statistics of the national real stock returns and the selected proxy variables. For both monthly and quarterly data, the rates of return on the Hong Kong stock market are the most volatile among these markets, with the Japanese the least volatile. The autocorrelations of TERM, SHD, SHM, and stock returns are small. The means and standard deviations of the U.S. and Japanese IPGs are very similar. However, the U.S. IPG is less persistent than the Japanese IPG, as the sample autocorrelation coefficients of the former are generally smaller.

MODEL AND METHODOLOGY

The Empirical Model

In this study we use the following models:

(M1) $$r_t = \alpha + \alpha_1 P_t + \alpha_2 P_{t+3} + \alpha_3 P_{t+6} + \alpha_4 P_{t+9} + v_t,$$

(M2) $$r_t = \alpha + \alpha_5 PDY_{t-1} + \alpha_6 TED_{t-1} + \alpha_7 TERM_{t-1} + \alpha_8 SHD_t + \alpha_9 SHM_t + v_t,$$

and

(M3) $$r_t = \alpha + \alpha_1 P_t + \alpha_2 P_{t+3} + \alpha_3 P_{t+6} + \alpha_4 P_{t+9} + \alpha_5 PDY_{t-1} + \alpha_6 TED_{t-1} + \alpha_7 TERM_{t-1} + \alpha_8 SHD_t + \alpha_9 SHM_t + v_t.$$

to study the relationships between real stock returns and variables proxying for time-varying expected returns, global shocks to expected returns, and global shocks to expected future cash flows (Fama 1990; Schwert 1990). r_t is the real return on a country stock index; P_{t+i} is the Japanese or U.S. IPG from t+i to t+i+3; v_t is the error term; and the remaining variables are as defined earlier. Model (M1) describes the relationship between real returns and future production growth rates, while (M2) describes the relationship between real returns and the proxies for time-varying expected returns and shocks to expected returns. The combined explanatory power of these global information variables is given by (M3).

The Maximum-Latent-Root Test

Let $Z_t = (r_{1t}, \ldots, r_{Nt})'$ be the vector of N individual country real stock returns; X_{1t} and X_{2t} are vectors of K1 and K2 instrumental variables; B_1 and B_2 are the K1 × N and K2 × N coefficient matrices; b is a vector of constants; and

$\varepsilon_t = (v_{1t}, \ldots, v_{Nt})'$ contains the corresponding regression error terms. It is assumed that $E_{t-1}[\varepsilon_t] = 0$ and $Var_{t-1}[\varepsilon_t] = \Sigma$. The regression model,

$$Z_t = B_1' X_{1,t-1} + B_2' X_{2,t-1} + b + \varepsilon_t,$$
$$\equiv B' X_{t-1} + \varepsilon_t, \tag{1}$$

is used to study the relationship between real equity returns and the two groups of instrumental variables. The incremental predictability of $X_{1,t-1}$ in the presence of $X_{2,t-1}$ is examined using a linear restriction test in the multivariate linear model. Specifically, the null hypothesis $RB = 0$, where $R = [I_{K1}\ 0]$ tests the incremental predictability of $X_{1,t-1}$. For notational convenience, we stack the observations and get $Z = XB + \varepsilon$.

Let $\hat{\Sigma}$ and $\hat{B}$ be the maximum likelihood estimates of Σ and B and define matrices S and Q as follows:

$$S \equiv \hat{B}'R'[R(X'X)^{-1}R']^{-1}R\hat{B} = Z_1^{*\prime} Z_1^*, \tag{2}$$

and,

$$Q \equiv T\hat{\Sigma} = Z'Z - \hat{B}'X'Z = Z_3^{*\prime} Z_3^*. \tag{3}$$

S and Q are known as matrices due to the hypothesis and due to error. Q measures the proportion of Z not explained by X_{t-1}, while S measures the increase in the unexplained component due to the restriction $B_1 = 0$.[4] If the restriction is valid, then S will be small relative to Q. Under the normality assumption, the distributions of Z_1^* and Z_3^* are given by $Z_1^* \sim N(M_1, I_{K1} \otimes \Sigma)$ and $Z_3^* \sim N(0, I_{(T-K1-K2-1)} \otimes \Sigma)$, where M_1 is the expected value of Z_1^* and T is the sample size (see, for example, Muirhead 1982, p. 436).

Suppose $\gamma = (\gamma_1, \ldots, \gamma_N)$ is a vector of portfolio weights which sum to one. Thus the real return on a portfolio, γZ_t, is a linear combination of individual real equity returns. Conditional on $X_{2,t-1}$, the increase in the unexplained component of γZ_t resulting from restricting $B_1 = 0$ is given by:

$$R^2(\gamma) \equiv \frac{\gamma' S \gamma}{\gamma'(Q+S)\gamma}. \tag{4}$$

The largest possible incremental predictability of $X_{1,t-1}$ is given by the maximum value of $R^2(\gamma)$. Given the sample observations on Z_t and X_{t-1}, $R^2(\gamma)$ is a function of γ. It can be shown that the maximum value of $R^2(\gamma)$ and the corresponding portfolio γ^* are given by ℓ, the largest latent root of the matrix $(Q+S)^{-1}S$, and the latent vector associated with this latent root.[5]

In the following section we use the ℓ statistic to test the significance of the restriction $RB = 0$. Intuitively, we will reject the restriction when the computed statistic is large. The distribution of ℓ under the null hypothesis $RB = 0$ is used to obtain the critical values. Analytically, the distribution of ℓ under the normality assumption can be obtained as follows. Under the null, the distribution of λ (the maximum latent root of SQ^{-1}) is given by Theorem 10.6.8 and Corollary 10.6.9 of Muirhead (1982). Based on this result, we can derive the distribution of ℓ under the null by observing that $\lambda = \ell/(1 - \ell)$, a monotone function of ℓ.[6]

The maximum-latent-root procedure is a generalization of the maximal R^2 method proposed by Lo and MacKinlay (1992). When $X_{2,t-1}$ is eliminated from the regression (i.e., $(B_2'X_{2,t-1} + b) \equiv b$), the $R^2(\gamma)$ in equation (4) is the coefficient of determination from regressing γZ_t on $X_{1,t-1}$ and a constant. In this case, the ℓ statistic gives the maximum proportion of variation in γZ_t that is attributable to $X_{1,t-1}$. Thus the Lo-MacKinlay maximal R^2 procedure is a special case of the maximum-latent-root method. The latter admits a more general conditional information set in calculating the maximum incremental explanatory power of the instruments.

While the null distribution of ℓ can be derived analytically, the resulting distribution is computationally intractable and, hence, Monte Carlo methods are employed to generate the required critical values. In our analysis the critical values are generated as follows. For each model specification, we generate T independent vectors of N normal variates with zero mean and identity covariance matrix as the left-hand-side variables, where T is the sample size. The ℓ statistics are then computed from these random vectors and X_ts. For a given combination of sample size, equities, and explanatory variables, we replicate this procedure 10,000 times to tabulate the empirical distribution of ℓ.[7]

INDIVIDUAL COUNTRY REGRESSION RESULTS

Estimates of the monthly and quarterly models (M1), (M2), and (M3) using individual country real equity returns are presented in Table 2. In addition to the full-sample period 1970 to 1991, we also report results based on two non-overlapping subsample periods: (a) 1970–1980, and (b) 1981–1991. For the interest of brevity, we only report the adjusted coefficients of determination, $\overline{R}^2$s. The detailed regression results are available from the authors.

For the full-sample period, the magnitudes of both the (M1) and (M3) $\overline{R}^2$s are comparable with those found in Fama (1990) and Schwert (1990). The monthly $\overline{R}^2$s are typically smaller than the quarterly. While the monthly $\overline{R}^2$s are similar to those reported by Fama and Schwert, the quarterly's are generally smaller. This is suggestive of structural changes in the correlation between real stock returns and the proxies for time-varying expected returns and expected-return shocks across different holding periods. In general, the global information variables exhibit power for explaining individual Pacific Basin country real stock returns, an evidence indicative of market rationality in stock prices.

Table 2 shows that the IPGs proxying for shocks to expected future cash flows have better explanatory power for quarterly real stock returns than do expected-re-

Table 2. $\overline{R}^2$s from Regressing Monthly and Quarterly Pacific Basin Country Real Stock Returns on the Proxies for Time-varying Expected Returns, Expected Return Shocks, and Shocks to Expected Future Cash Flows

	Monthly					Quarterly				
	U.S. IPG			Japanese IPG		U.S. IPG			Japanese IPG	
	M1	M3	M2	M1	M3	M1	M3	M2	M1	M3
1970–1991										
AUR	0.03	0.05	0.05	0.06	0.08	0.21	0.19	−.02	0.17	0.14
HKR	0.03	0.04	0.04	0.03	0.05	0.14	0.13	0.03	0.12	0.12
JPR	0.07	0.12	0.10	0.03	0.11	0.24	0.21	0.03	0.10	0.08
SMR	0.07	0.06	0.02	0.05	0.06	0.21	0.18	0.01	0.21	0.22
1970–1980										
AUR	0.05	0.04	0.01	0.09	0.08	0.32	0.29	0.08	0.20	0.31
HKR	0.03	0.06	0.06	0.07	0.10	0.11	0.05	0.11	0.22	0.23
JPR	0.12	0.12	0.11	0.12	0.14	0.32	0.27	0.19	0.27	0.30
SMR	0.06	0.03	0.03	0.10	0.08	0.15	0.08	0.06	0.29	0.33
1981–1991										
AUR	0.04	0.09	0.08	0.03	0.09	0.13	0.07	0.00	0.20	0.15
HKR	0.01	0.05	0.03	0.01	0.04	0.11	0.27	0.12	−.05	0.03
JPR	0.04	0.10	0.09	0.01	0.07	0.19	0.12	0.03	−.03	−.07
SMR	0.12	0.10	−.02	0.04	0.02	0.30	0.28	0.01	0.14	0.06

Note: The table reports $\overline{R}^2$s from the estimated models (M1), (M2), and (M3), as defined in the text. AUR, HKR, JPR, and SMR are U.S. dollar-denominated real returns on the Australia, Hong Kong, Japan, and Singapore/Malaysia stock indexes, respectively. IPG denotes growth rates in industrial production.

turn variables. The quarterly (M1) $\overline{R}^2$s are typically larger than the quarterly (M2)s. This observation contrasts with the monthly results but is consistent with Fama (1990, p. 1094–6), who focuses on the relationship between real returns on the NYSE market index and the U.S. IPG. Fama argues that the finding is attributable to the larger measurement-error problem associated with using production growth rates to explain variation in short-horizon real equity return. Given that IPGs measure investors' expectations of future cash flows, information about future growth rates of real activity is usually spread over many future periods. Not surprisingly, our results show that IPGs capture better the variation in long-horizon returns.

In comparing the two subperiod results, we find the $\overline{R}^2$s are lower in the second subsample, with 29 of the 40 estimations yielding a smaller $\overline{R}^2$. This implies that the correlation between real stock returns and global information variables is weaker in the 1980s than the 1970s. The evidence is more predominant for models incorporating the Japanese IPG as explanatory variables. There is only one out of 16 $\overline{R}^2$s in the first subperiod that is smaller when compared with those of the second. And in 14 out of the 16 second-subperiod models, the $\overline{R}^2$s are larger using the U.S. IPG than the Japanese IPG. We interpret this as evidence of a closer relationship between the U.S. economy and these Pacific Basin equity markets in the 1980s.

THE MAXIMAL EXPLANATORY POWER

Although the global information variables appear to capture the return variation in individual Pacific Basin stock markets, the preceding univariate regression analysis does not account for cross correlation commonly found in international equity returns. This section employs the Lo-MacKinlay maximal R^2 method to exploit the possible comovements among national real equity returns and among the global information variables to determine the maximum explainable component of real returns. The maximal R^2 yields the largest proportion of real return variation attributable to the selected instrumental variables.

Table 3 reports the maximal $\overline{R}^2$s attained under various optimal portfolio weights γs, with the empirical distributions of the maximal $\overline{R}^2$s in Appendix 1.[8] The $\overline{R}^2$s from these portfolio regressions are strikingly larger than the univariate $\overline{R}^2$s, implying that the instrumental variables have better explanatory power for portfolio real returns than for individual index real returns. The $\overline{R}^2$s of model (M3) are always smaller than the sum of the $\overline{R}^2$s of the corresponding models (M1) and (M2)—the combined explanatory power of the global information variables is weaker than the sum of the explanatory powers of the individual variables. The observed pattern of $\overline{R}^2$s suggests significant cross effects among country real returns and among the global information variables.[9]

We find that the monthly and quarterly full-period regression $\overline{R}^2$s are greater using the U.S. rather than Japanese IPG as explanatory variables. When the expected-return variables are included in addition to the U.S. IPG, the $\overline{R}^2$s are 15 percent for the monthly and 31 percent for the quarterly. These values, however, are slightly lower when we use the Japanese IPG; they are 14 percent for the monthly and 25 percent for the quarterly. Evidence shows a significant economic relationship between the country real returns and aggregate real activity over the entire sample.

When comparing the results across sample periods, several observations are made. First, the relationship between real returns and the IPG is fairly stable over time. Second, the quarterly real returns respond differently to changes in the proxies for expected-return variables across sample periods. In fact, the coefficient estimates (not reported) in the first subsample period are quite different from those in the second. The variability in the parameters across subperiods partly explains why the full-sample period $\overline{R}^2$s are much lower than the subsamples'.

According to the simulated critical values, 13 of the 15 monthly $\overline{R}^2$s and nine of the quarterly $\overline{R}^2$s are significant. With one exception, all the insignificant $\overline{R}^2$s are

Table 3. Maximal $\bar{R}^2$s from Regressing Monthly and Quarterly Pacific Basin Country Real Stock Portfolio Returns on Proxies for Time-varying Expected Returns, Expected Return Shocks, and Expected Future Cash Flow Shocks

Monthly					*Quarterly*				
U.S. IPG			*Japanese IPG*		*U.S. IPG*			*Japanese IPG*	
M1	*M3*	*M2*	*M1*	*M3*	*M1*	*M3*	*M2*	*M1*	*M3*
				1970–1991					
0.11	0.15	0.12	0.08	0.14	0.34	0.31	0.06	0.27	0.26
				1970–1980					
0.13	0.13	0.12	0.16	0.17	0.39	0.31	0.37	0.39	0.46
				1981–1991					
0.15	0.18	0.16	0.10	0.15	0.38	0.40	0.14	0.31	0.21

Note: The table reports the maximal $\bar{R}^2$s from estimated models (M1), (M2), and (M3), as given in the third section of the text, using portfolio returns as the right-hand-side variable. IPG denotes growth rates in industrial production.

found in the subsample periods. That is, the insignificant results are usually associated with a shorter sample period. This finding may be attributable to (1) the low power of the test in small samples, and (2) owing to the length of business cycles, the impact of real economic activity on real stock returns is more difficult to detect in small samples.

THE MAXIMUM-LATENT-ROOT TEST

The maximal R^2 regression results thus far suggest that the expected-return variables and shocks to expected future cash flows may have differential abilities to explain real-return variation across holding-period horizons and across sample periods. These two groups of instruments further seem to share some common information that is useful for explaining real return movements. This observation leads us to address the following issues: (1) whether the two measures of equity return variation contain any non-overlapping information on the real equity return, (2) whether the U.S. or Japanese IPG provides better information about equity variation in these Pacific Basin financial markets, and (3) whether issues (1) and (2) are sensitive to the choice of a sample period.

We use the maximum-latent-root test to infer and compare the information provided by two groups of selected instrumental variables. There are three possible cases. If a group of variables has its own unique information, then it will yield significant incremental explanatory power (in other words, a significant ℓ statistic) in the presence of another. If both groups contain essentially the same information, the ℓ statistic for neither group will be significant. Finally, if information contained in one group of variables is a subset of another, then the latter but not the former will yield a significant ℓ statistic.

Table 4 lists the eight hypotheses H1 to H8 we consider. Under H1, we test whether the U.S. proxy for shocks to expected future cash flows has any incremental explanatory power, given the expected-return variables. In this case, the U.S. IPGs are denoted by $X_{1,t-1}$ in equation (1), while the other by $X_{2,t-1}$. Under H2, the Japanese IPG are employed in place of the United States. H3 and H4 test whether the proxies for expected-return variables have explanatory power not already incorporated in the respective U.S. and Japanese IPGs. Hypotheses H5 to H8 are established to investigate the relative importance of the roles of the U.S. and Japanese economies in the Pacific Basin stock markets. H5 examines whether the Japanese IPG has unique information about the Pacific country real stock index returns in the presence of the U.S. IPG. H6 is similar to H5 with the exception that $X_{2,t-1}$ contains both the U.S. IPG and the expected-return variables. By interchanging the roles of the U.S. and Japanese IPG in hypotheses H5 and H6, we have H7 and H8.

Table 5 presents the maximum-latent-root test results. The simulated critical values reported in Appendix 2 are used to evaluate the statistical significance. The table shows an interesting pattern in the calculated ℓ statistics for hypotheses H1 to H4. While the ℓ statistics for the monthly H1 and H2 are generally smaller than those of H3 and H4, they are larger for the quarterly specifications. This observed pattern suggests that IPG contains more information on the quarterly real returns than on the monthly, while proxies for the expected-return variables are better at explaining the monthly real returns.

Table 4. Hypotheses Considered for the Maximum-latent-root Test

Hypothesis	$X_{1,t-1}$	$X_{2,t-1}$
H1	USIPG	ERV
H2	JPIPG	ERV
H3	ERV	USIPG
H4	ERV	JPIPG
H5	JPIPG	USIPG
H6	JPIPG	USIPG + ERV
H7	USIPG	JPIPG
H8	USIPG	JPIPG + ERV

USIPG ≡ (P_t, P_{t+3}, P_{t+6}, P_{t+9}), where P_{t+1} is constructed from the U.S. data,
JPIPG ≡ (P_t, P_{t+3}, P_{t+6}, P_{t+9}), where P_{t+i} is constructed from the Japanese data,
ERV ≡ (PDY_{t-1}, TED_{t-1}, $TERM_{t-1}$, SHD_t, SHM_t).

Note: *The table defines* $X_{1,t-1}$ and $X_{2,t-1}$ under different hypotheses. In all eight cases, we test if $X_{1,t-1}$ has any incremental explanatory power in the presence of $X_{2,t-1}$.

Table 5. Results for Testing the Incremental Explanatory Power of Various Groups of Instrumental Variables

	Monthly			*Quarterly*		
	1970–91	*1970–80*	*1981–91*	*1970–91*	*1970–80*	*1981–91*
H1	0.0726	0.0826	0.1539	0.3473	0.3425	0.4369
H2	0.0736	0.1150	0.1225	0.2975	0.4663	0.3444
H3	0.0901	0.1305	0.1974	0.1014	0.2883	0.3067
H4	0.1079	0.1139	0.1892	0.1031	0.4351	0.2218
H5	0.0575	0.0920	0.0960	0.1655	0.3368	0.2518
H6	0.0600	0.0975	0.0677	0.1991	0.4103	0.2520
H7	0.0580	0.0626	0.1299	0.2385	0.3806	0.4226
H8	0.0308	0.0751	0.1240	0.2353	0.2833	0.4545

Note: The table reports the maximum-latent-root ℓ statistic for the hypotheses H1 to H8, which are discussed in text and summarized in Table 4.

When their statistical significance is evaluated, it is found that the monthly full-sample and second-subsample period ℓ statistics are significant, but the monthly first-subsample period's are not. Thus these two groups of proxy variables contain essentially the same information on monthly real returns in 1970–1980. For the quarterly models, however, the selected expected-return variables provide no significant incremental explanatory power beyond that already contained in the expected future cash flow shocks. In contrast, both U.S. and Japanese IPGs exhibit significant marginal explanatory power. This indicates that expected future cash flow shocks dominate the expected-return variables in explaining quarterly real equity returns. The finding is in accord with the previous results that the IPG can better capture the long-horizon return variation (e.g., Fama 1990; Schwert 1990; Chen 1991).

We examine the computed ℓ statistics for H5 to H8 to evaluate the relative importance of the U.S. and Japanese economies to the Pacific Basin stock markets. The ranking of the monthly statistics typically change across hypotheses and sample periods. None of the monthly ℓ statistics are significant at the five percent level. This result implies that both U.S. and Japanese IPGs share similar information that is relevant to explaining monthly real returns in the Pacific Basin stock markets. The U.S. IPG, however, appears to dominate the Japanese in explaining quarterly real returns. The full-sample quarterly ℓ statistics for hypotheses H7 and H8 are significant, whereas the second-subsample's are marginally significant. But none of the quarterly ℓ statistics for hypotheses H5 and H6 are significant. The U.S. IPG appears to contain additional information on quarterly real returns which is not already incorporated in the Japanese IPG.

Compared with the monthly results, the quarterly results yield a sharper estimated relation between real returns and production activity. This is in line with Fama's (1990) conclusion that the use of long-horizon data is less subject to the measurement-error problem. In contrast to the expected-return variables, the IPG exhibits stronger power for explaining quarterly real equity returns. This evidence is more pronounced if U.S. IPGs are used instead of Japanese, indicating a greater U.S. influence on the Pacific Basin equity markets.

SUMMARY

This paper investigates the relationship between the Pacific Basin country stock index returns and the global information variables which proxy for time-varying expected returns and shocks to both expected returns and future cash flows. It also examines the relative influence of the U.S. and Japanese economies on the Pacific Basin equity markets. Our analysis employs both the standard univariate regression technique and the multivariate maximum-latent-root test procedure to determine the maximum explanatory power of the selected proxy variables and their marginal contributions in describing real equity return variability.

We find that the global information variables are able to explain real return movements in the individual Pacific Basin country equity markets. The $\overline{R}^2$s obtained are comparable to those reported in the literature using U.S. real equity returns. These selected information variables also capture the price rationality of portfolios constructed from these Pacific Basin stock market indexes. They can explain up to a maximum of 18 percent of the monthly variation in portfolio real returns and 46 percent of the quarterly variation. Generally, our evidence indicates that the explanatory power of the selected global instrumental variables is statistically and economically significant.

For monthly observations, the abilities of the expected-return variables and shocks to expected future cash flows vary across both countries and sample periods. These two groups of proxy variables typically contain unique information useful for explaining monthly real equity price movements. However, for quarterly observations, shocks to expected future cash flows dominate expected-returns variables. The former exhibit incremental explanatory power in the presence of the latter, but not *vice versa*. Evidence therefore suggests that shocks to expected future cash flows play a more important role in explaining quarterly real returns.

We find that neither U.S. nor Japanese future industrial production growth rates have any incremental explanatory power for monthly real equity returns in the presence of the other. They both provide essentially the same information about these stock markets. The result, however, is different using quarterly observations. The U.S. future industrial production growth rate dominates the Japanese in that the former provides more information about the quarterly real equity returns in the Pacific Basin stock markets. Even though Japan has undergone phenomenal growth over the past decade, she has yet to surpass the United States in affecting the Pacific Basin stock markets.

APPENDIX 1

Empirical Distributions of the Maximal $\overline{R}^2$ Statistic (the Maximum Latent Test ℓ Statistic in the Absence of $X_{2,t-1}$)

	Mean	S.D.	Min	Max	1%	5%	10%	50%	90%	95%	99%
Monthly, 1970–1991											
M1	0.029	0.016	–.006	0.136	0.002	0.007	0.010	0.027	0.049	0.057	0.074
M2	0.032	0.017	–.009	0.118	0.003	0.008	0.012	0.029	0.054	0.062	0.079
M3	0.041	0.020	–.010	0.136	0.004	0.012	0.017	0.039	0.067	0.077	0.094
1970–1980 and 1981–1991											
M1	0.061	0.032	–.008	0.256	0.005	0.016	0.023	0.057	0.103	0.120	0.152
M2	0.066	0.034	–.014	0.267	0.005	0.018	0.026	0.063	0.112	0.128	0.161
M3	0.087	0.041	–.016	0.286	0.010	0.027	0.037	0.083	0.142	0.160	0.198
Quarterly, 1970–1991											
M1	0.089	0.046	–.022	0.373	0.007	0.024	0.034	0.083	0.151	0.173	0.219
M2	0.097	0.049	–.021	0.329	0.006	0.026	0.038	0.092	0.162	0.184	0.229
M3	0.127	0.057	–.041	0.398	0.016	0.041	0.057	0.123	0.202	0.229	0.277
1970–1980 and 1981–1991											
M1	0.188	0.090	–.034	0.611	0.019	0.056	0.079	0.179	0.310	0.351	0.422
M2	0.208	0.095	–.051	0.622	0.022	0.066	0.090	0.200	0.335	0.376	0.459
M3	0.278	0.111	–.052	0.732	0.035	0.102	0.139	0.274	0.422	0.468	0.554

This appendix reports the empirical distributions for testing the significance of the maximal $\overline{R}^2$s reported in Table 3. Each empirical distribution can be applied to the model specification given in the first column.

APPENDIX 2

This appendix reports the empirical distributions for testing significance of the maximum latent root ℓ statistics in Table 5. Each empirical distribution can be used to test the hypotheses listed in the first column.

Appendix 2. Empirical Distributions of the Maximum-Latent-Root Test Stastistic ℓ in the Presence of $X_{2,t-1}$

	Mean	*S.D.*	*Min*	*Max*	*1%*	*5%*	*10%*	*50%*	*90%*	*95%*	*99%*
Monthly, 1970–1991											
H1, H2	0.041	0.016	0.005	0.121	0.014	0.019	0.023	0.039	0.062	0.070	0.086
H3, H4	0.048	0.017	0.009	0.149	0.018	0.025	0.028	0.046	0.070	0.080	0.097
H6, H8	0.042	0.016	0.008	0.135	0.014	0.020	0.024	0.040	0.063	0.070	0.089
H5, H7	0.041	0.015	0.006	0.121	0.014	0.019	0.023	0.039	0.061	0.070	0.083
1970–1980 and 1981–1991											
H1, H2	0.087	0.032	0.017	0.276	0.030	0.042	0.050	0.083	0.129	0.147	0.184
H3, H4	0.101	0.034	0.022	0.246	0.040	0.053	0.062	0.096	0.147	0.162	0.194
H6, H8	0.092	0.034	0.014	0.276	0.031	0.043	0.052	0.088	0.136	0.151	0.191
H5, H7	0.087	0.032	0.014	0.274	0.030	0.043	0.050	0.084	0.130	0.147	0.179
Quarterly, 1970–1991											
H1, H2	0.129	0.047	0.022	0.411	0.044	0.061	0.073	0.124	0.192	0.213	0.259
H3, H4	0.148	0.048	0.028	0.432	0.059	0.079	0.091	0.143	0.211	0.232	0.283
H6, H8	0.137	0.050	0.012	0.365	0.048	0.066	0.077	0.131	0.203	0.230	0.275
H5, H7	0.127	0.047	0.015	0.380	0.043	0.062	0.072	0.122	0.191	0.214	0.264
1970–1980 and 1981–1991											
H1, H2	0.288	0.092	0.047	0.704	0.114	0.150	0.174	0.279	0.411	0.454	0.526
H3, H4	0.322	0.093	0.077	0.724	0.137	0.180	0.204	0.316	0.450	0.487	0.560
H6, H8	0.321	0.100	0.069	0.722	0.127	0.171	0.199	0.313	0.457	0.502	0.578
H5, H7	0.278	0.091	0.064	0.698	0.102	0.142	0.166	0.270	0.400	0.441	0.507

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NOTES

1. Some recent studies are Cho, Eun, and Senbet (1986), Bailey and Stulz (1990), Bailey, Stulz, and Yen (1990), Ng, Chang, and Chou (1991), Harvey (1991), Campbell and Hamao (1992), and Cheung, He, and Ng (1994).
2. MSCI also provides data on New Zealand. However, this data series starts from 1977 and is therefore excluded from this study.
3. Shocks to PDY are not included to avoid any spuriously high R^2 resulting from the almost equivalence between these shocks and unexpected stock price changes, see Fama (1990).
4. Note that, in the univariate case, the ratios of S/Q and S/(S+Q), adjusted for the degrees of freedom, give the standard Wald and Lagrange multiplier tests for linear restriction hypotheses.
5. The result can be obtained from a direct maximization of $R^2(\gamma)$ subjected to the constraint that $\gamma_1, \ldots,$ and γ_N are summed to one. See also, Lo and MacKinlay (1992).
6. The distribution function of λ is given by, for example, Muirhead (1982, equation (37), page 483). As ℓ is a monotone function of λ, its distribution function can be obtained from that of λ by direct substitution.
7. Throughout this study, we generated the corresponding data-specific empirical distributions of λ under the null. However, it is observed that these empirical distributions are a function of (T, N, K), where K is the number of regressors. Also, the theoretical null distribution of λ depends only on T, N, and K. Thus, for brevity, we reported the empirical distributions of λ for the various (T, N, K) combinations used in our study. The data-specific empirical distributions are available from the authors.
8. The portfolio weights used to generate these maximal $\bar{R}^2$s are constructed according to the third section and are available from the authors. Since $\bar{R}^2$ is proportional to R^2, the portfolio that gives the maximal R^2 also gives the maximal $\bar{R}^2$. $\bar{R}^2$ provides a better comparison across specifications with different numbers of instrumental variables as it is adjusted for the degree of freedom.
9. Similar results are documented in Fama (1990) and Schwert (1990).

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