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Pacific-Basin stock markets and real activity

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Abstract

This paper investigates the relationship between the Pacific-Basin country stock returns and real economic activity. It also examines the importance of the Japanese and U.S. economies to the Pacific-Basin financial markets by investigating the effects of the former's industrial production growth rates on the latter's stock market movements. We find that the representative global instrumental variables can explain up to 18% of the monthly portfolio real return variability in the Pacific-Basin stock markets and 46% of the quarterly variability. Our evidence shows that U.S. industrial production growth rates tend to exhibit a stronger and more stable relationship with the Pacific-Basin real stock returns.

Key words: Asset pricing; Pacific-Basin stock markets; Real activity; Maximal R^2; MEP

JEL classification: G12; G15

1. Introduction

Over the past decade, the Pacific-Basin countries have been experiencing a rapidly growing importance in the global economy, resulting from their impressive economic growth and industrialization. While the world's industrialized nations grew at an annual rate of 3.1% in the 1980s, these Pacific-Basin countries such as Singapore, Japan, and Hong Kong grew more than twice as quickly as the world average. The economic dynamism suggests the

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likely emergence of an economic community in the Pacific-Basin region that parallels the European Economic Community.

The developments and changes toward a more cohesive and integrated region have attracted considerable research interests in the Pacific-Basin equity markets. Many studies, for example, have focused on: (1) the time series behavior of stock returns on the Pacific-Basin markets (Bailey et al., 1990), (2) the possible linkage of the Pacific-Basin stock returns via the lead-lag correlations among the stock returns or via the transmission of stock market volatility from one stock market to another (Ng et al., 1991), (3) the integration of the Pacific-Basin equity markets with the other national markets (Cho et al., 1986; Harvey, 1991; Campbell and Hamao, 1992), and (4) the diversification benefits to foreign investors for holding stocks that are traded on the Pacific-Basin stock markets (Bailey and Stulz, 1990). In contrast, there has been very little work investigating the relationships between the Pacific-Basin stock returns and macroeconomic variables, including measures of real activity.

In this paper we present an integrated approach to investigate the sources of total real stock return variation in the Pacific-Basin stock markets. Motivated by Fama (1990), we examine whether macroeconomic variables that proxy for time-varying expected returns, shocks to expected returns, and shocks to expected cash flows are the key elements that measure the total variation of the Pacific-Basin real stock market index returns. Fama argues that future production activity contains useful information pertaining to future cash flows; we therefore use future industrial production (IP) growth rates as proxies for shocks to expected cash flows. Using the post-1953 monthly and quarterly data, he finds that 43% of the annual real U.S. stock return variability are attributed to the variation of future U.S. IP growth rates and 30% to time-varying expected returns and shocks to expected returns. However, the combined explanatory power of these variables is about 59%.[1] Fama further shows that the shorter the holding period, the weaker the explanatory powers of these variables.

This study differs from Fama's (1990) in that we employ global information variables to explain real stock return variations in the Pacific-Basin region. Given the strong global economic linkages among these countries, it is of interest to investigate whether a common set of global economic variables has the ability to explain the variation of real returns in the Pacific-Basin stock markets. For this study, we use monthly and quarterly data on the national stock indexes of Australia, Hong Kong, Japan, and Singapore/Malaysia. We select macroeconomic variables that are representative of the

[1] Schwert (1990) extends the sample period from 1889 to 1988, and finds Fama (1990) results to be robust even with a much longer sample period.

existing empirical literature and are derived from both theoretical and empirical considerations.

Our analysis employs the Lo and MacKinlay (1992) procedure for the following reasons. First, the procedure allows us to determine the maximum explanatory power of a given set of determinants for portfolio returns, as measured by the R^2.[2] Second, it provides a systematic way to search for the best performance a financial valuation model can possibly achieve. Third, the method also allows us to assess the economic and statistical significance of the representative variables we use to explain the national stock returns.

We also investigate the relative importance of the Japanese and U.S. economies to the Pacific-Basin equity markets. Notwithstanding the fact that the Japanese and U.S. stock markets are the two largest in the world in terms of the market value of equity, the motivation for our investigation is primarily derived from the evolving U.S. and Japanese economic and financial roles in the world economy. To compare their influences on the Pacific-Basin equity markets, we use future Japanese and U.S. IP growth rates as two different proxies for expected cash flow shocks in this region. We also explore whether the trade patterns between the Pacific-Basin countries and the U.S. can provide an insight concerning the observed correlation patterns between real stock returns and the two IP growth rates.

The remainder of this paper is organized as follows. Section 2 describes the data and their sample statistics. The models and methodology are discussed in Section 3. Section 4 contains analyses of both the individual country stock index returns and portfolio returns. Section 5 summarizes the paper.

2. Data

The data on the national stock equity indexes of Australia, Hong Kong, Japan, and Singapore/Malaysia are provided by Morgan Stanley Capital International (MSCI).[3] 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 cash flows

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[2] Roll (1988), for example, has suggested using the coefficient of determination R^2 to measure the explanatory power and performance of a financial valuation model.

[3] Morgan Stanley Capital International also provides data on New Zealand. However, this data series starts from 1977 and is therefore excluded from this study.

are drawn from both theoretical and empirical considerations. These variables are representative of those used in the existing studies on international capital markets (e.g. Harvey, 1991; Solnik, 1991; Bekaert and Hodrick, 1992; Campbell and Hamao, 1992; Ferson and Harvey, 1992; Cheung et al., 1993; Cheung and Ng, 1994). The proxies for time-varying expected returns are: (1) the dividend yield on 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.

As in Fama (1990), the 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, and the quarterly future IP growth rates are used to measure shocks to expected cash flows. Data on the interest rates and IP indexes are obtained from the CRSP bond files and CITIBASE, respectively. In this study, we consider the Japanese and U.S. IP indexes as proxies because of their dominant positions in the Pacific-Basin region and in the world economy.

Table 1 presents summary statistics of national real stock returns and the proxy variables. Notice that for both monthly and quarterly data, the rate of returns on the Hong Kong stock market is the most volatile among these markets. The autocorrelations of *TERM*, *SHD*, *SHM*, and stock returns are small. The means and standard deviations of the U.S. and Japanese IP growth rates are very similar. However, the U.S. IP data are less persistent than those of the Japanese because the former has smaller estimated autocorrelations.

3. Models and methodology

As in Fama (1990) and Schwert (1990), the following three regression models that describe the relation between real stock returns and variables proxying for time-varying expected returns, global shocks to expected returns, and global shocks to expected cash flows are considered:

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

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

and

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

Table 1
Descriptive statistics of the country real stock returns and global proxies for expected returns, expected return shocks, and expected cash flow shocks

	Mean	Std Dev	$\rho(1)$	$\rho(2)$	$\rho(3)$	$\rho(4)$	$\rho(5)$
Monthly Data							
AUR	0.01	0.08	−0.01	−0.06	−0.00	0.01	−0.02
HKR	0.02	0.12	0.06	−0.04	−0.01	−0.05	−0.02
JPR	0.02	0.07	0.08	0.01	0.07	0.03	0.07
SMR	0.02	0.09	0.16	−0.01	−0.08	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	−0.02	−0.16	0.04	0.07
SHD	0.00	0.08	−0.10	−0.09	0.19	−0.02	0.08
SHM	−0.02	3.32	−0.00	−0.02	−0.16	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	−0.01	−0.09	0.08	0.00	−0.00
HKR	0.07	0.23	−0.04	−0.12	0.13	−0.06	−0.10
JPR	0.05	0.13	0.03	0.15	0.10	0.16	−0.15
SMR	0.05	0.20	−0.00	−0.11	0.12	−0.00	−0.14
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	−0.18
SHD	0.00	0.19	−0.13	0.05	−0.07	0.20	0.12
SHM	−0.13	6.42	0.01	0.05	0.11	0.07	−0.17
JPIP	1.01	2.05	0.44	0.30	0.17	−0.16	−0.31
USIP	0.66	2.05	0.40	0.05	0.06	0.01	−0.15

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*. *JPIP* and *USIP* are the growth rates of the Japanese and U.S. industrial production indexes, respectively. The mean and standard deviation of each series are reported under 'Mean' and 'Std Dev.' $\rho(k)$ represents the kth lag auto-correlation coefficient estimate.

r_t is the real return on a country stock index, P_{t+i} is the growth rate of the Japanese or U.S. IP index from $t+i$ to $t+i+3$, v_t is the error term, and the other variables are defined in the previous section. 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.

Let $Z_t=(r_{1t}, \ldots ,r_{Nt})'$ be the vector of N individual country real stock returns, X_t is a $K \times 1$ vector of explanatory variables, B is the $N \times K$ coefficient matrix, and $\epsilon_t = (v_{1t}, \ldots, v_{Nt})'$ contains the corresponding regression error terms. That is,

$$Z_t = BX_t + \epsilon_t. \tag{1}$$

It is assumed that $\text{Var}[B'X_t] = \Gamma_x$, $\text{Var}[Z_t] = \Gamma_z$, $E[\epsilon_t | X_t] = 0$, and $\text{Var}[\epsilon_t | X_t] = \Sigma$. Suppose γ is an Nx1 vector of portfolio weights which sum to one, and $\gamma' Z_t$ is the real return on the portfolio. Then the proportion of variation in $\gamma' Z_t$ explained by X_t, as measured by the coefficient of determination, is given by

$$R^2(\gamma) \equiv 1 - \text{Var}[\gamma' \epsilon_t]/\text{Var}[\gamma' Z_t] = (\gamma' \Gamma_x \gamma)/(\gamma' \Gamma_z \gamma). \tag{2}$$

Given Z_t and X_t, the $R^2(\gamma)$ of the portfolio is a function of the portfolio weights. By varying γ, one can obtain the portfolio for which the chosen X_t has the best explanatory power. Lo and MacKinlay (1992) show that the maximum of $R^2(\gamma)$ and the corresponding γ are given by the largest eigenvalue of the matrix $L = \Gamma_Z^{-1} \Gamma_x$ and the eigenvector associated with this eigenvalue. We call the portfolio that yields the maximal $R^2(\gamma)$, the maximally explainable portfolio (MEP). Throughout our analysis, we use the maximal $\bar{R}^2(\gamma)$, which is the maximal $R^2(\gamma)$ adjusted for the number of regressors in the model. Since $\bar{R}^2(\gamma)$ is proportional to $R^2(\gamma)$, the portfolio that gives the maximal $R^2(\gamma)$ also gives the maximal $\bar{R}^2(\gamma)$.

To account for the possible bias imparted by the in-sample γ-searching process, Lo and MacKinlay (1992) derive the distribution of the maximal $\bar{R}^2(\gamma)$ under the null hypothesis that the X_ts have no ability to explain the movements in $\gamma' Z_t$. However, they point out that it is computationally intractable to tabulate the critical values of the maximal $\bar{R}^2(\gamma)$ for all the relevant N, K, and sample sizes. It is therefore suggested that Monte Carlo methods be used to generate the required critical values. In this paper 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 maximal $\bar{R}^2(\gamma)$ and the associated γ are then computed from these random vectors and X_ts. We replicate this procedure 10,000 times to tabulate the empirical distribution of the maximal $\bar{R}^2(\gamma)$.

4. Empirical results

4.1. Individual country analyses

Results of the estimated models M1, M2, and M3 using both monthly and quarterly observations are presented in Table 2. In addition to the full-sample period 1970 to 1991, we also consider two non-overlapping subsample periods: (i) 1970–1980, and (ii) 1981–1991. For the interest of brevity, we only report the adjusted coefficients of determination, $\bar{R}^2$s.[4]

From Table 2, we observe that for the full-sample period, the magnitudes of the $\bar{R}^2$s from both M1 and M3 are comparable with those found in Fama (1990) and Schwert (1990). The $\bar{R}^2$s are typically less than 10% for the monthly regressions and about 20% for the quarterly. On the other hand, the $\bar{R}^2$s from the estimated M2 models are different for the two time horizons. While the monthly $\bar{R}^2$s are similar to those reported by Fama (1990) and Schwert (1990), the quarterly's are generally smaller. This is evidence of changes in the correlation pattern between real stock returns and the proxy variables for time-varying expected returns and expected return shocks across different holding periods. Overall, the results suggest that the predetermined global information variables have the ability to explain the variability of individual Pacific-Basin country real stock returns.

Our results also show that future IP growth rates proxying for shocks to expected cash flows have better explanatory power than do proxies for time-varying expected returns and expected return shocks for the country real quarterly stock returns. The monthly $\bar{R}^2$s for the M1 models are typically smaller than the quarterly. The evidence is consistent with Fama's (1990, p. 1094–6) finding on the relationship between real returns on the New York Stock Exchange market index and the U.S. IP growth rates. Specifically he argues that, because of the measurement-error problem, the IP growth rates can better explain long-horizon than short-horizon return data.

In comparing the $\bar{R}^2$s of each country across the two subperiods, we find that the $\bar{R}^2$s seem to be lower in the second subsample, with 29 of the 40 estimations yielding a smaller $\bar{R}^2$. This implies a weaker correlation between real stock returns and global information variables in the 1980s than in the 1970s. The evidence is more predominant for models that include the Japanese IP growth rates as explanatory variables.

For models using the Japanese IP growth rates as regressors, there is only one out of 16 first subperiod $\bar{R}^2$s that is smaller than the second subperiod's. For the second subperiod, in 14 out of 16 models the $\bar{R}^2$s are typically larger using the U.S. than the Japanese IP growth rate data. This suggests that the U.S. IP data have a better explanatory power for the Pacific-Basin equity returns in the 1980s than do the Japanese data. The decreased explanatory power of the Japanese IP data across the sample period results in smaller observed $\bar{R}^2$s in the second subperiod. The relationships between real stock returns and the two IP indexes will be further examined in subsection 4.3.

[4] Detailed results are available from the authors upon request.

Table 2
Adjusted coefficients of determination from regressing monthly and quarterly Pacific-Basin country real stock returns on proxies for time-varying expected returns, expectod return shocks, and expected cash flow shocks

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

The table reports adjusted coefficients of determination of the estimated models M1, M2, and M3, which are given in Section 3 of 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.

Table 3
Results of regressing monthly and quarterly maximally explainable portfolio (MEP) real returns on future production growth rates

	U.S. IP Data				Japanese IP Data			
	Monthly		Quarterly		Monthly		Quarterly	
	α_i	SE	α_i	SE	α_i	SE	α_i	SE
1970–1991								
P_t	−0.44	2.39	−1.65	0.68	−3.68	2.92	−2.32	1.03
P_{t+3}	8.82	1.98	3.21	0.54	7.74	2.57	2.75	0.96
P_{t+6}	1.99	1.87	1.03	0.46	3.38	2.14	1.86	0.77
P_{t+9}	2.93	1.36	0.57	0.48	0.81	1.91	0.34	0.81
$R^2(\bar{\gamma})$	0.11		0.34		0.08		0.27	
1970–1980								
P_t	2.11	2.65	−1.13	0.71	−0.12	3.23	−1.34	0.90
P_{t+3}	6.51	2.22	2.38	0.53	8.67	2.87	2.87	0.91
P_{t+6}	2.58	2.22	1.28	0.51	−0.90	2.47	1.24	0.77
P_{t+9}	3.11	1.52	0.04	0.45	3.16	2.13	−0.03	0.79
$\bar{R}^2(\bar{\gamma})$	0.13		0.39		0.16		0.39	
1981–1991								
P_t	−0.94	0.44	−5.45	1.26	−1.69	0.59	−3.90	2.41
P_{t+3}	2.28	0.52	6.40	1.56	1.10	0.65	1.98	1.64
P_{t+6}	−0.32	0.49	1.81	1.27	1.00	0.51	3.40	1.81
P_{t+9}	0.29	0.40	−1.71	1.41	1.01	0.62	3.84	1.73
$\bar{R}^2(\bar{\gamma})$	0.15		0.38		0.10		0.31	

Results are based on the model M1: $r_t = \alpha + \alpha_1 P_t + \alpha_2 P_{t+3} + \alpha_3 P_{t+6} + \alpha_4 P_{t+9} + v_t \cdot r_t$ is the real return on the monthly or quarterly MEPs constructed from individual Pacific-Basin country stock indexes. P_{t+i} is the U.S. or Japanese industrial production growth rates from $t+i$ to $t+i+3$. $\bar{R}^2(\bar{\gamma})$ is the estimated maximal adjusted coefficient of determination. Heteroskedasticlty-consistent standard errors are reported under 'SE'.

4.2. The maximally explainable portfolio

Although variables proxying for time-varying expected returns, expected return shocks, and shocks to expected cash flows appear to explain the return variation in the Pacific-Basin stock markets, their economic and statistical significance have yet to be determined. In this subsection we investigate the explanatory power of these global proxy variables from an alternative perspective. The MEP that provides the maximum explanatory power with respect to the global proxy variables is constructed. The sources of the MEP real return variation and the significance of the MEP results are evaluated in the following subsections.

Regression results of the MEP models are given in Tables 3, 4, and 5. These tables report the $\bar{R}^2(\bar{\gamma})$s, estimated maximal $\bar{R}^2(\gamma)$s of portfolios constructed from country stock indexes, coefficient estimates of the MEP

Table 4
Results of regressing monthly and quarterly maximally explainable portfolio (MEP) real returns on proxies for time-varying expected returns and expected returns shocks

	Monthly		Quarterly	
	α_1	SE	α_i	SE
1970–1991				
PDY_{t-1}	3.78	4.52	18.64	9.13
TED_{t-1}	−9.50	3.70	−19.77	14.35
$TERM_{t-1}$	0.37	0.10	−4.01	2.53
SHD_t	−13.74	4.01	4.92	18.13
SHM	0.14	0.11	4.33	2.52
$\bar{R}^2(\bar{\gamma})$	0.12		0.06	
1970–1980				
PDY_{t-1}	15.90	11.32	81.33	20.99
TED_{t-1}	−11.77	5.58	−42.90	12.36
$TERM_{t-1}$	0.27	0.22	9.22	5.21
SHD_t	−26.18	8.14	−26.83	19.75
SHM_t	0.05	0.25	−10.83	5.74
$\bar{R}^2(\bar{\gamma})$	0.12		0.37	
1981–1991				
PDY_{t-1}	12.50	13.29	−0.64	19.74
TED_{t-1}	−21.46	6.12	−26.50	15.70
$TERM_{t-1}$	0.53	0.21	−4.41	1.83
SHD_t	−22.16	7.30	32.10	16.37
SHM_t	−0.01	0.19	4.56	1.86
$\bar{R}^2(\bar{\gamma})$	0.16		0.14	

Results are based on the model M2: $r_t = \alpha + \alpha_5 PDY_{t-1} + \alpha_6 TED_{t-1} + \alpha_7 TERM_{t-1} + \alpha_8 SHD_t + \alpha_9 SHM_t + v_t \cdot r_t$ is the real return on the monthly or quarterly MEPs constructed from individual Pacific-Basin country 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 first-order autoregressions fitted to *TED* and *TERM*. $\bar{R}^2(\bar{\gamma})$ is the estimated maximal adjusted coefficient of determination. Heteroskedasticity-consistent standard errors are reported under 'SE'.

models, and heteroskedasticity-consistent standard errors. The $\bar{R}^2(\bar{\gamma})$ yields an estimate of the maximum proportion of variation in portfolio returns that can be explained by the predetermined global information variables. In all these tables the $\bar{R}^2(\bar{\gamma})$s are strikingly larger than the largest $\bar{R}^2$ of the individual country-real-return regressions, indicating a potential gain of the global variables' explanatory power when portfolio – rather than individual –

Table 5
Resuls of regressing monthly and quarterly maximally explainable portfolio (MEP) real returns on proxies for time-varying expected returns, expected returns shocks, and expected cash flow shocks

	U.S. IP Data				Japanese IP Data			
	Monthly		Quarterly		Monthly		Quarterly	
	α_i	SE	α_i	SE	α_i	SE	α_i	SE
1970–1991								
PDY_{t-1}	−0.21	4.36	−4.54	4.73	2.37	4.30	−1.96	5.02
TED_{t-1}	−2.58	3.95	1.15	6.47	−5.72	3.41	11.45	9.15
$TERM_{t-1}$	0.35	0.10	−0.70	1.18	0.37	0.10	−2.07	1.43
SHD_t	−8.20	3.94	3.29	8.64	−9.84	3.96	0.83	10.44
SHM_t	0.17	0.11	0.82	1.23	0.14	0.11	2.29	1.58
P_t	1.71	2.23	−1.49	0.81	−2.10	2.09	−2.05	1.14
P_{t+3}	5.13	1.88	3.19	0.54	5.01	1.92	3.31	1.06
P_{t+6}	1.87	1.58	1.10	0.49	1.78	1.72	1.83	0.73
P_{t+9}	2.05	1.45	0.52	0.59	1.53	1.70	0.11	0.88
$R^2(\hat{\gamma})$	0.15		0.31		0.14		0.26	
1970–1980								
PDY_{t-1}	12.11	12.45	−17.41	15.25	12.84	10.67	−28.77	11.10
TED_{t-1}	−2.02	9.31	19.49	13.89	−10.88	5.91	40.66	13.70
$TERM_{t-1}$	0.23	0.23	−2.33	3.91	0.13	0.20	−10.34	4.06
SHD_t	−21.24	9.54	−8.93	19.01	−7.72	7.76	−13.88	16.88
SHM_t	0.12	0.25	2.58	4.10	0.14	0.21	11.65	4.29
P_t	0.45	0.32	−0.99	1.15	0.55	3.14	−1.20	0.77
P_{t-3}	0.36	0.29	2.58	0.85	7.02	2.60	3.76	0.97
P_{t+6}	0.03	0.22	1.74	0.70	−2.46	2.40	1.44	0.77
P_{t+9}	0.25	0.19	0.08	0.78	3.22	2.05	−0.18	0.86
$\bar{R}^2(\hat{\gamma})$	0.13		0.31		0.17		0.46	
1981–1991								
PDY_{t-1}	9.06	12.45	−2.84	15.32	11.78	11.81	−7.82	15.84
TED_{t-1}	−15.24	5.67	−9.61	14.21	−16.29	5.10	−3.11	11.71
$TERM_{t-1}$	0.61	0.20	−7.08	1.99	0.50	0.17	1.11	1.97
SHD_t	−19.18	6.17	22.92	15.71	−19.05	6.16	3.89	13.88
SHM_t	0.09	0.20	7.17	2.00	0.06	0.18	−0.99	2.02
P_t	8.50	4.46	−6.39	1.68	−0.75	4.48	−3.86	2.22
P_{t+3}	1.40	5.46	6.78	1.82	2.32	4.29	1.89	1.57
P_{t+6}	−1.51	5.66	1.16	1.71	4.41	3.20	3.39	1.76
P_{t+9}	5.52	4.44	−4.55	1.66	3.42	3.54	3.70	1.93
$\bar{R}^2(\hat{\gamma})$	0.18		0.40		0.15		0.21	

Results are based on the model M3: $r_t = \alpha + \alpha_1 P_t + \alpha_2 P_{t+3} + \alpha_3 P_{t+6} + \alpha_4 P_{t+9} + \alpha_5 PDY_{t-l} + \alpha_6 TED_{t-l} + \alpha_7 TERM_{t-l} + \alpha_8 SHD_t + \alpha_9 SHM_t + v_t \cdot r_t$ is the real return on the monthly or quarterly MEPs constructed from individual Pacific-Basin country stock indexes. P_{t+i} is the U.S. or Japanese industrial index growth rate from $t+i$ to $t+i+3$. *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 first-order autoregressions fitted to *TED* and *TERM*. $\bar{R}^2(\hat{\gamma})$ is the estimated maximal adjusted coefficient of determination. Heteroskedasticity-consistent standard errors are reported under 'SE'.

equity returns are examined. It is further suggestive of significant cross effects among country real returns and among the global variables.

In general, the patterns of the estimated coefficients reported in Tables 3, 4, and 5 are similar to those based on individual country stock analyses. The real returns are mainly positively related to future IP growth rates. In contrast, the correlation between real returns and proxies for time-varying expected returns and unexpected return shocks is weaker in the presence of future IP growth rates. The $\bar{R}^2(\tilde{y})$ of model M3 is smaller than the sum of the corresponding models M1 and M2, suggesting the combined explanatory power of global information variables is weaker than the sum of the explanatory powers of individual variables. The observed phenomenon can be attributed to the correlation among the global information variables.[5]

In Table 3 the $\bar{R}^2(\tilde{y})$s of M1 are larger for the quarterly than monthly models. However, results of M2 reported in Table 4 show that the quarterly model has a higher $\bar{R}^2$ $(\tilde{y})$ only in the 1970–1980 subsample period. When comparing the results across different sample periods, several observations are made. Table 3 shows that the relationship between real returns and the IP growth rates is fairly stable over time. The $\bar{R}^2(\tilde{y})$s reported in Table 4 suggest that the quarterly real returns respond differently to changes in the proxies for time-varying expected returns and expected return shocks across the sample periods. Specifically the coefficient estimates in the first subsample period are quite different from those in the second. This partly explains why the $\bar{R}^2(\tilde{y})$ of the full sample model is much lower than those in the subsamples.

As seen from Table 5, the explanatory powers of the combined global information variables in the full sample period are 15% for the monthly and 31% for the quarterly real return on the MEPs when using the U.S. IP growth rates; they are slightly lower when using the Japanese IP growth rates. The largest $\bar{R}^2(\tilde{y})$s for the monthly and quarterly M3 models are, respectively, 18% from the second subperiod and 46% from the first subperiod. When comparing the subperiod performance, the combined explanatory powers of these variables are different for the two subperiods. In the second subperiod, the models including U.S. IP growth rates as explanatory variables give a larger $\bar{R}^2(\tilde{y})$ in the second subperiod, whereas those including the Japanese IP growth rates as regressors yield a smaller $\bar{R}^2(\tilde{y})$. However, the explanatory power unambiguously increases with the holding horizon.

4.3. Effects of the U.S. and Japanese IP growth rates

In this subsection we examine the effects of the U.S. and Japanese IP

[5] Similar results are documented in Fama (1990) and Schwert (1990).

growth rates on the MEP return. For the entire sample and second subperiod, the models using the U.S. IP growth rates as regressors generally yield a higher $\bar{R}^2(\bar{y})$ than those using the Japanese IP growth rates. The U.S. IP growth rates display a stronger effect in the second subperiod, while those of the Japanese are stronger in the first subperiod. These results apparently contradict the notion that Japan is gaining importance in the world economy and world capital market over the past decade.

These varying effects of the IP growth rates on the Pacific-Basin stock markets, however, may be explained by the trade positions maintained by the Pacific-Basin countries with the U.S. and Japan since international trade is one of the channels to transmit disturbances from one country to the another. Given their liberation and reliance on international trade, we expect trading activity will have a sizable effect on these Pacific-Basin country domestic economies. For instance, through her import demand, the U.S. or Japan can affect the economic activity in these Pacific-Basin countries, and hence their equity market performance. Thus we conjecture that the Pacific-Basin countries' exports to the U.S. and Japan may have some implications on the observed correlations between real stock returns and the two IP series.

Annual data on the Pacific-Basin countries' exports to the U.S. and Japan are used to infer the relative U.S. and Japanese influences on the former's stock markets. These data are extracted from the International Monetary Fund publications, *Directions of Trade Statistics.* Specifically, for each Pacific-Basin country, we calculate an annual ratio as its exports to the U.S. divided by its exports to Japan. In the case of Japan, the annual ratio of the U.S.'s imports from Japan to the Japanese IP index is used. Averages of these annual ratios for each subperiod are:

	Australia	Hong Kong	Japan	Malaysia	Singapore
1970–80	0.384	4.479	0.227	0.791	1.662
1981–91	0.399	5.768	0.678	0.808	2.220

Apart from Japan, these countries export relatively more to the U.S. than to Japan in the 1980s. During the period from 1970 to 1980, the growth rate of the Japanese exports to the U.S. is more than 100% of her own IP level. As indicated by their relative exports to the U.S., these countries seem to be more affected by the U.S. real aggregate activity in the 1980s than the 1970s. These statistics corroborate our above findings that the equity markets of these Pacific-Basin countries are more responsive to the economic development in the States during the second subperiod.

Table 6
Portfolio weights of monthly and quarterly maximally explainable portfolios (MEPs) constructed from Pacific-Basin country real stock indexes.

	U.S. IP Data						Japanese IP Data					
	Monthly			Quarterly			Monthly			Quarterly		
	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
1970–1991												
AUR	0.12	0.33	0.22	0.36	−0.69	0.39	0.46	0.33	0.35	0.49	−0.69	0.43
HKR	0.03	−0.01	−0.02	0.05	0.85	0.02	−0.09	−0.01	−0.05	−0.09	0.85	−0.10
JPR	0.53	0.70	0.66	0.39	1.26	0.40	0.27	0.70	0.57	0.14	1.26	0.09
SMR	0.32	−0.02	0.13	0.19	−0.42	0.19	0.35	−0.02	0.12	0.47	−0.42	0.58
1970–1980												
AUR	0.00	−0.08	−0.21	0.46	−0.92	0.71	0.15	−0.08	0.03	0.37	−0.92	0.72
HKR	0.06	−0.13	−0.07	0.06	0.51	−0.02	0.08	−0.13	0.07	0.05	0.51	−0.02
JPR	0.81	1.06	1.14	0.52	2.14	0.20	0.57	1.06	0.70	0.39	2.14	−0.14
SMR	0.13	0.16	0.14	−0.05	−0.74	0.11	0.20	0.16	0.19	0.19	−0.74	0.44
1981–1991												
AUR	0.16	0.64	0.62	−0.42	0.24	−0.63	0.78	0.64	0.62	0.79	0.24	0.81
HKR	−0.30	0.23	−0.12	0.08	0.76	0.53	−0.82	0.23	0.07	−0.40	0.76	−0.37
JPR	0.37	0.61	0.62	0.43	0.23	0.25	0.25	0.61	0.55	−0.07	0.23	−0.05
SMR	0.77	−0.47	−0.36	0.91	−0.23	0.85	0.79	−0.47	−0.24	0.68	−0.23	0.61

This table presents the portfolio weights of the MEPs, which are used to generate regression results reported in Table 3 (model M1), Table 4 (model M2), and Table 5 (model M3). *AUR*, *HKR*, *JPR*, and *SMR* are U.S. dollar-denominated real returns on the Australia, Hong Kong, Japan, and Singapore/Malaysia stock markets, respectively.

4.4. Portfolio weights of the MEP

The portfolio weights determine the contribution of each country stock index to the MEP. Table 6 reports the weights of the MEPs that are used to generate the results reported in Tables 3, 4, and 5. For each model specification, these estimated portfolio weights appear to change with the sample period and the holding-period horizon.

In the first subsample period, the portfolio weights are mainly concentrated in the two countries: Australia and Japan. The weights assigned to Hong Kong are generally less than 10% and those assigned to Singapore/Malaysia are usually less than 20%. In the second subsample period, the weights, however, are more evenly spread across the countries. The pattern of the portfolio weights for the entire sample is similar to that for the first subperiod, 1970–1980, in which the Australian and Japanese stock markets are the sources of the explained portion of these portfolio movements. In general, Australia and Japan contribute the most in terms of the explained components in these MEPs, and their weight allocations reflect the relative sensitivity of Australia and Japan to developments in the world economy.

Results in Table 6 show that the portfolio weights change dramatically with the time horizon. For example, the weight of the Australian stock index in the full sample model M2 decreases from 0.33 using monthly observations to -0.69 using the quarterly. These changes in weights across holding periods indicate that patterns of the correlation structure for these stock indexes also vary across time.

4.5. The significance of $\bar{R}^2(\tilde{\gamma})$

The empirical distributions of the maximal $\bar{R}^2(\gamma)$ simulated under the null hypothesis that the global information variables have no explanatory power for real stock returns are reported in Table 7. These distributions are generated with respect to different time horizons, different observations relating to the varying sample periods, and different model specifications considered in the previous subsections.

Based on simulated critical values, we find that the $\bar{R}^2(\tilde{\gamma})$s of the M1 models using U.S. IP growth rates are all significant at the 5% level. In contrast, those based on the monthly and quarterly Japanese IP growth rates are not significant in the second subperiod. For model M2, only two out of six $\bar{R}^2(\tilde{\gamma})$s are significant at the 5% level. Results based on model M3 indicate that the correlations between real returns and the global variables are significant in the full sample period. However, some of the subperiod results are likely to be spurious.

While the proxies for time-varying expected returns and expected return shocks have some explanatory power, future IP growth rates are significantly correlated with the real return on the MEP. The evidence shows significant economic relationship between the country real returns and aggregate real activity over the entire sample. However, unlike the full sample results, some of the subsample $\bar{R}^2(\tilde{\gamma})$s are insignificant. There are two possible reasons why the subperiod results are not significant. One, it may be due to the low power of the test associated with a small sample size. Two, due to fluctuating business cycles, the impact of real economic activity on the national stock indexes may not be immediate.

4.6. The constrained maximally explainable portfolio

In forming the MEPs reported in the previous subsections, no explicit restrictions on the portfolio weights are imposed. We merely determined the best attainable explanatory power of these global information variables. The sign and size of these weights are functions of the strength in correlation

Table 7
Empirical distributions of the maximal $\bar{R}^2$ of the maximally explainable portfolios (MEPs) simulated under the null hypothesis of no explanatory power.

	Mean	SD	Min	Max	1%	5%	10%	50%	90%	95%	99%
Model M1											
MFUS	0.029	0.016	−0.006	0.136	0.002	0.007	0.010	0.027	0.049	0.057	0.074
QFUS	0.089	0.046	−0.022	0.373	0.007	0.024	0.034	0.083	0.151	0.173	0.219
MFJP	0.028	0.015	−0.005	0.108	0.002	0.007	0.010	0.026	0.048	0.056	0.074
QFJP	0.088	0.046	−0.019	0.292	0.005	0.023	0.034	0.083	0.149	0.171	0.218
M1US	0.061	0.032	−0.008	0.256	0.005	0.016	0.023	0.057	0.103	0.120	0.152
Q1US	0.188	0.090	−0.034	0.611	0.019	0.056	0.079	0.179	0.310	0.351	0.422
M1JP	0.060	0.032	−0.013	0.253	0.005	0.016	0.022	0.056	0.103	0.118	0.151
Q1JP	0.187	0.090	−0.038	0.593	0.017	0.054	0.078	0.179	0.307	0.346	0.428
M2US	0.060	0.032	−0.012	0.232	0.003	0.015	0.023	0.056	0.103	0.119	0.152
Q2US	0.189	0.091	−0.042	0.650	0.019	0.055	0.078	0.180	0.312	0.354	0.432
M2JP	0.061	0.033	−0.010	0.236	0.003	0.016	0.023	0.057	0.105	0.121	0.155
Q2JP	0.187	0.089	−0.019	0.584	0.020	0.056	0.080	0.178	0.307	0.346	0.431
Model M2											
MF	0.032	0.017	−0.009	0.118	0.003	0.008	0.012	0.029	0.054	0.062	0.079
QF	0.097	0.049	−0.021	0.329	0.006	0.026	0.038	0.092	0.162	0.184	0.229
M1	0.066	0.034	−0.014	0.267	0.005	0.018	0.026	0.063	0.112	0.128	0.161
Q1	0.208	0.095	−0.051	0.622	0.022	0.066	0.090	0.200	0.335	0.376	0.459
M2	0.066	0.034	−0.013	0.250	0.005	0.018	0.026	0.063	0.110	0.129	0.162
Q2	0.209	0.093	−0.046	0.618	0.025	0.068	0.093	0.203	0.333	0.377	0.449

Model M3											
MFUS	0.041	0.020	−0.010	0.136	0.004	0.012	0.017	0.039	0.067	0.077	0.094
QFUS	0.127	0.057	−0.041	0.398	0.016	0.041	0.057	0.123	0.202	0.229	0.277
MFJP	0.041	0.020	−0.010	0.156	0.003	0.012	0.017	0.038	0.067	0.076	0.097
QFJP	0.127	0.057	−0.023	0.368	0.014	0.041	0.057	0.122	0.204	0.228	0.281
M1US	0.087	0.041	−0.016	0.286	0.010	0.027	0.037	0.083	0.142	0.160	0.198
Q1US	0.278	0.111	−0.052	0.732	0.035	0.102	0.139	0.274	0.422	0.468	0.554
M1JP	0.087	0.040	−0.023	0.257	0.009	0.026	0.038	0.084	0.140	0.160	0.192
Q1JP	0.279	0.110	−0.119	0.733	0.047	0.106	0.140	0.273	0.424	0.470	0.545
M2US	0.086	0.041	−0.017	0.313	0.008	0.026	0.037	0.082	0.140	0.160	0.197
Q2US	0.279	0.111	−0.061	0.745	0.042	0.106	0.140	0.274	0.427	0.468	0.552
M2JP	0.086	0.041	−0.026	0.279	0.008	0.026	0.038	0.082	0.141	0.159	0.196
Q2JP	0.278	0.110	−0.090	0.764	0.047	0.105	0.139	0.274	0.424	0.464	0.546

Empirical distributions of the maximal adjusted coefficients of determination of the MEP specified by 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: $r_t \alpha + \alpha_5 PDY_{t-1} + \alpha_6 TED_{t-1} + \alpha_7 TERM_{t-1} + \alpha_8 SHD_t + \alpha SHM_t + v_t$, and M3 $r_t = \alpha_1 P_t + \alpha_2 P_{t+3} + \alpha_3 P_{t+6} + \alpha_4 P_{t+9} + \alpha_5 PDY_{t-1} + \alpha_6 TED_{t-1} + \alpha_7 TERM_{t-1} + \alpha_8 SHD_t + \alpha_9 SHM_t + v_t$, are reported. r_t is the real return on the monthly or quarterly maximally explainable portfolio constructed from individual Pacific-Basin country stock indexes. P_{t+i} is the U.S. or Japanese industrial production growth rate from $t+i$ to $t+i+3$. *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 first-order autoregressions fitted to *TED* and *TERM*. For each model specificatlon, we consider: (1) the monthly and quarterly observations, (2) full sample period 1970–91, and two non-overlapping subsample periods, 1970–80 and 1981–1991, and (3) the U.S. and Japanese IP growth rates, where applicable. For each case, we generate T independent 4×1 vectors of normal varlates with zero means and identity covarlance matrix as the left-hand side variables. T is the sample size. Then the maximal $\bar{R}^2(\gamma)$ and the associated γ are computed from these random vectors and the regressors. We replicate this procedure 10,000 times to tabulate the empirical distribution of the maximal $\bar{R}^2$ (γ). In the first column of the table, the first letter indicates Monthly or Quarterly data, the second letter indicates Full sample, 1st subperiod, or 2nd subperiod, and the last two letters indicate the U.S. or Japanese industrial production growth rate.

among the national stock index returns and between the stock markets and global information variables.

In this subsection we evaluate the explanatory power of these global information variables for the real returns on a constrained MEP, a portfolio which is subjected to the no short-sale restriction. In other words, the portfolio weights are constrained to be nonnegative and can be obtained numerically by incorporating the restriction $\gamma \geqslant 0$ in the algorithm used to maximize Eq. (2).[6] The finite-sample distribution of the maximal $\bar{R}^2(\gamma)$ can be derived using the simulation procedure discussed in Section 3 after taking into account the nonnegativity constraint.

Estimation results pertaining to the constrained MEPs are reported in Tables 8 through 12. As expected, $\bar{R}^2(\tilde{\gamma})$s for the constrained MEPs are smaller than those for the unconstrained MEPs. The coefficient estimates are, however, typically similar to those reported in the previous subsections. The IP growth rates exhibit a stronger correlation with the constrained MEP returns than with proxies for time-varying expected returns and shocks to expected returns. The relationship between returns on the constrained MEP and the IP growth rates is consistent across the entire sample period when the U.S. IP growth rates are included as regressors, but is weaker in the 1980s when the Japanese IP growth rates are used instead. The $\bar{R}^2(\tilde{\gamma})$s of the constrained MEPs, in general, are also very close to those of the unconstrained MEPs. Based on the simulated critical values presented in Table 12, we conclude that the estimated relationships between the constrained MEP return and the global information variables are statistically and economically significant.

5. Summary

This paper studies 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. We find that the global information variables can explain movements in the Pacific-Basin real stock market returns and that the adjusted coefficients of determination are comparable to those reported in the literature using the U.S. stock price data.

By constructing the maximally explainable portfolio consisting of these Pacific-Basin stock market indexes, we find that the global information variables can explain up to a maximum of 18% of the monthly variation in portfolio real returns and 46% of the quarterly variation. Our evidence indicates that most observed relationships using monthly data are statisti-

[6] In contrast to the case of the unconstrained MEP, there is no closed-form solution for γ that maximizes the constrained MEP.

Table 8
Results of regressing monthly and quarterly constrained maximally explainable portfolio (MEP) real returns on future production growth rates

	U.S. IP Data				Japanese IP Data			
	Monthly		Quarterly		Monthly		Quarterly	
	α_i	SE	α_i	SE	α_i	SE	α_i	SE
1970–1991								
P_t	−0.44	2.39	−1.66	0.68	−2.83	2.96	−2.15	1.05
P_{t-3}	8.83	1.98	3.21	0.54	7.50	2.57	2.88	0.97
P_{t+6}	1.99	1.87	1.03	0.46	3.07	2.12	1.64	0.78
P_{t+9}	2.93	1.36	0.57	0.48	1.08	1.88	0.38	0.81
$\bar{R}^2(\tilde{y})$	0.11		0.34		0.08		0.27	
1970–1980								
P_t	2.09	2.65	−1.24	0.76	−0.12	3.23	−1.34	0.89
P_{t+3}	6.49	2.22	2.40	0.56	8.66	2.87	2.87	0.91
P_{t+6}	2.60	2.21	1.35	0.52	−0.90	2.47	1.24	0.77
P_{t+9}	3.09	1.52	0.04	0.46	3.16	2.13	−0.03	0.78
$\bar{R}^2(\tilde{y})$	0.13		0.39		0.16		0.39	
1981–1991								
P_t	−0.66	0.44	−3.60	1.09	−0.64	0.46	−2.96	2.09
P_{t+3}	2.00	0.51	5.22	1.19	0.34	0.37	2.11	1.41
P_{t+6}	−0.22	0.46	1.27	0.94	1.01	0.32	1.99	1.55
P_{t+9}	−0.12	0.38	−0.37	1.21	0.21	0.39	2.93	1.61
$\bar{R}^2(\tilde{y})$	0.13		0.35		0.06		0.25	

Results are based on the model M1: $r_t = \alpha + \alpha_1 P_t + \alpha_2 P_{t+3} + \alpha_3 P_{t+6} + \alpha_4 P_{t+9} + v_t \cdot r_t$ is the real return on the monthly or quarterly MEPs constructed from individual Pacific-Basin country stock indexes. The portfolio weights of the MEPs are constrained to be nonnegative. P_{t+i} is the U.S. or Japanese industrial production growth rates from $t+i$ to $t+i+3$. $\bar{R}^2(\tilde{y})$ is the estimated maximal adjusted coefficient of determination. Heteroskedasticity-consistent standard errors are reported under 'SE'.

mically significant, and that some of those using the quarterly data can be spurious in nature. Similar results are obtained when the portfolio weights are restricted to be nonnegative.

Our results also show that the U.S. and Japanese IP growth rates are significantly related to the Pacific-Basin stock market real returns. The U.S. IP tends to exhibit a stronger and more stable relationship with the portfolio of country real stock returns throughout the entire sample period than does the Japanese IP. These observed patterns are consistent with the trade relationships maintained between the Pacific-Basin countries and the U.S. and Japan over the sample period. Specifically the proportions of the Pacific-Basin countries' exports to the U.S. are greater in the 1980s than in the 1970s, as compared to their exports to Japan. Also the Japanese exports to the U.S. have grown by at least 100% more than her IP index from the 1970s to 1980s.

Table 9
Results of regressing monthly and quarterly constrained maximally explainable portfolio (MEP) real returns on proxies for time-varying expected returns and expected returns shocks

	Monthly		Quarterly	
	α_i	SE	α_i	SE
1970–1991				
PDY_{t-1}	4.04	4.48	17.50	5.11
TED_{t-1}	−9.61	3.66	−5.08	10.05
$TERM_{t-1}$	0.36	0.10	−2.88	1.51
SHD_t	−13.52	3.98	0.36	12.01
SHM_t	0.15	0.11	3.22	1.54
$\bar{R}^2(\hat{\gamma})$	0.12		0.04	
1970–1980				
PDY_{t-1}	15.28	10.86	22.76	12.84
TED_{t-1}	−15.57	5.40	1.67	13.61
$TERM_{t-1}$	0.16	0.20	−1.99	4.22
SHD_t	−18.82	7.54	−26.66	18.37
SHM_t	0.10	0.22	2.24	4.47
$\bar{R}^2(\hat{\gamma})$	0.11		0.22	
1981–1991				
PDY_{t-1}	6.09	11.21	−2.20	17.60
TED_{t-1}	−12.60	4.58	−21.12	14.88
$TERM_{t-1}$	0.43	0.14	−4.39	1.72
SHD_t	−15.25	4.97	29.63	15.25
SHM_t	0.08	0.14	4.60	1.77
$\bar{R}^2(\hat{\gamma})$	0.14		0.13	

Results are based on the model M2: $r_t = \alpha + \alpha_5 PDY_{t-1} + \alpha_6 TED_{t-1} + \alpha_7 TERM_{t-1} + \alpha_8 SHD_t + \alpha_9 SHM_t + v \cdot r_t$ is the real return on the monthly or quarterly MEPs constructed from individual Pacific-Basin country stock indexes. The portfolio weights of the MEPs are constrained to be non-negative. *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 first-order autoregressions fitted to *TED* and *TERM*. $\bar{R}^2(\hat{\gamma})$ is the estimated maximal adjusted coefficient of determination. Heteroskedasticity-consistent standard errors are reported under 'SE'.

Table 10
Results of regresslng monthly and quarterly constrained maximally explainable portfolio (MEP) real returns on proxies for time-varying expected returns, expected returns shocks, and expected cash flow shocks

	U.S. IP Data				Japanese IP Data			
	Monthly		Quarterly		Monthly		Quarterly	
	α_i	SE	α_i	SE	α_i	SE	α_i	SE
1970–1991								
PDY_{t-1}	−0.02	4.34	−4.53	4.73	2.94	4.27	−0.56	4.96
TED_{t-1}	−2.91	3.97	1.14	6.47	−6.59	3.41	10.68	9.28
$TERM_{t-1}$	0.34	0.10	−0.70	1.18	0.35	0.09	−2.41	1.40
SHD_t	−8.04	3.96	3.29					
P_t	1.74	2.23	−1.49	0.81	−1.70	2.08	−1.89	1.17
P_{t+3}	5.16	1.89	3.19	0.54	4.87	1.92	3.46	1.07
P_{t+6}	1.80	1.59	1.09	0.49	1.61	1.73	1.57	0.73
P_{t+9}	2.02	1.45	0.52	0.59	1.64	1.69	0.10	0.87
$\bar{R}^2(\hat{\gamma})$	0.15		0.31		0.14		0.25	
1970–1980								
PDY_{t-1}	7.83	11.19	−13.39	14.82	12.84	10.67	−22.07	10.29
TED_{t-1}	−5.52	7.65	17.19	13.31	−10.88	5.91	35.68	12.71
$TERM_{t-1}$	0.16	0.19	−1.81	3.75	0.13	0.20	−9.17	3.76
SHD_t	−12.39	7.60	−9.72	18.29	−7.72	7.76	−14.27	16.04
SHM_t	0.12	0.22	1.99	3.94	0.14	0.21	10.31	3.96
P_t	0.25	0.28	−0.93	1.13	0.55	3.14	−1.10	0.73
P_{t+3}	0.37	0.24	2.53	0.78	7.02	2.60	3.53	0.92
P_{t+6}	0.14	0.19	1.61	0.65	−2.46	2.40	1.34	0.74
P_{t+9}	0.22	0.15	0.11	0.73	3.22	2.05	−0.22	0.80
$\bar{R}^2(\hat{\gamma})$	0.12		0.31		0.17		0.45	
1981–1991								
PDY_{t-1}	2.80	10.80	−6.84	12.52	7.71	10.72	−5.89	11.41
TED_{t-1}	−8.46	4.85	−9.12	9.75	−11.74	4.51	−10.83	9.94
$TERM_{t-1}$	0.49	0.14	−3.88	1.52	0.44	0.13	−0.72	1.60
SHD_t	−12.71	4.68	16.47	10.74	−15.37	5.05	12.48	11.54
SHM_t	0.11	0.16	4.00	1.60	0.10	0.17	0.82	1.64
P_t	3.91	3.57	−3.63	1.16	−2.32	4.06	−3.15	1.84
P_{t+3}	7.77	3.83	5.12	1.19	3.06	3.69	2.02	1.30
P_{t+6}	−2.07	4.38	0.64	1.04	5.83	2.78	2.27	1.57
P_{t+9}	4.32	3.44	−1.81	1.33	3.23	3.38	2.38	1.67
$\bar{R}^2(\hat{\gamma})$	0.17		0.35		0.14		0.35	

Results are based on the model M3: $r_t = \alpha + \alpha_1 P_t + \alpha_2 P_{t+3} + \alpha_3 P_{t+6} + \alpha_4 P_{t+9} + \alpha_5 PDY_{t-1} + \alpha_6 TED_{t-1} + \alpha_7 TERM_{t-1} + \alpha_8 SHD_t + \alpha_9 SHM_t + v \cdot r_t$ is the real return on the monthly or quarterly MEPs constructed from individual Pacific-Basin country stock indexes. The portfolio weights of the MEPs are constrained to be nonnegative. P_{t+i} is the U.S. or Japanese industrial production growth rate from $t+i$ to $t+i+3$. 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 first-order autoregressions fitted to TED and $TERM$. $\bar{R}^2(\hat{\gamma})$ is the estimated maximal adjusted coefficient of determination. Heteroskedasticity-consistent standard errors are reported under 'SE'.

Table 11
Portfolio weights of monthly and quarterly constrained maximally explainable portfolios (MEPs) constructed from Pacific-Basin country real stock indexes.

	U.S. IP Data						Japanese IP Data					
	Monthly			Quarterly			Monthly			Quarterly		
	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
1970–1991												
AUR	0.12	0.31	0.22	0.37	0.00	0.39	0.41	0.31	0.33	0.46	0.00	0.38
HKR	0.03	0.00	0.00	0.05	0.32	0.03	0.00	0.00	0.00	0.00	0.32	0.00
JPR	0.53	0.69	0.66	0.39	0.68	0.40	0.26	0.69	0.56	0.13	0.68	0.09
SMR	0.32	0.00	0.13	0.19	0.00	0.19	0.33	0.00	0.11	0.42	0.00	0.53
1970–1980												
AUR	0.00	0.00	0.00	0.47	0.00	0.64	0.15	0.00	0.03	0.37	0.00	0.63
HKR	0.06	0.00	0.00	0.05	0.20	0.00	0.08	0.00	0.07	0.05	0.20	0.00
JPR	0.81	0.90	0.89	0.48	0.80	0.29	0.57	0.90	0.70	0.39	0.80	0.00
SMR	0.13	0.10	0.11	0.00	0.00	0.08	0.20	0.10	0.19	0.19	0.00	0.37
1981–1991												
AUR	0.03	0.41	0.46	0.00	0.13	0.00	0.41	0.41	0.52	0.62	0.13	0.67
HKR	0.00	0.07	0.00	0.00	0.65	0.31	0.00	0.07	0.00	0.00	0.65	0.00
JPR	0.26	0.52	0.54	0.36	0.23	0.20	0.06	0.52	0.48	0.00	0.23	0.00
SMR	0.71	0.00	0.00	0.64	0.00	0.49	0.53	0.00	0.00	0.38	0.00	0.33

This table presents the portfolio weights of the constrained MEPs, which are used to generate regression results reported in Table 8 (model M1), Table 9 (model M2), and Table 10 (model M3). *AUR*, *HKR*, *JPR*, and *SMR* are U.S. dollar-denominated real returns on the Australia, Hong Kong, Japan, and Singapore/Malaysia stock markets, respectively.

Table 12
Empirical distributions of the maximal $\bar{R}^2$ of the constrained maximally explainable portfolios (MEPs) simulated under the null hypothesis of no explanatory power.

	Mean	S.D.	Min	Max	1%	5%	10%	50%	90%	95%	99%
Model M1											
MFUS	0.022	0.014	−0.007	0.100	0.001	0.003	0.006	0.020	0.040	0.048	0.065
QFUS	0.069	0.042	−0.021	0.403	0.004	0.011	0.019	0.062	0.124	0.147	0.195
MFJP	0.022	0.014	−0.008	0.132	0.001	0.003	0.006	0.020	0.041	0.049	0.065
QFJP	0.068	0.041	−0.022	0.279	0.002	0.012	0.020	0.061	0.124	0.145	0.188
M1US	0.047	0.029	−0.015	0.230	0.002	0.007	0.014	0.043	0.086	0.100	0.137
Q1US	0.145	0.083	−0.035	0.535	0.001	0.026	0.046	0.135	0.257	0.298	0.375
M1JP	0.047	0.029	−0.016	0.213	0.002	0.007	0.014	0.043	0.086	0.101	0.134
Q1JP	0.145	0.083	−0.038	0.618	0.003	0.028	0.046	0.135	0.257	0.297	0.381
M2US	0.047	0.029	−0.016	0.201	0.002	0.007	0.014	0.042	0.087	0.101	0.135
Q2US	0.146	0.084	−0.058	0.537	0.004	0.027	0.046	0.136	0.260	0.300	0.376
M2JP	0.048	0.030	−0.015	0.212	0.002	0.008	0.014	0.044	0.087	0.103	0.135
Q2JP	0.147	0.083	−0.053	0.575	0.003	0.028	0.047	0.137	0.258	0.298	0.383
Model M2											
MF	0.024	0.015	−0.011	0.117	0.001	0.004	0.007	0.022	0.044	0.052	0.069
QF	0.076	0.045	−0.024	0.364	0.002	0.014	0.024	0.069	0.135	0.160	0.206
M1	0.052	0.031	−0.022	0.230	0.001	0.008	0.015	0.047	0.093	0.109	0.144
Q1	0.162	0.090	−0.059	0.577	0.003	0.033	0.054	0.152	0.283	0.325	0.408
M2	0.051	0.031	−0.021	0.215	0.003	0.008	0.015	0.047	0.093	0.109	0.143
Q2	0.163	0.090	−0.052	0.565	0.001	0.033	0.054	0.153	0.284	0.326	0.412

Table 12 continued

	Mean	S.D.	Min	Max	1%	5%	10%	50%	90%	95%	99%
Model M3											
MFUS	0.031	0.018	−0.014	0.136	0.002	0.005	0.010	0.029	0.056	0.064	0.085
QFUS	0.098	0.055	−0.049	0.351	0.007	0.017	0.031	0.093	0.170	0.197	0.247
MFJP	0.032	0.018	−0.013	0.169	0.002	0.006	0.010	0.030	0.056	0.065	0.084
QFJP	0.098	0.054	−0.056	0.417	0.009	0.017	0.032	0.093	0.170	0.196	0.246
M1US	0.067	0.039	−0.032	0.250	0.004	0.012	0.021	0.062	0.118	0.138	0.180
Q1US	0.217	0.109	−0.122	0.694	0.003	0.051	0.082	0.210	0.363	0.409	0.490
M1JP	0.067	0.038	−0.031	0.262	0.004	0.011	0.021	0.062	0.117	0.137	0.173
Q1JP	0.217	0.109	−0.106	0.688	0.003	0.051	0.083	0.210	0.361	0.410	0.498
M2US	0.067	0.038	−0.034	0.273	0.004	0.013	0.022	0.063	0.118	0.135	0.174
Q2US	0.217	0.110	−0.110	0.671	0.006	0.050	0.081	0.210	0.365	0.408	0.496
M2JP	0.066	0.038	−0.028	0.324	0.004	0.011	0.021	0.062	0.117	0.135	0.171
Q2JP	0.217	0.109	−0.102	0.634	0.005	0.048	0.081	0.210	0.363	0.410	0.490

Empirical distributions of the maximal adjusted coefficients of determination of the constrained MEP specified by models M1: $r_t=\alpha+\alpha_1P_t+\alpha_2P_{t+3}+\alpha_3P_{t+6}+\alpha_4P_{t+9}+v_t$, M2: $r_t=\alpha+\alpha_5PDY_{t-1}+\alpha_6TED_{t-1}+\alpha_7TERM_{t-1}+\alpha_8SHD_t+\alpha_9SHM_t+v_t$ and M3 $r_t=\alpha+\alpha 1P_t+\alpha_2P_{t+3}+\alpha_3P_{t+6}+\alpha_4P_{t+9}+\alpha_5PDY_{t-1}+\alpha_6TED_{t-1}+\alpha_7TERM_{t-1}+\alpha_8SHD_t+\alpha_9SHM_t+v_t$, are reported. r_t is the real return on the monthly or quarterly maximally explainable portfolio constructed from individual Pacific-Basin country stock indexes. The portfolio weights are constrained to be nonnegative. P_{t+i} is the U.S. or Japanese industrial production growth rate from $t+i$ to $t+i+3$. 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 residuals from first-order autoregressions fitted to *TED* and *TERM*. For each model specification, we consider (1) the monthly and quarterly observations, (2) full sample period 1970–91, and two non-overlapping subsample periods, 1970–80 and 1981–1991, and (3) the U.S. and Japanese IP growth rates, where applicable. For each case, we generate T independent 4×1 vectors of normal variates with zero means and identity covariance matrix as the left-hand side variables. T is the sample size. Then the maximal $\bar{R}^2(\gamma)$ and the associated γ are computed from these random vectors and the regressors under the restriction $\gamma\geqslant0$. We replicate this procedure 10,000 times to tabulate the empirical distribution of the maximal $\bar{R}^2(\gamma)$. In the first column of the table, the first letter indicates Monthly or Quarterly data, the second letter indicates Full sample, 1st subperiod, or 2nd subperiod, and the last two letters indicate the U.S. or Japanese industrial production growth rate.

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