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Abstract

We test for shift contagion between pairs of East Asian equity markets over a sample including the financial crisis of the 1990's. Employing the methodology of Gravelle et al. (2006), we find little evidence of change in the mechanism by which common shocks are transmitted between countries. Furthermore, we analyze the effects of idiosyncratic shocks and generate time-varying conditional correlations. While there clearly is significant time variation in the pair wise correlations, this is not more pronounced during the Asian crisis than it had been historically.

Keywords: Shift contagion; Financial market crises; Regime switching; Structural transmission; Emerging markets

JEL Classification: F42; G15; C32

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1. Introduction

A major crisis swept through many Asian financial markets in the late 1990s. The entire financial system was rocked by adverse shocks, which spread throughout the region and affected currency, equity and fixed income markets alike. In its aftermath, both policy makers and financial market participants became embroiled in a debate as to whether or not this episode represented market contagion. The extent to which financial crises are contagious and how this contagion can be reduced or eliminated represents a major difficulty for all market agents.

Despite the voluminous literature generated during this and earlier debates following the US market crash of 1987, there is still little consensus as to what exactly is meant by contagion. The academic literature tends to distinguish between 'fundamentals based' and 'pure' contagion. The former occurs due to pre-existing market linkages such as goods trade, financial flows and other economic connections. It occurs due to common factors. The latter reflects excess contagion suffered during a crisis that is not explained by market fundamentals. Such contagion is due to country-specific shocks. [1] It is important to correctly identify the type of contagion that is present in markets before prescribing policy to deal with it. For example, if markets decline due to 'pure' contagion, then policies such as capital controls aimed at breaking market linkages are unlikely to be successful. A better strategy would be to introduce policies aimed at reducing country specific risks.

Whether or not the crisis period was characterized by contagion in East Asian equity markets has already attracted much attention but there is great disparity in the reported results. For example, Forbes and Rigobon (2002) reject the hypothesis that correlation coefficients between markets increased significantly during the crisis period, while Rigobon (2003b) fails to find evidence of a structural break in the propagation of shocks. Likewise, Bordo and Mucshid (2000) fail to find evidence in favor of contagion during this crisis. In contrast, Corsetti et al (2001), Caporale et al. (2003), Bekaert et al. (2005), and Bond et al. (2006) all find evidence of contagion between many pairs of Asian markets.[2]

[1] For an overview of the various definitions of contagion, the reader is referred to Dornbusch et al. (2000) or Pericoli and Sbracia (2003).

[2] For a more complete review of the literature, the reader is referred to Dungey et al. (2006) and references therein.

Once more, we focus on the equity markets of this region. We choose equity markets since a comparison of results from Dungey et al. (2003, 2004) suggests that the impact of contagion on return variation is more important for equity rather than currency markets. In this study, we specifically test for the presence of changes in the transmission mechanism of common shocks between pairs of countries. The phenomenon has been termed 'shift' contagion in the literature. In essence, it states that in the absence of contagious effects, common shocks should be transmitted in the same manner during both 'normal' and 'crises' periods. Hence, we aim to disentangle changes in the structural transmission mechanism of shocks from changes in the volatility due to increased common volatility shocks. We employ the methodology of Gravelle et al. (2006, henceforth GKM) to test if the process governing the transmission of common shocks changed during the turbulent period associated with the Asian crisis. GKM specify a bivariate regime-switching model in which both common and idiosyncratic shocks move between low- and high-volatility episodes. [3] This provides (as discussed below) an unambiguous test of structural changes in asset return co-movements between regimes.

This method has many advantages over and above previous techniques. Firstly, the country where the shock originated does not need to be identified or included in the analysis. Hence we can focus on the Asian markets and detect changes in the transmission of shocks that may have originated elsewhere. This is going to be particularly beneficial in the latter part of our sample when the LTCM and Russian crisis occurred. Of course, the source of the shock may itself be a disputed issue. In the extant literature, Forbes and Rigobon (2002) and Bond et al. (2005) identify Hong Kong as the source of the crisis, while Thailand is identified as the source in Kleimeier et al. (2003) and Baur and Schulze (2005). Secondly, the start and end points of the high-volatility regime are determined by the data and do not have to be exogenously specified as in Forbes and Rigobon (2002). The exogenous choice of crisis period is often a contentious issue (see Kaminsky and Schmukler, 1999) and may be further compounded by having more than one shock simultaneously impacting on equity markets. Rigobon (2003a) stresses the importance of correctly specifying the crisis period. Thirdly, the test for shift contagion is akin to testing for contagion transmitted through common fundamentals

[3] Regime-switching models have been shown to perform well in capturing equity market behaviour, e.g Ang and Bekaert (2002) and Guidolin and Timmermann (2005).

but has the added advantage that we do not have to explicitly identify these factors.[4] Simultaneously, we allow the common and idiosyncratic shocks to be regime switching, which facilitates comparison of their relative importance in generating movements in the estimated conditional correlations.

Our paper is organized as follows. Section 2 presents our model. Section 3 describes the data and presents our empirical findings and the tests for contagion. It proceeds to examine the 'traditional' view of contagion. Section 4 investigates the impact of foreign exchange risk on our results and also serves as a robustness check. Section 5 summarizes our empirical findings and offers some policy implications.

2. Econometric Methodology

In this section, we present the empirical model employed to study the interdependence between two stock markets during both calm and turbulent periods. Let r_{1t} and r_{2t} represent stock market returns from countries 1 and 2, respectively. These can be decomposed into an expected component, μ_i, and an unexpected one, u_{it}, reflecting unexpected information becoming available to investors, i.e.

$$r_{it} = \mu_i + u_{it}, E(u_{it}) = 0, i = 1,2 \text{ and } E(u_{1t}, u_{2t}) \neq 0. \qquad (1)$$

The existence of contemporaneous correlation between the forecast errors u_{1t} and u_{2t} suggests that common structural shocks are driving both returns. Therefore, we decompose the forecast errors into two structural shocks, one idiosyncratic and one common. Let z_{ct} and $z_{it}, i = 1,2$ denote the common and idiosyncratic common shocks respectively and let the impacts of these shocks on asset returns be σ_{cit} and $\sigma_{it}, i = 1,2$. Then the forecast errors are written as:

$$u_{it} = \sigma_{cit} z_{ct} + \sigma_{it} z_{it}, i = 1,2. \qquad (2)$$

Normalizing the variance of shocks to unity implies that the impact coefficients may be interpreted as the standard deviations of structural shocks.

Following GKM we allow both the common and the idiosyncratic shocks to switch between two states – high- and low-volatility.[5] Thus, the structural impact

[4] Prescribing appropriate fundamental factors in another contentious issue for Asian economies; see Karolyi (2003) and Dungey et al. (2006).

[5] This heterogeneity in the heteroskedasticity of the structural shocks ensures the identification of the system (see also Rigobon, 2003a). As argued by GKM, only the assumption of regime switching in the common shocks is necessary for this. For further

coefficients $\sigma_{it}, \sigma_{ct}, i=1,2$ are given by the following:

$$\begin{aligned} \sigma_{it} &= \sigma_i(1-S_{it}) + \sigma_i^* S_{it},\ i=1,2 \\ \sigma_{cit} &= \sigma_{ci}(1-S_{ct}) + \sigma_{ci}^* S_{ct},\ i=1,2 \end{aligned} \tag{3}$$

where $S_{it} = (0,1), i=1,2,c$ are state variables that take the value of zero in normal and unity in turbulent times. Variables with an asterisk belong to the high-volatility or crisis regime. To complete the model, we need to specify the evolution of regimes over time. Following the regime-switching literature, the regime paths are Markov switching and consequently are endogenously determined. Specifically, the conditional probabilities of remaining in the same state, i.e. not changing regime are defined as follows:

$$\begin{aligned} \Pr[S_{it} = 0 / S_{it} = 0] = q_i, i=1,2,c \\ \Pr[S_{it} = 1 / S_{it} = 1] = p_i, i=1,2,c \end{aligned} \tag{4}$$

Furthermore, we relax the assumption of expected constant returns in (1). These are allowed to be time varying and depend on the state of the common shock.[6] In this respect, our model suggests that part of the stock market return represents a risk premium that changes with the level of volatility.[7] In particular, expected returns are modeled as follows:

$$\mu_{it} = \mu_i(1-S_{ct}) + \mu_i^* S_{ct},\ i=1,2 \tag{5}$$

Given that idiosyncratic shocks are uncorrelated with common shocks and mainly associated with diversifiable risk, expected returns are not allowed to vary with the volatility state of these shocks. An extra assumption of normality of the structural shocks enables us to estimate the full model given by equations (1)-(5) via maximum likelihood along the lines of the methodology for Markov-switching models (see Hamilton, 1989).

Our rationale behind detecting and testing for shift contagion (see also GKM) lies on the assumption that in the absence of contagion, a large unexpected shock that affects both countries does not change their interdependence. In other words, the observed increase in the variance and correlation of returns during crisis periods is due to increased impulses stemming from the common shocks and not from

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details of the identification process, please see GKM.

[6] Guidolin and Timmermann (2005) find that returns are statistically different across regimes though Ang and Bekaert (2002) fail to reject the equality of mean returns between regimes.

[7] GKM also relax this assumption when modeling the interdependence of bond returns.

changes in the propagation mechanism of shocks. To empirically test for contagion, we conduct hypothesis testing specifying the null and the alternative as follows:

$$H_0 \ : \ \frac{\sigma_{c1}^*}{\sigma_{c2}^*} = \frac{\sigma_{c1}}{\sigma_{c2}} \text{ versus } H_1 \ : \ \frac{\sigma_{c1}^*}{\sigma_{c2}^*} \neq \frac{\sigma_{c1}}{\sigma_{c2}} \tag{6}$$

The null hypothesis postulates that in the absence of shift contagion, the impact coefficients in both calm and crisis periods should be in the same ratio. This likelihood ratio test is the common test for testing restrictions among nested models and follows a x^2 distribution with one degree of freedom corresponding to the restriction of equality of the ratio of coefficients between the two regimes.

3. Empirical Results

3.1. Data

Our dataset comprises weekly closing stock market indices from six East Asian countries: Malaysia, Taiwan, Singapore, Hong Kong, the Philippines and Japan. All indices are value-weighted, expressed in US dollars and were obtained from Datastream International. The Datastream codes for the corresponding stock market indices are the following: TOTMKXX, where XX stands for the country code, i.e. MY (Malaysia), TA (Taiwan), SG (Singapore), HK (Hong Kong), PH (Philippines) and JP (Japan). The indices span a period of 16 years from 1/1/1990 to 31/12/2005, a total of 836 observations. Conducting the analysis with US dollar denominated returns is akin to taking the perspective of a US investor.[8] Moreover, we prefer weekly return data to higher frequency data, such as daily returns, in order to account for any non-synchronous trading in the countries under examination. For each index, we compute the return between two consecutive trading days, *t-1* and *t* as $ln(p_t)$- $ln(p_{t-1})$ where p_t denotes the closing index on week *t.*

[TABLE 1 ABOUT HERE]

Table 1 (Panel A) presents descriptive statistics for the weekly returns, while Panel B provides some preliminary evidence on the cross-country return correlation structure. Mean returns vary considerably across countries, ranging from -0.037% in Taiwan to 0.201% in Hong Kong. Taiwan is the most volatile while the Japanese market, which is the only developed country in our sample, appears to be the least

[8] In section 4, we analyze for impact of foreign exchange risk on our results.

volatile. The Jarque-Bera test rejects normality for all markets, which is usual in the presence of both skewness and excess kurtosis. Specifically, return distributions are negatively skewed for half the countries with Singapore being the most skewed. On the other hand, the most positively skewed return is Malaysia followed by Japan and the Philippines. Malaysian and Hong Kong returns exhibit considerable leptokurtosis with the coefficient of kurtosis exceeding 13. These features should be accommodated in any model of equity returns. The high level of kurtosis coupled with the rejection of normality in all markets could suggest that the behavior of returns is best modeled as a mixture of distributions, which is consistent with the existence of a number of volatility regimes.

Panel B provides some preliminary evidence on the correlation structure between country returns. Correlation coefficients range from 0.185 for the Philippines/Japan pair to 0.693 for the Singapore/Hong Kong pair. The average correlation is 0.384. Despite the regional proximity, the pair wise correlation coefficients are low enough to imply that markets are different in terms of influence and composition. This suggests that these markets offer diversification possibilities.

3.2. Estimates

Table 2 reports the estimates of model parameters for the expected returns. Specifically, columns 2 and 3 report the mean returns during calm periods and the corresponding figures for crises periods are reported in columns 4 and 5.

[TABLE 2 ABOUT HERE]

This Table presents us with a number of striking features, which are consistent with the behavior of developed markets; see Flavin and Panopoulou (2006). Firstly, the low volatility regime is characterized by positive mean returns in all cases. Furthermore, the majority of the mean estimates are statistically significant at conventional levels. In contrast, high volatility regimes are associated with negative returns in the majority of cases, though admittedly, many of these are not statistically different from zero. Therefore, a feature of turbulent periods is that they generate negative returns to investors. Secondly, we compute a likelihood ratio statistic to test the hypothesis of equal means between regimes. In all cases, this hypothesis is rejected and is consistent with the findings of Guidolin and

Timmermann (2005) for UK assets. Consequently, it is important to account for this difference in means between regimes when modeling the behavior of returns.

[FIGURE 1 ABOUT HERE]

Figure 1 presents us with the filtered probabilities of the common shock being in the high-volatility regime for each pair of markets. It is obvious, for all pairs, that the common shock is often in the turbulent regime and this is most evident around the Asian crisis from 1997-1998. In fact, in many cases the turbulent regime is seen to persist for much longer and continued into the start of the next decade.

[TABLE 3 ABOUT HERE]

Table 3 presents a more detailed description of our results. Firstly, the column labeled 'Unc Prob' tells us the proportion of time the common shock of each pair is in the high volatility state. It is calculated using the formula $\frac{1-P}{2-P-Q}$, where P is the probability that the respective regime will prevail over two consecutive years, i.e. the transition probability from say the high volatility regime to the same regime. In our analysis, it varies from a high of 59% in the case of the Taiwan/Japan pair to a low of 8.5% for the Malaysia/Philippines pair. Averaging over all market pairs, we see that the common shock is in the turbulent regime approximately 27% of the time.

The column labeled 'Duration' gives the length of time (in years) for which a common shock persists - $Duration = \frac{1}{1-P}$. The highest duration is 3.15 years for common shocks to Taiwan and Japan, with the lowest duration being recorded for the Taiwan / Hong Kong pair. The average duration across pairs is 0.84 years.

The remainder of Table 3 presents our estimates of the impact coefficients of common structural shocks for calm (σ) and turbulent (σ*) times (columns 2-3 and 4-5 respectively) as well as the ratio, γ, (column 6) which allows us to test for contagion. For the low volatility regime, the estimated coefficients are quite tightly clustered with all but two lying in the range 0.52 – 2.03. Furthermore all estimates are statistically significantly different from zero. In this calm time period the average for impact coefficients across pairs of countries is 1.308 with a standard deviation of 0.50. Turning to the high volatility regime, we see much larger estimates and much more dispersion. Here the average of the coefficients is 4.57 with a standard deviation of

2.24. Therefore both the average impact and the dispersion of estimates increase by 3.5 and 4.5 times respectively. There is also considerable variation on the volatility impacts between pairs of countries.

In order to gain some insight on shift contagion, we report the ratio of the estimated impact coefficients of common structural shocks in column 6 of Table 3. We construct the following statistic:

$$\gamma = \max\left\{\left|\frac{\sigma_{c1}^{*}\sigma_{c2}}{\sigma_{c2}^{*}\sigma_{c1}}\right|, \left|\frac{\sigma_{c2}^{*}\sigma_{c1}}{\sigma_{c1}^{*}\sigma_{c2}}\right|\right\}.$$

This reveals whether impact coefficients in the high volatility regime are proportional to their corresponding values in the low volatility regime. A ratio of unity indicates that there is no difference in the transmission mechanism of shocks between the high- and low-volatility regimes, whereas deviations from unity would imply market contagion. At this point we can only talk of the economic significance of the γ ratio but we will later test for its statistical significance.

Even without a formal test, our results suggest that for a large number of country pairs, the transmission mechanism governing common shocks does not experience major changes between high- and low-volatility regimes. Seven of the fifteen pairs generate ratios less than 1.01, while two thirds of our sample (10 from 15) produces ratios of less than 1.1. If this turns out to be evidence of shift contagion, at least it's at a relatively low level. At the other end of the scale, one pair – Malaysia/Japan – has a ratio in excess of 2.

Before testing for shift contagion, we check whether our model is appropriate for the countries at hand. Table 4 reports results from a number of diagnostic tests. Columns 2 and 3 report the LM test for serial correlation in the standardized residuals of the country pairs examined.[9] For the majority of country pairs, we cannot reject the null of no serial correlation at both one and four lags. Likewise we find little evidence of ARCH effects (see Columns 3 and 4), though when testing for ARCH effects up to fourth order, the percentage of series for which we can reject the null increases to 20 percent. Instead of applying the Jarque Bera statistic, which concentrates on the third and fourth moment, to test for Normality, we test for Normality based on the overall approximation of the empirical distributions of standardized residuals to the Normal by employing the Craner-von Mises test. Our

[9] Please note that all sets of standardized residuals are reported for each country.

results, reported in Column 6, suggest that all the country residuals are Normally distributed.[10] This suggests that our two-regime model captures quite well the distribution of asset returns.

[TABLE 4 ABOUT HERE]

As a measure of our models' regime qualification performance, we employed the Regime Classification Measure (RCM) developed by Ang and Bekaert (2002). RCM is a summary statistic that captures the quality of a model's regime qualification performance. According to this measure, a good regime-switching model should be able to classify regimes sharply, i.e. the smoothed (ex-post) regime probabilities, p_t are close to either one or zero. For a model with two regimes, the regime classification measure (*RCM*) is given by:

$$RCM = 400 * \frac{1}{T}\sum_{t=1}^{T} p_t(1-p_t),$$

where the constant serves to normalize the statistic to be between 0 and 100. A perfect model will be associated with a RCM close to zero, while a model that cannot distinguish between regimes at all will produce a RCM close to 100. The last three columns of Table 4 report the RCMs with respect to both the idiosyncratic shocks and the common volatility shock. Interestingly, Malaysia/Philippines achieves the best regime classification performance for the common shock, with a RCM statistic as low as 5.69 (see also Figure 1), while the worst one is for the Japanese idiosyncratic based on the Taiwan/Japanese pair with RCM of 67.9. However, even the worst cases with respect to the regime classification measure do not exceed 70% safely below the 100%, which would be the worst case.

3.3. *Tests for shift contagion*

In testing for the presence of contagion between market pairs, we focus on the ratio γ, and test whether or not it is statistically different from unity. We perform a likelihood ratio test, whose test statistic has a $\chi^2(1)$ distribution under the null hypothesis. Table 5 presents the results.

[TABLE 5 ABOUT HERE]

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[10] We also employed the Kolmogorov-Smirnov, Lilliefors, Anderson-Darling, and Watson empirical distribution tests, which yielded similar results. These results are available upon request.

The most striking feature of our results is that we find little evidence of shift contagion. In all cases, we fail to reject the null hypothesis of no shift contagion at the conventional 5% level. Consequently, we conclude that the mechanism by which common shocks are transmitted between these equity markets is unaffected by the switch from a low- to high-volatility regime. This is a reassuring result for proponents of international diversification across equity markets as a means of reducing portfolio risk. The only pair for which we cannot reject the null of no shift contagion, albeit at the 10% level, is Malaysia/ Japan, which has a ratio, γ, of 2.7. [11] Our results show that for the majority of markets the general level of interdependence is not affected by the prevailing volatility regime of the common shock and any observed increase in correlation should not be construed as contagion.

3.4. Traditional contagion

In this section, we compare our methodology of detecting shift contagion with the traditional (conditional) correlation based methodology. Interestingly, our model accommodates both. Just recall from (2), that the aggregate shock of each country return is decomposed into an idiosyncratic and a common shock. Both common and idiosyncratic shocks are allowed to switch between high -and low-volatility states, which are assumed to be independent. In this respect, eight states of nature are possible, ranging from the state when all shocks are in the low volatility regime to the one when all shocks display high volatility. Each state is associated with a different variance-covariance matrix, which is uniquely calculated on the basis of our model given by (1)-(4). For example, the variance covariance matrices associated with the extreme states are as follows:

$$\Sigma_1 = \begin{bmatrix} \sigma_1^2 + \sigma_{c1}^2 & \sigma_{c1} * \sigma_{c2} \\ \sigma_{c1} * \sigma_{c2} & \sigma_2^2 + \sigma_{c2}^2 \end{bmatrix}$$

$$\Sigma_8 = \begin{bmatrix} \sigma_1^{*2} + \sigma_{c1}^{*2} & \sigma_{c1}^{*} * \sigma_{c2}^{*} \\ \sigma_{c1}^{*} * \sigma_{c2}^{*} & \sigma_2^{*2} + \sigma_{c2}^{*2} \end{bmatrix} \qquad (7)$$

[11] Surprisingly, even the ratios approaching 1.5 do not prove to be statistically significant. This is likely to be a result of the low precision of the estimated coefficients due to the relatively small number of observations in the high-volatility regime.

It is apparent from (7) that the correlation between market returns is dependent on both types of shocks and the state the pair is in.

To assess the impact of the idiosyncratic shocks on the covariance structure of our system, Table 6 presents estimates of the impact coefficients of idiosyncratic structural shocks for calm (σ) and turbulent (σ*) times (columns 2-3 and 4-5 respectively). The last two columns of Table 6 present the unconditional probability of each idiosyncratic shock being in the high volatility regime along with its duration (comparable to Table 3 for the common shock).

It is clear that both common and idiosyncratic shocks experience normal and turbulent periods and that both types of shock can exert important influences on market comovement. Focusing on the idiosyncratic shocks, we find that on average the impact is 1.78 (versus 1.31 for the common shock) in the normal regime and 5.63 (4.57) in the turbulent regime. Therefore relative to the common shock, idiosyncratic shocks, on average, exert a stronger influence on the stock return generating process. The probability of being in the high-volatility regime and the persistence of the shock are comparable with the common shocks reported earlier. In particular, the average probability of being in the high-volatility regime is about 30% with an average duration of 0.87 years – both statistics are slightly higher than that for the common shocks. It is difficult to extract a pattern across countries but it is noticeable that for market pairs including Taiwan, the common shock is more often in the high-volatility regime than the country-specific shock while the reverse is true for pairs involving the Philippines.

The correlation between markets changes across states. For each market pair, the highest correlation is realized when both idiosyncratic shocks are in the low-volatility regime and the common shock is in the high volatility regime. This allows the common shock to dominate and correlations range from 0.354 for the Malaysia / Taiwan pair to 0.938 for the Singapore / Hong Kong pair in this state. It is noticeable that high-volatility common shocks generate increased comovement. In contrast, the lowest correlation for all pairs is recorded when the idiosyncratic shocks are in the turbulent regime and the common shock is in the normal state. [12] In this case, correlations range from 0 for Taiwan/Japan to 0.223 for Singapore/Hong Kong.

[12] For brevity, the covariance matrices across the eight states are not reported, but are available upon request.

High volatility country-specific shocks generate diversity between markets and hence lower comovement.

The evolution of this conditional correlation (conditional on the prevailing state) over time can be calculated by utilizing the estimated filter probabilities for each type of shock (those for the common shock are depicted in Figure 1) and the implied conditional covariance matrix of returns. The filter probabilities give the probability of being in each state for each shock given the history of the process up to that point of time. Figure 2 provides a graphical illustration of the conditional correlation for each pair of markets. The most striking feature is the amount of time variation exhibited by all market pairs. This finding is consistent with Longin and Solnik (1995) and Karolyi and Stulz (1996) among others. Bordo and Murshid (2000) show that over a period of 108 years, stock market correlations have exhibited large variation, both in tranquil and crisis periods. For most country pairs in our analysis, there is little evidence that movement in the conditional correlation coefficient is different around the Asian crisis period than its historical evolution. Therefore, when taking market conditions into account, it would be difficult to argue that any contagion has occurred between Asian markets. The one exception to this would appear to be the Philippines. Figure 2 clearly shows that the conditional correlation of all pairs including the Philippines exhibit a marked increase over the 1997-99 period before returning to lower levels in the immediate aftermath. However, post-2001 there is another spike for most countries. This pattern is most easily seen for the Philippines / Japan and the Philippines / Taiwan. [13]

Taking the statistical test for shift contagion in conjunction with our time-varying conditional correlations, we have to conclude that there is little evidence of cross-country contagion. Where contagion may have occurred for pairs involving the Philippines, it is most likely to be an example of 'pure' rather than 'fundamentals-based' contagion and therefore driven more by idiosyncratic factors rather than economic or financial linkages. In general, we find that the transmission of common shocks is unaffected by equity market volatility. Hence, policies aimed at strengthening common fundamentals or links should prove to be an effective way to address the problem of potential market downturns.

[13] Goetzmann et al. (2002) show that increased correlation may in part be attributed to expanding the investment opportunity set and therefore should not be completely interpreted as increased market integration.

4. The role of exchange rate movements in detecting contagion

In this section, we investigate the robustness of our results by repeating the analysis with returns measured in local currencies. This is analogous to undertaking the analysis from the perspective of an investor, who has completely hedged away foreign exchange risk. In effect, this analysis disentangles exchange rate risk or contagion in the currency markets from financial contagion in equity returns. The importance of this analysis may be seen in Figure 3 where we plot the nominal exchange rate of each country versus the US dollar. For all countries, the value of their currencies plunged in the period of the Asian crisis with a subsequent rebound. This cross-country pattern is likely to have contributed to the magnitude of the common shock in the previous analysis.

4.1 Data description

Table 7 (Panel A) presents descriptive statistics for the equity returns. Interestingly, Malaysian, Taiwanese and Philippines returns in local currency are greater than the USD denominated returns, while these of Japan and Taiwan are even more negative. With the exception of Taiwan, volatility is greater for returns in domestic currency. In general, return distributions are broadly similar to the full sample. Panel B reports unconditional correlations for the returns denominated in US dollars. The information is similar to that for local currency returns.

[TABLE 7 ABOUT HERE]

4.2 Results

We find little evidence of shift contagion between the local currency denominated returns of the East Asian equity markets. Table 8 contains the results.

[TABLE 8 ABOUT HERE]

A number of issues ought to be highlighted. Firstly, the probability of the common shock being in the high-volatility regime is, on average, lower than the dollar denominated returns, 21.8 versus 26.9%. Thus, it would seem that at least part of the common shock may be attributed to a foreign exchange component. However, the common shock is now much more persistent, 2.06 versus 0.84 years, suggesting that periods of turbulence in equity markets endures far longer than currency market crises. Secondly, there are less large movements in our estimated impact coefficients and consequently the ratio γ exhibits fewer large values than for our sample of dollar denominated returns. The largest ratio value generated is 1.45 (2.74 in the USD returns) but only three others are in excess of 1.20. Finally, the likelihood ratio test for shift contagion reveals that only one market pair, Taiwan / Philippines, displays evidence of a change in the transmission of shocks between regimes. Figure 4 presents the filtered probabilities of being in the high-volatility regime and again provide evidence in favor of adopting a regime-switching methodology.

Turning to the idiosyncratic shocks, we find that results, reported in Table 9, are comparable to the USD returns. The impact coefficients are slightly higher in both regimes; the average probability of being in the turbulent state decreases as for the common shock but interestingly, the average duration of the shock remains about the same. This suggests that in the previous analysis, the influence of the foreign exchange risk largely affected the common shock only and is consistent with the evidence in Figure 3.

Figure 5 presents the conditional correlation for each market pair. The pattern is similar to that of the earlier analysis. We observe a great deal of time variation but only for pairs involving the Philippines is it different during the period of the Asian crisis. For all other pairs, there is nothing to suggest that the behavior of the correlation is different around the time of the crisis. In summary, our results appear to be quite robust to the denomination of equity returns. We find little evidence of contagion in either case.

5. Conclusions

We test for equity market contagion between six East Asian countries and analyze the effectiveness of policy responses. We define 'shift' contagion as changes in the transmission of structural shocks induced by a pair of markets being hit by a common adverse shock. We use the methodology introduced by GKM, which is well suited to our analysis. The main advantages of this methodology are that we can test for contagion between countries without having to identify or including the source of the shock, the crisis period is endogenously identified and we can disentangle the contribution of volatility changes in both common and idiosyncratic shocks.

A regime-switching model is employed to exploit the heteroskedasticity inherent in stock returns to identify whether or not we have contagion between each pair of markets. We report a number of interesting findings. Firstly, expected stock returns are statistically different between regimes. Calm markets are associated with significantly positive returns while turbulent markets are characterized by negative mean returns. Secondly, our model captures the features of return distributions quite well. We find that common market shocks are, on average, in a high-volatility regime about 27% of the time – though this varies substantially across market pairs. Thirdly, we find little evidence of changes in the transmission of common shocks between low- and high-volatility regimes. Hence, we reject the presence of shift contagion. In its absence, we argue that policies designed to reinforce common market fundamentals are likely to achieve their aim.

The idiosyncratic shocks also exert a major influence. This is best seen through the evolution of the conditional correlations produced by the model. We find that states characterized by high volatility in the common shock generate relatively high pair wise correlation while, states where the country-specific shocks are in the turbulent regime, generate lower correlations. Weighting each state by the appropriate filtered probability enables us to construct the conditional correlation. For all pairs, and consistent with Bordo and Murshid (2000), we observe significant time variation in both calm and crisis periods. However, excluding pairs involving the Philippines, there is no evidence that changes to the correlation were different around the Asian crisis than those observed in earlier, more tranquil periods.

We check the robustness of our results by repeating the analysis for local currency denominated returns. We find that our major results are unaffected. In conclusion we find no support for the contagion in the East Asian markets during the crisis of the late 1990's.

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Table 1: Summary Descriptive Statistics

Panel A: USD denominated (1/1/1990-31/12/2005)

	Malaysia	*Taiwan*	*Singapore*	*Hong Kong*	*Philippines*	*Japan*
Mean	0.053	-0.037	0.074	0.201	0.022	-0.023
Median	0.123	0.195	0.164	0.299	0.050	0.000
Maximum	46.149	21.969	21.143	16.487	25.352	15.772
Minimum	-35.333	-24.728	-29.413	-25.798	-22.007	-12.078
Std. Dev.	4.789	4.894	3.291	3.850	4.241	3.244
Skewness	0.688	-0.241	-0.683	-0.633	0.138	0.163
Kurtosis	22.719	5.958	13.530	7.667	7.861	4.628
Jarque Bera	13594.0 (0.000)	312.5 (0.000)	3922.6 (0.000)	813.5 (0.000)	824.7 (0.000)	95.9 (0.000)

Panel B: Correlations

Market	*Malaysia*	*Taiwan*	*Singapore*	*Hong Kong*	*Philippines*	*Japan*
Malaysia	1.000	0.254	0.558	0.481	0.399	0.259
Taiwan		1.000	0.375	0.327	0.289	0.205
Singapore			1.000	0.693	0.509	0.404
Hong Kong				1.000	0.472	0.356
Philippines					1.000	0.185
Japan						1.000

Table 2. Estimates of mean returns across regimes

Country pairs	μ_1	μ_2	μ^*_1	μ^*_2	*LR*	*p-val*
ML/TW	0.302	0.102	-0.043	0.024	0.936	0.626
	(0.093)	(0.143)	(0.042)	(0.029)		
ML/SG	0.292	0.233	-1.176	-0.800	4.181	0.124
	(0.090)	(0.083)	(0.638)	(0.489)		
ML/HK	0.263	0.437	-1.090	-1.033	5.251*	0.072
	(0.090)	(0.104)	(0.697)	(0.633)		
ML/PH	0.248	0.126	-2.004	-0.769	2.101	0.350
	(0.086)	(0.106)	(0.887)	(0.482)		
ML/JP	0.285	0.065	0.055	-0.040	0.992	0.609
	(0.107)	(0.162)	(0.138)	(0.058)		
TW/SG	0.021	0.241	-0.088	-0.220	2.682	0.262
	(0.051)	(0.092)	(0.408)	(0.068)		
TW/HK	0.041	0.372	0.179	-0.581	1.629	0.443
	(0.023)	(0.096)	(0.880)	(0.989)		
TW/PH	0.095	0.128	-0.508	-0.484	0.852	0.653
	(0.098)	(0.102)	(0.840)	(1.193)		
TW/JP	0.315	0.090	-0.279	-0.115	3.311	0.191
	(0.232)	(0.105)	(0.192)	(0.154)		
SG/HK	0.279	0.455	-0.459	-0.461	4.618*	0.099
	(0.094)	(0.117)	(0.425)	(0.465)		
SG/PH	0.190	0.172	-0.640	-0.891	2.409	0.300
	(0.092)	(0.128)	(0.607)	(0.753)		
SG/JP	0.228	0.014	-0.034	-0.099	1.047	0.592
	(0.086)	(0.100)	(0.253)	(0.306)		
HK/PH	0.410	0.166	-0.463	-0.470	2.216	0.330
	(0.067)	(0.154)	(0.134)	(0.485)		
HK/JP	0.500	0.036	-0.045	-0.088	5.097*	0.078
	(0.123)	(0.038)	(0.250)	(0.096)		
PH/JP	0.164	0.018	-0.750	-0.366	1.771	0.413
	(0.118)	(0.042)	(0.421)	(0.151)		

Notes: Standard errors in parentheses below coefficients. Likelihood ratio statistic is for the null of equality of mean returns across the regimes. The test statistic has a $\chi^2(2)$ distribution under the null hypothesis. *** denotes significance at 1% level, ** denotes significance at 5% level, and * denotes significance at 10% level.

Table 3. Estimates of impact coefficients of common shocks

Country pairs	σ_{c1}	σ_{c2}	σ^*_{c1}	σ^*_{c2}	γ	*Unc. Prob.*	*Duration*
ML/TW	1.957	0.920	4.749	1.482	1.506	34.39%	0.56
	(0.084)	(0.155)	(0.382)	(0.270)			
ML/SG	1.788	1.432	6.782	5.429	1.001	15.49%	0.23
	(0.381)	(0.356)	(0.943)	(0.520)			
ML/HK	1.578	1.444	6.700	6.152	1.004	14.80%	0.24
	(0.319)	(0.294)	(0.667)	(0.575)			
ML/PH	2.031	1.018	12.225	5.472	1.120	8.52%	0.53
	(0.033)	(0.054)	(1.132)	(0.828)			
ML/JP	1.179	1.164	3.234	1.164	2.744	41.08%	2.15
	(0.451)	(0.253)	(0.256)	(0.252)			
TW/SG	1.228	1.195	3.671	3.573	1.000	31.99%	0.22
	(0.030)	(0.339)	(0.382)	(0.251)			
TW/HK	1.677	2.006	4.326	5.205	1.005	16.83%	0.20
	(0.209)	(0.068)	(0.517)	(0.829)			
TW/PH	0.922	1.879	3.127	6.618	1.039	18.77%	0.45
	(0.176)	(0.507)	(0.452)	(0.728)			
TW/JP	0.094	0.100	2.495	2.169	1.213	58.84%	3.15
	(0.142)	(0.282)	(0.405)	(0.301)			
SG/HK	1.933	1.264	4.952	4.781	1.476	27.60%	0.21
	(0.117)	(0.173)	(0.466)	(0.532)			
SG/PH	1.360	1.374	5.787	5.934	1.015	13.85%	0.37
	(0.211)	(0.207)	(0.531)	(0.669)			
SG/JP	1.748	0.801	3.835	1.821	1.036	43.44%	0.32
	(0.114)	(0.237)	(0.287)	(0.182)			
HK/PH	1.528	1.347	5.740	5.061	1.000	18.14%	0.39
	(0.234)	(0.260)	(0.537)	(0.757)			
HK/JP	1.126	1.063	2.726	2.584	1.004	45.26%	2.94
	(0.559)	(0.154)	(0.255)	(0.212)			
PH/JP	1.575	0.521	7.023	2.315	1.003	14.70%	0.60
	(0.127)	(0.171)	(0.672)	(0.385)			

Notes: Standard errors in parentheses below coefficients. "Duration" refers to the duration of the high volatility common shock expressed in years. "Unc. Prob." refers to the unconditional probability of the high volatility regime expressed in percentage.

Table 4. Diagnostic tests on standardized residuals and model specification

Country pairs	*LM(1)*	*LM(4)*	*ARCH(1)*	*ARCH(4)*	*Normality*	RCM_1	RCM_2	RCM_3
ML/TW	1.428	4.992	0.055	10.395	0.059	6.34	14.34	38.67
	0.688	6.962	0.210	3.488	0.093			
ML/SG	0.132	6.830	2.168	26.860*	0.088	14.49	18.85	20.18
	0.549	2.679	36.374*	43.135*	0.067			
ML/HK	0.030	6.710	0.959	10.752	0.071	12.23	37.95	17.55
	0.285	3.348	0.007	1.755	0.104			
ML/PH	0.409	7.072	0.864	8.424	0.065	32.91	30.52	5.69
	0.089	13.168	0.253	4.387	0.027			
ML/JP	0.055	4.409	2.755	14.995*	0.024	11.14	36.80	30.75
	0.863	0.684	1.810	3.151	0.102			
TW/SG	0.442	6.956	1.619	5.421	0.112	24.91	14.27	52.30
	0.749	2.802	36.421*	44.112*	0.024			
TW/HK	0.195	6.959	0.637	3.109	0.117	17.20	31.03	32.54
	0.349	4.646	2.129	5.035	0.107			
TW/PH	0.213	8.326	0.656	2.871	0.115	33.20	11.71	24.21
	0.114	15.005*	2.412	9.931	0.033			
TW/JP	0.561	7.070	0.189	2.533	0.091	27.57	67.86	40.64
	0.826	1.817	0.035	1.368	0.042			
SG/HK	0.001	1.743	18.088*	25.223*	0.061	23.75	35.92	37.12
	0.154	5.451	3.555	9.337	0.097			
SG/PH	0.007	1.437	25.145*	31.842*	0.035	64.31	38.04	15.46
	0.249	10.815	0.811	8.142	0.052			
SG/JP	0.232	2.986	5.448	10.366	0.044	5.18	37.95	52.52
	0.844	0.716	0.670	1.771	0.077			
HK/PH	1.336	3.721	2.507	3.400	0.083	40.69	29.65	22.98
	0.196	13.061	0.332	7.067	0.035			
HK/JP	1.384	4.990	7.064*	12.318	0.071	38.74	60.68	35.20
	0.828	1.178	0.026	0.832	0.030			
PH/JP	3.479	14.532*	0.196	6.916	0.029	68.80	61.63	16.36
	0.526	1.134	0.020	1.364	0.049			

Notes: LM(k) is the Breusch-Godfrey Lagrange Multiplier test for no serial correlation up to lag k, ARCH(k) is the Lagrange Multiplier test for no ARCH effects of order k, Normality is the Cramer-von-Mises test for the null of Normality, RCM*i* is the Regime Classification Measure, where i=1,2,3 for the idiosyncratic shock of the first, second and the common shock, respectively. * denotes significance at 1% level. LM(k) and ARCH(k) have a $\chi^2(k)$ distribution under the null hypothesis. The Cramer-von-Mises test has a non-standard distribution and the cut-off value for RCM is 50.

Table 5. Likelihood ratio tests for shift contagion

Market	*Malaysia*	*Taiwan*	*Singapore*	*Hong Kong*	*Philippines*	*Japan*
Malaysia	---	1.422 (0.233)	6E-05 (0.994)	6E-05 (0.994)	0.205 (0.651)	2.773* (0.096)
Taiwan		---	0.0001 (0.991)	0.811 (0.368)	8E-05 (0.993)	0.0009 (0.976)
Singapore			---	0.370 (0.543)	2E-05 (0.996)	0.028 (0.868)
Hong Kong				---	0.0001 (0.991)	4E-05 (0.995)
Philippines					---	2E-05 (0.996)
Japan						---

Notes: Likelihood ratio statistic is for the null of no contagion against the alternative of contagion for the indicated country pairs. The test statistic has a $\chi^2(1)$ distribution under the null hypothesis. *** denotes significance at 1% level, ** denotes significance at 5% level, and * denotes significance at 10% level. *p*- values are reported in parentheses below coefficients.

Table 6. Estimates of impact coefficients of idiosyncratic shocks

Country pairs	σ_1	σ_2	σ^*_1	σ^*_2	*Unc. Prob./ Duration (1)*	*Unc. Prob./ Duration (2)*
ML/TW	0.034	3.919	11.745	8.999	8.01%	8.42%
	(0.066)	(0.114)	(1.320)	(0.840)	0.97	0.42
ML/SG	1.313	1.325	9.390	2.736	10.83%	40.14%
	(0.593)	(0.411)	(1.076)	(0.155)	0.14	5.56
ML/HK	1.499	1.853	7.915	3.666	15.62%	40.30%
	(0.330)	(0.178)	(0.626)	(0.302)	0.71	1.22
ML/PH	0.349	2.725	4.308	6.292	25.78%	21.87%
	(0.440)	(0.102)	(0.424)	(0.435)	0.52	0.33
ML/JP	1.401	1.522	11.066	3.367	11.76%	73.68%
	(0.405)	(0.205)	(0.978)	(0.175)	0.24	1.48
TW/SG	3.107	1.331	7.597	4.169	16.38%	17.62%
	(0.052)	(0.315)	(0.578)	(0.331)	0.30	2.30
TW/HK	3.242	0.949	8.432	3.464	12.02%	48.66%
	(0.135)	(0.104)	(0.682)	(0.181)	0.35	2.28
TW/PH	3.402	2.208	7.677	7.001	18.96%	3.65%
	(0.170)	(0.430)	(0.261)	(3.743)	0.20	0.04
TW/JP	3.177	1.799	8.035	3.719	17.06%	39.67%
	(0.195)	(0.105)	(0.677)	(0.022)	0.21	0.21
SG/HK	0.018	1.760	2.486	3.249	11.13%	51.12%
	(0.024)	(0.077)	(0.561)	(0.148)	0.68	1.83
SG/PH	1.082	2.436	2.802	5.042	43.96%	25.13%
	(0.224)	(0.092)	(0.204)	(0.733)	0.32	0.43
SG/JP	0.048	1.666	7.264	3.274	3.61%	73.30%
	(0.249)	(0.106)	(1.331)	(0.131)	0.47	1.37
HK/PH	1.265	2.546	3.018	5.372	68.17%	19.58%
	(0.237)	(0.128)	(0.111)	(0.365)	2.02	0.48
HK/JP	1.849	1.727	4.887	3.862	31.52%	32.19%
	(0.151)	(0.199)	(0.379)	(0.327)	0.41	0.19
PH/JP	2.021	1.904	4.167	3.787	30.71%	56.09%
	(0.068)	(0.120)	(0.616)	(0.244)	0.13	0.36

Notes: Standard errors in parentheses below coefficients. "Duration" refers to the duration of the high volatility regime of the idiosyncratic shock expressed in years. "Unc. Prob." refers to the unconditional probability of the high volatility regime expressed in percentage.

Table 7: Summary Descriptive Statistics

Panel A: Local currency (1/1/1990-31/12/2005)

	Malaysia	*Taiwan*	*Singapore*	*Hong Kong*	*Philippines*	*Japan*
Mean	0.092	-0.012	0.056	0.200	0.127	-0.050
Median	0.108	0.176	0.183	0.307	0.176	-0.163
Maximum	42.275	21.769	23.088	16.454	25.302	13.433
Minimum	-35.333	-25.205	-31.698	-25.979	-28.127	-18.264
Std. Dev.	4.994	4.858	3.390	3.857	4.325	3.375
Skewness	0.362	-0.186	-0.885	-0.638	0.112	-0.155
Kurtosis	22.539	5.707	16.372	7.721	8.455	5.010
Jarque Bera	13301.0 (0.000)	259.8 (0.000)	6329.8 (0.000)	832.0 (0.000)	1037.1 (0.000)	144.0 (0.000)

Panel B: Correlations

Market	*Malaysia*	*Taiwan*	*Singapore*	*Hong Kong*	*Philippines*	*Japan*
Malaysia	1.000	0.254	0.590	0.481	0.426	0.263
Taiwan		1.000	0.370	0.320	0.283	0.211
Singapore			1.000	0.681	0.516	0.433
Hong Kong				1.000	0.467	0.351
Philippines					1.000	0.211
Japan						1.000

Table 8. Estimates of impact coefficients of common shocks (Local currency)

Country pairs	σ_{c1}	σ_{c2}	σ^*_{c1}	σ^*_{c2}	γ	*Unc. Prob.*	*Duration*
ML/TW	1.955	0.759	4.965	1.599	1.205	30.37%	1.0
	(0.083)	(0.130)	(0.338)	(0.278)	[0.661]		
ML/SG	1.668	1.436	7.007	6.035	1.000	14.72%	1.2
	(0.230)	(0.186)	(0.921)	(0.666)	[0.999]		
ML/HK	1.501	1.528	5.887	5.990	1.001	17.57%	1.4
	(0.398)	(0.409)	(0.659)	(0.560)	[0.969]		
ML/PH	1.947	1.034	13.381	6.578	1.080	8.19%	6.4
	(0.118)	(0.051)	(1.267)	(0.958)	[0.970]		
ML/JP	1.956	0.658	5.027	1.316	1.286	29.96%	1.1
	(0.147)	(0.121)	(0.320)	(0.231)	[0.432]		
TW/SG	0.994	1.271	2.898	3.718	1.003	40.09%	0.5
	(0.011)	(0.544)	(0.374)	(0.313)	[0.987]		
TW/HK	1.664	1.838	4.513	4.982	1.001	17.75%	0.8
	(0.361)	(0.484)	(0.750)	(0.961)	[0.984]		
TW/PH	0.989	1.689	3.616	6.153	1.004	17.96%	2.1
	(0.034)	(0.480)	(0.532)	(0.589)	[0.967]		
TW/JP	1.370	1.896	3.148	6.318	1.450	6.89%	0.7
	(0.122)	(0.188)	(0.174)	(1.042)	[0.386]		
SG/HK	1.525	1.550	4.599	4.678	1.001	29.55%	0.6
	(0.243)	(0.227)	(0.428)	(0.447)	[0.999]		
SG/PH	1.383	1.491	6.712	6.946	1.042***	10.48%	5.6
	(0.700)	(0.982)	(0.763)	(1.176)	[0.000]		
SG/JP	1.742	0.897	3.919	1.991	1.014	41.64%	0.5
	(0.145)	(0.066)	(0.228)	(0.186)	[0.968]		
HK/PH	1.544	1.527	6.047	5.921	1.010	14.25%	3.1
	(0.689)	(0.587)	(0.447)	(0.702)	[0.968]		
HK/JP	1.742	1.140	3.713	2.425	1.002	33.09%	2.2
	(0.924)	(0.580)	(0.799)	(0.203)	[0.992]		
PH/JP	1.523	0.789	6.995	2.610	1.389	14.35%	3.7
	(1.280)	(0.719)	(0.382)	(0.353)	[0.890]		

Notes: Standard errors in parentheses below coefficients. "Duration" refers to the duration of the high volatility common shock expressed in years. "Unc. Prob." refers to the unconditional probability of the high volatility regime expressed in percentage. *** denotes significance at 1% level, ** denotes significance at 5% level, and * denotes significance at 10% level. *p*- values are reported in brackets below LR stat.

Table 9. Estimates of impact coefficients of idiosyncratic shocks (Local currency)

Country pairs	σ_1	σ_2	σ^*_1	σ^*_2	*Unc. Prob./ Duration (1)*	*Unc. Prob./ Duration (2)*
ML/TW	0.016	3.908	13.041	8.711	7.78%	8.85%
	(0.198)	(0.116)	(1.370)	(0.941)	1.10	0.46
ML/SG	1.406	1.277	9.040	2.709	12.49%	38.47%
	(0.247)	(0.198)	(0.960)	(0.235)	0.16	5.42
ML/HK	1.507	2.188	8.617	5.746	16.74%	6.11%
	(0.401)	(0.301)	(0.650)	(1.788)	0.45	0.02
ML/PH	0.540	2.778	4.482	6.387	26.48%	20.46%
	(0.366)	(0.107)	(0.358)	(0.493)	0.53	0.29
ML/JP	0.244	2.122	12.871	4.028	7.85%	50.52%
	(1.039)	(0.352)	(1.320)	(0.379)	1.01	0.21
TW/SG	3.301	1.222	7.631	6.744	16.69%	5.07%
	(0.171)	(0.552)	(0.689)	(1.055)	0.28	0.68
TW/HK	3.161	1.229	8.137	3.643	12.75%	46.83%
	(0.266)	(0.673)	(0.657)	(0.447)	0.40	2.52
TW/PH	3.426	2.372	7.705	7.762	16.88%	5.78%
	(0.182)	(0.326)	(0.748)	(1.792)	0.22	0.07
TW/JP	3.323	0.531	8.086	2.557	18.15%	79.84%
	(0.139)	(0.216)	(0.621)	(0.158)	0.21	1.92
SG/HK	1.209	1.496	4.281	3.140	4.60%	52.16%
	(0.262)	(0.210)	(0.710)	(0.220)	0.46	1.66
SG/PH	1.116	2.432	3.028	5.405	40.76%	23.86%
	(0.989)	(0.549)	(0.800)	(0.502)	0.30	0.24
SG/JP	0.140	2.396	8.623	5.042	3.27%	17.28%
	(0.918)	(0.134)	(1.466)	(0.664)	0.44	0.06
HK/PH	1.165	2.518	3.109	6.000	72.75%	16.13%
	(1.124)	(0.402)	(0.358)	(0.549)	1.79	0.31
HK/JP	1.496	2.346	4.764	5.646	26.88%	11.40%
	(1.016)	(0.213)	(0.296)	(0.817)	0.50	0.05
PH/JP	2.205	2.468	4.969	5.164	21.94%	18.67%
	(0.962)	(0.155)	(0.807)	(0.490)	0.11	0.08

Notes: Standard errors in parentheses below coefficients. "Duration" refers to the duration of the high volatility regime of the idiosyncratic shock expressed in years. "Unc. Prob." refers to the unconditional probability of the high volatility regime expressed in percentage.

Figure 1. Filter Probabilities of high volatility common shocks

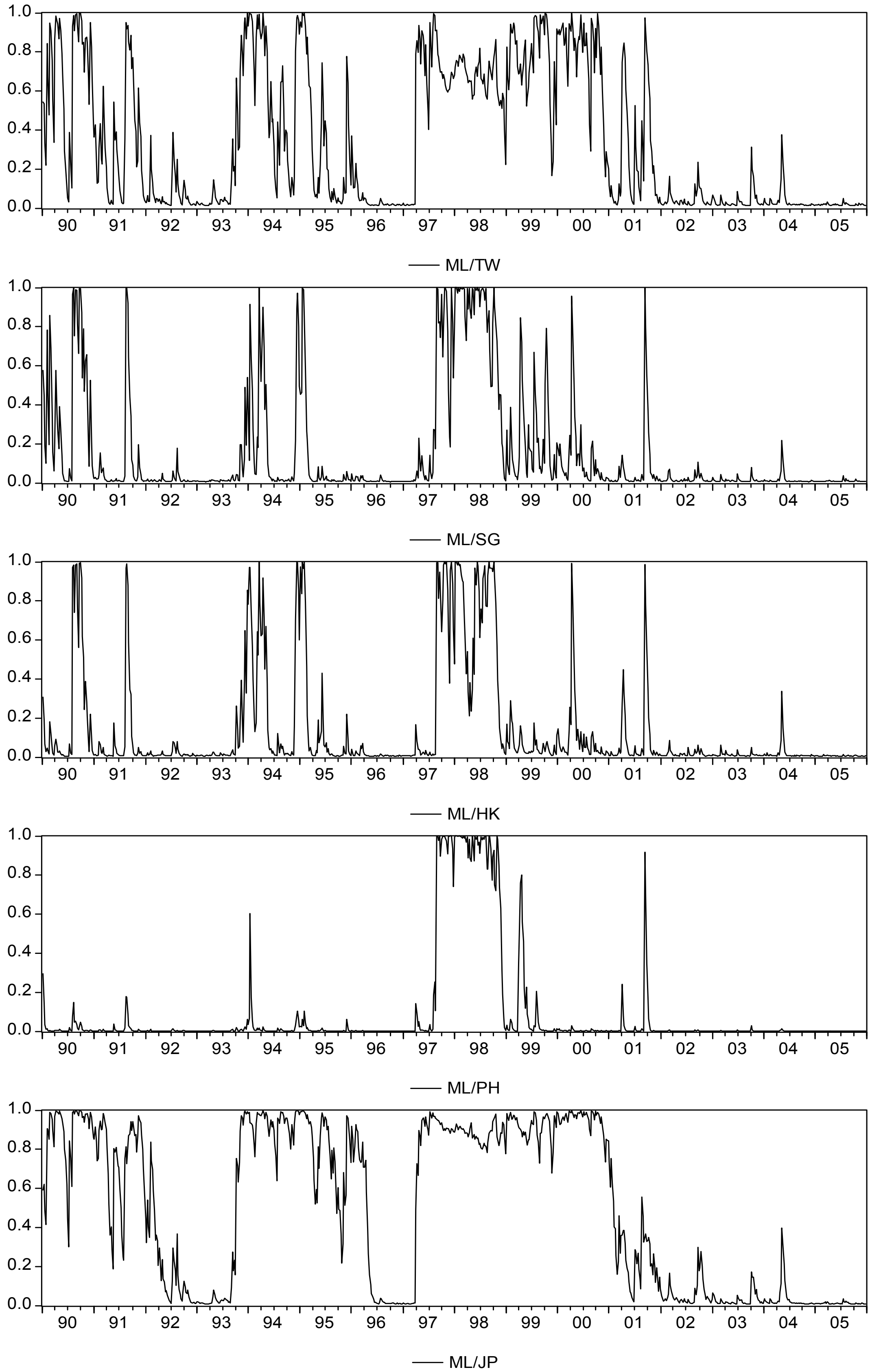


Figure 1 (continued)

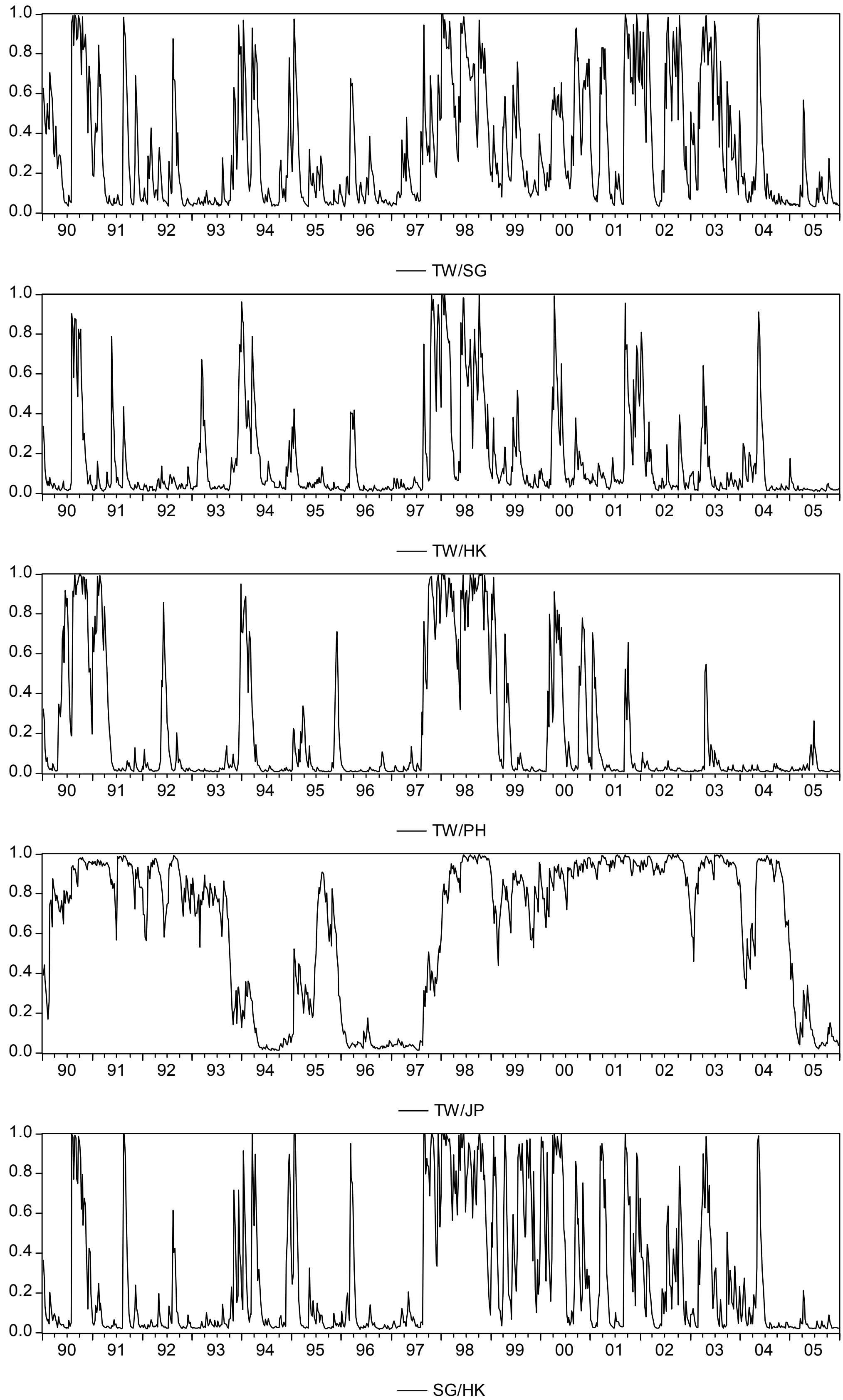


Figure 1 (continued)

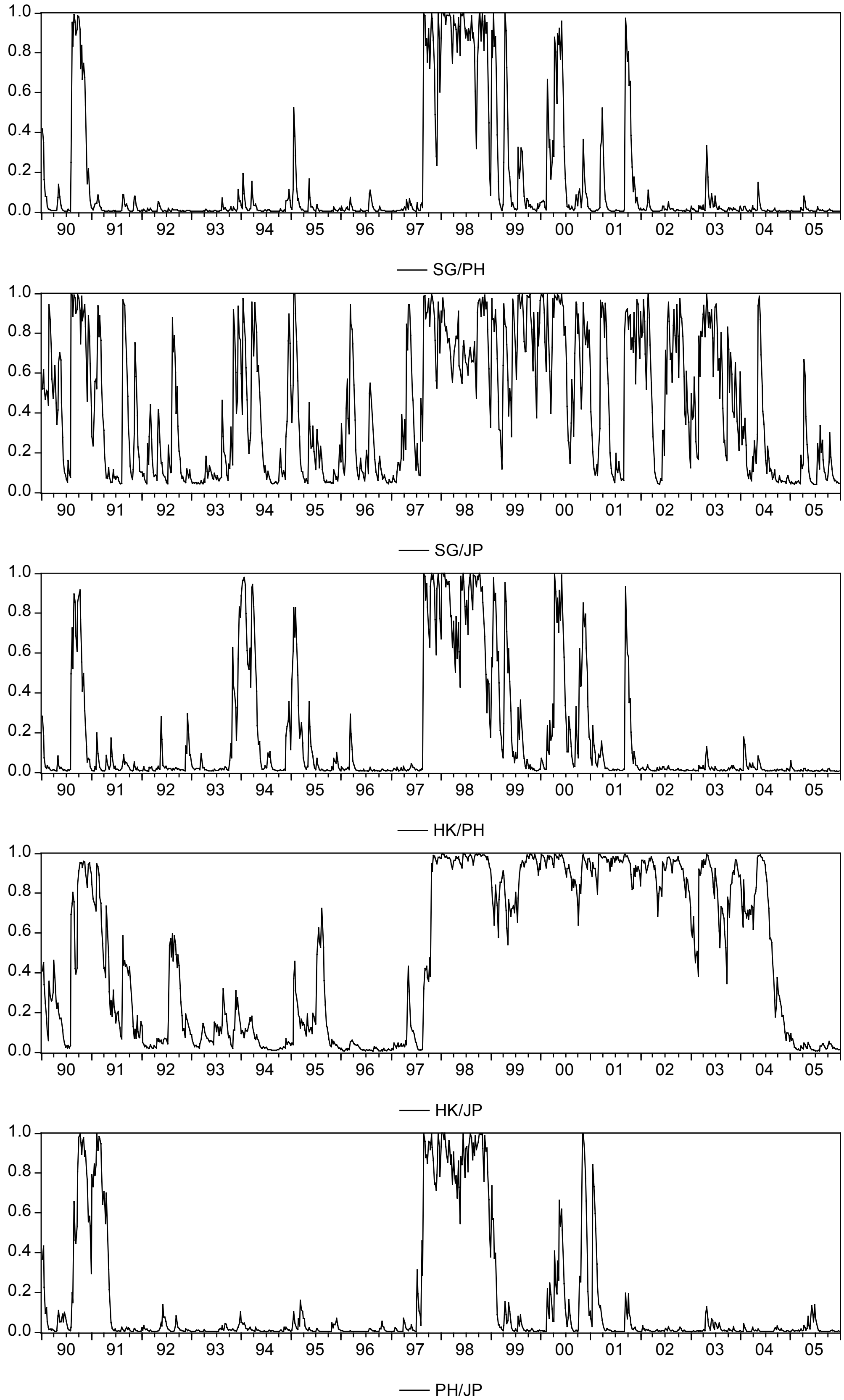


Figure 2. Conditional Correlations

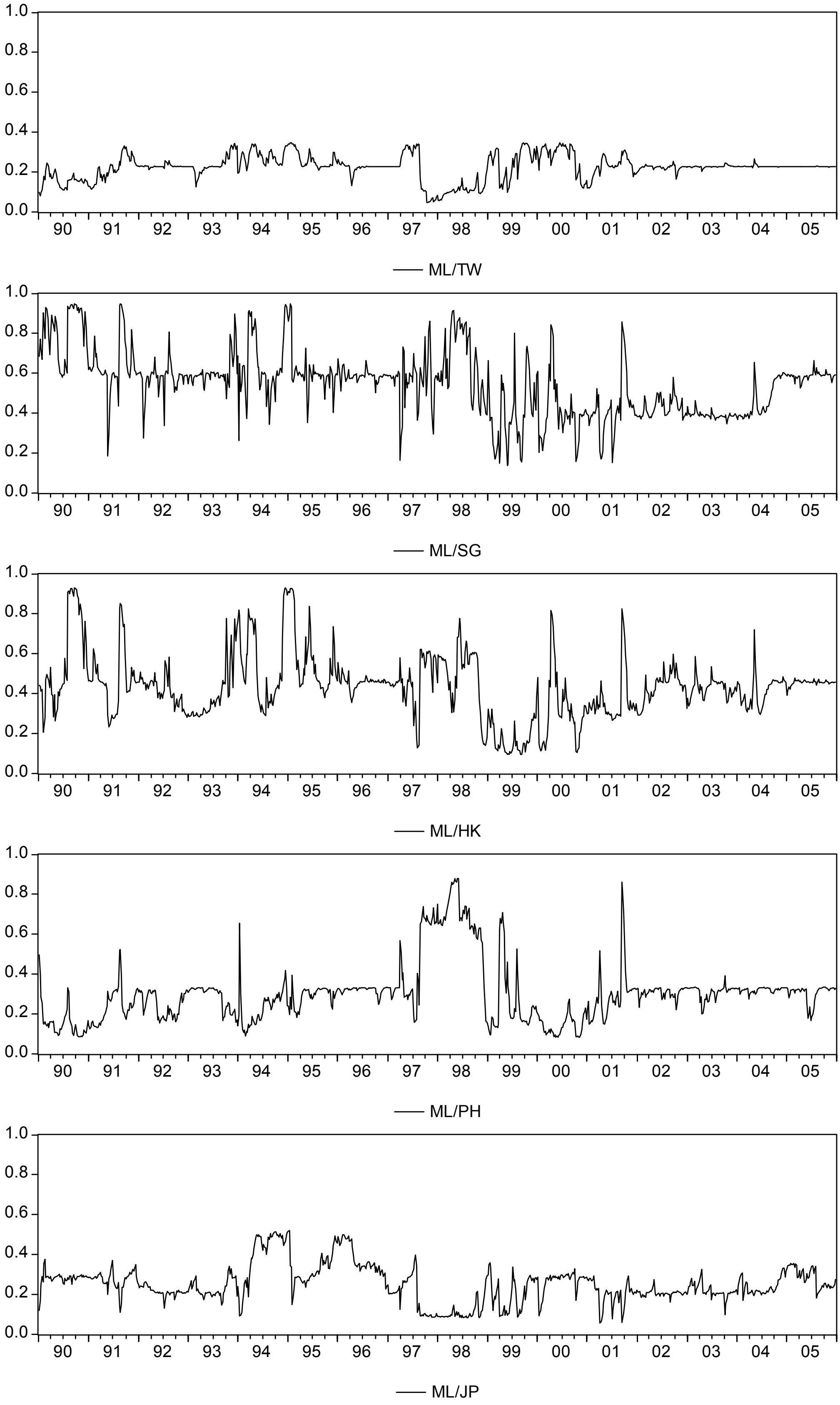


Figure 2 (continued)

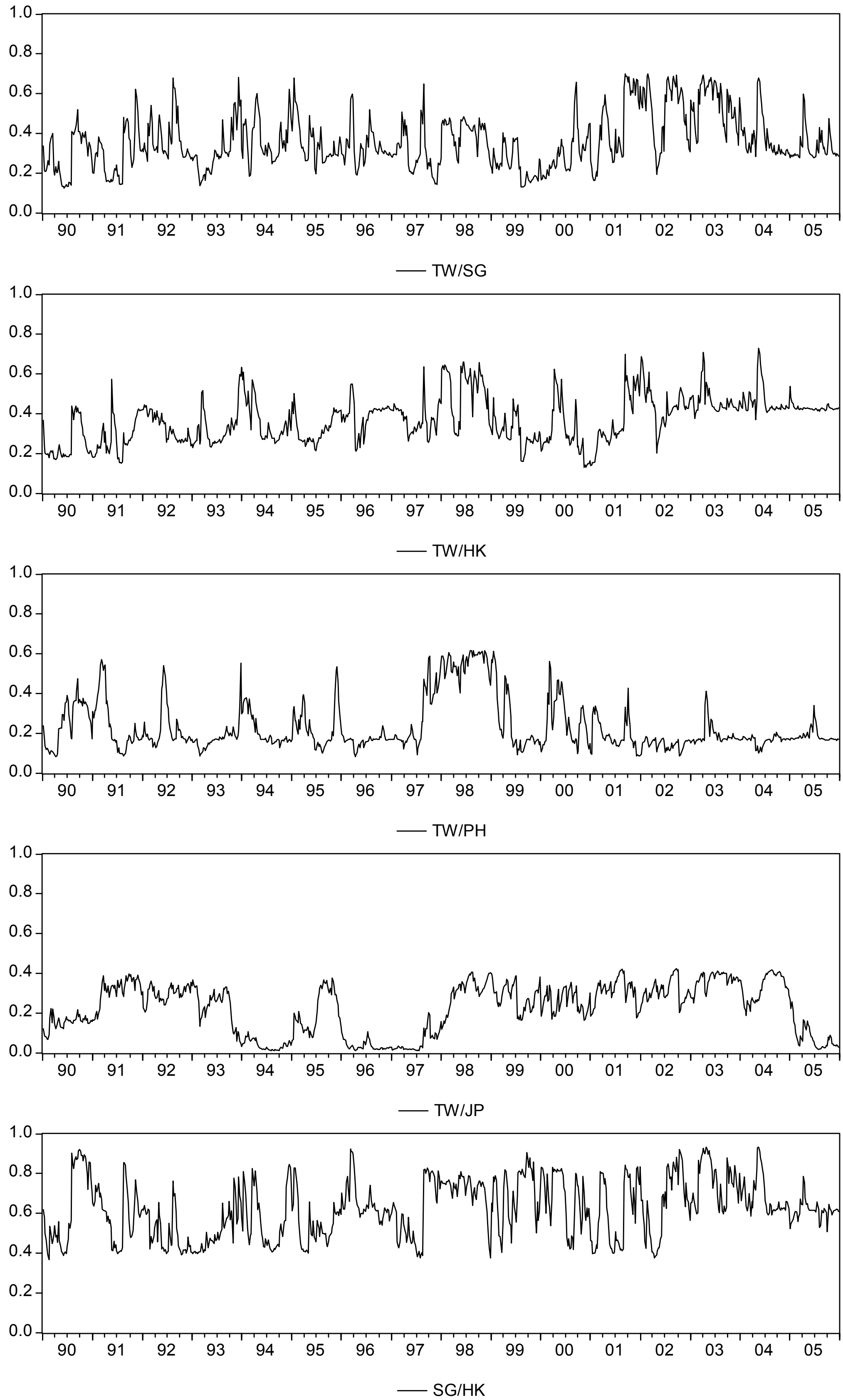


Figure 2 (continued)

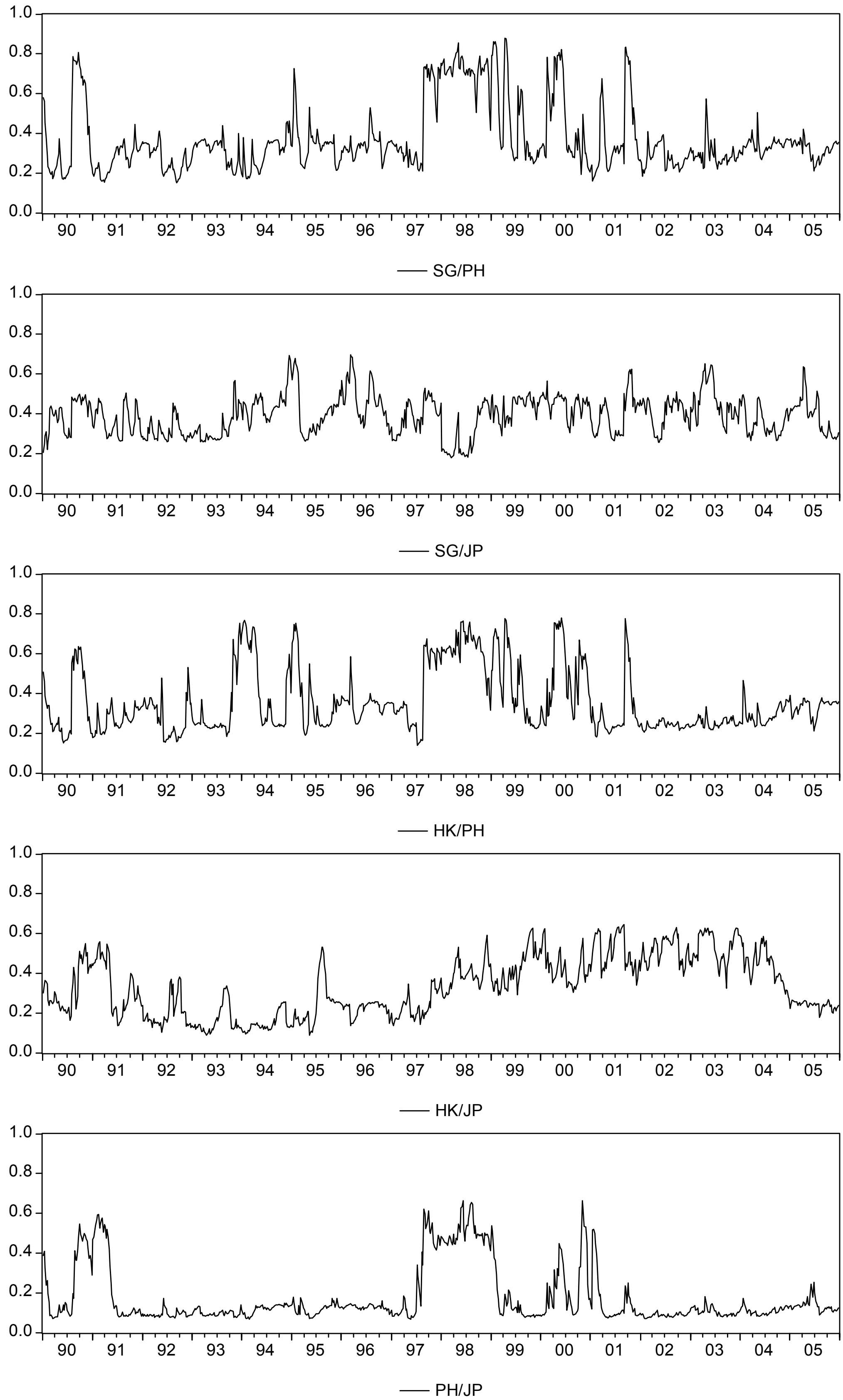


Figure 3. Exchange rates (vis-à-vis USD)

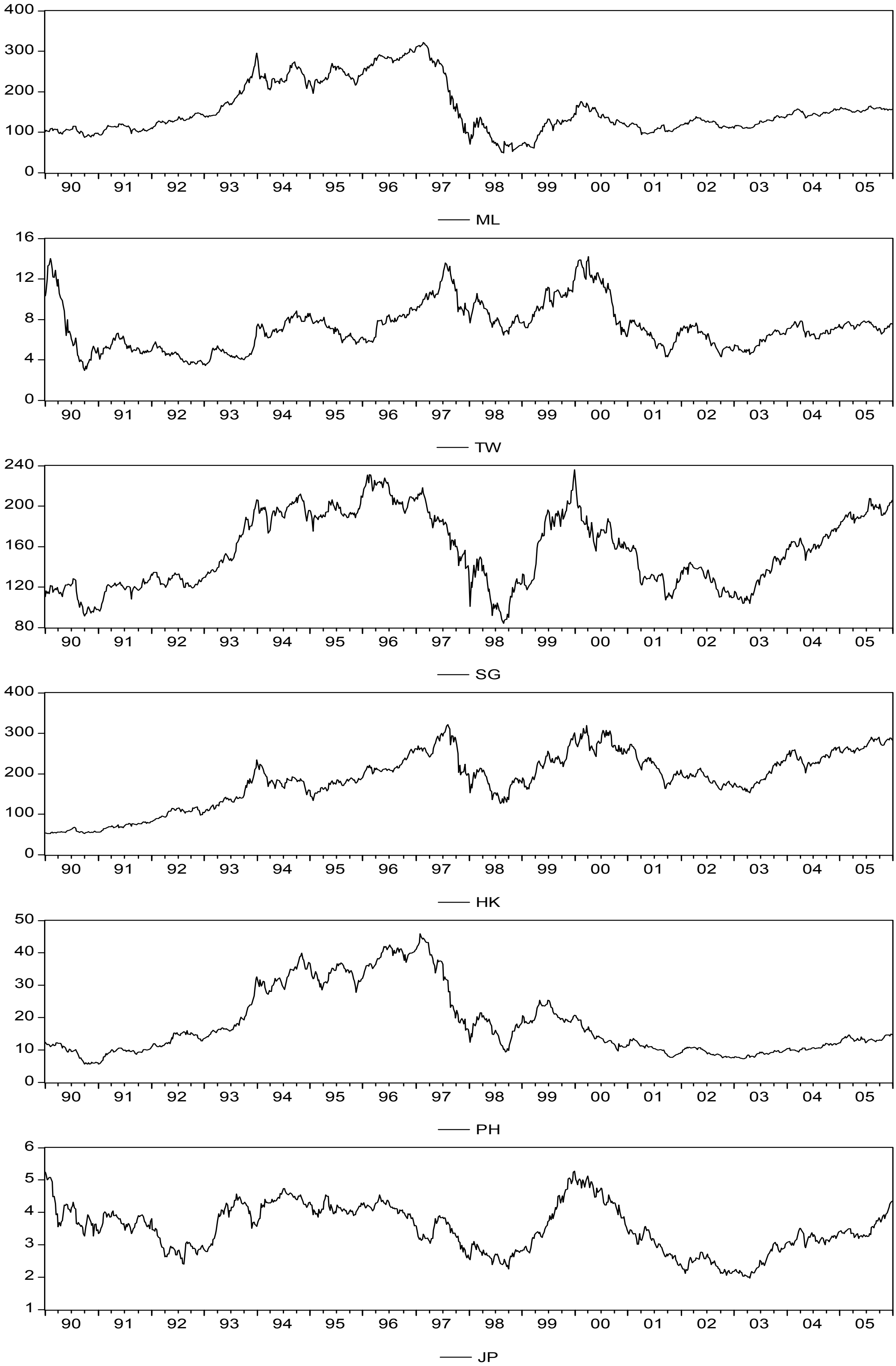


Figure 4. Filter Probabilities of high volatility common shocks (Local currency)

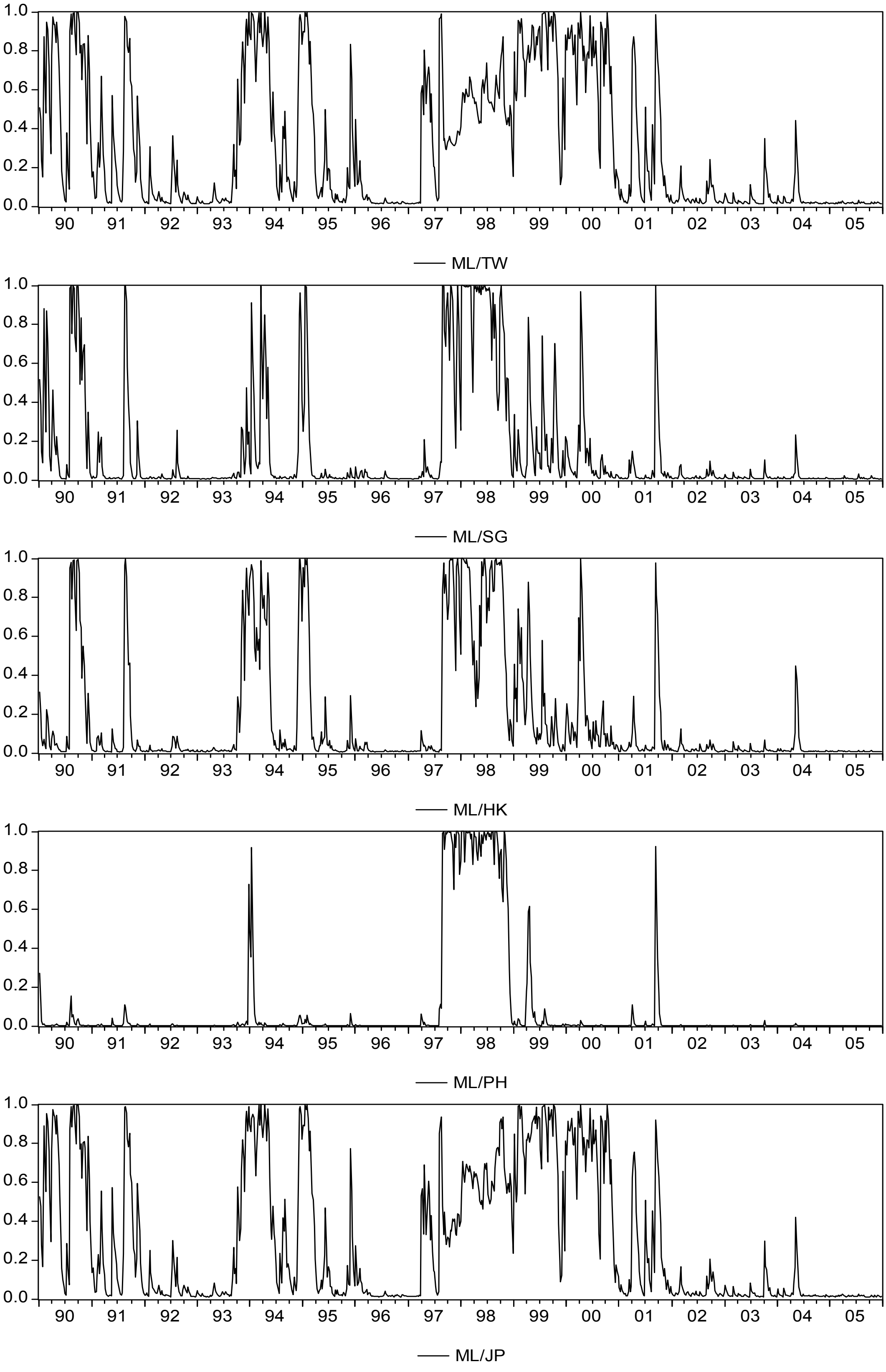


Figure 4. (continued)

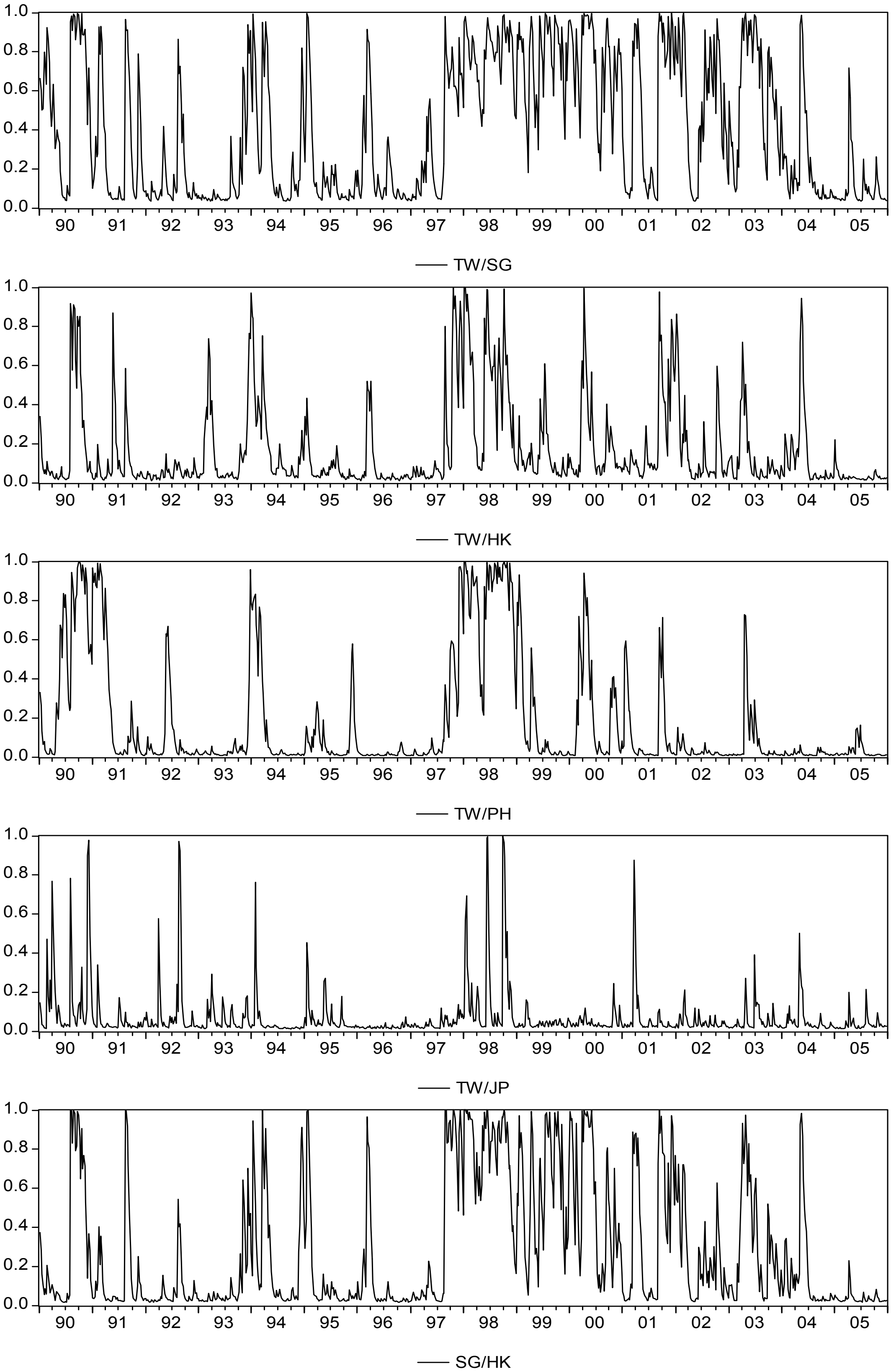


Figure 4. (continued)

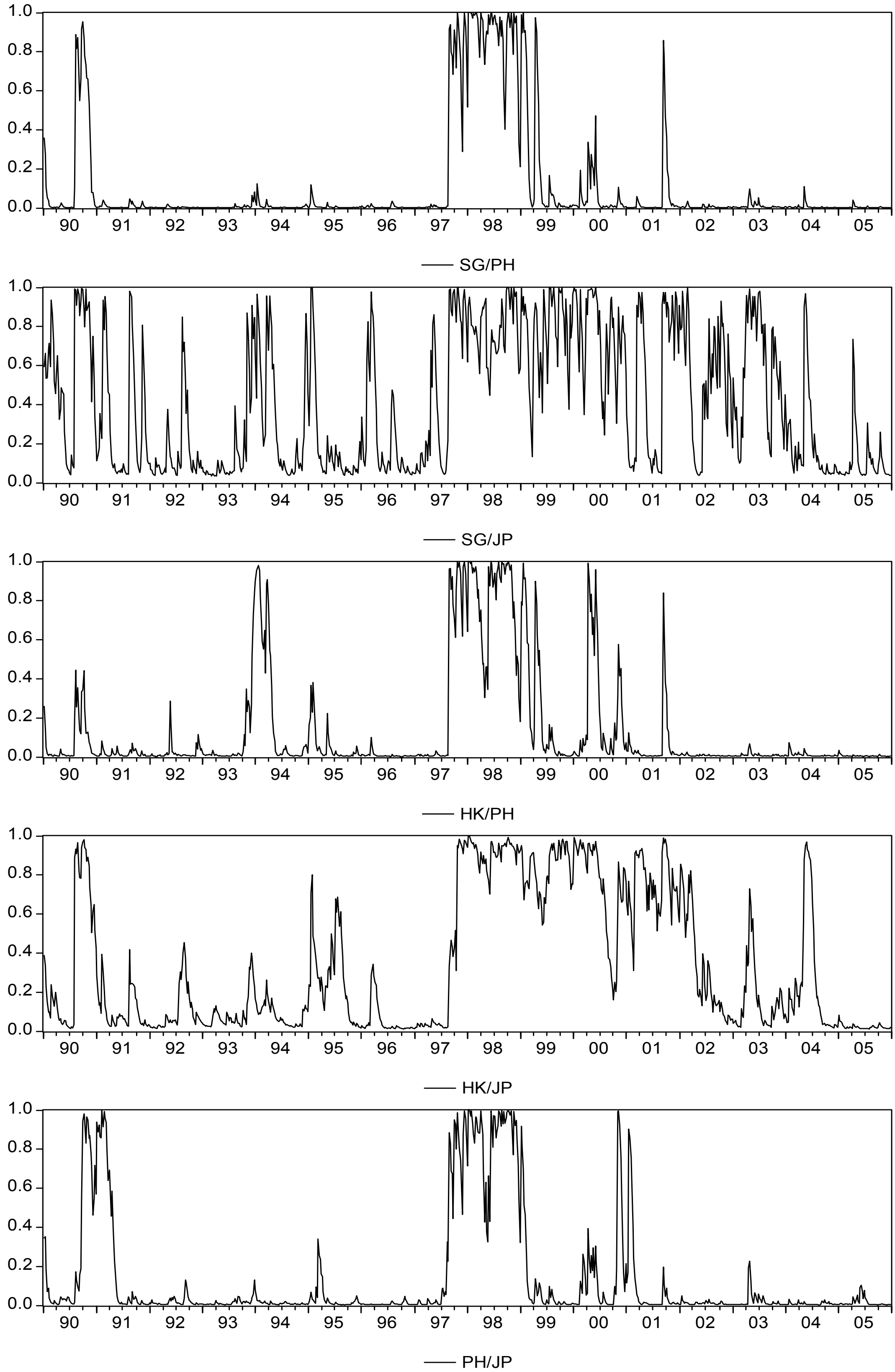


Figure 5. Conditional Correlations (Local currency)

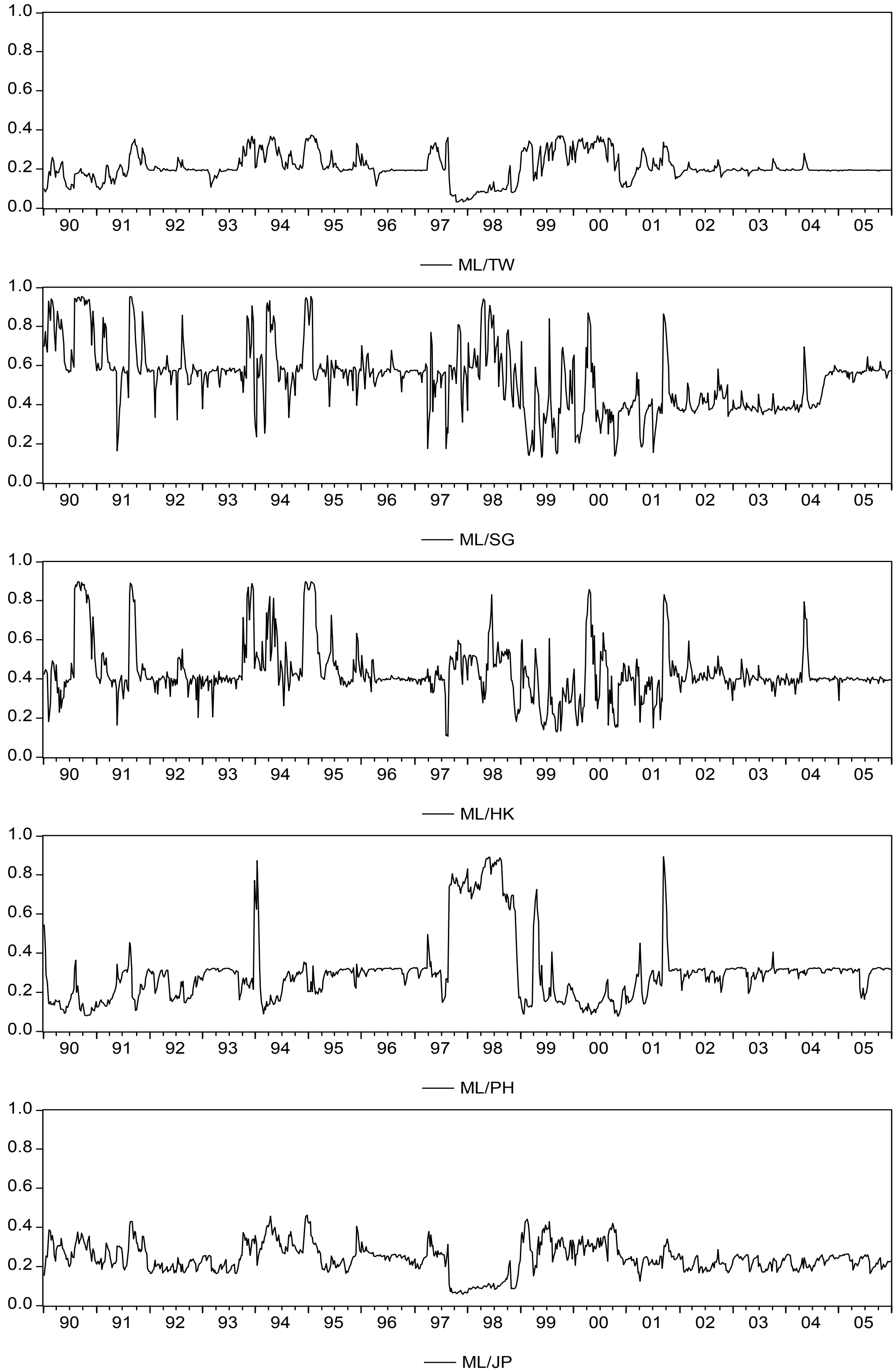


Figure 5. (continued)

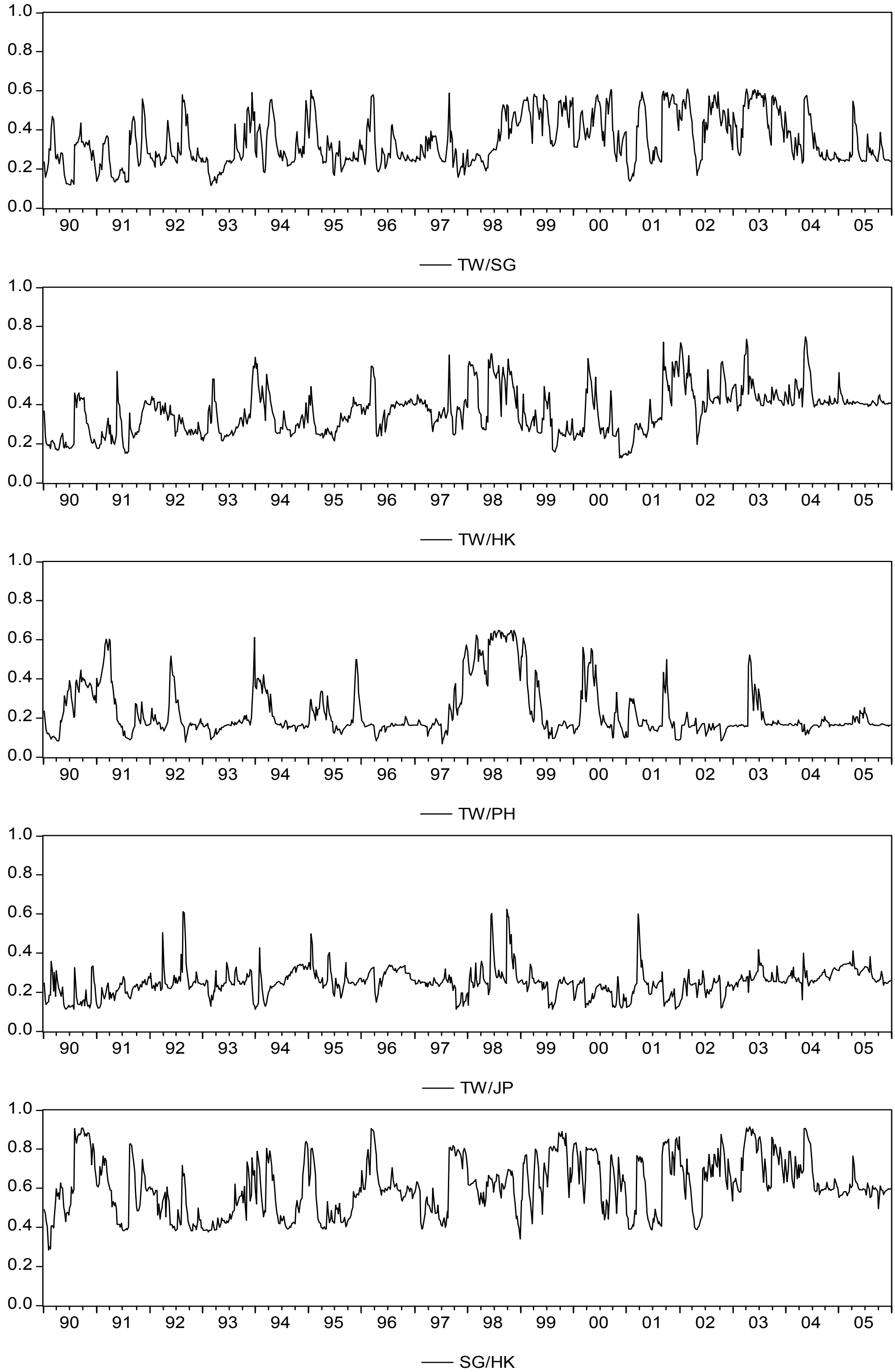
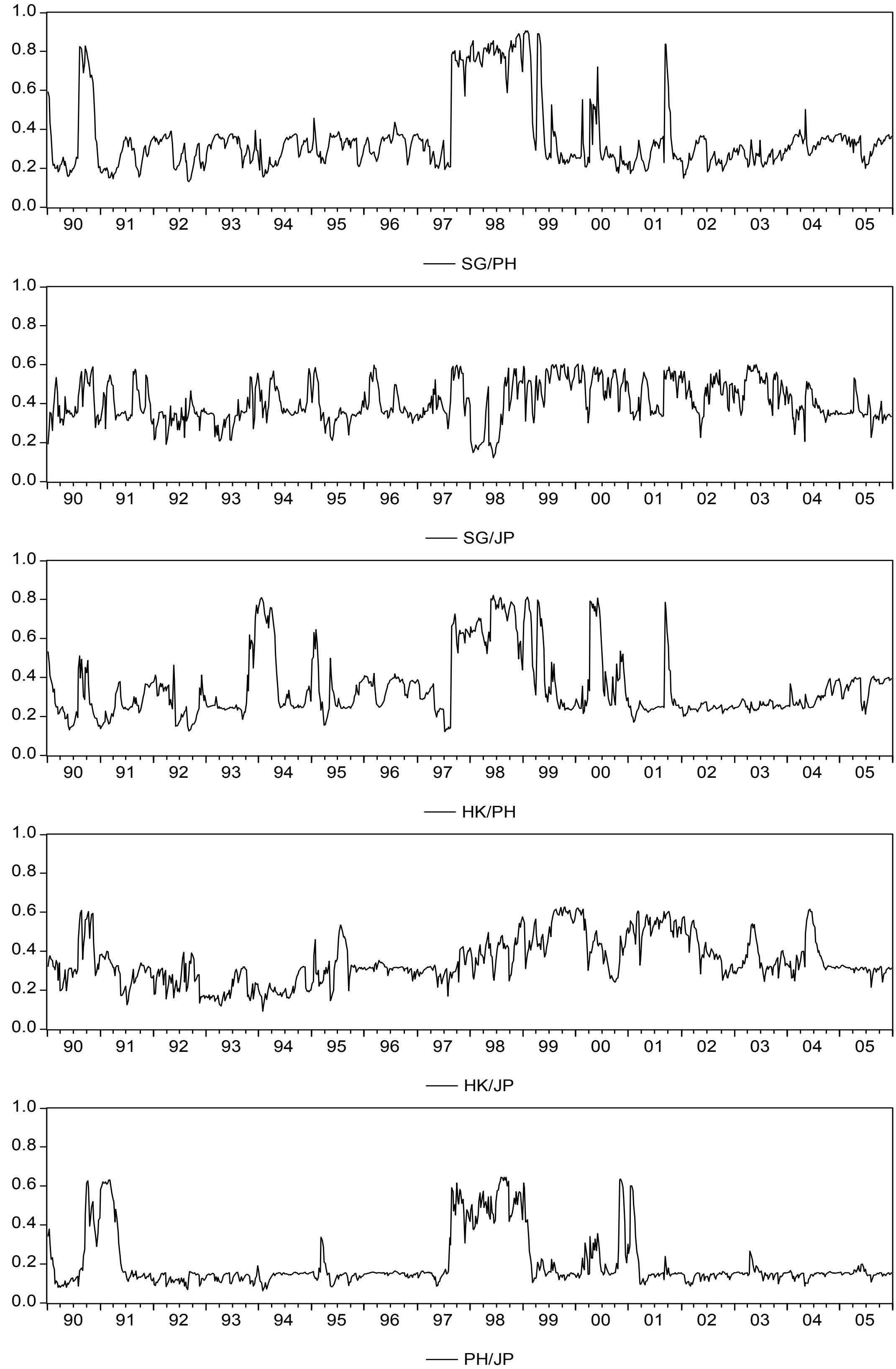


Figure 5. (Continued)



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