

# **Factors Affecting the Credit Spreads of Asia Pacific Issuers In International Bond Market**

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# **Factors Affecting the Yields of Emerging Market Issuers: Evidence from the Asia Pacific Region**

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## **Abstract**

We investigate the yield spread between the sovereign bonds issued in international markets by major Asia-Pacific issuers (China, Korea, Malaysia, Philippines and Thailand) and matched with near maturity benchmark U.S. Treasury bonds (2, 5, 10 year maturities) to determine the extent that various factors affect changes in credit spreads. The results suggest that the credit spreads of these sovereign bonds tend to be negatively related to changes in interest rates on U.S. benchmark bonds and positively related to changes in the slope of the yield curve. The asset and exchange rate variables were only significant for spreads on Philippine bonds where it was negatively related to changes in the local stock market index, and positively to changes in the exchange rate. The complex dynamics of these processes highlight concerns for portfolio managers when constructing portfolios of sovereign Asian bonds by aggregating bonds of different credit ratings.

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# Factors Affecting the Credit Spreads of Asia Pacific Issuers In International Bond Market

## 1. Introduction

Recent data published by the Bank for International Settlements (BIS) reveals the deterioration in international bank lending to the Asia-Pacific<sup>1</sup> region following the Asian Financial Crisis from record levels of U.S.\$379 billion in 1997 to below U.S.\$280 billion by December 2002. The liquidity crisis that followed this reduction in funds has drawn attention to the regions' over reliance on intermediated financing and the need for financial reform and capital market liberalization, which also includes the development of alternative sources of financing<sup>2</sup>. It is therefore not surprising that the attention of academics and policy-makers has focused on identifying, and then overcoming, those obstacles to building viable domestic bond markets and improving the issuance in international markets by those developing economies that dominate the Asia-Pacific region.

However, in the empirical literature rarely are those factors that influence the prices of bonds investigated. This is a concern of considerable importance for issuers in international markets from developing economies, as well as the portfolio managers who may be the ultimate investors. For example, current market practice assumes that the term structure (yield curve) for an emerging market issuer is based on the riskless "benchmark" curve -in practice in U.S. dollar markets, generally the term structure of U.S. government securities-plus a credit spread (De Almeida et al., 1998). The credit spread reflects the premium for default risk over an otherwise riskless security. In the recent finance literature much attention has been drawn to models of the pricing of credit spreads and their empirical implications (Longstaff and Schwartz, 1995; Jarrow, Lando and Turnbull, 1997, and Collin-Dufresne, Goldstein and Martin (2001)), with empirical results from studies of U.S. bonds being consistent with changes in default risk proxied by an asset variable (generally a stock index)

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<sup>1</sup> The Bank for International Settlements includes the following countries in the Asia-Pacific category: Afghanistan Bangladesh, Bhutan, British Overseas Territories, Brunei, Cambodia, China, Fiji, French Polynesia, India, Indonesia, Kiribati, North and South Korea, Laos, Macao, Malaysia, Maldives, Mongolia, Myanmar, Nauru, Nepal, New Caledonia, Pakistan, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka, Taipei, China (Taiwan), Thailand, Tonga, Tuvalu, U.S. Pacific Islands, Vietnam, Wallis-Futuna Islands, Western Samoa. Singapore and Hong Kong, China are treated as offshore banking centres and are not included.

<sup>2</sup> The proposal to develop disintermediated financial markets in the Asia-Pacific region has been proposed by Arndt (1983), and Chelliah (1993) amongst others. More recently various authors have argued for the development of corporate bond markets as an alternative to bank lending. Examples include, Benzie (1992), Schinasi and Todd-Smith (1998), Kim (1999), Herring and Chatusripitak (2000), Stulz (2000) and Batten and Kim (2001).

and interest rate factors (generally proxied by the yield on a riskless bond), negatively affecting changes in credit spreads. Importantly, the findings from more recent studies, including those on the behaviour of credit spreads on Sterling and Australian dollar denominated bonds by Manzoni (2002) and Batten and Hogan (2003), are consistent with the results from these other studies in U.S. markets.

The objective of this study is to apply these same empirical techniques to investigate the factors associated with the changes in credit spreads on bonds issued in international markets by sovereign borrowers from developing countries in the Asia-Pacific region. Due to data and liquidity limitations only sovereign bonds issued by China, South Korea, Malaysia, the Philippines and Thailand are investigated. This in itself is not a significant limitation since these issuers dominate issues from the Asia-Pacific region and in 2002 accounted for approximately 83% (about U.S.\$106 billion) of outstanding issues by Asia-Pacific issuers (excluding the developed economies of Australia, Japan, New Zealand and Singapore).

Understanding these relationships is important for two main reasons. First, the results of this study add to recent evidence (Afonso and Strauch, 2004) on the nature of the risk premium that applies to issuers in international bond markets. Second, the results will also assist those responsible for pricing and managing the risks of sovereign debt in international markets. For example, the interest rate spreads of unknown or new issuers demanded by the markets have also been wider than demanded by similarly rated European or U.S corporations in recent years and may have discouraged non-sovereign borrowers (Eichengreen and Mody, 1997; Kamin and von Kleist, 1999). Thus, the findings can also provide a framework for investigating the international bonds issued by other developing countries.

These issues are investigated using a regression model, first proposed by Longstaff and Schwartz (1995) and Collin-Dufresne, Goldstein and Martin (2001), for explaining changes in the credit spread. In the spirit of Batten and Hogan (2003), to accommodate the time varying volatility of the return series, a GARCH specification of the Collin-Dufresne, Goldstein and Martin (2001) model is used in this paper.

The paper is set out as follows. In the next section the data and method employed in this study is described. The results are then presented and the final section allows for some concluding remarks.

## 2. Data and Method

International issues from the Asia-Pacific regions' economies have largely focused on bond issues in the United States (U.S.) market (termed Yankee bond issues) by quasi-government or sovereign borrowers, though some issuers (such as the Philippines, and more recently China and Malaysia) have opted for larger global bond issues. Global bond issues are sold simultaneously in a number of markets including the Eurobond and U.S. domestic markets. European private investors are easily able to buy these higher yielding securities in Eurobond markets (often enjoying the tax anonymity which comes with a bearer security), whereas the Yankee bond market is largely a professional market. Yankee bonds generally need to be registered with U.S. Securities and Exchange Commission (SEC), which requires the bond issuer to have a credit rating from a recognized rating agency. However, declining issuing and compliance costs, and the withdrawal by international banks to the region following the Asian Crisis has encouraged borrowers to bypass national banking systems and pursue direct security market processes. Also, while the U.S. Internal Revenue Service (IRS) discourages the sale of Eurobonds to U.S. citizens due to their bearer nature, which offers the possibility of tax avoidance, strong investor demand for high-yielding Yankee issues has encouraged issuance from better-rated Asia Pacific economies. Despite the non-investment grade status of most of these U.S. dollar issues, investors can take comfort from their quasi-government or sovereign status. Historically, few non-government or quasi-government issuers have tapped U.S. domestic markets since they have little or no issuance history and they lack the marketability of a sovereign issue.

(insert Table 1 about here)

Daily bond data was obtained from the Reuters Fixed Income Database for the period from the 30 December 1999 to the 28 November 2002 (749 daily observations). All bonds were fixed rate, semi-annual coupons priced on a 30/360-day basis. The yield to maturity (YTM) was calculated as the ISMA yield to maturity, with indicative daily bids provided by market practitioners at the close of trading. To overcome potential distortions in yield due to illiquidity and the time path effects due to the bond approaching maturity, only liquid bonds and those with a modified duration of greater than 1 year were included in the final group of bonds. Only nine bonds issued by the governments of China (3 bonds), Korea (1 bond), Malaysia (1 bond), Philippines (3 bonds) and Thailand (1 bond) passed these simple tests and also had a complete set of price data. Table 1 reports the information on each bond: the first

and second column shows the formal name of the issuer and the code used for this bond in the study. The next columns show the issue and maturity date of each bond and the credit rating. The last three columns show the price of the bond at the 28<sup>th</sup> November 2002 (the end of the data period), and the modified duration of the bond at this time. The modified duration was used to match the bond with a near maturity U.S. benchmark bond. The credit spreads between these nine bonds and the nearest equivalent U.S. benchmark Treasury 2, 5 and 10-year bonds were estimated in this study.

The empirical and theoretical investigation of the behaviour of credit spreads began with Merton (1974) and Longstaff and Schwartz (1995), with more recent models providing a better specification of the process of default (e.g. Madan and Unal, 2000 and Zhou, 2001). Batten and Hogan (2002) provide a summary and critical analysis of these methods. Notwithstanding differences in the theoretical approaches, it is possible to form a general conclusion that changes in credit spreads may be expressed as a function of an interest rate and asset factor.

Subsequently various authors have employed regression based techniques to determine whether these relationships exist. Collin-Dufresne, Goldstein and Martin (2001) expand upon the simple two-factor regression model proposed by Longstaff and Schwartz (1995) and include a wider set of independent variables to accommodate macroeconomic factors which are known to influence credit spreads (see Afonso and Strauch, 2004). Guha and Hiris (2002) show that a credit spread is a leading indicator of macroeconomic business conditions, with turning points in the credit spread anticipating changes in the business cycle, while Joutz and Maxwell (2002) note that non-investment grade bonds are more susceptible to external shocks (such as the Russian and Asian financial crises) than higher rated bonds. Expanding upon the regression techniques employed to study the credit spread phenomena, Manzoni (2002) and Batten and Hogan (2003), investigating the sterling eurobond market and the Australian eurobond market respectively, apply Generalized Autoregressive Conditional Heteroskedastic (GARCH) models to capture the persistence evident in the conditional variance of credit spreads.

These papers suggest that a credit spread,  $S$ , may be expressed as the arithmetic difference between the risky and default-free bond. The proxy for the change in the asset value factor is the return on a broad stock market index (in this instance the Shanghai Index (China: CHS), KOSPI (Korea), KL (Malaysia: MYKLS), Philippines Stock Exchange (PSE), Thailand SET index (THSET)) designated by  $I_t$ , where  $\Delta I_t$  is the natural logarithm of the

daily change on the stock index. The proxy for the interest rate factor is simply the yield on the U.S. Treasury benchmark bond ( $Y_t$ ), where  $t$  has a value of 2, 5 and 10-years. In addition we also consider the three independent variables proposed by Collin-Dufresne, Goldstein and Martin (2001) and also used by Batten and Hogan (2002): (i) the difference in yield between the 30 and the 2 year U.S. Treasury bond representing the slope of the yield curve at time  $t$  ( $Y_{30}-Y_2$ ). This variable provides a proxy for the expected future short rate and the potential level of future inflation and economic activity; (ii) a squared change in the level of the U.S. Treasury bond yield which captures the non-linear effects due to convexity  $(\Delta Y_t)^2$ ; and (iii) a final variable the U.S. dollar exchange rate against the renimbi (China), won (Korea), ringitt (Malaysia), peso (Philippines) and bhat (Thailand), broadly representing the macroeconomic uncertainty that influences the performance and value of the firm ( $e_t$ ).

This GARCH specification estimated was up to a GARCH (3,3). This specification is necessary given the volatility clustering clearly evident in the time series plots of the return series (not provided). GARCH models also provide better estimates of volatility (Diebold, Hickman, Inoue and Schuermann, 1998). Since the first differenced time series demonstrate statistically significant auto and partial correlation up to lag 3, an Autoregressive term (AR) and Moving Average term (MA) was also included in the regression model. In most cases, an ARMA(1,1) correction was sufficient to eliminate any remaining autocorrelation in the regression residuals.

A GARCH specification from a GARCH (11) to a GARCH (33) was considered. The GARCH (3,3) form of the model including the maximum estimated ARMA (3,3) terms, has the form:

$$\Delta S_t = a + b\Delta Y_t + c\Delta(Y_{30}-Y_2)_t + d(\Delta Y)^2_t + e\Delta I_t + f\Delta e_t + g_1\Delta S_{t-1} + g_2\Delta S_{t-2} + g_3\Delta S_{t-3} + h_1\varepsilon_{t-1} + h_2\varepsilon_{t-2} + h_3\varepsilon_{t-3} + \varepsilon_t; \sigma^2 = \alpha + \beta_1 \varepsilon^2_{t-1} + \beta_2 \varepsilon^2_{t-2} + \beta_3 \varepsilon^2_{t-3} + \gamma_1 \sigma^2_{t-1} + \gamma_2 \sigma^2_{t-2} + \gamma_3 \sigma^2_{t-3}$$

where  $\Delta S_t$  = the change in the credit spread (for the various Asian bond issues as described in Table 1) at time  $t$ ,  $\Delta Y_t$  is the change in the risk free interest rate (identical in maturity to the riskless bond used to calculate the spread),  $\Delta(Y_{30}-Y_2)_t$  is the change in the slope of the yield curve,  $(\Delta Y)^2_t$  is the change in the squared spot rate (rates with the same maturity as the riskless bond),  $\Delta I_t$  is the change in the logarithm of the stock market index, and  $\Delta e_t$ , is the change in the spot exchange rate. The autoregressive terms  $\Delta S_{t-n}$ , for  $n = 1, 2, 3$  represent the lagged dependant variable, while the moving average terms  $\varepsilon_{t-n}$ , for  $n = 1, 2, 3$  represent the lagged residual.

The one-period ahead forecast variance based on past information is provided by the conditional variance term ( $\sigma^2$ ). This term is a function of three components: the mean  $\alpha$ ; news about volatility from the previous period, measured as the lag of the squared residual from the mean equation (the ARCH term  $\beta_n \varepsilon_{t-n}^2$  for  $n = 1,2,3$ ); and last period's forecast variance (the GARCH term  $\gamma_n \sigma_{t-n}^2$  for  $n = 1,2,3$ ). This specification interprets this period's variance as being formed by a weighted average of a long-term average (the constant), the forecast variance from the last period (the GARCH term), and information about volatility observed in the previous period (the ARCH term). As established by Longstaff and Schwartz (1995) and Collin-Dufresne, Goldstein and Martin (2001), the coefficients of the interest rate dependant variables ( $b$ ,  $c$  and  $d$ ) are expected to be negative, while the coefficient  $e$  is also expected to be negative since the higher the value of the firms assets (represented by a rise in the stock market) the lower will be the probability of default. The sign of the exchange rate variable  $f$  is expected to be positive when the local currency is expressed in terms of single units of U.S. dollars. Since this variable proxies macroeconomic uncertainty a depreciation of the local currency-expressed as an appreciation of the U.S. dollar-would be expected to be associated with an increase in credit spreads.

### 3. Results

To estimate the credit spread these 9 sovereign bonds are matched on a duration basis with a set of U.S. Treasury benchmark<sup>3</sup> bonds with a maturity of 2, 5 and 10 years. The sample period covers daily data for the period from 30 December 1999 to the 28 November 2002 (749 daily observations).

(Insert Figure 1 and 2 about here)

Figure 1 plots the yields of three of these bonds over the sample period which share an equivalent maturity: the China Global 7.3% 2008 (CHG08), Korea Global 8.875% 2008 (KOG08) and the Philippines Global 8.875% 2008 (PHG08) bonds, while Figure 2 plots the difference in yield between the Philippines bond (PHG08) and the Korea bond (KOG08) and the China (CHG08) and the Korean bond (KOG08). The China bond currently is rated BBB, the Korea bond is rated A- and the Philippines bond has a non-investment grade rating of

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<sup>3</sup>Benchmark bonds of a specific maturity are interpolated from yields of selected on-the-run bonds using splining or other techniques (Kim, Moon and Lee 1998). Industry associations usually specify bonds, which are the most liquid, for this purpose.

BB+. There are also slight differences in the modified duration of these three securities (PHG08 has a modified duration of 4.20, KOG08 has 4.39 and the KOG08 has 5.02). Despite these differences, it is clear from Figure 1 that the two bonds from China and Korea, which have similar credit ratings tend to trade at similar levels of yield while the lower rated Philippines bond trades at a much higher yield.

What is interesting to observe from Figure 2 is that the difference in yield between the Philippines and Korean bond is time varying and that during a period when interest rate levels tended to decline (from Figure 1) the credit spread between the very closely duration matched Korean and Philippines bond, rose. This curious observation, suggestive of a negative relationship between changes in the levels of interest rates and credit spreads, has been identified in the recent theoretical literature and will be discussed further in the next section. Despite the slight differences in the modified duration in the Korea and the China bond (the China bond had a slightly longer maturity), the spread between the two bonds was clearly less volatile and tended to fluctuate around a mean of  $-0.24$ . Given the unique and different experiences of the credit spreads based on these pairs of bonds, these figures illustrate the difficulty-yet the importance-of providing a general explanation of behaviour that may apply to a wide class of sovereign issuers.

(insert Table 2 about here)

(ii) *Description of Variables*

Table 2 provides the descriptive statistics of the levels and first differences of the variables used in this study. They are divided into four groups: Asian stock market indices (CHS (China-Shanghai), KOSPI (Korea), MYKLS (Malaysia), PSE (Philippines), THSET (Thailand); U.S. Benchmark bonds with 2 (US2), 5 (US5) and 10 (US10) year maturities and the nine Asian International Bonds reported in Table 1. The mean, standard deviation (std. dev) and coefficient of variation (CoVar) are reported for levels, while the mean, median, standard deviation, skewness and kurtosis are reported for the first differences. The coefficient of variation enables a comparison to be made between series with different means. Using this statistic the lowest variance of the stock indices was the Shanghai Index while the highest was in Korea; the lowest variance of the U.S. bonds was the U.S. 10 year bond and the highest was the U.S. 5 year; the lowest variance of the Asian international bonds was the Philippine 2024 Yankee bond (PHU24: 0.0682) and the highest was the China 2004 Yankee (CHU04: 0.317). Interestingly the five global bonds as a group had a lower average variance

than the other four Yankee issues (0.2028 compared with 0.157), which may be attributed to the higher levels of liquidity in these issues.

The standard deviation of the first differences suggests that the U.S. benchmarks (range from 0.058 to 0.124) were less volatile than the other bonds. Comparing the Asian bonds of equivalent maturity (CHU08, KOG08, MYG09, PHG08), the Korean KOG08 bond had the least volatility (0.086: rated A-) while the Philippines PHG08 had the highest (0.136 rated BB+). This is largely consistent with the credit ratings of the respective bonds-the highest rated bonds would be expected to be less volatile compared with equivalent maturity but lower rated bonds. The correlations<sup>4</sup> between the bond pairs were also calculated, although they were all generally low and below 0.5 for both levels and first differences. The highest correlation was between yield changes in the US2 and US10 with a value 0.460. The correlations between the nearest maturity Asian international bonds are higher than between bonds of differing maturity. This would be consistent with the risk premiums, reflected in the credit spreads between same maturity bonds, being stable over the sample period. The correlations between the bond pairs and the various Asian stock indices are in the range -0.11 to +0.292. There appears to be no consistent pattern in these correlations.

(Insert Table 3)

(iii) *Changes in Credit Spreads*

Regressions of the change in the credit spread against the change in the U.S. Treasury benchmark bond and the asset, interest rate and macroeconomic variables was conducted using a GARCH (3,3) specification. The GARCH specification was undertaken to adjust for the time varying volatility structure of the return series. To ensure that the statistical significance of the results was not affected by conditionally non-normally distributed residuals, we also applied the methods described by Bollerslev and Wooldridge (1992) when calculating the standard errors. Only these adjusted results are reported in Table 3.

The intercept term (a) was statistically significant in 7 of the 9 regressions. However, with a value of less than 0.01 it was not economically significant and so would not have a significant effect on the spread return. A significant alpha implies a risk premium in addition to that proposed by theory.

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<sup>4</sup> For the sake of brevity complete Tables are not reported but are available from the authors upon request.

The interest rate factor ( $\Delta Y_t$ ) was statistically and economically significant in all 9 cases. The coefficient was negative and this result is consistent with the results of other researchers including Longstaff and Schwartz (1995). The variable to accommodate the change in the shape of the yield curve ( $\Delta(Y_{30}-Y_2)_t$ ) was statistically significant in 7 of the 9 cases- the 2 exceptions being the Philippine bonds. The sign was positive in all cases and the economic value of the coefficient was no less than 10% of the size of the interest rate variable. The positive sign suggests that a steepening of the yield curve-due to expectations that the rate of future inflation will rise- results in a rise in the credit spread. The adjustment to accommodate possible convexity in the yield curve ( $(\Delta Y)^2_t$ ) was statistically significant in 5 of the 9 cases. However, the actual coefficient was small and generally not economically significant.

Interestingly, the asset factor ( $\Delta I_t$ ) was only significant in 3 of the 9 cases, although it was negative in 2 cases and positive in the remaining one. A positive relationship suggests that a rise in the stock market is associated with an increase in the spread. This result is inconsistent with theory, however one possible explanation concerns possible rebalancing between bonds and stocks held by international portfolio managers. In the regressions involving 2 of the 3 Philippines bonds, the stock index variable was negative and also economically significant. This suggests that changes in credit spreads are negatively related to changes in the stock market index. This result-consistent with theory-is an important result for emerging market issuers with non-investment grade credit ratings.

The exchange rate variable ( $\Delta e_t$ ) was not significant with the exception of Philippine bonds where for 2 of the 3 possible regressions the value was positive and of a scale consistent with the stock index variable. This suggests that a rise in the exchange rate (a depreciation of the peso) was also associated with an increase in the credit spread and a fall in the stock index.

The complexity of the dynamics of the change in spreads is evident from the fact that 7 of the 9 of the regressions required an ARMA adjustment. These adjustments suggest that markets trading these securities are not efficient in the weak-form sense- a result consistent with other studies including Manzoni (2002) and Batten and Hogan (2003). The results of the GARCH (33) are reported in Table 3. The statistical significance of the variance equation is specified by the three terms (alpha, beta and gamma in Table 3). The constant,  $\alpha$ , represents the long term average; the coefficient  $\beta$  of the ARCH term, represents the significance of volatility observed in the previous period, and the coefficient  $\gamma$  of the GARCH term

represents the forecast variance from the last period. One of the ARCH and GARCH terms is significant in all the regressions in the sample. The first coefficient,  $\alpha$ , though statistically significant has a near zero value in most cases. The size of the  $\beta$  and  $\gamma$  coefficients were not of a similar order suggesting that past and forecast volatility have a dissimilar effect on the prediction of variance. The estimates of the coefficients for the ARCH and GARCH terms sum up close to, or less than, one (from 0.492 to 1.074). The reported GARCH (33) results tend to show a better goodness of fit, lower kurtosis in the standardised residuals, and higher log likelihood values than other simpler specifications. The tests for serial correlation in the residuals and squared residuals at lag 10 (Panel B) now largely reject the presence of significant ARCH effects, though there is still evidence of nonnormality in some of the residuals. Despite some reservations, these results are consistent with correct model specification<sup>5</sup>.

Overall, the size of the coefficients, and therefore their contribution to the return on the credit spread was not of a similar order; the interest rate variables were the most important though this was partially offset by the asset coefficient in the case of the Philippine bonds. The adjusted  $R^2$  had a range from 0.157 (PHG19-US10) to 0.564 (CHU06-US5), which on average is consistent with those statistics reported by other authors investigating international bonds (e.g. Batten and Hogan, 2003).

#### **4. Conclusions**

The objective of this study was to investigate the extent that asset, interest rate and certain macroeconomic factors affect changes in credit spreads. A GARCH specification derived from the regression equation proposed by Longstaff and Schwartz (1995) to accommodate the time-varying volatility structure of credit spread returns, suggests credit spreads of Asian sovereign bonds are negatively related to changes in U.S. interests. Rarely were asset and exchange rate variables important, the clear exception being those bonds issued by the Philippines, which were not of the same credit class as the other Asian issues.

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<sup>5</sup> For the sake of brevity only some diagnostics are reported. Further details are available from the authors.

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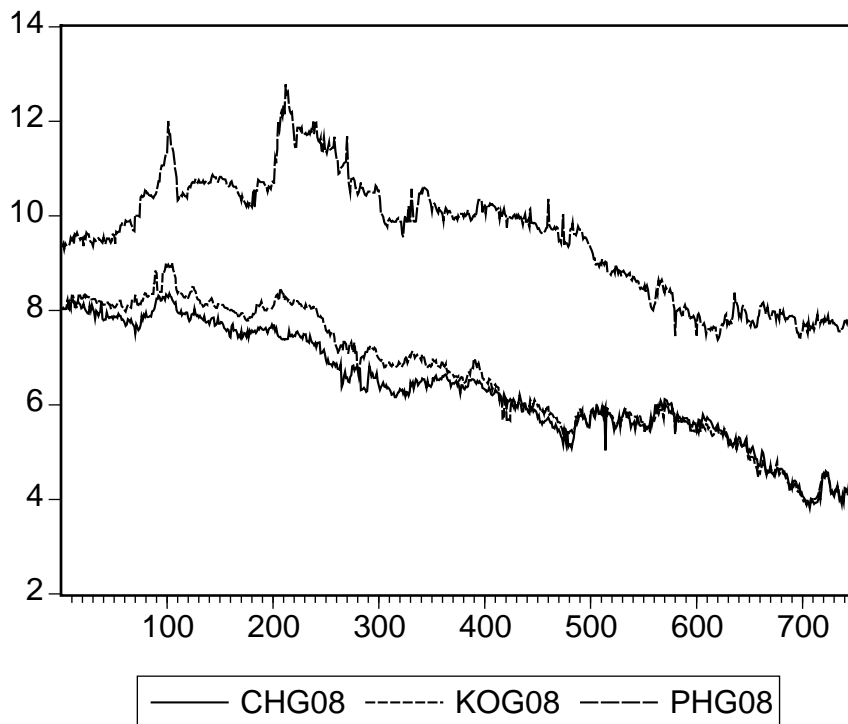
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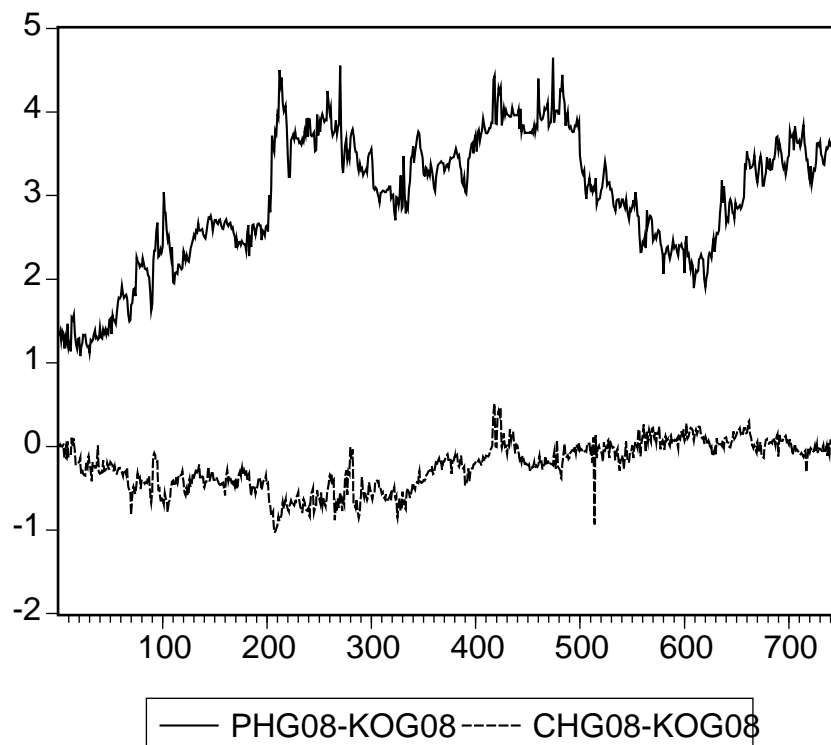
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**Figure 1**  
**Plot of the yield of three international bonds issued by China, Korea and the Philippines 30 December 1999 to 28 November 2002**



**Figure 2**  
**Plot of the yield spread between selected bond pairs**



**Table 1**  
**Information on the sovereign bonds of Asian issuers as at the 28<sup>th</sup> November 2002**

Issuer	Code	Coupon	Issued	Maturity	Rating	Price	YTM	Modified Duration
CHINA, PEOPLE'S REPUBLIC OF	CHG08	7.3	12/9/1998	12/15/2008	BBB	118.41	3.928	5.017
CHINA, PEOPLE'S REPUBLIC OF	CHU06	7.75	7/1/1996	7/5/2006	BBB	115.52	3.327	3.266
CHINA, PEOPLE'S REPUBLIC OF	CHU04	6.5	2/2/1994	2/17/2004	BBB+	105.43	2.472	1.319
FEDERATION OF MALAYSIA	MYG09	8.75	5/27/1999	6/1/2009	BBB-	123	4.692	5.116
KOREA, REPUBLIC OF	KOG08	8.875	4/7/1998	4/15/2008	A-	124.14	3.978	4.385
PHILIPPINES, REPUBLIC OF	PHU24	9.5	10/14/1999	10/21/2024	BB+	108.8	8.602	9.286
PHILIPPINES, REPUBLIC OF	PHG19	9.875	1/6/1999	1/15/2019	BB+	99.25	9.965	7.834
PHILIPPINES, REPUBLIC OF	PHG08	8.875	4/2/1998	4/15/2008	BB+	105.3	7.681	4.197
THAILAND, KINGDOM OF	THU07	7.75	4/10/1997	4/15/2007	BBB-	115.46	3.994	3.772

Note: YTM is the ISMA yield to maturity of the bond. The designation "G" or "U" in the bond code refers to whether the bond was a global bond (G), or a Yankee bond (U).

Source: Reuters Fixed Income Database

**Table 2****Descriptive statistics of Asian stock indexes, U.S. Treasury benchmark bonds and Asian international bonds**

	Asian Stock Indices					U.S. Benchmark Bonds			
<b>Levels</b>	CHS	KOSPI	MYKLS	PSE	THSET	US2	US5	US10	
Mean	1807.295	689.084	733.438	1389.885	338.150	1.948	2.915	3.921	
Std. Dev.	230.346	132.150	107.530	241.725	50.231	0.221	0.619	0.309	
CoVar	0.127	0.192	0.147	0.174	0.149	0.113	0.212	0.078	
<b>Differences</b>									
Mean	0.009	-0.386	-0.249	-1.446	-0.153	0.000	-0.001	0.000	
Std. Dev.	29.126	18.363	9.281	22.353	7.133	0.124	0.058	0.091	
Skewness	0.077	-0.187	-0.016	2.905	-0.149	1.750	2.073	1.572	
Kurtosis	9.142	9.898	8.396	38.482	14.525	42.028	28.962	16.807	
	<b>Asian International Bonds</b>								
<b>Levels</b>	CHU04	CHU06	CHG08	KOG08	MYG09	PHG08	PHG19	PHU24	THU07
Mean	5.527	6.138	6.370	6.605	6.975	9.597	11.292	9.522	6.348
Std. Dev.	1.755	1.389	1.185	1.367	1.049	1.249	1.250	0.649	1.271
CoVar	0.317	0.226	0.186	0.207	0.151	0.130	0.111	0.0682	0.200
<b>Differences</b>									
Mean	-0.007	-0.006	-0.005	-0.005	-0.004	-0.002	-0.002	-0.001	-0.005
Std. Dev.	0.135	0.095	0.102	0.086	0.127	0.136	0.242	0.075	0.146
Skewness	0.219	0.050	-0.180	0.141	0.441	0.418	-0.676	1.019	0.204
Kurtosis	14.550	13.222	12.914	21.598	8.953	27.583	10.118	37.748	13.791

Table 3: Panel A: Regressions of changes in credit spreads of Asian international issues on U.S. Treasury (Benchmark) bonds

Pair	Mean Equation						ARMA(3,3) terms						Variance equation: GARCH(3,3) terms						
	a	$b\Delta Y_t$	$c\Delta(Y_{30}-Y_2)_t$	$d(\Delta Y)_t^2$	$e\Delta I_t$	$f\Delta e_t$	$g_1\Delta S_{t-1}$	$g_2\Delta S_{t-2}$	$g_3\Delta S_{t-3}$	$h_1\varepsilon_{t-1}$	$h_2\varepsilon_{t-2}$	$h_3\varepsilon_{t-3}$	$\alpha$	$\beta_1 \varepsilon_{t-1}^2$	$\beta_2 \varepsilon_{t-2}^2$	$\beta_3 \varepsilon_{t-3}^2$	$\gamma_1 \sigma_{t-1}^2$	$\gamma_2 \sigma_{t-2}^2$	$\gamma_3 \sigma_{t-3}^2$
CHU04-US2	-0.004 0.002	-1.234 0.000	0.107 0.026				-0.877 0.000	-0.447 0.000	0.372 0.000	0.551 0.000		-0.659 0.000	0.000 0.000	0.380 0.000			0.694 0.086		
CHU06-US5	-0.005 0.000	-2.242 0.000	0.319 0.000	0.099 0.000	0.363 0.010			-0.879 0.000	0.309 0.000	-0.341 0.000	0.778 0.000	-0.638 0.000		0.071 0.098	0.421 0.081				
CHU08-US5	-0.007 0.000	-2.458 0.000	0.157 0.000	0.063 0.000				-0.554 0.005		-0.453 0.009	0.485 0.027	-0.303 0.045	0.003 0.000	0.463 0.000					0.191 0.000
KOG08-US5	-0.006 0.001	-2.520 0.000	0.157 0.000	0.067 0.000			0.833 0.000	-1.029 0.000	0.646 0.000	-0.928 0.000	1.075 0.000	-0.795 0.000	0.001 0.000		0.100 0.005	0.293 0.000		0.373 0.000	
*MYG09-US5	-0.001 0.002	-0.681 0.000	0.046 0.000	0.016 0.000									0.000 0.000	0.567 0.000	-0.379 0.018		0.882 0.000		-0.158 0.044
*PHG08-US5		-0.412 0.000			-0.206 0.000	0.217 0.033	-1.175 0.041			0.974 0.087			0.000 0.000	0.142 0.000	0.092 0.002	0.119 0.000	-0.188 0.002	-0.284 0.000	0.732 0.000
PHG19-US10		-3.639 0.000						-0.512 0.000	-0.374 0.002		0.529 0.000		0.013 0.000	0.206 0.000	0.374 0.000	0.262 0.000		0.301 0.000	-0.146 0.000
PHU24-US10	-0.003 0.057	-3.726 0.000			-0.479 0.001	0.702 0.037							0.002 0.000	0.233 0.000	0.367 0.000				-0.083 0.000
THU07-US5	-0.005 0.001	-2.389 0.000	0.110 0.072	0.084 0.000			-1.153 0.000			0.785 0.000		-0.338 0.002	0.000 0.000	0.289 0.000	-0.237 0.002		0.813 0.000	0.659 0.000	-0.513 0.000

Notes: This table reports the regression from a GARCH(3,3) specification of the regression models  $\Delta S_t = a + b\Delta Y_t + c\Delta(Y_{30}-Y_2)_t + d(\Delta Y)_t^2 + e\Delta I_t + f\Delta e_t + g_1\Delta S_{t-1} + g_2\Delta S_{t-2} + g_3\Delta S_{t-3} + h_1\varepsilon_{t-1} + h_2\varepsilon_{t-2} + h_3\varepsilon_{t-3} + \varepsilon_t$ ,  $\sigma^2 = \alpha + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \varepsilon_{t-2}^2 + \beta_3 \varepsilon_{t-3}^2 + \gamma_1 \sigma_{t-1}^2 + \gamma_2 \sigma_{t-2}^2 + \gamma_3 \sigma_{t-3}^2$

\* Log transformation of dependant variable

Panel B: Diagnostics

Pair	Adjusted R-Squared	F-Statistic	LBQ( $\varepsilon$ ), lag10	LBQ( $\varepsilon^2$ ), lag 10
CHU04-US2	0.381	26.65	7.25	5.74
CHU06-US5	0.564	54.57	11.98	4.21
CHU08-US5	0.555	52.69	2.89	3.07
KOG08-US5	0.617	67.84	6.15	7.66
MYG09-US5	0.516	45.15	7.37	2.55
PHG08-US5	0.524	46.56	3.17	9.85*
PHG19-US10	0.157	8.74	3.88	4.75
PHU24-US10	0.511	44.30	14.89**	2.23
THU07-US5	0.451	34.85	6.67	3.71