Factors Affecting the Credit Spreads of Asia Pacific Issuers in Int'l Bond Market

Jonathan Batten, Macquarie Grad. School of Mgt, Sydney.
Tom A. Fetherston, Univ. of Alabama at Birmingham,
and
Pongsak Hoontrakul,
Sasin of Chulalongkorn Univ., Thailand.
Email: Pongsak@Hoontrakul.com
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Objectives and Outline:

- To investigate the yield spread between the sovereign bonds issued in international markets by major Asia-Pacific issuers (China, Korea, Malaysia, Philippines and Thailand) and various benchmark US Treasury bonds (2, 5, 10 and 30 year maturities)
- Extends earlier BFH (2002-AsER)study which was limited to Thailand only determine the equilibrium dynamics, and extent that various factors, including interest rate and asset factors, affect changes in credit spreads.
- Understanding these issue is critical for portfolio managers as well as central bank issuers.

Summary of Results

- Equalibruim relationship holds only between pairs of bonds of equivalent credit status-not consistent with expectations theory.
- GARCH specification suggests credit spreads of the sovereign bonds are negatively related to interest rates on US benchmark bonds and positively related to a upward sloping 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.

Motivation for the Study – the Changing Role of Emerging Bond Market

From Table 1: Asia-Pacific domestic debt securities markets have expanded in recent years but they are still generally small in terms of GDP and with comparable developed countries:

Country Billions of US dollars	Year End	Public Sector	Financial Institutions	Corporate Sector	Private Sector Total*	Total
		A	B	C	D=B+C	E=A+D
China	1996	84.6	n/a	n/a	34.8	158.0
	1997	112.6	n/a	n/a	47.0	137.6
	1998	140.7	62.9	6.3	69.2	157.7
	2001	227.3	96.6	8.2	104.8	332.1
Hong Kong	1996	2.9	n/a	n/a	18.6	21.5
	1997	4.8	n/a	n/a	24.6	29.4
	1998	13.3	21.1	3.6	24.7	38.0
	2001	19.2	19.4	5.0	24.4	43.6
Korea South	1996	43.9	n/a	n/a	195.1	239.0
	1997	25.4	n/a	n/a	104.8	130.2
	1998	51.2	86.9	101.9	188.9	240.1
	2001	77.3	97.9	117.5	215.4	292.7

Motivation for the study- note the role of international bond markets

Table 2 highlights the economic importance of international bond and money markets are an important alternate source of funding apart from international bank based lending

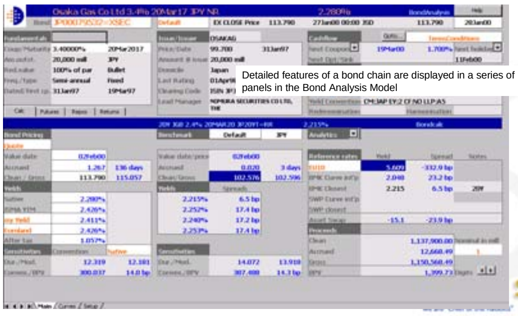
Country	Year End	International Money Markets	International Bonds and Notes
All Countries	1996	171.3	3,054.1
	1998	194.3	4,100.6
	2001	397.7	6,839.1
Asia & Pacific	1996	16.4	102.0
	1998	12.6	136.5
	2001	1.9	128.1
China	1996	-	14.0
	1998	-	17.6
	2001	-	17.3
Hong Kong	1996	10.3	15.6
	1998	10.1	21.8
	2001	0.8	34.7

Motivation: New theoretical developments in the valuation of risky debt provide a basis for estimating and understanding credit spread behaviour – very relevant for risky, emerging market issuers

Recent theoretical developments on the valuation of risky debt proposed by Longstaff and Schwartz (1995), Das and Tufano (1996) and Duffie and Singleton (1999), predict a negative correlation between changes in default-free interest rates, the return on risky assets and changes in credit spreads.

Collin-Dufresne, Goldstein and Martin (2001) expand the range of independent variables to include variables for general macroeconomic uncertainty

What is a credit spread- start with information about the bond available in secondary markets- Reuters Fixed Income 3000



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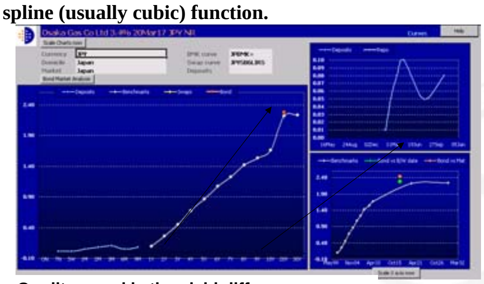
A credit spread is the yield difference between the individual bond and an underlying benchmark which is formed from a spline (usually cubic) function.



Credit spread is the yield difference between the risky bond and the benchmark

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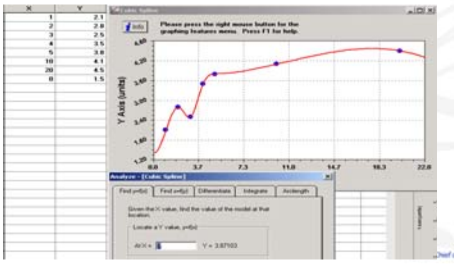
Benchmark bonds and aggregated bond by credit ratings are usually interpolated to produce smooth curves- but there are many issues associated with this approach and of course one must also consider liquidity.

For example, a cubic spline interpolates the 7 year bond rate at 3.87103% compared with 3.92% with a linear spline



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We consider the following set of bonds-we are limited in choice by price availability in the secondary market.

Table 3

Information on the sovereign bonds of Asian issuers as at the 28th 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 refer to whether the bond was a global bond (G), or a Yankee bond (U)
Source: Reuters Fixed Income Database

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Data: Basic statistics of levels and first differences (returns)

Table 4 provides the descriptive statistics of the Asian stock indexes, US Treasury benchmark bonds and Asian International bonds, The PSE was the most volatile index, long dated bonds were less volatile than short dated and there were significant differences between the risk properties of the various Asian bonds.

	Asian Stock Indices					US Benchmark Bonds			
Level	CHS	KOSPI	MYKLS	PSE	THSET	US2	US5	US10	US30
Mean	1807.295	689.084	733.438	1389.885	338.150	1.948	2.915	3.921	5.270
Maximum	2243.299	1028.330	1016.370	2153.180	490.780	2.673	4.239	4.689	5.938
Minimum	1343.358	466.570	553.400	979.340	250.020	1.223	1.826	3.216	4.552
Std. Dev.	230.346	132.150	107.530	241.725	50.231	0.221	0.619	0.309	0.335
CoVar	0.127	0.192	0.147	0.174	0.149	0.113	0.212	0.078	0.064
Asian International Bonds									
Level	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
Maximum	8.036	8.418	8.353	9.007	9.030	12.783	14.590	11.078	8.575
Minimum	2.080	3.154	3.817	3.867	4.645	7.380	9.205	8.396	3.605
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
Kurtosis	14.550	13.222	12.914	21.598	8.953	27.583	10.118	37.748	13.791

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Data: Correlations of first differences (returns) between bonds

Table 5 shows that the highest correlations in the changes in yields on Asian international bonds and US Treasury benchmark bonds were between bonds of similar maturity.

Generally the correlations BETWEEN the changes in Asian bond yields was low and in many cases insignificant

	CHU04	CHU06	CHG08	KOG08	MYG09	PHG08	PHG19	PHU24	THU07	US2	US5	US10
CHU06	0.295											
CHG08	0.081	0.119										
KOG08	0.073	0.204	0.222									
MYG09	0.103	0.144	0.091	0.292								
PHG08	0.042	0.111	0.049	0.172	0.237							
PHG19	-0.021	0.022	0.024	0.061	0.017	0.123						
PHU24	0.064	0.118	0.038	0.033	0.044	0.181	0.127					
THU07	0.084	0.200	0.157	0.131	0.054	-0.023	-0.032	0.010				
US2	0.083	0.117	0.078	0.128	0.095	0.016	-0.023	-0.007	0.036			
US5	0.187	0.285	0.196	0.154	0.082	0.090	0.012	0.055	0.203	0.238		
US10	0.148	0.270	0.100	0.109	0.091	0.057	-0.020	0.009	0.104	0.460	0.388	
US30	0.105	0.231	0.113	0.131	0.103	0.057	-0.037	0.042	0.075	0.341	0.279	0.473

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Data: Correlations- bonds to stock indices (mostly positive)

Table 6 also shows that the correlations between changes in yields of Asian international bonds and various Asian stock market indices were as low.

The lack of correlation is also consistent with segmentation-rather than integration- of the regions' stock markets.

The stock market index is generally considered to be a good indication of potential default risk.

	CHS	KOSPI	MYKLS	PSE	THSET	CHU04	CHU06	CHG08	KOG08	MYG09	PHG08	PHG19	PHU24
KOSPI	0.081												
MYKLS	0.085	0.228											
PSE	0.105	0.281	0.137										
THSET	-0.103	0.036	0.074	0.064									
CHU04	0.081	0.160	0.019	0.103	-0.037								
CHU06	0.110	0.207	0.037	0.118	-0.158	0.295							
CHG08	0.054	0.083	0.076	0.024	-0.062	0.081	0.119						
KOG08	0.033	0.083	0.023	0.018	-0.111	0.073	0.204	0.222					
MYG09	-0.026	0.097	-0.017	0.014	-0.100	0.103	0.144	0.091	0.292				
PHG08	0.064	0.062	0.078	-0.110	-0.138	0.042	0.111	0.049	0.172	0.237			
PHG19	0.049	-0.028	0.025	0.001	-0.090	-0.021	0.022	0.024	0.061	0.017	0.123		
PHU24	-0.017	-0.008	0.044	-0.044	-0.047	0.064	0.118	0.038	0.033	0.044	0.181	0.127	
THU07	0.057	0.148	0.053	0.022	-0.052	0.084	0.200	0.157	0.131	0.054	-0.023	-0.032	0.010

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Figure 1: Plot of the yield of three international bonds issues by China, Korea and the Philippines 30 December 1999 to 28 November 2002 – note that while the trend was down that the bonds did not necessarily move up and down together

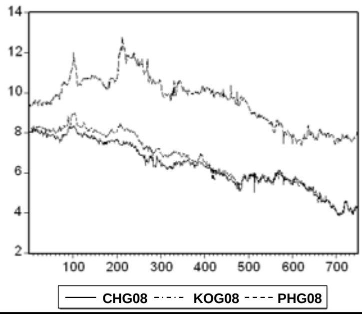

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Figure 3: Plot of the spread between the Philippines and China Global 2008 maturity bond-note the time varying nature of the spread

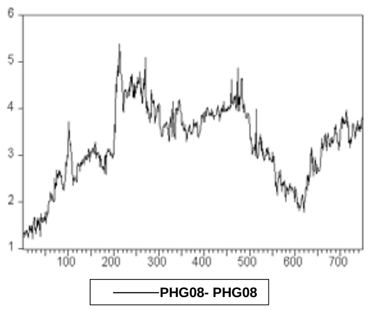

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Table 7 shows that the bivariate cointegration between pairs of bonds comprising Asian international bonds and US Treasury benchmark bonds

Interestingly cointegrations between bonds of the same issuer were significant.

The short term US bond was consistently the most highly cointegrated with the Asian bonds, while the long bond was not at all.

	CHU04	CHU06	CHG08	KOG08	MYG09	PHG08	PHG19	PHU24	THU07	US2	US5	US10
CHU06	25.50**											
CHG08	29.28**	36.75**										
KOG08	35.34**	24.86	28.81*									
MYG09	30.45**	38.11**	40.81**	27.81*								
PHG08	22.26	16.43	17.42	21.60	20.24							
PHG19	23.49	16.67	18.09	20.08	19.71	34.81**						
PHU24	25.65*	18.02	19.09	23.01	22.31	39.73**	26.97*					
THU07	32.93*	28.41*	53.08**	38.00**	41.82**	19.28	17.42	20.87				
US2	61.35**	60.44**	56.78**	57.64**	61.87**	48.39**	49.20**	50.32**	51.66**			
US5	25.76*	19.76	24.69	22.32	21.79	15.82	17.11	19.46	17.45	53.99**		
US10	3.17**	23.86	24.41	28.47*	29.13*	20.46	20.49	22.55	22.39	56.36**	15.89	
US30	24.02	17.88	17.78	22.04	23.16	17.07	15.92	19.22	17.42	53.99**	12.40	16.63

Notes: Johansen Cointegration Test at 4 lags, Critical levels *5% (25.32), 1% (30.45)

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Data: Unit Root Tests- as expected

Note that standard unit root test results in all series are consistent with levels being I(1) processes so that changes (first differences) were stationary with all tests supporting the unit root hypothesis at the 5% level of significance for all the data series.

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Model: We estimate the following model- extension of recent papers

The GARCH (3,3) model including the ARMA (3,3) terms, has the form:

(4) $$\Delta S_t = a + b\Delta Y_t + c\Delta(Y_{30}\text{-}Y_2)_t + d(\Delta Y)^2_t + e\Delta I_t + f\Delta e_t + g_1\Delta S_{t-1} + g_2\Delta S_{t-2} + g_3\Delta S_{t-3} + h_1\varepsilon_{t-1} + h_2\varepsilon_{t-2} + h_3\varepsilon_{t-3} + \varepsilon_t$$

$$\sigma^2 = \alpha + \beta_1 \varepsilon^2_{t-1} + \beta_2 \varepsilon^2_{t-2} + \beta_3 \varepsilon^2_{t-3} + \gamma_1\sigma^2_{t-1} + \gamma_2\sigma^2_{t-2} + \gamma_3\sigma^2_{t-3}$$

Where ΔS_t = the change in the credit spread (for the various Asian bond issues as described in Table 3) at time t, ΔY_t is the change in the risk free interest rate (identical in maturity to the riskless bond used to calculate the spread), $\Delta(Y_{10}\text{-}Y_2)_t$ is the change in the slope of the yield curve, $(\Delta Y)^2_{t,}$ is the change in the squared spot rate (rates with same maturity as the riskless bond), ΔI_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 ΔS_{t-n}, for n = 1, 2, 3 represent the lagged dependant variable, while the moving average terms ε_{t-n}, for n = 1, 2, 3 represent the lagged residual.

Model: Expected signs

The first two coefficients (*b* and *c*) in this regression, and the coefficient *f* are expected to be negative (i.e. $b, c, f < 0$). The explanation that $c < 0$ is non-controversial and an intuitive explanation lies with the solvency ratio (from the Longstaff and Schwartz model). Thus when a firm's value increases the probability of default falls.

The negative value for ΔY (or ΔY_{10}^2) which accommodates potential non-linear effects due to bond convexity, is due to the increase in the drift of the risk-neutral process for V. As interest rates increase, the risk-neutral probability of default is reduced.

Model: Expected signs

The coefficient *d*, which represents the slope of yield curve, is expected to be negative ($d < 0$) due to the effect on the recovery rate of changes in economic activity-as the economy moves into recession, as evidenced by a decline in the steepness of the yield curve, credit spreads should increase.

The coefficient *e*, which represents stock market volatility, is expected to be positive ($e > 0$) increased volatility will lead to an increase in the probability of default of the firm.

The coefficient *g* focuses on the level of macroeconomic uncertainty induced by the exchange rate, proxied by the respective USD exchange rate. This is expected to be positive ($g > 0$), since an increase in uncertainty will also lead to an increase in the potential default of the firm.

Results: presented in Table 8- 3 groups of variables in the Table

Table 8 – Sample from Panel A shows the regressions of changes in credit spreads of Asian international issues on US Treasury (Benchmark) bonds of various maturities.

Table comprises – mean equation, ARMA (3,3) specification and the variance equation (3,3) specification.

Note the importance of the ARMA/GARCH specification given the presence of significant autocorrelation in the residuals and the **residuals squared**

	Mean Equation						ARMA(3,3) terms						Variance equation GARCH(3,3) terms				
Pair	a	$b\Delta Y_t$	$c\Delta(Y_{30}-Y_2)_t$	$d(\Delta Y)^2_t$	$e\Delta I_t$	$f\Delta e_t$	$g_1\Delta S_{t-1}$	$g_2\Delta S_{t-2}$	$g_3\Delta S_{t-3}$	$h_1\varepsilon_{t-1}$	$h_2\varepsilon_{t-2}$	$h_3\varepsilon_{t-3}$	α	$\beta_1\varepsilon^2_{t-1}$	$\beta_2\varepsilon^2_{t-2}$	$\beta_3\varepsilon^2_{t-3}$	$\gamma_1\sigma^2_{t-1}$
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
CHU04-US5	0.001 0.003	-2.556 0.000	0.192 0.000	0.079 0.000			0.395 0.000	0.700 0.000	-0.267 0.002	-0.766 0.000	-0.665 0.000	0.511 0.000	0.000 0.000	0.353 0.000	0.034 0.081	-0.313 0.000	
CHU04-US10	-0.007 0.000	-3.200 0.000	0.199 0.000	0.063 0.000			0.371 0.000	0.832 0.000	-0.249 0.000	-0.776 0.000	-0.787 0.000	0.569 0.000	0.000 0.056	0.434 0.000		-0.346 0.000	
CHU04-US30	-0.006 0.000	-3.648 0.016					0.374 0.000	0.732 0.000	-0.210 0.032	-0.734 0.000	-0.700 0.000	0.473 0.000	0.000 0.009	0.379 0.000			
CHU06-US2	-0.004 0.049		0.399 0.000	-0.080 0.034	0.682 0.000									0.020 0.052	0.179 0.001		
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		
CHU06-US10	-0.004 0.012	-2.635 0.000	0.259 0.000	0.073 0.000	0.598 0.000			-0.637 0.000		-0.288 0.051	0.585 0.000	-0.399 0.002		0.053 0.048	0.236 0.000		
CHU06-US30	-0.005 0.013				0.649 0.000			-0.519 0.078					0.003 0.002	0.038 0.029	0.210 0.000	-0.104 0.045	0.560 0.005
CHU08-US2	-0.006	-0.788	0.308		0.358			-0.806		-0.511	0.753	-0.476	0.000	0.441			

Results: intercept and interest rate factor

(iii) Regression Results: Changes in Credit Spreads

The intercept term (a) was statistically significant in most of the 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.

With the exception of 3 of the 36 regressions of credit spreads, the interest rate factor (ΔY_t) was statistically and economically significant.

Results: other interest rate variables

The variable to accommodate the change in the shape of the yield curve yield curve ($\Delta(Y_{30}-Y_2)_t$) was statistically significant in 22 of the 36 cases. The sign was positive in all cases and the economic value of the coefficient was as much as 30% 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-result 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 16 cases. However the actual coefficient was small and generally not economically significant.

Results: asset and exchange rate factor

Interestingly, the asset factor was significant in 19 of the 36 cases but it was negative in 8 cases and positive in the remaining 11. A positive relationship suggests that a rise in the stock market results in an increase in the spread and may be due to rebalancing of bonds and stocks held by international portfolio managers.

The exception to this story appears to be the Philippines. In 8 out of the possible 12 regressions involving Philippines bonds, the stock index variable was negative and also economically significant at least at the 95% level.

The exchange rate variable was not significant with the exception of Philippines bonds where for 6 out of 12 possible regressions the value positive and of and economic variable consistent with the stock index variable. This suggest that a rise in the exchange rate (a depreciation of the peso) was also associated with an increase in the credit spread.

Results: ARMA and GARCH terms

The complexity of the dynamic of the change in spreads is evident from the fact that 26 of the regressions required an ARMA adjustment. These adjustments suggest that markets trading these securities are not efficient in the weak-from sense- a result consistent with other studies including Manzoni (2002) and Batten and Hogan (2003).

The statistical significance of the variance equation is specified by the three terms (alpha, beta and gamma in table 8) The constant, α, represents the long term average, the coefficient β of the ARCH term, represents the significance of volatility observed in the previous period, and the coefficient γ of the GARCH term represent the forecast variance from the last period.

Results: ARMA and GARCH terms

One of the ARCH and GARCH terms is significant in all the regressions in the sample. The first coefficient, α, though significant has a near zero value in most cases. The size of the β and γ coefficients where not of a similar order suggesting that past and forecast volatility have a dissimilar effect on predicting variance.

The adjusted R^2 had a range from 0.117 to 0.731, which on average is consistent with those reported by other authors investigating international bonds (e.g. Batten and Hogan, 2003)

END

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Please, send me comments or advises to Pongsak@Hoontrakul.com.