THE DYNAMIC STRUCTURE OF SOVEREIGN CDS SPREADS AND EMERGING EQUITY MARKETS

Mitchell Ratner, College of Business, Rider University, 2083 Lawrenceville Rd., Lawrenceville, NJ 08648, 609-896-5164, ratner@rider.edu
Chih-Chieh (Jason) Chiu, College of Business, Rider University, 2083 Lawrenceville Rd., Lawrenceville, NJ 08648, 609-896-5229, cchiu@rider.edu

ABSTRACT

This paper analyzes the relationship between sovereign CDS price spreads and equity market returns in eight emerging markets using dynamic conditional correlation (DCC). The findings demonstrate that the correlation structure in all sample countries is both non-constant, and negative. While there is strong evidence of a contemporaneous relationship, the lead/lag structure is largely insignificant. In addition, the impact of four local factors and five global factors on the correlation structure are examined. Overall significance is low, but there is some influence observed among global factors including U.S. equities.

INTRODUCTION

The CDS market is relatively new, with consistent data available for most countries starting in 2000-2004. As such, this area has not been extensively studied in the scholarly literature. Given the broad interest in emerging markets from an array of investors, the main contribution of this paper is to examine the correlation structure between CDS price spreads and country equity markets. As CDS prices reflect the underlying risks of governments, they are especially useful to investors who are trying to globally diversify their portfolios in an effective manner.

[3] [6] [7] provide some evidence that sovereign credit spreads are affected by a common set of global factors. [5] find that CDS spreads for Mexico, Turkey, and Korea are significantly affected by the volatility of the U.S. stock market used as a common factor. [4] find that CDS spreads are more closely related to common factors in the U.S. market than local markets, which may diminish the usefulness of CDS contracts as investment vehicles. As explained below in the methodology section, none of the aforementioned studies examines the relationship between CDS spreads and other variables using a dynamic model. The correlation structure, in particular, is sensitive to changes over time that may not be adequately captured without using a dynamic model.

The correlation structure is analyzed using dynamic conditional correlation (DCC), a recently developed methodology that examines the time varying properties of the variables. A secondary contribution of this paper investigates the major economic/financial factors that influence the correlation structure identified between CDS price spreads and the corresponding emerging equity markets. Using MV-GARCH analysis, the impact of four local factors and five global factors are examined.

DATA

Most data (exceptions noted) are collected from the *DataStream* database. Due to the recent and limited availability of CDS data, this study is performed from January 2004 through June 2010 on the following emerging markets: Argentina, Brazil, Chile, Mexico, Korea, Malaysia, Thailand, and Turkey. Monthly

frequency data is examined as there is little to no change in daily and weekly CDS data. Data for all series are from the last quotation available in each month unless otherwise indicated. Sovereign CDS spreads consist of midmarket prices for five-year contracts and are denominated in U.S. dollars for all countries. Monthly total stock market prices are represented by the MSCI total return index including dividends for each country. To achieve stationarity, both series are transformed using log-difference form to calculate continuously compounded returns.

A large number of potential variables may explain the correlation structure between emerging equity returns and sovereign CDS spreads. Following [4] and [5], four local factors and five global factors are selected for inclusion in the model. The local factors include currency exchange rates, international reserves, inflation, and economic growth. Global factors are U.S. stocks, U.S. interest rates, corporate yield spreads, U.S. equity premium, and a measure of U.S. volatility. Currency exchange rates are expressed as local currency to the U.S. dollar on the last trading day of each month. International reserves consist of foreign currency holdings valued in U.S. dollars provided by the International Monetary Fund through the *DataStream* database. Inflation is measured as the CPI index for each country. The industrial production index is used as a proxy of local economic growth. All series are transformed into log-difference form.

For the global factors, the U.S. MSCI total stock return index including dividends represents the U.S. stock market. Monthly excess stock returns are calculated by subtracting the one-month Treasury-bill return. The stock series is transformed into log-difference form. U.S. interest rates are represented as monthly log-differences in the five-year constant maturity Treasury rates provided by the H.15 Federal Reserve Statistical Release. Changes in the S&P 100 price/earnings ratio serves as the proxy for the U.S. equity premium. Corporate yield spreads are calculated as the basis-point difference between the U.S. corporate AAA total return bond index and the BBB total return bond index. These bonds have an average maturity of 1-5 years, and are transformed into log-difference form. Realized volatility is based on the Garman-Klass open-high-low-close volatility measure of the S&P 100 stock index [2].

RESULTS

Dynamic conditional correlation (DCC) is a recent technique developed by [1] to examine time series with non-constant correlation. The procedure uses a multivariate generalized autoregressive conditional heteroscedasticity (MVGARCH) model to generate time-varying estimates of the conditional co-movement between assets. The model follows a two step procedure. First, a univariate GARCH model is estimated for each series. Second, standardized residuals from the first stage are input into a GARCH model to estimate the time-varying correlation matrix. The DCC technique in this study follows [1] using a GARCH(1,1) model allowing for time-varying correlations.

To determine the validity of using GARCH DCC estimates, it is first necessary to test for constant correlation between the variables. The Tse test indicates rejection of the null hypothesis that the correlations are constant [8]. The constant correlations between the CDS changes and emerging stock returns are negative for all countries. In a static sense, this indicates that an increase the price of CDS contracts (to cover the cost of default of sovereign bonds) is associated with a decline in equity market returns. The correlations range from a high (least negative) in Argentina (-0.27) to a low in Turkey (-0.67). That is, a change in CDS prices in Turkey are related to greater changes in equity prices than other countries during the sample period. However, the null of constant correlation is rejected for all countries at the 1% level necessitating the use of a GARCH DCC model to better understand the nature of the relationship between the variables over time.

Table 1 shows the GARCH DCC model estimation between the CDS price changes and the equity returns of the individual countries. The univariate GARCH parameters (a_1, b_1, and d_1) are largely significant across most countries. The asymmetry coefficient (d_1) is significant and has the correct sign for all countries except the Korean CDS variable, i.e., volatility is expected to increase more after a large negative shock than a large positive shock. Series' with significant a_1 and b_1 indicate time variation and dependence in the variance. Large and significant β coefficients demonstrate persistence in the correlation series. A sum of α and β close to 1 shows a strong degree of persistence in the conditional variance [1]. The DCC estimates for Chile and Malaysia are not significant, demonstrating weaker persistence in both correlation and conditional variance.

Table 1

GARCH-DCC estimates for monthly local total stock returns vs. changes in sovereign credit default swap spreads, 2004-2010. ***,**,* indicate significance at the 1%, 5%, and 10% levels, respectively.

Estimate	ARG	BRA	CHI	MEX	KOR	MAL	THA	TUR
c_{STK}	.001***	.004***	.001	.003***	.000***	.002***	.002***	.000***
a_{STK}	.019***	.094	.697	-.085***	-.127***	-.120***	.160	-.136***
b_{STK}	-.060***	-.078**	.143	.305***	1.066***	-.089***	.155	1.106***
d_{STK}	.686***	.569	-.186	.012***	.095***	.803***	.409	.102***
c_{CDS}	.082***	.012	.060***	.042***	.006***	.006	.061***	.024**
a_{CDS}	.266***	.539	.258***	-.076***	.282***	.174	-.045	.082
b_{CDS}	-.079***	.290	-.080***	-.005***	.932***	.724***	-.581	.226
d_{CDS}	.671***	.037	.288***	.196***	-.596***	-.084	-.051	-.412**
α-*DCC*	.031	-.096***	.169	.072	-.035***	.152	.008	.054
β-*DCC*	.899***	.314***	.002	.813***	.497***	-.107	.927***	.854***

A GARCH-M model is constructed using changes in CDS prices and equity returns as independent variables, in turn, for each country. The results in table 2 show a significant and negative relationship between the variables in all countries, with the exception of Argentine CDS price changes as the independent variable. In general, the nature of the contemporaneous relationship appears well established.

To test predictability, a GARCH-M model is constructed using lags of both CDS price changes and equity returns. The appropriate lags of each variable are tested for significant Granger causality. (Lag lengths are determined using AIC criteria). The results in table 3 indicate little predictive ability of either variable. Significant chi-square statistics show the predictive power of the variable. CDS price changes predict stock changes at the 1% level in Malaysia. Equity prices are significant at the 5% level in Argentina, and at the 10% level in Mexico and Thailand. The use of monthly data potentially accounts for the lack of significance.

Given the volatility in the conditional correlations, it is worthwhile to examine common shocks that may impact the DCC estimates. A GARCH-M model is utilized to examine the relationship between the DCC estimates and both local and global factors following [4] and [5]. The local factors include exchange rates (foreign currency per U.S. dollar), international reserves of foreign currency, local inflation (CPI), and industrial production. Global factors include the U.S. stock market (U.S. MSCI

total market index), U.S. interest rates (five-year Treasury note), U.S. corporate yield spread, U.S. equity premium (S&P 100 P/E), and a measure of U.S. volatility.

Table 2

Contemporaneous tests of GARCH(1,1)-M estimates derived from local total stock returns and changes in sovereign credit default swap spreads. GARCH coefficient estimates reported reported. ***,**,* indicate significance at the 1%, 5%, and 10% levels, respectively.

	Independent Variable	
Country	CDS spreads	Stock returns
Argentina	0.002	-1.061***
Brazil	-0.222***	-1.799***
Chile	-0.053***	-2.513***
Mexico	-0.177***	-2.589***
Korea	-0.158***	-2.126***
Malaysia	-0.115***	-2.477***
Thailand	-0.119***	-1.183***
Turkey	-0.385***	-1.127***

Table 3

Bi-directional causality tests of GARCH(1,1)-M estimates derived from local total stock returns and changes in sovereign credit default swap spreads. Chi-square statistics reported. Rejection of null indicates the presence of significant causality.

Country	CDS→Stock	Stock→CDS
Argentina	0.340	5.249**
Brazil	1.960	0.164
Chile	0.011	1.150
Mexico	0.225	2.797*
Korea	0.628	1.734
Malaysia	10.167**	0.006
Thailand	1.182	2.931*
Turkey	0.402	0.021

The results contained in table 4 show that the global exogenous variables are more significant than the local factors, which are largely insignificant. The Argentine DCC estimates are significantly affected by changes in foreign exchange rates, the U.S. MSCI, and the S&P 100 P/E at the 1% level. The negative sign in the Argentine foreign exchange variable (-1.680) indicates that a strengthening peso is associated with a decline in the value of the DCC estimate (more negative). The negative sign of the U.S. MSCI (-0.310) indicates that rising U.S. stock values are associated with a decline in the value of the DCC estimate. The positive sign of the S&P 100 P/E demonstrates that DCC estimates decline as the U.S. equity premium declines.

In Brazil, only the U.S. MSCI is significant (5% level). The positive sign indicates that DCC estimates rise and fall proportionally with U.S. stocks. No exogenous factors are significant in Chile or Mexico. In Korea, industrial production (-0.473) and the U.S. MSCI (0.082) are significant at the 1% level. International reserves (0.579) and the S&P 100 P/E (-0.126) are significant at only the 10% level in Malaysia, suggesting very little explanatory power.

In Thailand, international reserves (-0.330, 10%), inflation (1.607, 5%), the U.S. MSCI (-0.205, 1%), corporate yield spreads (0.122, 1%), and the S&P 100 P/E (0.116, 5%) demonstrate greater impact of global factors compared with local factors. Similarly, in Turkey the U.S. MSCI (-0.183), the 5-year Treasury (-0.138), and the volatility measure (0.075) are global factors significant at the 1% level. There are certainly relevant exogenous variables that can influence this relationship that are not specified in this model.

Table 4

GARCH(1,1)-M model of dynamic correlation coefficients and exogenous local and global variables, monthly data (2004-2010). ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

Parameter	ARG	BRA	CHI	MEX	KOR	MAL	THA	TUR
Constant	-.380***	-.520***	-.361***	-.655***	-.470***	-.526***	-.443***	-.648***
FX rates	-1.680***	-.174	-.054	.198	.007	-.061	-.218	-.198
Reserves	-.123	-.676	-.192	-.080	-.180	.579*	-.330*	.125
CPI-local	4.418	-5.044	-.514	-.255	.717	.580	1.607**	-1.069
Indus. Prod	-.006	-.225	-0.153	-.286	-.473***	.059	-0.063	0.086
MSCI-US	-.310***	.250**	-.072	-.063	.082***	-.020	-.205***	-.183***
5 Yr Treas	-.093	-.070	.270	.004	.056	-.071	-.076	-.138***
Corp Yld	-.168	.206	-.167	.088	-.042	.068	.122***	-.027
S&P100PE	.175***	-.082	-.218	.045	-.031	-.126*	.116**	-.040
Volatility	-.061	-.001	-.003	.037	-.033	.021	.021	.075***

CONCLUSIONS

This study evaluates the relationship between sovereign credit default swaps (CDS) and eight emerging equity markets from 2004-2010. It is shown that the correlation structure between changes in CDS prices and equity returns are not constant during the sample period. Using a GARCH dynamic conditional correlation (DCC) model, it is demonstrated that the conditional correlations are consistently negative for all countries, and largely volatile for most countries. Thus, a rise in CDS prices (the cost to insure sovereign debt) is associated with a decline in equity market returns.

A GARCH-in-mean model is used to examine the predictive relationship between changes in CDS prices and equity market returns. While a significant contemporaneous relationship is observed, the predictive relationship is sparse. Granger-causality tests of the lagged independent variables show CDS price changes leading stock returns in Malaysia only. Stock returns are shown to lead CDS price changes in Argentina, Mexico, and Thailand, but the significance levels are generally low.

Lastly, a GARCH-in-mean model is used to examine the influence of a set of common shocks from a limited selection of local and global factors on the DCC estimates. The local factors include exchange

rates, international reserves of foreign currency, local inflation, and industrial production. Global factors include the U.S. stock market, U.S. interest rates, U.S. corporate yield spread, U.S. equity premium, and a measure of U.S. volatility. Of the local factors, exchange rates in Argentina (1% level), inflation in Thailand (5% level), and industrial production in Korea (1% level) are the only variables with significance. International Reserves show only 10% significance in Malaysia and Thailand. Global factors appear more relevant, with the U.S. MSCI showing the most consistent significance at the 1% or 5% level in Argentina, Brazil, Korea, Thailand, and Turkey.

REFERENCES

[1] Engle, R. (2002). Dynamic Conditional Correlation—A Simple Class of Multivariate GARCH. *Journal of Business and Economics Statistics*, 20(3), 339–50.

[2] Garman, M., and M. Klass (1980). On the estimation of security price volatilities from historical data. *The Journal of Business* 53, 67-78.

[3] Geyer, A., Kossmeier, S. and S. Pichler (2004), Measuring Systematic Risk in EMU Government Yield Spreads, *Review of Finance* 8, 171-197.

[4] Longstaff, F., Pan, J., Pedersen L., and K. Singleton (2010). How sovereign is sovereign credit risk? *American Economic Journal, forthcoming*.

[5] Pan, J., and K. Singleton (2008). Default and Recovery Implicit in the Term Structure of Sovereign CDS Spreads, *Journal of Finance*, 63 (5), 2345-2384.

[6] Remolona, E., Scatigna, M. and E. Wu (2008). The Dynamic Pricing of Sovereign Risk in Emerging Markets: Fundamentals and Risk Aversion, *The Journal of Fixed Income*, 17(4), 57-73.

[7] Rozada, M., and E. Yeyati (2008). Global Factors and Emerging Market Spreads, *The Economic Journal*, 118(533), 1917-1936.

[8] Tse, Y. (2000). A test for constant correlations in a multivariate garch model. *Journal of Econometric*, 98, 107–127.