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COUNTRY CREDIT RISK AND SPILLOVER EFFECTS

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ABSTRACT

Country risk reflects the ability and willingness of a country to service its financial obligations. This paper analyses the country risk returns, or the rate of change in the risk ratings compiled by the International Country Risk Guide, which provides extended monthly data for numerous countries. A constant conditional correlation asymmetric VARMA-GARCH model is estimated and tested for Australia, Canada, Japan and the USA. The empirical results enable an analysis of the conditional means and volatilities of risk returns, highlight the importance of the economic, financial and political components of a composite risk rating, and evaluate the spillover effects of risk returns.

1. INTRODUCTION

The 1970s witnessed a lending boom by Western banks to Eastern bloc, Latin American, and other less developed countries. This boom was in response to demand for funds by these countries beyond those provided by the World Bank, the International Monetary Fund (IMF) and other international creditors to aid their development. Moreover, Western banks needed to recycle their large funds from oil producing countries. Lending decisions were frequently made with little judgment regarding the credit quality of the borrowing country. As a result, the debt repayment problems of Poland and other Eastern bloc countries in the beginning of the 1980s, and the debt moratoria announced by the Mexican and Brazilian governments in the fall of 1982, caused major and long-lasting effects on the balance sheets and profits of the commercial banks in some countries (Saunders and Lange, 1996).

In light of these events, the concept of country risk, or the likelihood that a sovereign state or borrower from a particular country may be unable and/or unwilling to fulfill their obligations towards one or more foreign lenders and/or investors (Krayenbuehl, 1985), has become a topic of major concern for the international financial community.

Economic, financial and political risks are the three major components of country risk. The country risk literature holds that the three risk components affect each other. Economic and financial risks include factors such as sudden deterioration in the country's terms of trade, rapid increases in production costs and/or energy prices, unproductively invested foreign funds, and unwise lending by foreign banks (Nagy, 1988). Other factors, such as changes in the macroeconomic and financial management of the country, are also important as they interfere with the free flow of capital or arbitrarily alter the expected risk-return features for investment (Juttner, 1995). In general, political risk is viewed as a non-business risk introduced strictly by domestic and international political forces. Political risk has been identified by banks and other multinational corporations as a factor that could seriously affect the profitability of their international ventures (Shanmugam, 1990). Examples of political risk relate to the possibility that the sovereign government may impose foreign exchange and capital controls, additional taxes, and asset freezes or expropriations due to political changes (Juttner, 1995).

Following the international debt crisis in the early 1980s, leading risk rating agencies such as Moody's, Euromoney, Standard and Poor (S&P), Fitch IBCA, Institutional Investor, Economist Intelligence Unit, International Country Risk Guide, and Political Risk Services, have compiled country risk ratings as measures of credit risk associated with sovereign countries. These rating agencies provide qualitative and quantitative country risk ratings, combining information regarding alternative measures of economic, financial and political risk ratings to obtain a composite risk rating (for a critical survey of the alternative country risk rating systems, especially as they apply to the range of countries that have been assessed, see Hoti and McAleer (2004a,b)).

This paper provides an analysis of country risk ratings and returns compiled by the International Country Risk Guide (ICRG). Although most risk rating agencies provide an independent analysis of country risk and a systematic method of risk assessment, the ICRG is the only rating agency to provide detailed and consistent monthly data over an extended period for a large number of countries.

Conditional volatility has been used frequently to evaluate risk, asymmetric shocks, and leverage effects in economics and finance. Volatility that is present in country risk ratings will naturally reflect risk considerations inherent in such ratings. For this reason, the rate of change in risk ratings, that is, their underlying returns, merits the same attention as has been bestowed on financial returns.

The purpose of the paper is to estimate and test the multivariate symmetric and asymmetric GARCH models across alternative risk returns for Australia, Canada, Japan and the USA, estimate the multivariate spillover effects of four different risk returns, and test for asymmetric effects.

The plan of the paper is as follows. Section 2 describes the nature of the country risk data. The Hoti, Chan and McAleer (2002) asymmetric VARMA-GARCH, or VARMA-AGARCH, model is discussed in Section 3. The multivariate empirical results in Section 4 provide a comparative assessment of the conditional means and volatilities associated with the four country risk returns over time, analyse the multivariate ratings and spillover effects of alternative economic, financial, political and composite risk returns, and evaluate the usefulness of the ICRG risk ratings. Some concluding remarks are given in Section 5.

2. DATA SOURCE AND DESCRIPTION

The International Country Risk Guide (ICRG) has compiled economic, financial, political and composite risk ratings for 93 countries on a monthly basis since January 1984. As of April 2004, the four risk ratings were available for a total of 140 countries. The ICRG rating system comprises 22 variables representing three major components of country risk, namely economic, financial and political. Using each set of variables, a separate risk rating is created for the three components, on a scale of 0-100. Each of the five economic and financial components account for 25%, while the twelve political component accounts for 50%, of the composite risk rating. The lower (higher) is a given risk rating, the higher (lower) is the associated risk. In essence, the country risk rating is a measure of country creditworthiness.

This paper analyses country risk returns and their associated volatility for four countries for which ICRG risk ratings data have been collected since January 1984, namely Australia, Canada, Japan and the USA.

Table 1 presents the descriptive statistics for risk returns by country. The means of the four risk returns for the four countries are all very close to zero, with standard deviations in the range (0.008, 0.021) for Australia, (0.006, 0.014) for Canada, (0.008, 0.016) for Japan, and (0.010, 0.031) for the USA. There is no general pattern of skewness for the four risk returns for the four countries, with negatively skewed economic risk returns for Australia and Japan, negatively skewed financial risk returns for Australia, Canada and the USA, positively skewed political risk returns for Australia, Canada and Japan, and negatively skewed composite risk returns for Japan and the USA.

Table 2 reports the correlation coefficients for the risk returns by country. The economic, financial and political risk returns seem to be highly correlated with the composite risk returns, but not with each other. For each country, the highest correlation coefficient is between the political and composite risk returns. In the case of Australia and the USA, the second highest correlation is between the financial and composite risk returns, while for Canada and Japan the second highest correlation coefficient is between the economic and composite risk returns.

3. MULTIVARIATE CONDITIONAL VOLATILITY MODELS FOR COUNTRY RISK RATINGS AND RETURNS

A comparison of the structural and statistical properties of alternative univariate and multivariate conditional and stochastic volatility models is given in McAleer (2004). In this paper, a constant (or static) conditional correlation asymmetric VARMA-GARCH model, or VARMA-AGARCH, is proposed. This model includes the constant conditional correlation (CCC) multivariate GARCH model of Bollerslev (1990) and the constant conditional correlation VARMA-GARCH model of Ling and McAleer (2003) as special cases. Bollerslev (1990) presented an *m*-dimensional multivariate conditional covariance model, as follows:

$$Y_t = E\left(Y_t \mid F_{t-1}\right) + \varepsilon_t, \qquad t = 1,\dots,n$$

$$\varepsilon_t = D_t \eta_t \qquad \eta_t \sim iid(0,\Gamma) \tag{1}$$

$$Var\left(\varepsilon_t \mid F_{t-1}\right) = D_t \Gamma D_t$$

where F_t is the information set available to time t, $D_t = diag(h_{it}^{1/2})$, $i = 1,\dots,m$ is a diagonal matrix of the square root of the conditional variances, and $\Gamma = \{\rho_{ij}\}$ is the matrix of constant conditional correlations, in which $\rho_{ij} = \rho_{ji}$ for $i, j = 1,...,m$.

The main feature of the CCC model is that the conditional correlation, given by $E\left(\varepsilon_{it}\varepsilon_{jt} \mid F_{t-1}\right) \Big/ \sqrt{E\left(\varepsilon_{it}^2 \mid F_{t-1}\right) E\left(\varepsilon_{jt}^2 \mid F_{t-1}\right)} = \rho_{ij}$, is constant over time, where $i, j = 1,...,m$, $i \neq j$, and ε_{it} is the ith element of ε_t. Bollerslev (1990) assumed that

$$h_{it} = \omega_i + \sum_{l=1}^{r} \alpha_{il}\varepsilon_{it-l}^2 + \sum_{l=1}^{s} \beta_{il} h_{it-l} \tag{2}$$

in which there is independence, and hence no spillover effects, between h_{it} and $\left(\varepsilon_{jt-k}, h_{jt-l}\right)$ for $i, j = 1,...,m$, $i \neq j$, $k = 1,...,r$, and $l = 1,...,s$. Thus, the multivariate effects are determined solely through the constant (or static) conditional correlation matrix, Γ. The multivariate constant conditional correlation model based on equations (1)-(2) is denoted CCC.

An extension of (2) to accommodate asymmetries with respect to ε_{it} is given by

$$h_{it} = \omega_i + \left(\sum_{l=1}^{r} \alpha_{il} + \sum_{l=1}^{r} \gamma_{il} I\left(\eta_{it-l}\right) \right) \varepsilon_{it-l}^2 + \sum_{l=1}^{s} \beta_{il} h_{it-l} \tag{3}$$

in which $\varepsilon_{it} = \eta_{it}\sqrt{h_{it}}$ for all i and t, and $I(\eta_t)$ is an indicator variable such that

$$I\left(\eta_{it}\right) = \begin{cases} 1, & \varepsilon_{it} < 0 \\ 0, & \varepsilon_{it} > 0. \end{cases}$$

As in (1), $\eta_t = \left(\eta_{1t},...,\eta_{mt}\right)'$ is a sequence of *iid* random vectors, with zero mean and covariance Γ, so that $\varepsilon_t = D_t\eta_t$, in which D_t depends only on $H_t = \left(h_{1t},...,h_{mt}\right)'$.

As an extension of (3) to incorporate multivariate spillover effects across alternative risk ratings and returns, it is necessary to define h_{it} to contain past information from ε_{it}, ε_{jt}, and h_{jt}, for $i, j = 1,...,m$, $i \neq j$. Thus, the asymmetric VARMA-GARCH model developed by Hoti, Chan and McAleer (2002) is defined as follows:

$$\Phi(L)(Y_t - \mu) = \Psi(L)\varepsilon_t \tag{4}$$

$$\varepsilon_t = D_t\eta_t$$
$$H_t = W + \left(\sum_{l=1}^{r} A_l + \sum_{l=1}^{r} C_l I\left(\eta_{t-l}\right) \right) \vec{\varepsilon}_{t-l} + \sum_{l=1}^{s} B_l H_{t-l} \tag{5}$$

where $D_t = diag(h_{it}^{1/2})$, A_l, C_l and B_l are $m \times m$ matrices with typical elements α_{ij}, γ_{ij} and β_{ij}, respectively, for $i, j = 1,...,m$, $I\left(\eta_t\right) = diag\left(I\left(\eta_{it}\right)\right)$ is an $m \times m$ matrix, $\Phi(L) = I_m - \Phi_1 L - ... - \Phi_p L^p$ and $\Psi(L) = I_m - \Psi_1 L - ... - \Psi_p L^p$ are polynomials in L, I_k is the $k \times k$ identity matrix, and $\vec{\varepsilon}_t = \left(\varepsilon_{1t}^2,...,\varepsilon_{mt}^2\right)'$. The parameter vector $\lambda = (\varphi', \delta', \rho')'$ is given as

$$\varphi = vec(\mu, \Phi_1,...,\Phi_p, \Psi_1,...,\Psi_q)$$

$$\delta = vec(W, A_1,...,A_r, C_1,...,C_r, B_1,...,B_s)$$

$$\rho = vec(\rho_{21},...,\rho_{m1}, \rho_{32},...,\rho_{m2},...,\rho_{m,m-1}).$$

The univariate constant-mean GJR model is obtained from (4)-(5) either by setting $m = 1$ and $\Phi(L) = \Psi(L) = 1$, or by specifying A_l, C_l and B_l as diagonal matrices. Bollerslev's (1990) CCC model (2) is obtained from (4)-(5) by setting $A_l = diag(\alpha_{il})$, $B_l = diag(\beta_{il})$ and $C_l = 0$ for $l = 1,...,r$, while Ling and McAleer's (2003) VARMA-GARCH model is obtained from (4)-(5) by setting $C_l = 0$ for $l = 1,...,r$.

4. EMPIRICAL RESULTS

All the estimates in this paper are obtained using EViews 4. Virtually identical estimates are obtained from using the RATS 6 econometric software package. The Berndt, Hall, Hall and Hausman (1974) (BHHH) algorithm has been used in most cases, but the Marquardt algorithm is used when BHHH does not converge. Several different sets of initial values have been used in each case, but do not lead to a substantial difference in the estimates.

Using the monthly data on economic, financial, political and composite risk returns for Australia, Canada, Japan and the USA for the period 1984(1) to 2002(5), the VAR(1)-GARCH(1,1) and VAR(1)-AGARCH(1,1) models are used to provide estimates of the risk returns, spillover effects, and volatilities for the four risk returns for four countries. Table 3 reports the VAR(1)-AGARCH(1,1) estimates for four risk returns by country, otherwise referred to as ratings effects. Both the asymptotic and the Bollerslev and Wooldridge (1992) robust t-ratios are reported. In general, the robust t-ratios are smaller in absolute value than their asymptotic counterparts.

The estimates of the VAR(1)-AGARCH(1,1) model are given in Table 3. For economic and financial risk returns, each of the γ_i (or asymmetry) estimates is insignificant, so that VAR(1)-GARCH(1,1) is preferred to VAR(1)-AGARCH(1,1). For political risk returns, the γ_i estimates are significant for all countries, so that VAR(1)-AGARCH(1,1) is preferred to VAR(1)-GARCH(1,1). The γ_i estimates are also insignificant for Australia, Canada and Japan in the case of composite risk returns. Based on the results in Table 3, the political risk returns for Australia are affected by previous long run shocks in economic, financial and political risk returns; for Canada and Japan, by previous short and/or long run shocks in all four risk returns; and for the USA by previous short and/or long run shocks in financial, political and composite risk returns. The composite risk returns for the USA in Table 3 are affected by previous short and/or long run shocks in financial, political and composite risk returns. Thus, in general there are significant risk returns spillover effects for each country.

Estimates of the VARMA-GARCH conditional correlation coefficients for risk returns by country are given in Table 4. It is clear that the conditional correlations are generally not zero, with the conditional correlation coefficients of the composite risk returns with each of the economic, financial and political risk returns being the highest for each country. The estimates in Table 4 are quantitatively similar to those obtained using the CCC model based on equations (1)-(2), and on the VARMA-AGARCH model based on equations (4)-(5). In virtually all cases, the conditional correlations are positive.

5. CONCLUSION

This paper analysed the country risk ratings and returns compiled by the International Country Risk Guide (ICRG) for Australia, Canada, Japan and the USA. The VARMA-AGARCH model of Hoti, Chan and McAleer (2002) was used to estimate the multivariate effects of four different risk returns by country and to test for asymmetric effects.

The empirical results provided a comparative assessment of the conditional means and volatilities associated with the four country risk returns over time. Multivariate spillover effects were observed across all risk returns for all four countries, with the exception of financial risk returns for Australia. This suggests that risk returns are not independent of each other. The paper also analysed the importance of ICRG economic, financial and political risk ratings as components of a composite country risk rating.

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Table 1: Descriptive Statistics for Risk Returns by Country

Country	Risk Returns	Mean	SD	Skewness
Australia	Economic	0.000350	0.019158	-0.448578
	Financial	-0.000646	0.020811	-2.624942
	Political	0.000078	0.010578	0.951969
	Composite	-0.000028	0.008478	0.001765
Canada	Economic	0.000222	0.014450	1.038457
	Financial	-0.000433	0.012679	-7.502530
	Political	0.000156	0.008767	0.201160
	Composite	2.67E-05	0.006209	0.127021
Japan	Economic	-0.000871	0.015692	-1.937662
	Financial	4.86E-05	0.012003	0.299467
	Political	-0.000387	0.013118	1.491078
	Composite	-0.000378	0.008093	-0.090309
USA	Economic	-5.72E-05	0.020467	2.615394
	Financial	-0.001136	0.031031	-3.382983
	Political	-0.000725	0.013714	-0.832759
	Composite	-0.000670	0.010343	-0.703243

Table 2: Correlation Coefficients for Risk Returns by Country

Country	Risk Returns	Economic	Financial	Political	Composite
Australia	Economic	1.000	-0.037	-0.017	0.502
	Financial		1.000	0.054	0.564
	Political			1.000	0.657
	Composite				1.000
Canada	Economic	1.000	-0.248	0.050	0.464
	Financial		1.000	0.032	0.400
	Political			1.000	0.754
	Composite				1.000
Japan	Economic	1.000	0.219	-0.004	0.549
	Financial		1.000	-0.104	0.430
	Political			1.000	0.732
	Composite				1.000
USA	Economic	1.000	-0.150	0.046	0.356
	Financial		1.000	0.001	0.589
	Political			1.000	0.686
	Composite				1.000

Table 3: VAR(1)-AGARCH(1,1) Estimates of Risk Ratings and Spillover Effects

Economic Risk Ratings

Country	ω_E	α_E	γ_E	β_E	α_F	β_F	α_P	β_P	α_C	β_C
Australia	3.4E-05	-0.066	0.133	0.759	-0.074	0.052	-0.441	-0.114	0.888	1.726
	0.370	-0.931	0.995	4.476	-8.397	0.462	-2.519	-0.170	6.639	0.885
	0.321	-0.712	1.100	5.900	-1.454	0.284	-1.982	-0.295	0.990	0.737
Canada	1.5E-06	0.022	0.101	0.965	-0.001	0.056	0.162	0.135	-0.500	-0.406
	0.014	0.663	3.814	3.702	-0.085	0.309	1.316	0.120	-2.233	-0.419
	2.286	0.499	0.836	2.333	-0.039	0.205	1.901	0.264	-1.561	-1.060
Japan	2.9E-04	-0.056	0.094	0.721	0.022	-0.079	0.608	-2.069	-0.469	1.771
	3.726	-1.281	1.807	5.112	0.187	-0.882	4.513	-3.995	-1.305	1.891
	2.921	-1.652	1.419	5.825	0.478	-1.400	4.149	-2.245	-1.415	2.179
USA	1.9E-04	0.516	-0.066	0.359	-0.015	-0.005	-0.110	-0.220	0.295	0.149
	3.108	2.223	-0.252	3.228	-1.827	-4.118	-0.789	-0.476	1.625	0.286
	2.572	1.864	-0.149	3.471	-1.622	-3.814	-1.809	-0.777	1.254	0.707

Table 3: VAR(1)-AGARCH(1,1) Estimates of Risk Ratings and Spillover Effects (Continued)

Financial Risk Ratings

Country	ω_F	α_E	β_E	α_F	γ_F	β_F	α_P	β_P	α_C	β_C
Australia	8.5E-05	0.003	0.004	0.071	-0.083	0.857	0.383	-1.398	0.315	1.123
	1.583	0.130	0.079	1.003	-1.182	10.344	2.195	-5.304	1.527	1.799
	4.133	0.141	0.105	0.606	-1.151	5.351	0.638	-1.001	0.352	0.595
Canada	4.9E-4	3.8E-5	-0.407	-0.076	0.088	0.355	0.004	-0.623	-0.067	-5.852
	4.225	0.001	-1.966	-0.616	0.588	1.454	0.019	-1.012	-0.091	-25.782
	0.985	0.001	-1.286	-1.328	1.519	1.000	0.031	-1.590	-0.163	-0.740
Japan	1.3E-04	-0.074	0.763	0.057	0.075	0.686	-0.093	-0.093	0.294	0.274
	4.729	-2.359	3.945	0.608	0.436	4.633	-2.320	-3.706	1.316	0.700
	3.523	-2.182	3.494	0.569	0.752	4.196	-2.216	-2.144	1.200	0.465
USA	2.3E-04	0.127	0.020	0.025	0.151	0.784	0.499	-1.687	-2.875	4.218
	1.962	1.802	0.274	7.556	2.476	7.250	2.560	-3.938	-3.431	2.472
	1.872	1.329	0.488	0.292	0.932	2.166	1.146	-2.302	-1.388	1.680

Political Risk Ratings

Country	ω_P	α_E	β_E	α_F	β_F	α_P	γ_P	β_P	α_C	β_C
Australia	6.8E-05	0.028	-0.108	-0.004	0.086	-0.064	0.581	0.471	0.074	-0.292
	3.596	1.760	-4.250	-0.408	5.077	-0.806	2.879	4.047	0.318	-0.803
	2.865	1.659	-6.762	-0.502	2.207	-1.267	2.392	3.964	0.274	-1.246
Canada	1.4E-04	-0.027	0.120	0.003	0.770	-0.135	0.134	0.753	0.169	0.706
	20.763	-2.624	10.064	1.595	9.105	-3.814	2.352	8.752	1.166	1.762
	4.802	-2.840	6.945	1.405	1.957	-3.296	2.305	7.669	1.300	2.086
Japan	1.2E-05	0.014	0.092	0.078	-0.060	-0.049	0.363	0.923	-0.166	-0.240
	3.260	1.258	5.197	1.682	-1.295	-3.426	3.844	42.701	-1.871	-2.577
	3.606	0.876	2.292	1.760	-1.249	-2.273	4.238	19.834	-1.478	-1.822
USA	1.4E-05	-0.008	0.008	-0.003	-0.001	-0.068	0.156	0.843	-0.047	0.376
	1.134	-2.224	1.616	-1.114	-0.808	-3.024	2.543	12.025	-0.907	3.919
	6.434	-0.969	1.309	-0.899	-1.748	-2.758	2.633	13.959	-0.468	2.143

Table 3: VAR(1)-AGARCH(1,1) Estimates of Risk Ratings and Spillover Effects (Continued)

Composite Risk Ratings

Country	ω_C	α_E	β_E	α_F	β_F	α_P	β_P	α_C	γ_c	β_C
Australia	5.17E-05	0.000	0.000	0.015	-0.060	0.121	-0.344	0.007	-0.050	0.998
	17.184	0.406	-1.378	4.267	-5.480	5.408	-6.414	0.279	-1.534	34.170
	3.980	0.318	-0.585	1.697	-1.896	3.631	-3.716	0.131	-0.375	15.456
Canada	7.23E-7	3.6E-5	-2E-4	0.002	0.010	-0.014	-0.010	-0.039	0.002	1.019
	3.594	0.750	-2.490	2.026	4.981	-47.01	-2.322	-2.659	0.137	66.749
	1.683	0.038	-0.206	0.902	1.248	-1.312	-0.646	-0.854	0.035	12.206
Japan	4.52E-05	-3.7E-04	0.000	0.007	-0.015	0.054	-0.292	-0.008	0.065	0.963
	5.968	-3.488	3.463	2.599	-9.152	5.244	-10.421	-0.400	2.244	17.531
	4.095	-0.316	0.485	0.220	-0.556	2.865	-3.821	-0.719	1.010	6.680
USA	4.56E-05	0.001	-0.001	-0.020	0.007	-0.129	0.080	0.656	-0.034	0.409
	1.681	2.221	-0.530	-5.425	1.518	-1.717	1.387	3.891	-8.113	2.236
	0.800	0.779	-0.515	-3.044	1.740	-2.737	0.522	2.573	-3.427	2.019

Notes: (1) The three entries for each parameter are their respective estimate, the asymptotic t-ratio and the Bollerslev-Wooldridge (1992) robust t-ratio. (2) The ratings effects refer to the multivariate spillover effects of alternative risk returns by country.

Table 4: VARMA-GARCH Conditional Correlations for Four Risk Returns by Country

Country	Risk Returns	Economic	Financial	Political	Composite
Australia	Economic	1.000	-0.005	0.024	0.528
	Financial		1.000	0.115	0.496
	Political			1.000	0.644
	Composite				1.000
Canada	Economic	1.000	-0.165	0.041	0.424
	Financial		1.000	0.051	0.417
	Political			1.000	0.745
	Composite				1.000
Japan	Economic	1.000	0.189	-0.032	0.473
	Financial		1.000	-0.021	0.380
	Political			1.000	0.718
	Composite				1.000
USA	Economic	1.000	-0.173	0.049	0.342
	Financial		1.000	-0.010	0.486
	Political			1.000	0.683
	Composite				1.000