Modelling Volatility Spillovers In Country Risk Ratings

S. Hoti

School of Economics and Commerce, University of Western Australia, Email: Suhejla.Hoti@uwa.edu.au

Keywords: *Country risk; Balkan countries; risk ratings; risk returns; ICRG; economic risk; financial risk; political risk; composite risk; multivariate volatility models; shocks; spillover effects.*

EXTENDED ABSTRACT

In times of uncertainty, the risks associated with engaging in international operations have increased substantially. Country risk reflects the ability and willingness of a country to service its foreign financial obligations. Such risk may be prompted by country-specific and regional economic, financial, political and composite factors. The paper provides a novel analysis of four risk ratings using multivariate conditional volatility models for six countries situated in the Balkan Peninsula. These ratings are compiled by the International Country Risk Guide (ICRG), the only risk rating agency to provide consistent monthly data for a large number of countries since 1984. The empirical results show that these models are able to capture the dynamics in the conditional variance and the country spillover effects in the country risk ratings.

Country risk is of critical concern in the world today, with almost every economic, financial and political crisis or conflict threatening to exceed their initial borders. In the current state of world affairs, the economic and financial wealth and political power of a country are decisive for its dominant position in the international financial community and political status.

This paper focuses on the Balkan Peninsula, an emerging region of Europe, which has been characterised by violent conflicts both in the past and present. Situated in southeast Europe and surrounded by the Adriatic, Ionian, Aegean, Marmara and Black Seas, the Balkan Peninsula consists of ten countries, namely Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Former Yugoslav Republic of Macedonia, Romania, Slovenia, Serbia and Montenegro, and European Turkey.

After the fall of the Berlin Wall in November 1989 and the start of the conflicts in the former Federal Republic of Yugoslavia in March 1992, the Balkan region has experienced major economic, financial and political changes. Two years after the onset of the conflicts, Yugoslavia ceased to exist and several new countries were subsequently created. Today, of the six former Yugoslav republics, Bosnia-Herzegovina, Croatia, Macedonia and Slovenia are internationally recognised as sovereign states. The remaining two republics of Montenegro and Serbia, which includes the UN-administered southern province of Kosovo and northern province of Vojvodina, now form the union of Serbia and Montenegro. These conflicts hampered the regional transition to market economies. Although not involved in the conflicts, Albania was seriously affected by the neighbour crises, especially in relation to the status of the UN-administered province of Kosovo. Two countries that remained relatively unaffected by the neighbour crises were Bulgaria and Romania (for further details on the regional profile, see BBC News (2005)).

While the Balkan economic cooperation is crucial for the development of the region, it may be regarded as a deviation from European integration. In general, the emerging Balkan countries see regional cooperation as a way of entering the European Union. The Stability Pact for South Eastern Europe, launched in June 1999, was an important regional initiative which encouraged the regional efforts to foster peace, democracy, respect of human rights and economic prosperity (see Stability Pact for South Eastern Europe (2005)). However, the effectiveness of the Pact initiatives in the Balkan region remains open to question.

In view of the above, the primary purpose of the paper is to analyse the degree of economic, financial and political cooperation between the countries in the Balkan region, using a multivariate conditional variance model of monthly risk ratings data for the period October 1985 to April 2005. Six Balkan countries have been selected for the empirical analysis, namely Albania, Bulgaria, Greece, Romania, Serbia and Montenegro, and Turkey, with all being partners in the Stability Pact for South Eastern Europe. The plan of the paper is as follows. Section 1 introduces the rating system of the ICRG, and Section 2 describes the country risk data for the six selected countries. Multivariate conditional volatility models are discussed in Section 3. The empirical results and some concluding remarks are given in Section 4.

1. COUNTRY RISK RATINGS

Of the six selected Balkan countries, five are non-EU countries, the exception being Greece. Turkey, while not entirely a Balkan country, is a big market which plays an important role in the region. A common feature of the non-EU Balkan countries is that they depend heavily on foreign aid to finance development. Moreover, given their past of violent conflicts and central economic planning, these countries are regarded as being of high risk. Country risk ratings issued by rating agencies are relatively low, indicating high level of associated risk. Moreover, highly unstable political systems and the weak legal and institutional frameworks in the Balkan countries deter foreign investment. As a result, the cost of borrowing becomes relatively high, so that these countries have to make a considerable effort to integrate into the international financial markets, and particularly to join the EU.

Country risk refers broadly to the likelihood that a sovereign state or borrower from a particular country fails to meet their obligations towards foreign lenders and/or investors. Following the Third World debt crisis in the early 1980s, political changes after the end of the Cold War, the implementation of market-oriented economic and financial reforms in Eastern Europe, the East Asian and Latin American crises since 1997, and the aftermath of 11 September 2001, the uncertainty associated with engaging in international businesses has increased substantially. Owing to the increased uncertainty in the last two decades, the associated risks have become more difficult to analyse and predict for decision makers in the economic, financial and political sectors (for further details, see Hoti and McAleer (2004, 2005a)).

A primary function of country risk assessment is to anticipate payment problems by sovereign borrowers. There are three main components of country risk, namely economic, financial and political risk. Country risk assessment evaluates economic, financial, and political factors, and their interactions in determining the risk associated with a particular country. The importance of country risk analysis is underscored by the existence of prominent country risk rating agencies, such as Moody's, Standard and Poor's, Fitch IBCA, Euromoney, Institutional Investor, Economist Intelligence Unit, International Country Risk Guide, and Political Risk Services (for a critical survey of the country risk rating systems, see Hoti (2005) and Hoti and McAleer (2004, 2005a)). Country risk ratings are crucial for countries seeking foreign investment and selling government bonds on the international financial market, and for lending and investment decisions by large corporations and international financial institutions. These agencies provide qualitative and quantitative country risk ratings, combining information about economic, financial and political risk ratings into a composite risk rating.

Of these rating agencies, the International Country Risk Guide (ICRG) has compiled quantitative economic, financial, political and composite risk ratings for 93 countries on a monthly basis since January 1984. As of June 2005, 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.

Both the economic and financial risk components are comprised of five variables, namely (GDP per capita, GDP growth, inflation rate, budget balance as a percentage of GDP, current account balance as a percentage of GDP), and (foreign debt as a percentage of GDP, foreign debt service as a percentage of export in goods and services, current account as a percentage of export in goods and services, net liquidity as months of import cover, exchange rate stability), respectively. The political risk component comprises the following 12 variables, namely government stability, socio-economic conditions, investment profile, internal and external conflicts, corruption, military in politics, religious and ethic tensions, law and order, democratic accountability, and bureaucracy quality. Using each set of variables, a separate risk rating is created for the three components, on a scale of 0-100.

The three component risk ratings are then combined to derive a composite risk rating as an overall measure of country risk, or country creditworthiness. Each of the five economic and financial components accounts for 25%, while the twelve political components account for 50% of the composite risk rating. The lower (higher) is a given risk rating (or creditworthiness), the higher (lower) is the associated risk.

Although the ICRG rating system does not take into account the interdependencies between economic, financial and political risk ratings, they are important in determining a composite country risk rating. Hoti and McAleer (2005b) found significant multivariate spillover effects in the rate of change of country risk ratings (or risk returns) across economic, financial, political and composite risk returns. Similarly, the ICRG rating system does not accommodate country spillover effects in economic, financial, political and composite risk returns. This paper is the first attempt to model such spillover effects for risk returns across different countries using monthly risk ratings data for six Balkan countries, for the period 1985/10 – 2005/04.

2. DATA DESCRIPTION

Economic, financial, political and composite risk ratings are compiled by the ICRG. Only six Balkan countries have been selected for the analysis in this paper, namely Albania, Bulgaria, Greece, Romania, Serbia and Montenegro, and Turkey, all being partners in the Stability Pact for South Eastern Europe. These countries were selected based on ICRG data availability and/or their economic, financial and political influences in the region.

In this paper, a multivariate conditional volatility model is estimated using monthly ICRG data on economic, financial, political and composite risk for Albania, Bulgaria, Greece, Romania, Serbia and Montenegro, and Turkey. ICRG data for Albania are available from October 1985, for Bulgaria from December 1984, for Romania from August 1984, and for Greece, Serbia and Montenegro, and Turkey from January 1984. Therefore, the common sample for purposes of the empirical analysis is October 1985 to April 2005. This paper focuses on the rate of change of country risk ratings (that is, risk returns) in order to avoid any problems of non-stationarity (or unit roots) in the data. Moreover, as country risk ratings can be treated as financial indexes, their rate of change merits the same attention as their financial market counterparts.

Country risk returns are defined as the rate of change in country risk rating, while volatility is defined as the squared deviation of each observation from its sample mean. All six countries have relatively low economic, financial, political and composite risk ratings, with noticeable structural changes over the sample period.

Of the six countries, Romania, Serbia and Montenegro, and Turkey have experienced substantial increases in all four risk ratings after 2000. Albania and Bulgaria show moderate improvements in the four risk ratings, while the four risk ratings for Greece have generally fallen after 2000. For all six countries, significant differences are evident in the economic, financial and political risk ratings, risk returns and their associated volatilities. Moreover, the composite risk ratings and risk returns closely reflect the trends and volatilities of the three component risk ratings and returns.

In all cases, noticeable volatility clusterings and/or outliers are evident. For a detailed analysis of the trends and the associated volatilities of the four risk ratings and risk returns for the six countries according to economic, financial and political factors, see Hoti and McAleer (2005a).

3. MULTIVARIATE MODELS OF CONDITIONAL VOLATILITY FOR COUNTRY RISK RETURNS

Models of conditional volatility (or uncertainty) have been widely used in economics and finance to evaluate risk, asymmetric shocks and leverage effects (namely, the effects of positive and negative shocks on risk). The primary empirical purpose of the paper is to model country risk returns and their associated volatility for six Balkan countries for the period October 1985 to April 2005. Country risk returns are defined as the monthly percentage change in country risk ratings, while volatility (or uncertainty) refers to the changes in the variability of shocks country risk returns over time, and is defined as the squared deviation of each observation from the respective sample mean.

As a result of many factors that can affect economic, financial, political and composite country risk, it is clear that shocks to risk returns may not have the same variability over time. Such risk may be prompted by country-specific and regional economic, financial, political and composite factors. Variations in the degree of uncertainty across country risk returns need to be appreciated in order to make optimal macroeconomic management and policy decisions. In addition, models of uncertainty permit a distinction to be made between the short and long run persistence of shocks to country risk returns, which provide useful information regarding the effects of shocks on uncertainty. The inter-relationship of the short and long run effects of shocks to uncertainty permits a classification of countries according to uncertainty in risk returns.

The analysis in this paper is based on Engle's (1982) development of time-varying volatility using the autoregressive conditional heteroscedasticity (ARCH) model, and subsequent developments associated with the ARCH family of models (see, for example, the recent survey by Li, Ling and McAleer (2002)). Several theoretical developments have been suggested by Wong and Li (1997), Hoti, Chan and McAleer (2002), and Ling and McAleer (2002a, 2002b, 2003). For a detailed comparison of the structural and statistical properties of alternative univariate and multivariate, conditional and stochastic, volatility models, see McAleer (2005).

A general constant conditional correlation model is the symmetric vector autoregressive moving average - generalized autoregressive conditional heteroscedasticty (VARMA-GARCH) model of Ling and McAleer (2003). This model, which permits an analysis of risk spillovers between

country risk returns across countries, is estimated using monthly data on country risk returns for Albania, Bulgaria, Greece, Romania, Serbia and Montenegro, and Turkey.

Consider the following specification for risk return, *i*, for a country (measured in log-differences), y_t:

$$\begin{aligned} y_t &= E(y_t \mid \Im_{t-1}) + \varepsilon_t, \qquad t = 1,...,n \\ \varepsilon_t &= D_t \eta_t \end{aligned} \tag{1}$$

where $y_t = (y_{1t},..., y_{mt})'$ measures country risk returns for the six Balkan countries; $\eta_t = (\eta_{1t},...,\eta_{mt})'$ is a sequence of independently and identically distributed (*iid*) random vectors that is obtained from standardising the shocks to risk returns, ε_t, using the standardisation $D_t = diag(h_{1t}^{1/2},...,h_{mt}^{1/2})$, where h_t is modelled based on historical data, as discussed below; $\Im_t$ is the historical information available to time *t*; $m\,(=24)$ is the number of monthly data series, and $t = 1,...,235$ monthly observations for the period October 1985 to April 2005.

The constant conditional correlation (CCC) GARCH model of Bollerslev (1990) assumes that the conditional variance of the shocks to the 24 data series i, $i = 1,...,m$, follows a univariate GARCH(*r*,*s*) process, that is,

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

where α_{il} represents the ARCH effects, or the short run persistence of shocks to i, and β_{il} represents the GARCH effects, or the contribution of such shocks to long run persistence. This model assumes the independence of conditional variances, and hence no spillovers in volatility, across the 24 data series. It is important to note that Γ is the matrix of constant conditional correlations of standardized return shocks, with the typical element of Γ being given by $\rho_{ij} = \rho_{ji}$ for $i, j = 1,...,m$. Therefore, the multivariate effects are determined solely through the constant conditional correlation matrix.

As an extension of (2) to incorporate the effects of shocks to risk returns across the six countries, and hence spillover effects in uncertainty across the 24 data series, it is necessary to define h_{it} on the basis of past information from ε_{it}, ε_{jt}, h_{it} and h_{jt} for $i, j = 1,...,m$, $i \neq j$. Thus, the VARMA-GARCH model of Ling and McAleer (2003) is defined as follows:

$$\Phi(L)(Y_t - \mu) = \Psi(L)\varepsilon_t \tag{3}$$

$$\begin{aligned} \varepsilon_t &= D_t \eta_t \\ H_t &= W + \sum_{l=1}^{r} A_l \underset{\sim}{\varepsilon}_{t-l} + \sum_{l=1}^{p} B_l H_{t-l} \end{aligned} \tag{4}$$

where $D_t = diag(h_{1t}^{1/2},...,h_{mt}^{1/2})$, $H_t = (h_{1t},...,h_{mt})'$, $\underset{\sim}{\varepsilon}_t = (\varepsilon_{1t}^2,...,\varepsilon_{mt}^2)'$, and A_l and B_l are matrices with typical elements α_{ij} and β_{ij}, respectively. The CCC model (1)-(2) is obtained from (3)-(4) by setting $A_l = diag\{\alpha_{il}\}$ and $B_l = diag\{\beta_{il}\}$ for $l = 1,...,r$.

4. EMPIRICAL RESULTS

Using the data on the 24 monthly data series, namely economic, financial, political, and composite risk returns for Albania, Bulgaria, Greece, Romania, Serbia and Montenegro, and Turkey, the conditional mean is modelled in each case as an AR(1) process. In addition to estimating the conditional mean for each data series, the VARMA-GARCH(1,1) model is used to estimate the conditional volatility (or uncertainty) associated with the risk returns series.

The parameters are estimated using the Berndt, Hall, Hall and Hausman (BHHH) (1974) in the EViews 4 econometric software package. Using the RATS 6 econometric software package yielded virtually identical results. Tables 1-6 report the VARMA-GARCH estimates for the 24 data series. Both the asymptotic and the Bollerslev-Wooldridge (1992) robust t-ratios are reported in order to accommodate possible extreme values in the data.

Tables 1-6 report the estimates of VARMA-GARCH for four risk returns and six countries. The conditional mean estimates show significant dynamics for only 9 of the 24 four data sets, namely financial and composite risk returns for Albania, all four risk returns for Greece, economic risk returns for Romania and Turkey, and financial risk returns for Serbia and Montenegro.

Based on the statistical significance of the conditional variance estimates in Table 1, the economic risk return for Albania is affected by its own previous long run shocks, and by previous short and/or long run shocks to the economic returns for Bulgaria and Turkey. The financial return for Albania is affected by its own previous long run shocks, and by previous short and/or long run shocks in the financial returns for the remaining countries. Albania's political risk return is affected by its own previous short and long run shocks, and by previous short and/or long run shocks in the political risk returns for all the remaining countries,

apart from Turkey. Finally, Albania's composite risk return is affected by its own previous short and long run shocks, and by previous short and/or long run shocks in the composite risk return for Bulgaria, Greece, and Serbia and Montenegro. Overall, significant country spillover effects are observed for all four risk returns for Albania.

Table 2 presents the estimated country spillover effects for the four risk returns of Bulgaria. The economic risk return for Bulgaria is affected by its own previous long run shocks, and by previous short and/or long run shocks to the economic returns for Albania and Romania. In terms of the financial risk return, Bulgaria is affected by its own previous long run shocks, and by previous short and/or long run shocks to the financial returns to Greece and Romania. Bulgaria's political RETURN is affected by its own previous long run shocks, and by previous short and long run shocks to the political risk return for Greece. The composite risk return is affected by its own previous long run shocks, and by previous short and/or long run shocks to the composite return for Greece and Romania. Overall, significant country spillover effects are observed for all four risk returns for Bulgaria, but fewer than in the case of Albania.

The estimated country spillover effects for Greece are presented in Table 3. For Greece, the economic risk is affected by its own previous long run shocks, and previous short and/or long run shocks to the economic risk returns for all remaining countries, except for Albania. The financial risk is affected by its own previous long run shocks, and previous short run shocks to the economic risk returns for Albania and Serbia and Montenegro. No country spillover effects are observed for the political risk return for Greece, which is affected only by its own previous long run shocks. Similarly, there is only one country spillover effect for the country risk return for Greece, namely the previous short run shocks to the composite risk return for Bulgaria. Overall, strong country spillover effects are observed only for economic risk returns for Greece.

As given in Table 4, the economic risk return for Romania is affected by its own previous long run shocks, as well as by previous short run shocks to the economic risk return for Greece and short and long run shocks to the economic risk return for Turkey. The financial risk return is affected by its own previous long run shocks, as well as by previous short run shocks to the financial risk return for Greece and long run shocks to the financial risk return for Turkey. In terms of political risk return, Romania is affected by its own previous short and long run shocks, and by previous short and/or long run shocks to the political risk returns for Albania, Greece and Turkey. No country spillover effects are observed in the volatility of the composite risk return for Romania, which is affected only by its own previous long run shocks. Overall, country spillover effects are present only for economic, financial and political risk returns for Romania.

Figure 5 presents the country spillover estimates for the four risk returns of Serbia and Montenegro. For the economic risk return, only its own previous long run shock is significant, as well as previous long run shocks to the economic risk returns for Albania and Romania, and short run shocks to the economic risk return for Greece. The financial and political risk returns for Serbia and Montenegro are affected by their own previous long run shocks, and previous short and/or long run shocks to the respective risk returns for all five remaining countries. Only country spillover effects are observed for the composite risk return for Serbia and Montengro, with the return being affected by previous short and/or long run shocks to the composite risk returns for all the remaining countries, apart from Albania.

The estimated spillover effects for Turkey are given in Table 6. The economic risk is affect by its own previous long run shock and by the previous long run shocks to the economic return for Albania. Only spillover effects are observed for the financial risk for Turkey, namely previous short and/or long run shocks to financial risk returns for Albania, Romania and Greece. The political risk return is affected by its own previous long run shock and by the previous short run shock to the political return for Greece. Finally, the composite risk return for Turkey is affected by its own previous short and long run shocks, as well as previous short and/or long run shocks to the composite risk return for Bulgaria, Greece and Romania. Overall, at least one country spillover effect is observed in the volatilities of the four risk returns for Turkey.

The empirical results in Tables 1-6 suggest that the six Balkan countries are closely related in terms of the shocks to their economic, financial, political and composite risk returns. Country spillover effects are observed in almost every risk return across the six countries. In general, the risk return volatility of a country is negatively related with the shocks to risk returns for the other countries in the region. Such issues based on models of volatility have not previously been considered in the country risk literature.

AKNOWLEDGMENTS

The author wishes to thank Michael McAleer for very helpful comments and suggestions, and to acknowledge the financial support of the Australian Research Council.

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Table 1: VARMA-GARCH Spillover Effects for Albania

Risk Returns	Conditional Mean		Conditional Variance													
			Own Effects			Spillover Effects										
	θ_1	θ_2	ω	α	β	α_B	β_B	α_G	β_G	α_R	β_R	α_{SM}	β_{SM}	α_T	β_T
Economic	0.007	0.117	-1.E-04	0.030	0.803	0.084	-0.176	0.005	0.028	0.118	0.515	-0.006	0.030	-0.025	-0.014
	0.713	0.818	-0.284	0.595	7.817	1.335	-2.963	0.133	0.370	3.648	1.579	-0.651	1.879	-6.120	-0.873
	1.553	1.336	-0.315	0.579	5.087	1.771	-3.051	0.273	0.492	0.588	1.201	-0.529	0.642	-3.835	-0.782
Financial	5.E-04	-0.199	0.001	0.434	0.243	0.028	-0.005	-0.014	-0.782	-0.012	0.171	0.007	-0.008	-0.002	0.016
	-0.239	-1.127	3.689	3.922	3.806	4.406	-1.629	-5.542	-4.976	-5.166	3.389	2.674	-6.428	-2.216	7.490
	-1.138	-2.304	7.942	1.706	3.833	2.400	-2.688	-7.155	-8.135	-4.889	4.247	1.183	-7.045	-3.282	1.872
Political	-5E-04	0.148	5.E-04	0.201	0.596	0.134	0.314	-0.045	-1.536	-0.014	-0.384	0.014	-0.018	0.013	0.037
	-0.269	1.497	5.136	2.878	8.629	1.347	0.909	-1.639	-54.147	-0.448	-2.429	1.974	-1.862	0.583	1.969
	-1.207	1.623	9.233	2.416	6.807	2.160	1.092	-2.102	-5.933	-0.424	-2.479	2.062	-1.854	0.760	1.663
Composite	0.003	0.254	2.E-04	0.110	0.633	0.236	0.094	-0.004	-0.386	0.067	-0.187	-0.003	-0.007	0.016	0.001
	1.541	2.267	1.699	1.056	5.245	2.629	3.049	-0.075	-2.111	0.719	-0.608	-0.333	-0.700	0.698	0.120
	2.654	2.627	3.087	2.247	6.394	2.464	0.915	-0.127	-3.187	1.036	-0.999	-1.093	-2.308	1.675	0.369

Table 2: VARMA-GARCH Spillover Effects for Bulgaria

Risk Returns	Conditional Mean		Conditional Variance												
			Own Effects			Spillover Effects									
	θ_1	θ_2	ω	α	β	α_A	β_A	α_G	β_G	α_R	β_R	α_{SM}	β_{SM}	α_T	β_T
Economic	0.003	0.047	0.001	0.013	0.969	-0.022	0.033	0.002	-0.076	4.1E-04	-0.114	0.005	-0.013	-0.011	0.002
	0.370	0.236	7.550	0.557	68.452	-1.809	2.236	0.020	-0.688	0.015	-2.451	0.777	-1.245	-1.773	0.267
	1.321	1.082	4.092	0.385	15.135	-2.388	3.027	0.029	-0.651	0.019	-2.290	1.015	-1.095	-1.248	0.312
Financial	-0.004	0.063	-3.2E-04	0.055	0.844	-0.006	0.195	-0.056	0.165	-0.024	0.118	-0.002	-0.004	-0.003	-0.002
	-1.044	0.446	-0.553	2.633	28.286	-0.244	4.598	-3.730	0.280	-3.236	3.125	-1.303	-1.572	-0.671	-0.685
	-1.226	0.881	-8.532	1.451	18.423	-0.341	0.618	-5.904	1.588	-0.554	2.761	-1.330	-1.641	-1.166	-0.970
Political	0.001	0.073	2.5E-04	0.166	0.516	0.008	-0.002	-0.117	-0.571	-0.042	0.442	0.006	-0.011	-0.001	-0.010
	0.560	0.596	1.582	2.180	2.759	0.306	-0.142	-3.145	-1.085	-1.102	1.529	1.190	-1.681	-0.118	-1.095
	1.165	0.883	50.690	1.676	3.928	0.517	-0.178	-3.800	-1.924	-1.534	1.601	1.069	-1.594	-0.151	-1.233
Composite	0.001	-0.040	-4.9E-05	0.059	0.957	-0.009	0.009	-0.104	0.064	-0.098	0.230	-0.004	-0.002	0.023	-0.008
	0.347	-0.314	-6.493	1.465	24.094	-0.281	0.361	-2.693	1.337	-2.384	4.609	-0.477	-0.249	1.770	-1.142
	1.168	-0.770	-27.337	1.557	23.996	-0.439	0.363	-2.323	0.746	-2.447	3.619	-0.614	-0.448	1.209	-1.075

Table 3: VARMA-GARCH Spillover Effects for Greece

Risk Returns	Conditional Mean		Conditional Variance													
			Own Effects			Spillover Effects										
	θ_1	θ_2	ω	α	β	α_A	β_A	α_B	β_B	α_R	β_R	α_{SM}	β_{SM}	α_T	β_T
Economic	-0.001	-0.195	3.E-04	0.031	0.682	0.002	0.009	0.000	0.009	-0.008	-0.047	-0.001	-0.007	-0.001	0.001
	-0.246	-2.227	2.557	0.463	5.677	1.481	1.585	-0.017	0.844	-2.059	-1.769	-1.178	-1.497	-0.591	0.635
	-0.448	-2.780	3.003	0.663	8.409	0.802	1.771	-0.031	1.920	-3.646	-2.126	-2.158	-1.759	-3.853	1.455
Financial	0.004	-0.215	-9.E-05	0.041	0.621	-0.018	0.025	0.004	0.004	-0.010	0.201	-0.003	-0.008	-0.001	-0.001
	1.180	-2.327	-0.551	0.859	1.648	-1.421	0.946	0.294	0.449	-0.812	0.971	-64.827	-0.750	-0.393	-0.382
	1.793	-2.420	-0.186	0.808	3.394	-1.930	0.357	0.473	0.576	-1.255	1.037	-4.244	-1.306	-0.728	-0.544
Political	0.001	-0.086	2.E-04	-0.013	0.546	0.001	-0.005	0.010	-0.059	-0.007	-0.045	-2.0E-04	-0.001	-0.005	-0.006
	0.756	-0.702	1.031	-0.248	1.111	0.143	-0.694	0.708	-1.219	-0.382	-0.388	-0.231	-0.616	-4.740	-0.642
	1.769	-1.965	85.441	-0.213	3.737	0.052	-0.670	0.230	-0.499	-0.356	-0.377	-0.128	-0.446	-1.439	-1.333
Composite	0.001	-0.092	1.E-04	0.096	0.493	0.000	-0.002	-0.015	-0.012	-0.009	-0.018	-0.001	-0.001	-0.002	-0.001
	0.941	-0.963	1.166	0.815	1.234	0.087	-0.369	-1.244	-0.372	-0.764	-0.526	-0.577	-0.425	-0.434	-0.281
	1.409	-2.853	19.778	1.563	6.398	0.050	-0.168	-2.249	-0.470	-0.606	-1.232	-1.237	-0.475	-0.967	-0.551

Table 4: VARMA-GARCH Spillover Effects for Romania

Risk Returns	Conditional Mean		Conditional Variance												
			Own Effects			Spillover Effects									
	θ_1	θ_2	ω	α	β	α_A	β_A	α_B	β_B	α_G	β_G	α_{SM}	β_{SM}	α_T	β_T
Economic	0.003	-0.172	0.003	0.053	0.553	0.026	-0.019	0.011	0.006	-0.073	-0.235	-0.003	-0.083	-0.011	-0.038
	0.628	-1.306	3.473	1.498	4.159	1.327	-0.891	0.328	0.142	-1.648	-1.148	-1.713	-2.219	-2.297	-3.165
	1.164	-3.037	2.077	0.836	3.076	0.573	-0.216	0.194	0.028	-2.023	-0.980	-1.257	-1.728	-2.543	-2.457
Financial	0.007	-0.021	0.004	-0.036	0.555	0.084	0.071	0.042	0.015	-0.245	-0.265	-0.015	-0.033	-0.017	-0.009
	0.593	-0.392	1.709	-0.690	3.839	0.571	0.619	0.824	0.384	-6.478	-0.146	-3.234	-1.689	-1.372	-1.616
	2.262	-0.688	0.807	-0.211	2.359	0.314	0.040	0.301	0.090	-4.172	-0.079	-1.637	-1.423	-1.093	-2.679
Political	0.000	0.060	9.E-05	0.242	0.460	0.036	0.010	0.071	-0.165	-0.120	0.669	0.000	-0.002	-0.012	-0.009
	-0.146	0.341	0.992	2.523	3.393	3.002	0.535	3.202	-1.131	-6.222	1.551	-0.305	-0.867	-6.696	-1.131
	-0.401	1.292	19.270	2.018	2.989	2.664	0.442	1.034	-0.774	-4.742	2.545	-0.329	-1.137	-4.540	-1.000
Composite	0.003	-0.018	3.E-04	-0.023	0.389	0.015	0.041	0.031	0.056	-0.061	-0.332	-0.003	-0.003	-0.003	-0.002
	1.598	-0.181	1.309	-0.427	0.765	0.313	0.639	0.443	0.641	-0.654	-1.000	-0.670	-0.831	-0.367	-0.297
	3.748	-0.289	80.158	-0.605	2.198	0.399	0.308	0.542	0.363	-1.232	-1.385	-1.073	-0.777	-0.383	-0.365

Table 5: VARMA-GARCH Spillover Effects for Serbia and Montenegro

Risk Returns	Conditional Mean		Conditional Variance												
			Own Effects			Spillover Effects									
	θ_1	θ_2	ω	α	β	α_A	β_A	α_B	β_B	α_G	β_G	α_R	β_R	α_T	β_T
Economic	-0.001	0.081	6.0E-04	0.160	0.698	0.003	0.061	0.012	-0.053	-0.059	-0.069	0.007	-0.132	0.021	0.069
	-0.253	0.491	4.796	2.542	9.260	1.454	3.630	1.440	-2.358	-1.317	-3.025	0.388	-2.904	1.314	2.717
	-0.346	1.124	2.786	1.491	8.709	1.355	3.719	1.241	-1.853	-3.567	-1.746	0.696	-2.446	0.566	0.612
Financial	0.013	0.160	-0.005	0.073	0.700	-0.052	0.608	-0.115	0.032	-0.080	4.596	-0.043	0.359	0.235	0.012
	2.017	0.913	-1.729	1.825	11.582	-4.142	3.678	-5.195	1.065	-0.909	1.524	-1.516	1.914	7.258	0.242
	3.640	2.212	-3.171	1.330	13.634	-4.025	3.650	-3.639	1.252	-2.391	2.757	-2.592	2.258	2.911	0.339
Political	0.002	-0.035	-0.005	0.233	0.541	0.062	-0.232	0.379	-5.463	0.603	15.690	-0.831	20.231	-0.107	0.159
	0.245	-0.248	-2.706	2.904	5.965	0.196	-1.472	0.322	-2.554	0.430	1.834	-4.321	4.917	-1.545	1.002
	0.595	-0.259	-29.606	1.624	4.371	0.271	-2.088	0.809	-4.893	0.748	5.356	-4.110	6.368	-2.293	1.459
Composite	0.004	0.088	0.003	0.450	0.166	-0.079	-0.104	-0.147	0.838	0.528	-6.439	-0.147	-0.744	-0.056	-0.041
	0.990	0.682	3.806	3.797	1.004	-0.584	-0.681	-1.384	1.314	1.228	-3.057	-2.168	-	-2.111	-0.938
	1.494	0.781	4.318	1.373	1.103	-1.655	-0.965	-5.058	2.355	2.376	-3.986	-2.191	-3.124	-3.546	-4.424

Table 6: VARMA-GARCH Spillover Effects for Turkey

Risk Returns	Conditional Mean		Conditional Variance												
			Own Effects			Spillover Effects									
	θ_1	θ_2	ω	α	β	α_A	β_A	α_B	β_B	α_G	β_G	α_R	β_R	α_{SM}	β_{SM}
Economic	-0.005	-0.334	0.002	0.103	0.705	-0.001	-0.076	-0.024	-0.012	0.049	-0.278	0.022	0.278	-0.015	0.087
	-0.420	-1.607	1.301	1.044	5.357	-0.046	-1.332	-0.721	-0.090	0.194	-0.688	0.320	0.877	-0.687	0.918
	-1.301	-3.491	1.014	1.128	3.015	-0.065	-1.925	-1.509	-0.132	0.486	-0.982	0.408	1.098	-1.749	1.472
Financial	-0.011	-0.122	0.006	0.742	0.062	0.107	0.814	0.006	-0.088	0.153	-4.290	-0.075	-0.129	0.004	0.079
	-1.667	-0.565	2.905	9.271	0.963	2.563	4.368	0.130	-2.348	0.724	-3.107	-4.361	-0.206	0.262	1.877
	-2.209	-0.465	4.087	0.744	0.809	1.932	1.646	0.218	-1.870	1.348	-3.214	-4.418	-0.416	0.190	1.711
Political	0.001	0.054	0.003	0.153	0.538	-0.021	0.062	0.164	-1.187	-0.447	-8.215	0.220	-0.707	-0.001	-0.002
	0.325	0.367	2.924	1.711	2.734	-0.241	0.698	18.573	-1.524	-1.820	-2.402	0.905	-0.499	-0.099	-0.063
	0.390	0.381	2.662	1.577	4.186	-0.498	1.002	0.555	-1.481	-3.687	-1.789	1.189	-0.666	-0.287	-0.221
Composite	0.002	-0.109	0.001	0.096	0.625	-0.014	0.071	-0.104	-0.050	-0.112	-0.984	0.067	-0.518	0.115	-0.039
	0.932	-0.959	6.646	1.243	23.180	-1.637	2.296	-2.614	-0.543	-1.814	-3.307	0.958	-3.216	3.219	-1.394
	1.820	-1.375	32.486	1.974	6.776	-1.269	0.813	-4.035	-0.651	-1.733	-3.590	1.210	-3.086	0.892	-0.414

Notes: The three entries corresponding to each parameter are their estimates, their asymptotic t-ratios, and the Bollerslev and Wooldridge (1992) robust t-ratios. A, B, G, R, SM, and T refer to Albania, Bulgaria, Greece, Romania, Serbia and Montenegro, and Turkey, respectively.