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COMMODITY-PRICE VOLATILITY AND EXTERNAL RISK: IMPLICATIONS FOR THE MACROECONOMIES OF CENTRAL AND EASTERN EUROPE

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Summary: In an era of increased global risk and the possibility of international "contagion," managers worldwide must be cognizant of the role that various types of volatility might have on their countries and regions. In particular, statistical analysis can provide estimates of the macroeconomic implications of shocks to foreign asset and commodity prices. This study performs such an analysis, applying time-series econometric modelling to analysis of four Central European countries (Bulgaria, Croatia, Hungary, and Poland), as well as Russia and Ukraine.
Using monthly data and applying Vector Autoregressive (VAR) time-series methods, this study first models oil-price volatility and real effective exchange-rate volatility. We then study the effects of these volatility terms and of changes in U.S. stock prices on credit growth, output growth, and the currency markets of our set of European countries. Overall, Granger Causality tests show that risk does have a strong impact on the region's economies, but that the effects differ from country to country. For example, U.S. stock-price declines uniformly put pressure on the region's currencies. At the national level, oil-price volatility puts pressure on the zloty and also contributes to Polish growth, and also hurts Russian growth. Our findings therefore offer the region's industries insights into their exposure to global risk and the global macroeconomy.

Keywords: Commodity Prices; Volatility; Central Europe; Time Series

1. Introduction

Following a decade of large increases and decreases on global markets, commodity prices began to drop significantly in 2014. While the resulting revenue losses can hurt emerging-market commodity exporters, oil-price declines may help lower costs and boost profits for manufacturers, particularly in Central and Eastern European (CEE) nations. At the same time, however, large swings in commodity prices create volatility that might be detrimental; increased risk hurts individual businesses and the overall macroeconomy. This paper investigates the impact of oil-price volatility on the exchange markets of six CEE nations, as well as interactions with macroeconomic variables. Using time-series methods, we find important effects that differ from country to country.
This study focuses on a measure of Exchange-Market Pressure (EMP), which captures exchange-rate depreciations as well as central-bank measures to combat these depreciations. This monthly measure is then modelled as a function of U.S. stock prices and key macroeconomic variables. These include domestic credit growth, the growth rate of government borrowing, GDP growth, and inflation. Previous research, by Phylaktis and Ravazzolo (2005), Van Poeck et al. (2006), Stavarek (2011), Koseoglu and Cevik (2013) and others shows these variables to be significant determinates of EMP and currency crises in the CEE region. And while Hegerty (2012, 2014, 2014b) examines the link between commodity price *changes* and EMP in Latin America, Russia, and the Baltics, he does not include price *variability* in any specification. This study, therefore provides a key addition to this important

branch of the literature, providing business leaders with increased ability to understand and mitigate this risk.

2. Methodology

In this study, monthly data for all variables are taken from the International Financial Statistics of the International Monetary Fund. The timespan differs from country to country, but generally begins in the mid-1990s and ends in late 2014. First, we calculate EMP as a function of exchange-rate depreciations (an increase in the number of units per U.S. dollar), reserve losses (as a percentage of the lagged monetary base), and the change in the interest-rate differential (money-market rate) vis-à-vis the United States:

$$EMP_t = \frac{1}{\sigma_{\Delta e}}\left(\ln E_t - \ln E_{t-1}\right) - \frac{1}{\sigma_{\Delta RES}}\frac{\Delta RES_t}{MB_{t-1}} + \frac{1}{\sigma_{\Delta r}}\Delta\left(r_t - r_t^{US}\right) \qquad (1).$$

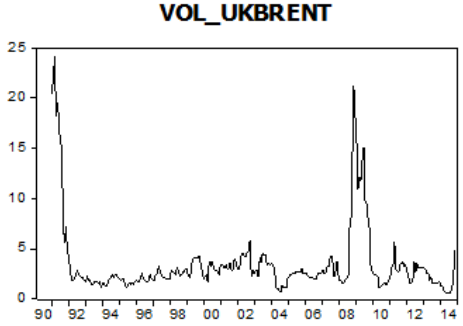
Next, oil-price volatility is calculated as the standard error of a rolling AR(1) regression (of the price on its lagged value), with 12-month windows. A similar calculation is carried out with the real effective exchange rate (REER), which represents a country's level of competitiveness against a broad range of trade partners. This volatility, therefore, represents another type of external risk.

After plotting these time series, we then conduct Vector Autoregressive (VAR) analysis to assess for spillovers among variables. These allow for any variable in the specification to have an impact on any other; for example, EMP and growth might have effects on each other. We first perform a bivariate Granger Causality test between oil-price and REER volatility to see whether the addition of one variable to a regression of the other on its own lagged values increases the regression's explanatory power. Our main test, however, is this test's multivariate version, applied to the following vector:

$$\left[EMP_t, CRG_t, GOVG_t, GROWTH_t, INF_t, d\ln USPS_t, POILVOL_t\right] \qquad (2).$$

The lag length of each VAR is chosen by minimizing the Schwarz goodness-of-fit-criterion. Significant Granger Causalty/Block exogeneity statistics suggest that one variable has an effect on the variable of interest. In an additional analysis (results available upon request), wee also generate a number of Impulse-Response Functions (IRFs) following the Generalized VAR methodology of Pesaran and Shin (1998). These functions plot the time path of one variable after a shock to another, as well as significance bands to show whether these responses differ from zero. Our Granger Causality results are shown below.

Figure 1: Oil-Price Volatility (U.K. Brent)

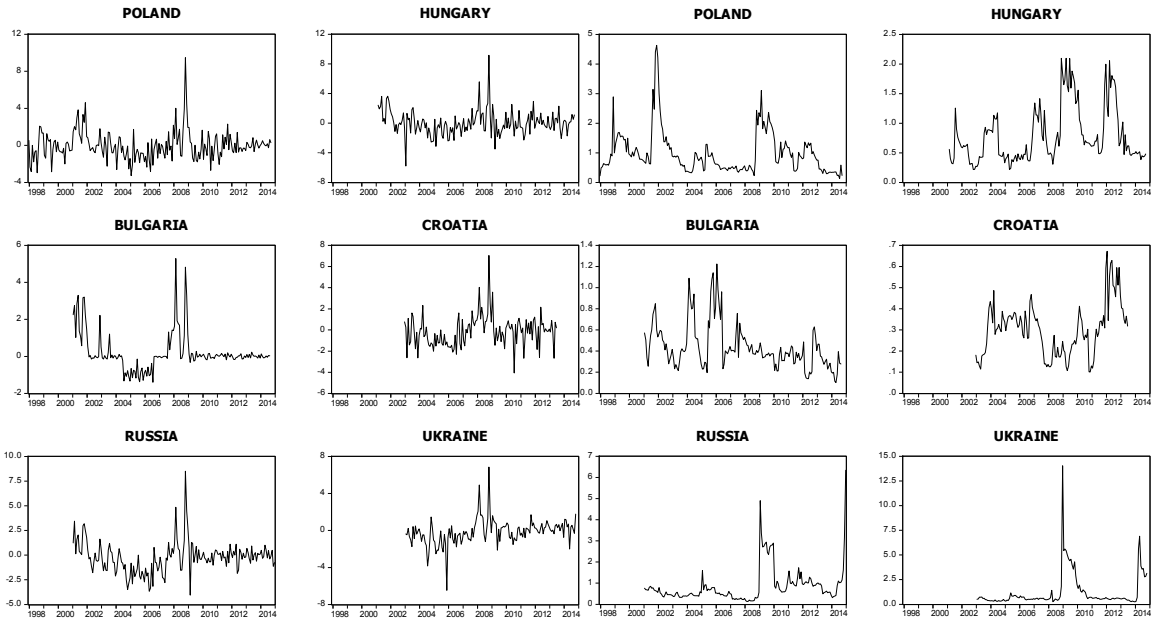


Measured as the standard errors of a rolling AR(1) regression over 12-month windows.

3. Results

Figure 1 shows the calculated time series of volatility in the price of U.K. Brent from 1990 to 2014. We see increases in this variability throughout the sample period, but the largest "spike" occurs immediately before and during the 2008 Global Financial Crisis. At the same time, EMP increased during this period, as did real exchange-rate volatility for these CEE countries. Our goal is to test empirically the causes and interlinkages of these movements.

Figure 2: Exchange market pressure indices (left side) and REER volatility (right side)



First, we test for direct spillovers between volatility measures using a bivariate Granger-causality test. The results are provided in Table 1. We see that in four of the six countries, increased oil-price variability spills over to the real effective exchange rate. In other words, oil price risk leads to risk in the "terms of trade," or the competitiveness of the CEE region. Only in Ukraine is the other direction of causation significant at 5 percent. Perhaps world markets are sensitive to events in this country.

Table 1: Bilateral Granger causality test results (p-values in parentheses).

	Poland	Hungary	Bulgaria	Croatia	Russia	Ukraine
REER → POILB	0.288 (0.599)	3.774 (0.054)	0.360 (0.549)	2.502 (0.116)	0.457 (0.500)	**3.989 (0.048)**
POILB → REER	**6.645 (0.011)**	**10.644 (0.001)**	0.016 (0.898)	0.435 (0.511)	**8.844 (0.003)**	**42.245 (0.000)**

Bold = significant at 5 percent.

Finally, Table 2 shows the main Granger causality/Block exogeneity test results. Variables are differenced based on stationarity tests results that are available upon request. Our key item of interest is the effect of oil-price volatility on EMP, credit growth, GDP growth (proxied by log changes in the monthly index of industrial production), and CPI inflation. Our main finding is that CEE exchange markets are less affected by commodity-price risk than are other variables. Oil-price volatility has a significant impact on credit

Table 2: Bilateral Granger causality test results (p-values in parentheses).

Poland	EMP	DCRG	GROWTH	DINF
EMP		0.578 (0.447)	**14.785 (0.000)**	0.604 (0.437)
DCRG	0.116 (0.733)		**7.790 (0.005)**	**7.696 (0.006)**
GROWTH	0.572 (0.449)	1.349 (0.245)		**6.097 (0.014)**
DINF	0.063 (0.802)	**14.217 (0.000)**	**9.793 (0.002)**	
DGOVG	1.182 (0.277)	0.156 (0.693)	2.077 (0.150)	1.227 (0.268)
DLNUSPS	2.526 (0.112)	0.666 (0.414)	0.316 (0.574)	0.070 (0.791)
DVOLPOILB	0.777 (0.378)	**6.892 (0.009)**	0.241 (0.624)	0.212 (0.645)
All	5.138 (0.526)	**25.643 (0.000)**	**28.004 (0.000)**	**18.152 (0.006)**
Hungary	EMP	DCRG	DGROWTH	DINF
EMP		1.901 (0.168)	0.307 (0.579)	0.136 (0.712)
DCRG	1.934 (0.164)		0.145 (0.703)	0.000 (0.993)
DGROWTH	0.143 (0.705)	0.058 (0.810)		2.393 (0.122)
DINF	0.035 (0.851)	3.233 (0.072)	0.38 (0.538)	
DGOVG	2.365 (0.124)	2.187 (0.139)	3.793 (0.052)	0.179 (0.673)
DLNUSPS	1.629 (0.202)	0.252 (0.616)	0.131 (0.717)	2.881 (0.090)
DVOLPOILB	0.410 (0.522)	0.803 (0.370)	2.489 (0.115)	0.343 (0.558)
All	4.928 (0.553)	12.316 (0.055)	**13.958 (0.030)**	7.815 (0.252)
Bulgaria	EMP	DCRG	DGROWTH	DINF
EMP		0.557 (0.456)	3.634 (0.057)	0.336 (0.562)
DCRG	0.830 (0.362)		0.008 (0.927)	0.456 (0.500)
DGROWTH	0.965 (0.326)	0.494 (0.482)		0.357 (0.550)
DINF	0.250 (0.617)	0.635 (0.425)	0.148 (0.701)	
GOVG	0.000 (0.993)	0.136 (0.712)	0.315 (0.575)	0.063 (0.802)
DLNUSPS	**6.018 (0.014)**	**7.991 (0.005)**	0.152 (0.696)	**5.156 (0.023)**
DVOLPOILB	1.051 (0.305)	0.011 (0.916)	0.003 (0.957)	0.001 (0.979)
All	9.207 (0.162)	9.461 (0.149)	4.927 (0.553)	6.496 (0.370)
Croatia	EMP	DCRG	GROWTH	DINF
EMP		0.092 (0.762)	0.771 (0.380)	0.213 (0.645)
DCRG	1.270 (0.260)		0.001 (0.974)	
GROWTH	0.449 (0.503)	0.003 (0.957)		0.608 (0.435)
DINF	0.324 (0.569)	1.599 (0.206)	0.491 (0.484)	0.725 (0.394)
DGOVG	1.105 (0.293)	0.048 (0.827)	0.825 (0.364)	0.475 (0.491)
DLNUSPS	1.634 (0.201)	0.267 (0.605)	0.428 (0.513)	0.084 (0.772)
DVOLPOILB	0.558 (0.455)	**4.633 (0.031)**	0.159 (0.690)	**9.475 (0.002)**
All	4.423 (0.620)	9.790 (0.134)	4.492 (0.610)	11.50 (0.074)
Russia	EMP	DCRG	DGROWTH	DINF
EMP		1.099 (0.295)	**4.986 (0.026)**	0.437 (0.508)
DCRG	0.007 (0.933)		3.484 (0.062)	0.001 (0.978)
DGROWTH	1.794 (0.180)	2.947 (0.086)		2.585 (0.108)
DINF	0.701 (0.402)	2.200 (0.138)	0.802 (0.371)	
DGOVG	0.332 (0.565)	1.623 (0.203)	0.090 (0.764)	0.192 (0.662)
DLNUSPS	2.832 (0.092)	0.503 (0.478)	**4.546 (0.033)**	0.026 (0.871)
DVOLPOILB	0.729 (0.393)	0.886 (0.347)	**4.415 (0.036)**	0.175 (0.676)
All	5.804 (0.446)	9.916 (0.128)	**25.082 (0.000)**	3.105 (0.796)
Ukraine	EMP	DCRG	DGROWTH	DINF
EMP		1.280 (0.258)	2.023 (0.155)	0.754 (0.385)
DCRG	2.172 (0.141)		0.040 (0.841)	1.630 (0.202)
DGROWTH	1.340 (0.247)	**9.834 (0.002)**		**6.294 (0.012)**
DINF	0.748 (0.387)	**4.783 (0.029)**	1.262 (0.261)	
GOVG	0.214 (0.644)	2.849 (0.091)	2.094 (0.148)	0.020 (0.887)
DLNUSPS	1.152 (0.283)	0.187 (0.665)	**4.785 (0.029)**	3.277 (0.070)
DVOLPOILB	0.252 (0.616)	0.036 (0.849)	0.487 (0.485)	0.172 (0.678)
All	6.789 (0.341)	**26.01 (0.000)**	**14.872 (0.021)**	**14.232 (0.027)**

growth in Poland and Croatia and GDP growth in Russia. U.S. stock-price movements significantly affect EMP, credit growth, and inflation in Bulgaria, and GDP growth in Russia and Ukraine. The other macroeconomic variables (such as the linkage between inflation and

credit growth and Poland) have important effects as well. Clearly, business leaders and policy makers must be wary of the role that commodity-price fluctuations have on the macroeconomies of the countries in which they operate.

4. Conclusion

Commodity-price volatility, which has increased over the past year with the recent plunge in oil prices, has the potential to introduce risk into the business environment. In particular, CEE countries might find the costs of this risk to outweigh the benefits brought by high energy costs. This study models oil-price and real effective exchange rate risk for six CEE economies before using VAR methods to test for spillovers between risk and a set of macroeconomic variables. The Granger causality results are supported by IRFs that are discussed elsewhere. We find that credit growth and output growth are most affected by oil-price risk, but not for every country in the study.

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