

**Conditional Heteroscedasticity and
Testing of the Granger Causality:
Case of Slovakia**

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The main aim of presentation:

- to analyze the relationships between the SKK/USD exchange rate and the stock index SAX using the daily data

January 1, 1999 - December 31, 2008

with exclusion of days in which the exchange rate or the stock index was not defined taking into account the existing volatility effects

Used methodology

:unit root test – ADF test

:cointegration procedure

:autoregressive conditional heteroscedastic (ARCH)
methodology

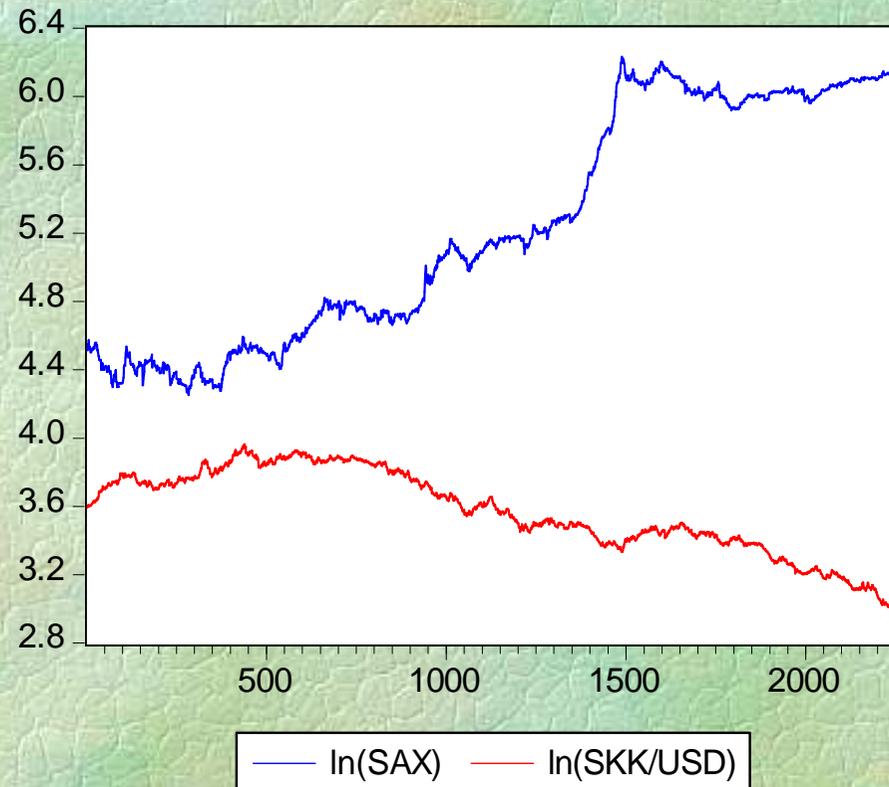
:Granger causality

:impulse responses analysis

The main descriptive statistics

	ln(SAX)	ln(SKK/USD)
Mean	5.235456	3.571590
Median	5.135504	3.570968
Maximum	6.230442	3.962963
Minimum	4.251206	2.967539
Std. Dev.	0.677958	0.245902
Skewness	0.130919	-0.352251
Kurtosis	1.390241	2.124059
Jarque-Bera	250.5832	119.0411
Probability	0.000000	0.000000
Sum	11837.37	8075.365
Sum Sq. Dev.	1038.758	136.6569
Observations	2261	2261

Analyzed time series and testing of the stationarity (ADF test)



	Level			1.difference	Conclusion
	trend & intercept	intercept	without both trend & intercept	trend & intercept	
$\ln(SAX)$	-2,0528	-0,1079	2,5325	-47,1473***	I(1)
$\ln(SKK/USD)$	-2,6491	1,4838	-1,7328	-46,5886***	I(1)

Johansen cointegration procedure

- number of lags in the VAR model (Schwarz Criterion): 1
- test statistics for model with intercept and trend in CE and no trend in VAR

$$r = 0; N - r = 2: \lambda_{trace} = 22,6859 (0,1185)$$

$$r = 1; N - r = 1: \lambda_{trace} = 1,8119(0,9790)$$

where p-value is in parentheses, r is number of cointegrating vectors and N is number of variables

- conclusion: there exist no cointegration relationship (i.e. no long-run relationship) between the analyzed time series

Volatility effects = existence of the autoregressive conditional heteroscedasticity

- the impact of the volatility effects - methodology of the autoregressive conditional heteroscedasticity (ARCH) models
- mean equation of the individual logarithmic return series x_t

$$d(\ln(x_t)) = \text{constant} + \varepsilon_t$$

- conditional variance GARCH(p,q) equation

$$h_t = \alpha_0 + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^p \beta_i h_{t-i}$$

Estimation of the GARCH model and Granger causality test for volatility – filtered series

- mean and conditional variance equations with p-values 0,0000:

$$d(\ln(SAX_t)) = 0,001$$

$$\text{GARCH}(2,2): \quad h_t = 3.10^{-8} + 0,0496\varepsilon_{t-1}^2 - 0,0469\varepsilon_{t-2}^2 + 1,7006h_{t-1} - 0,7037h_{t-2}$$

and

$$d(\ln(SKK / USD_t)) = -0,0004$$

$$\text{GARCH}(1,1): \quad h_t = 7.10^{-7} + 0,0199\varepsilon_{t-1}^2 + 0,9658h_{t-1}$$

- volatility-filtered series, i.e. residuals divided by the predicted value of volatility, standardized residuals
- Granger causality tests (2lags) for volatility-filtered series:

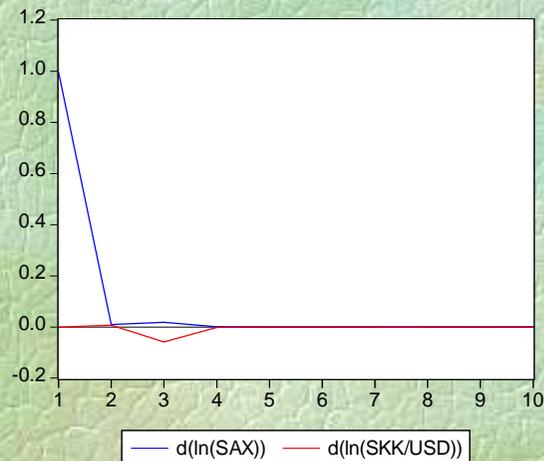
<i>Null Hypothesis:</i>	Wald F-Statistic	Probability
d(ln(SKK/USD) does not Granger Cause d(ln(SAX))	0.05566	0.81351
d(ln(SAX)) does not Granger Cause d(ln(SKK/USD)	0.04205	0.83755

Impulse responses analysis

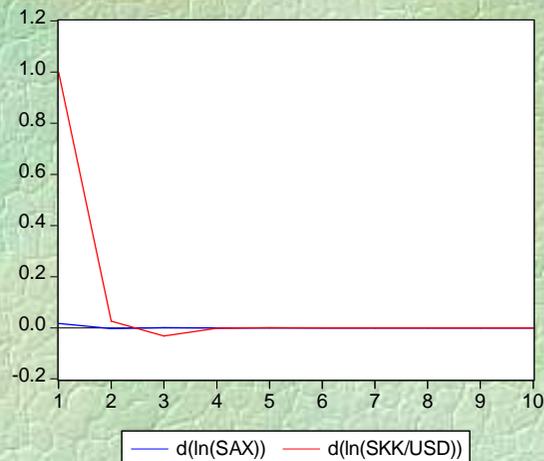
- the existence of the Granger causality for volatility-filtered series was not confirmed
- to examine the short-run dynamic relations between volatility-filtered stock returns and volatility-filtered exchange rate returns the impulse responses (IR) analysis was used
- the essence of the IR analysis:
for each variable from each equation separately, a unit shock is applied to the error, and the effects upon the VAR system over time are recorded

Impulse responses : volatility-filtered series

Response of volatility-filtered $d(\ln(\text{SAX}))$ to Cholesky
One S.D. Innovations



Response of volatility-filtered $d(\ln(\text{SKK/USD}))$ to Cholesky
One S.D. Innovations



: there is almost no reaction of the stock returns to one standard deviation innovation in the exchange rate returns and vice versa

: the reaction of the exchange rate (stock) returns to the innovation in itself is at the beginning of the tested period quite strong

Conclusion

- the study deals with the relationship between the exchange rates and the stock indices in case of Slovakia
- Johansen cointegration procedure: no long-run relationship between these two variables
- the conditional heteroscedasticity was confirmed in both return series (GARCH models)
- Granger causality tests based on volatility-filtered series: independence between the analyzed series
- impulse responses: no considerable reaction

References

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