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Dynamics of Crude Oil Prices, Economic Factors and Equity Markets: Evidence from CEEC-3 Economies

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Abstract

This paper investigates the bi-directional long run relationship between macroeconomic factors, oil and stock prices of three transition economies of Central and Eastern European Countries (CEEC-3) namely Czech Republic, Hungary and Poland. Using Toda-Yamamoto estimation procedure with generalized impulse response analysis, it is found in this study that stock market index of each of these countries are not affected by any of these economic factors except for the industrial production in Poland. In Czech Republic and Poland, there is granger causality running from industrial production to inflation. In addition, oil prices granger causes inflation in Czech Republic implying the indicator of inflation in Czech Republic. In Czech Republic and Poland, inflation and industrial production Granger causes interest rates. However, this causality is bidirectional in Poland rather than unidirectional in Czech Republic. It is also found that there is unidirectional causality running from inflation, interest rates and stock market returns to industrial production in Hungary. These findings may have important implications for decision-making by investors and national policymakers.

Keywords: Crude Oil Prices, Economic Factors, Stock Prices, Toda-Yamamoto Approach and Impulse Response Analysis

PETROL FİYATLARI, EKONOMİK FAKTÖRLER VE HİSSE SENEDİ PİYASASI ARASINDAKİ DİNAMİK İLİŞKİ: CEEC-3 EKONOMİLERİ ÜZERİNE BİR ÇALIŞMA

Özet

Bu çalışma Orta ve Doğu Avrupa geçiş ekonomisi ülkerinden Çek Cumhuriyeti, Macaristan and Polonya (CEEC-3) makroekonomik faktörleri, hisse senedi verileri ve petrol fiyatları arasındaki iki yönlü uzun dönem ilişkisinin test edilmesini amaçlamaktadır. Toda-Yamamoto nedensellik ve etki tepki analizleri kullanılarak elde edilen bulgular, Polonya için hisse senedi fiyatlarının sanayi üretiminden etkilendiğini gösterirken, diğer ülkeler için hisse senedi fiyatları üzerinde etkili olan herhangi bir

ekonomik faktöre rastlanmamıştır.Bulgular, sanayi üretiminden enflayona doğru tek yönlü bir nedenselliğin Çek Cumhuriyeti ve Polonya için var olduğunu göstermektedir.Ayrıca, Çek Cumhuriyeti için petrol fiyatlarından enflasyona doğru yine tek yönlü bir nedensellik olduğu ve dolayısıyla enflasyonun bir göstergesi olduğu sonucuna ulaşılmıştır.Bunun yanısıra, sanayi üretimi ve enflasyondan faiz oranlarına doğru tek yönlü nedenselliğin Çek Cumhuriyeti için varlığına karşın söz konusu nedenselliğin varlığı iki yönlü olarak Polonya için ortaya konulmuştur.Ayrıca elde edilen bulgular Macaristan için enflasyon, faiz oranları ve hisse senedi piyasalarından sanayi üretime doğru tek yönlü bir nedenselliğin varlığına işaret etmektedir.Elde edilen bulguların uluslarası yatırımcılar ve ulusal politika belirleyiciler açısından önemli olduğu düşünülmektedir.

Anahtar Kelimeler: Petrol Fiyatları, Ekonomik Faktörler, Hisse Senedi Fiyatları, Toda-Yamamoto Yaklaşımı ve Etki Tepki Analizleri

I. Introduction

The Czech Republic, Hungary and Poland as Central and Eastern European Countries (CEEC-3) have put great effort throughout the process of their integration to European Union. These countries experienced higher levels of inflation that distorts other macroeconomic variables in essence. However, through the mid of the 1990's, these countries achieved great success in privatization and capital movements. In particular, these countries succeeded in establishing competition, liberalization, privatization and macroeconomic stabilization. There are three common points of these three countries. First of all, these three countries went into the same process of accession to European Union through the end of the 1990's. Second, financial markets of these countries are among the largest ones in that region. Finally, these countries experience heavy international trade with each other (Kocenda, 2001; Büttner and Hayo, 2009). Transition processes of result in great shocks to their macroeconomic variables. Especially, macroeconomic variables are not stable throughout this transition process. More than two decades after their transition, it is highly crucial to investigate the relation between macroeconomic factors and stock market returns of these countries.

The aim of this paper is to investigate the relation between some local macroeconomic indicators (inflation rates, interest rates, industrial production and stock market returns) and a global indicator namely the oil price. It is found in this study that stock market index of each of these countries are not affected by any of these economic factors except for the industrial production in Poland. In Czech Republic and Poland, there is granger causality running from industrial production to inflation. In addition, oil prices granger causes inflation in Czech Republic implying the indicator of inflation in Czech Republic. In Czech Republic and Poland, inflation and industrial production causes interest rates. However, this causality is bidirectional in Poland rather than unidirectional in Czech Republic. It is also found that there is unidirectional causality running from inflation, interest rates and stock market returns to industrial production in Hungary.

This paper proceeds as follows. First section focuses on the brief summary of literature review. Data and methodology is explained in section II. Results are presented in section III. Finally, conclusions and policy implications are summarized in section IV.

II. Literature Review

The relevant empirical studies can be grouped into categories regarding the economic factors used and the data of different countries. As the earliest study, Fama (1981) searched for the relation between some economic factors and stock returns and found that stock market returns predicts economic factors in US. In a pioneering study, Chen et al. (1986) found that economic factors affect stock market returns significantly. Canova and De Nicol´o (1995) examined the same relation and found the same result for European countries. Tsouma (2009) found that stock market returns granger cause industrial production for fifteen developed countries (Australia, Austria, Canada, Denmark, Finland, France, Germany, Italy, Japan, Norway, Singapore, Spain, Sweden, UK, USA) and 12 emerging markets (Brazil, Chile, China, Hungary, Indonesia, Jordan, Malaysia, Mexico, South Africa, South Korea, Thailand, Turkey). Tsouma (2009) could not find significant bidirectional relation; in particular the power of economic factors in predicting the stock market returns is quite low. Indeed, earlier studies were able to find evidence supporting the view that economic factors can predict the stock market returns such as inflation (Bodie, 1976, Fama and Schwert, 1977) and economic output (Balvers et al., 1990; Marathe and Shawky, 1994). However, some later studies could not find significant evidence supporting the view that economic factors can predict the stock market returns (Balvers et al., 1990; Park, 1997).

Though, the relation between macroeconomic factors and stock returns is extensively investigated for developed countries very few studies have examined this relation for emerging markets. In one of these studies, Kwon et al. (1997) found that many stock markets developing countries are mainly driven by exchange rates, oil prices and interest rates. In another study, Wongbangpo and Sharma (2002) examined the same relation for ASEAN-5 countries (Indonesia, Malaysia, Philippines, Singapore and Thailand) and showed a negative relation between stock market returns and interest rates for Philippines, Singapore and Thailand. However, they found a positive relation for Indonesia and Malaysia. They also found a negative relation between exchange rates and stock market returns for Singapore and Thailand whereas a positive relation for Indonesia, Malaysia and Philippines. Harvey (1995) examined the relation between many economic factors (exchange rates, oil prices, industrial production and inflation rates) and stock market returns for 21 emerging markets and concluded that economic factors cannot significantly predict the stock market return in emerging economies. Fifield et al. (2002) examined the effects of both local factors (GDP, inflation, money and interest rates) global economic indicators (world industrial production and world inflation) and found that while stock market returns of Greece, Korea, Mexico, Portugal, Singapore and

Thailand are affected by global economic indicators, returns of the markets of India and Turkey are mainly driven by local economic factors.

There is also a growing literature exploring the relationship among oil prices, macroeconomic factors and stock prices. As the earliest study examining the relation between oil prices and stock market returns Chen et al. (1986) could not find any significant relation for US market. Similarly, Papapetrou (2001) could not find any relation for stock market return for Greece. However, there are also some other studies showing that there oil price has significant effect on stock market returns for US (Rotemberg and Woodford, 1996) for Turkey (Sarı and Soytas, 2005) and Saudi Arabian (Hammoudeh and Eleisa, 2004). In addition, some studies also showed that oil price shocks significantly affect some macroeconomic indicators such as economic outputs (Federer, 1996) and GDP, inflation, employment (Sarı and Soytaş, 2005).

Rockinger and Urga (2000) examined the power of economic factors in predicting the stock market returns in CEEC-3 countries (Czech Republic, Hungary and Poland) and found that economics factor can explain the stock market returns of Czech Republic and Poland but not that of Hungary. In another study examining the same relation for the same countries, Hanousek and Filer (2000) found significant relation between economic factors and stock market for Hungary and Poland but not for Czech Republic.

III. Data And Methodology

Monthly data are obtained from International Finance Statistics (IFS) for the time period of January 1998 to June 2011 due to the availability of the data. The interest rates are one month discount rates, and the stock prices indices are the national index of each country. Consumer price indices are used to calculate the inflation for each of three countries. West Texas oil prices are taken to represent crude oil prices. Data are obtained from DSI data services of IMF statistics.

Unit root test are conducted to examine the maximum order of integration. The unit root test results for Czech Republic, Hungary and Poland are shown in Appendix-A. These results indicate that oil price variable is I(0), and all of the economic factors are I(1) for Czech Republic, Hungary and Poland.

Engle-Granger (1987) and Johansen Juselius (1990) cointegration tests require all variables to be same integration of order. However, Bounds testing procedure developed by (Pesaran et al., 2001) allows cointegration testing for variables in different order of integration. Bounds cointegration testing can be applied to arbitrary order level of integration. In this respect it is possible to apply bounds testing procedure since our variables are either I(0) or I(1). Bounds testing results for Czech Republic, Hungary and Poland indicate that there are seven cointegrating vectors. These vectors show the cointegration among economic factors, oil price and stock market index. These cointegrating relationships indicate at least one direction of causality, whereas it cannot show the direction of causality.

In this manner we applied augmented VAR procedure of the Toda and Yamamoto (1995) approach to determine the causal relationship and the direction of

the relationship between economic factors, oil price and stock prices for all three countries for comparison reasons. Toda-Yamamoto procedure is valid for variables that are integrated or cointegrated, and gives the same result with Granger Causality test. The main difference is that extra lag(s) is added to each variable regarding the highest order of integration in the testing equation. It is possible to reduce the possibility to verify improper orders of integration and artificial cointegration using this methodology (Giles, 1997: 6).

Using an asymptotic distribution, a VAR(k+d_max) is estimated, and then Wald tests are conducted for each of the pair of variables to determine the relationship between variables. Using the LR[1] information criteria, optimal lag length (k) is determined to be 7, 2 and 7 for Czech Republic, Hungary and Poland respectively and the maximum lag length (d_max; maximum order of integration) is found to be 1 for all these countries. Hence, VAR lag structures (k+d) are found to be 8, 3 and 8 respectively. Thus, we estimate the following VAR(8) system of equations for Czech Republic, VAR(3) for Hungary and VAR(8) s for Poland.

$$C_t = \alpha_c + \beta_1 C_{t-1} + .. + \beta_{k+d} C_{t-k-d} + \varepsilon_{ct} \quad (1)$$

$$H_t = \alpha_h + \gamma_1 H_{t-1} + .. + \gamma_{k+d} H_{t-k-d} + \varepsilon_{ht} \quad (2)$$

$$P_t = \alpha_p + \delta_1 P_{t-1} + .. + \delta_{k+d} P_{t-k-d} + \varepsilon_{pt} \quad (3)$$

Where $\alpha_c, \alpha_h, \alpha_p$ C_t=(cindex,cinf,cint,cip,op), $\varepsilon_{ct}, \varepsilon_{ht}, \varepsilon_{pt}$ t=(hindex,hinf,hint,hip,op), P_t=(pindex,pinf,pint,pip,op), $\beta_i, \gamma_i, \delta_i$ are vectors of constants, are coefficients matrices, and donate the white noise residuals. Hence, cindex, cinf, cint, cip, op represent the natural logs of stock market index, inflation, interest rates, industrial production in Czech Republic. hindex, hinf, hint and hip represent the natural logs of stock market index, inflation, interest rates, industrial production in Hungary. Finally, pindex, pinf, pint and pip represent the natural logs of stock market index, inflation, interest rates, and industrial production in Poland. Though Toda Yamamoto (1995) procedure allows for a powerful test of cointegration, it does not give any information about short term temporary effect. Hence, impulse response functions are carried out to examine the speed of adjustment in the short run.

IV. Emprical Results

In this paper mainly two different analyses are carried out. The first analysis, Toda Yamamoto is run to find out the causality between the macroeconomic variables. Impulse analysis is carried out to examine the effect of the shocks given to these variables.

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[1]AIC information criteria is also considered and it is seen that the results do not change.

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A. Granger Causality Results

Toda-Yamamoto approach is used to test for the long run Granger causality for CEEC-3 countries. The results presented in Table 1 indicate unidirectional Granger causality running from industrial production to inflation for Czech Republic. Moreover, it is also seen that oil prices granger causes inflation but not that inflation causes oil prices. It is found that inflation and industrial production rates granger causes higher interest rates.

Table 1: Toda-Yamamoto Results for Czech Republic

	C_{index}	C_{inf}	C_{int}	C_{ip}	OP
C_{index}		0.531318	1.155763	0.959779	1.232258
C_{inf}	1.455160		0.936717	2.334871**	3.650691***
C_{int}	2.044170	2.189681**		4.260535***	1.296285
C_{ip}	1.901729	1.465131	1.997345		0.467808
OP	0.520299	1.023110	0.565420	1.031620	

Table should be read in rows. In particular, the significant statistic 2.189681 rejects the non-granger causality running from inflation to the interest rate. Superscripts ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

However, this relation is unidirectional. That is, interest rates do not cause inflation and industrial production. Contrary to the Czech Republic, inflation granger causes industrial production in Hungary. It is seen in Table 2 that stock market index, interest rates, inflation rate and oil prices granger cause industrial production in Hungary. However these causes unidirectional. These results indicate that industrial production in Hungary is mainly under the effects of many economics factors. This result may mean that these effects may create quite high risk for the economy of the Hungary since industrial production is even affected significantly by oil price which is quite volatile and obviously not under the control of the Hungary.

Table 2: Toda-Yamamoto Results for Hungary

	H_{index}	H_{inf}	H_{int}	H_{ip}	OP
H_{index}		1.245828	0.103047	0.212839	2.086200
H_{inf}	0.543033		0.711592	0.053893	1.027494
H_{int}	0.697815	0.921731		0.873403	0.445701
H_{ip}	4.680338**	3.771686**	5.049554***		3.392417**
OP	1.517939	1.039909	0.275808	0.128184	

Table should be read in rows. In particular, the significant statistic 5.049554 rejects the non-granger causality running from inflation to the interest rate. Superscripts ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

Table3 shows the results for Poland. It is found for Poland that industrial production granger causes stock market index whereas not that stock market index causes industrial production which is not a surprise. The surprising result is that inflation in Poland granger causes oil prices. However, we think that this is only a statistical significance which cannot be supported by any intuition. Results for Poland

also indicate that there is bidirectional causality relation between inflation and industrial production. It is also seen that there is bidirectional causality between interest rates and industrial production.

To summarize, it is seen that stock market index of each of these countries are not affected by any of these economic factors except for the industrial production in Poland. In Czech Republic and Poland. There is granger causality running from industrial production to inflation. In addition, oil prices granger causes inflation in Czech Republic implying the indicator of inflation in Czech Republic. In Czech Republic and Poland, inflation and industrial production causes interest rates. However, this causality is bidirectional in Poland rather than unidirectional in Czech Republic. It is also found that there is unidirectional causality running from inflation, interest rates and stock market returns to industrial production in Hungary.

Table 3: Toda-Yamamoto Results for Poland

	P_{index}	P_{inf}	P_{int}	P_{ip}	OP
P_{index}		1.266379	0.951061	2.277921**	1.187780
P_{inf}	0.839226		1.299293	4.295147***	1.789118
P_{int}	1.609873	3.264920***		3.734400***	1.437319
P_{ip}	1.282155	6.671700***	3.519523***		1.411666
OP	0.834353	2.063791	3.369355***		1.205466

Table should be read in rows. In particular, the significant statistic 2.277921 rejects the non-granger causality running from inflation to the interest rate. Superscripts ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

B. Generalized Impulse Response Analyses

Since a number of causalities is identified, it is necessary to examine the impact of innovations for all causalities at this point. In this paper, we apply generalized impulse response analysis developed by Koop et al. (1996). The generalized impulse responses of stock returns, inflation rates, interest rates and industrial production are depicted in Figures 1 through 4 respectively for Czech Republic.

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Figure 1: Generalized Responses of Stock Returns of Czech Republic to Shocks in Interest rates, Inflation and Industrial Production and Oil Prices
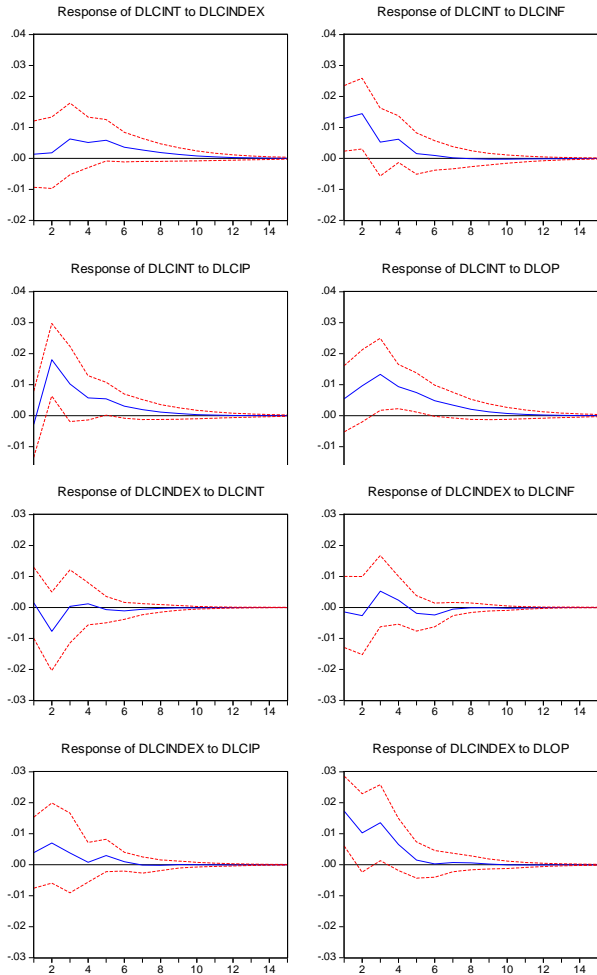

Figure 2: Generalized Responses of Inflation Rates of Czech Republic to Shocks in Stock Returns, Interest Rates, Industrial Production and Oil Prices
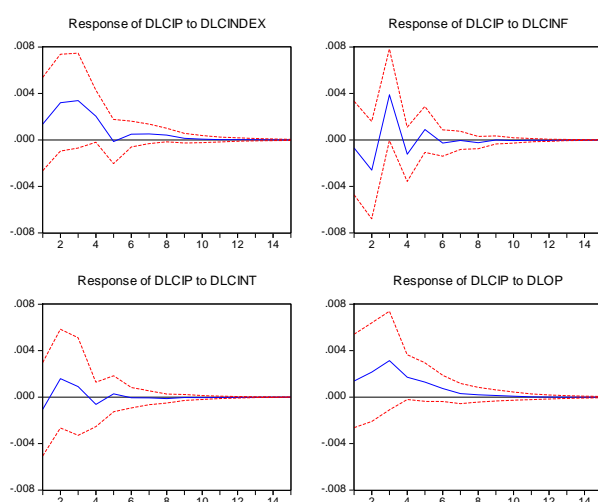
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Figure 3: Generalized Responses of Interest Rates of Czech Republic to Shocks in Stock Returns, Inflation, Industrial Production and Oil Prices
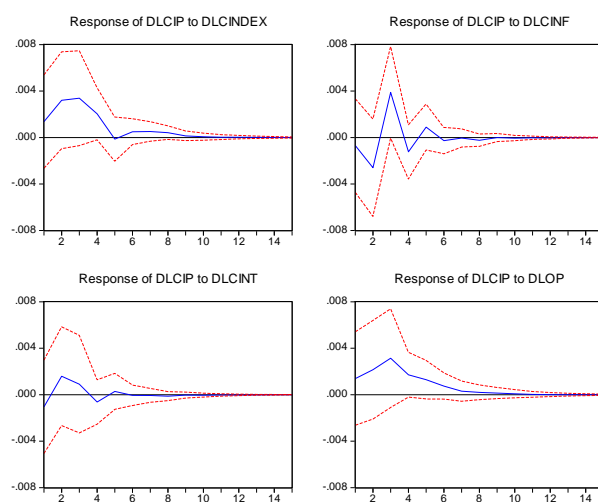

Figure 4: Generalized Responses of Industrial Production of Czech Republic to Shocks in Stock Returns, Inflation, Interest Rates and Oil Prices

The impulse response results in Figure 1 show that none of the impulse response functions is significant except for the unanticipated oil price changes on Czech stock market return. The initial impact of shocks to the oil price is positive but the effect dies out quickly in the second month. It is seen in Figure 2 that the only

significant effect is for shocks to the oil prices. In particular, a volatility shock in oil returns causes a positive immediate response of the volatility of inflation rates. This positive effect seems to be continuing over two months. After that time period, the magnitude of the positive impact starts to decrease and eventually becomes insignificant.

It is seen in Figure 3 that none of the impulse response functions is significant except for the initial impact of unanticipated inflation changes on interest rates. In particular, the effect is significant in the first two month, however dies out after then. It is seen in Figure 4 that none of the shocks seems to have impact on industrial production. The generalized impulse responses of stock returns, inflation rates, interest rates and industrial production are depicted in Figures 5 through 8 respectively for Hungary. The results for Hungary in Figure 5 indicate that neither of the shocks to the interest rate, inflation, and oil prices has a significant effect on Hungary stock market returns. It is seen in Figure 6 that initial impact of interest rates to inflation is positive. It is seen that this impact dies out after two month.
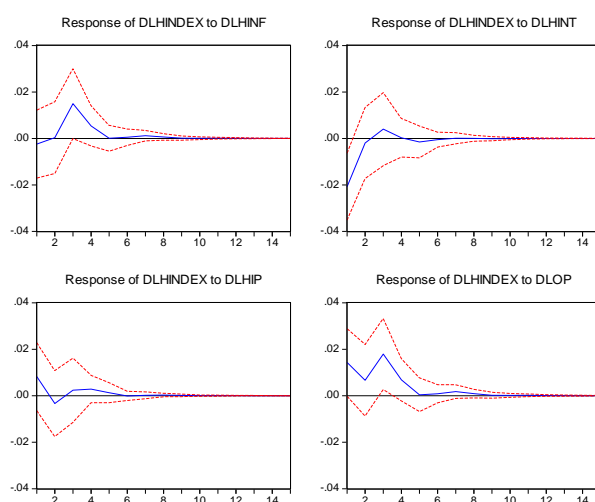
Figure 5: Generalized Responses of Stock Returns of Hungary to Shocks in Interest rates, Inflation and Industrial Production and Oil Prices
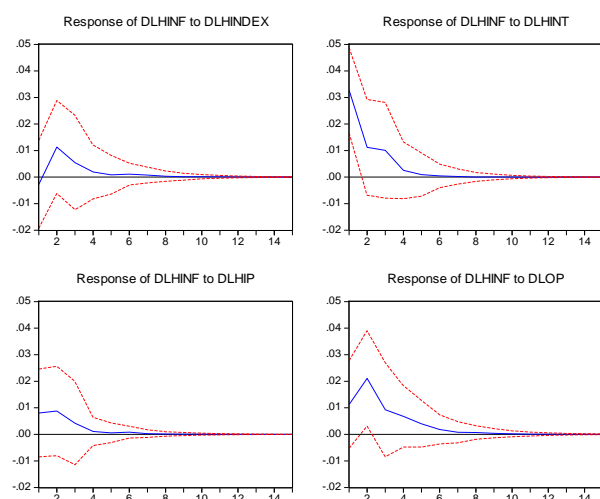
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Figure 6: Generalized Responses of Inflation Rates of Hungary to Shocks in Stock Returns, Interest Rates, Industrial Production and Oil Prices
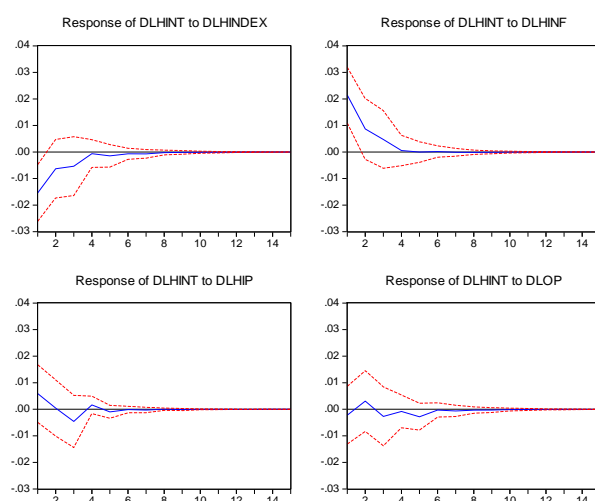

Figure 7: Generalized Responses of Interest Rates of Hungary to Shocks in Stock Returns, Inflation, Industrial Production and Oil Prices

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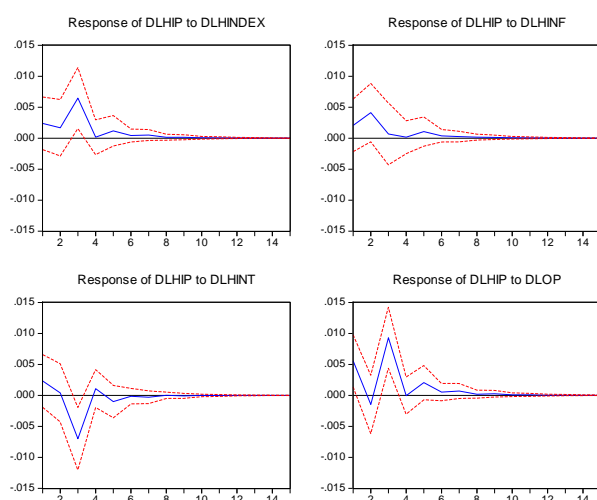and Equity Markets:
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Figure 8: Generalized Responses of Industrial Production of Hungary to Shocks in Stock Returns, Inflation, Interest Rates and Oil Prices

It is seen in Figure 7 none of the impulse response functions are significant. It is seen in Figure 8 that industrial production do not respond to neither of the shocks to the stock market return, inflation interest rates and oil price.

The generalized impulse responses of stock returns, inflation rates, interest rates and industrial production are depicted in Figures 9 through 12 respectively for Poland. It seems that none of the unanticipated changes in Figure 9, Figure 10, Figure 11 and Figure 12 is significant for Poland.

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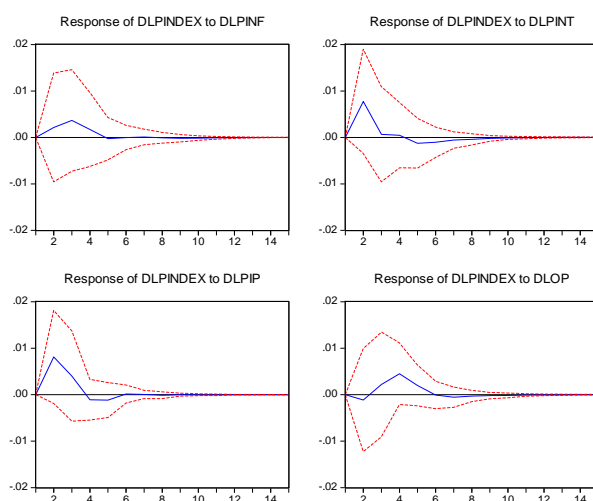and Equity Markets:
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Figure 9: Generalized Responses of Stock Returns of Poland to Shocks in Interest rates, Inflation and Industrial Production and Oil Prices.
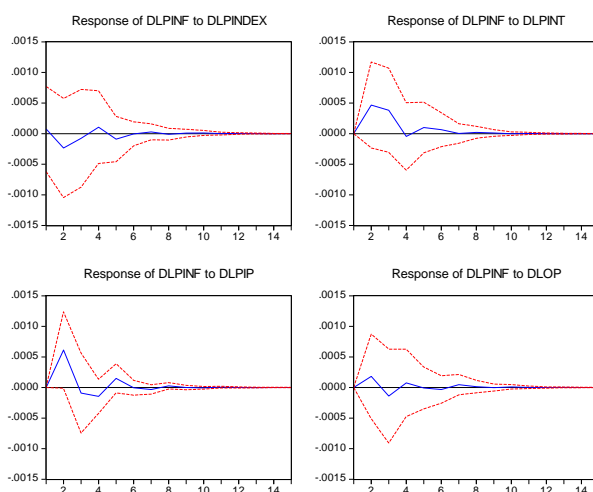
Figure 10: Generalized Responses of Inflation Rates of Poland to Shocks in Stock Returns, Interest Rates and Inflation and Oil Prices

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Figure 11: Generalized Responses of Interest Rates of Poland to Shocks in Stock Returns, Inflation, Industrial Production and Oil Prices

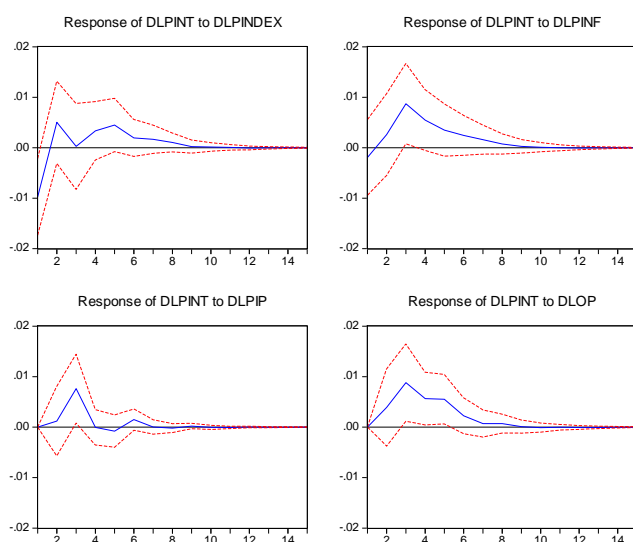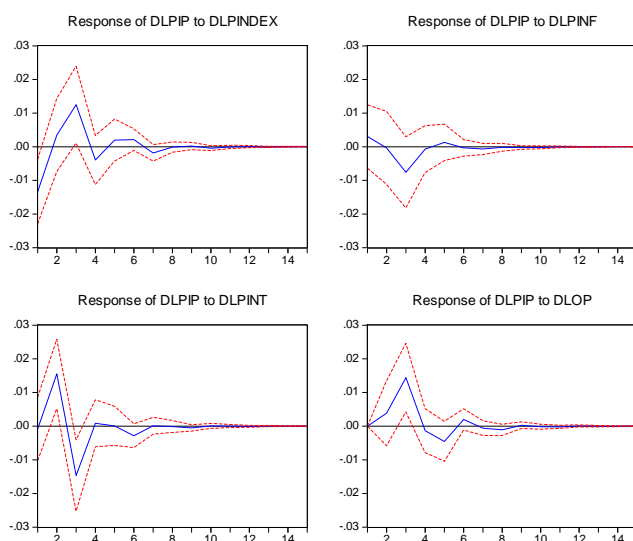**Figure 12:** Generalized Responses of Industrial Production of Poland to Shocks in Stock Returns, Inflation, Interest Rates and Oil Prices

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V. Conclusions and Policy Implications

In this study, bi-directional long run relationship between interest rates, inflation, industrial production, oil and stock prices of three transition economies of Central and Eastern European Countries (CEEC-3) namely Czech Republic, Hungary and Poland are examined. We find that stock market index of each of these countries are not affected by any of these economic factors except for the industrial production in Poland. In Czech Republic and Poland, there is granger causality running from industrial production to inflation. In addition, oil prices granger causes inflation in Czech Republic implying the indicator of inflation in Czech Republic.

In Czech Republic and Poland oil prices and industrial production granger cause inflation. However, this causality is bidirectional in Poland rather than unidirectional in contrast to the case in Czech Republic. These results indicate that stock markets of these countries cannot be predicted by these economic factors. Hence, the lack of sufficient correlation between stock market returns and other macroeconomic variables indicate the inefficiency of stock market. Moreover, it is seen that oil prices can only predict inflation rates in Czech Republic. It is also found that there is unidirectional causality running from inflation, interest rates and stock market returns to industrial production in Hungary. In addition, it seems that Czech Republic and Poland have more similarities in terms of macroeconomic factors. Impulse response analysis for Czech Republic indicate that a volatility shock in oil returns causes a positive immediate response of the volatility of inflation rates in the short run. Moreover, unanticipated inflation changes has positive initial impact on interest rates. Though there is long run causality for Czech Republic running from industrial production to inflation, we cannot see this impact in the short run. The short term impact that the oil returns causes a positive immediate response of the volatility of inflation rates is also not supported by the long term results. For Hungary, it is seen that that initial impact of interest rates to inflation is positive in the short run. Hence, the long term results of cointegrating relations running from inflation, interest rates and stock markets to industrial production are not supported by the short term analysis. For Poland, it is found that none of the unanticipated changes has significant impact. Hence, the long run bidirectional relation between the oil prices and industrial production is also not supported in the short run.

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APPENDIX-A

Table 4: Unit Root Tests for Czech Republic

	Variable	ADF	ADF-GLS	PP	KPSS	ERS-PO	Ng-Perron
Levels Intercept	OP	-1.425900 (1)	-0.246354 (1)	-1.319643	1.300620 a	25.12422 (1)	-0.50637 (1)
	CIP	-0.933124 (1)	-0.121016 (1)	-0.98542	1.233253 a	51.57777 (1)	-0.09433 (1)
	CINF	-3.009702 b (4)	-0.449816 (1)	-3.371338 b	0.251373	3.506624 c (4)	-2.07524 (1)
	CINT	-2.347670 (3)	0.064481 (3)	-1.946242	1.049870 a	46.67361 (3)	-0.19562 (3)
	CINDEX	-1.098587 (3)	-0.629278 (3)	-1.088631	1.148213 a	20.10014 (3)	-1.16871 (3)
Levels Interceptand Trend	OP	-3.641190 b (3)	3.599907 a (3)	-2.859052 c	0.067527	2.271303 a (3)	-37.5174 a (3)
	CIP	-1.232655 (1)	-1.253962 (1)	-1.864016	0.098445	21.12967 (1)	-4.16034 (1)
	CINF	-2.992857 (4)	-1.474429 (1)	-3.370756 c	0.177873 b	3.693177 a (1)	-7.41705 (1)
	CINT	-2.861406 (3)	-1.968266 (3)	-1.996186	0.291406 b	14.10896 (3)	-8.40787 (3)
	CINDEX	-1.512521 (3)	-1.498279 (3)	-1.340205	0.157851b	15.84288 (3)	-5.62560 (3)
First differences Intercept	OP	-4.653234 a (5)	-4.640569 a (5)	-13.36150 a	0.176521	0.360197 a (5)	-44.1060 a (5)
	CIP	-10.27244 a (0)	-9.037230 a (0)	-10.33447 a	0.064474	-0.825357 a (0)	-61.3323 a (0)
	CINF	-3.490870 a (2)	-3.314809 a (2)	-10.24602 a	0.194168	1.693055 a (2)	-13.5173 b (2)
	CINT	-5.574283a (2)	-5.594530 a (2)	-7.844619 a	0.166358	0.441189 a (2)	-37.9624 a (2)
First differences Interceptand Trend	CINDEX	-4.704528 a (5)	-4.450028 a (5)	-13.34402 a	0.158873 b	1.170665 a (5)	-64.0237 a (5)
	OP	-10.24998 a (0)	-8.507038 a (0)	-10.31110 a	0.058099	-0.772849 (0)	-59.3829 (5)
	CIP	-3.535013 b (2)	-3.422902 b (2)	-10.26722 a	0.096941	6.086678 c (2)	-14.3477 c (2)
	CINF	-5.563993a (2)	-5.601650a (2)	-7.916729 a	0.158214b	1.620551 a (2)	-50.3614 a (2)
	CINDEX	-1.425900 (1)	-0.246354 (1)	-1.319643	1.300620 a	25.12422 (1)	-0.50637 (1)

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Table 5: Unit Root Tests for Hungary

	Variable	ADF	ADF-GLS	PP	KPSS	ERS-PO	Ng-Perron
Levels Intercept	OP	-1.425900 (1)	-0.246354 (1)	-1.319643	1.300620 a	25.12422 (1)	-0.50637 (1)
	HIP	-2.339833 (1)	0.485081 (1)	-2.349715	1.350191 a	192.1478 (1)	0.37446 (1)
	HINF	-2.129889 (1)	-0.423324 (1)	-2.178999	0.809298 a	22.34630 (1)	-0.83794 (1)
	HINT	-2.267050 (1)	-0.453244 (1)	-2.295755	0.957022 a	50.15295 (0)	-0.31507 (0)
	HINDEX	-1.136374 (1)	-0.714987 (1)	-1.134865	1.143847a	15.66497 (1)	-1.51061 (1)
Levels Interceptand Trend	OP	-3.641190 b (3)	-3.599907 a (3)	-2.859052 c	0.067527	2.271303 a (3)	-37.5174 a (3)
	HIP	0.080755 (1)	-0.128779 (1)	-0.860629	0.145342 c	41.47016 (1)	-0.46370 (1)
	HINF	-2.409833 (1)	-2.017018 (1)	-2.468021	0.162078 b	11.89838 (b)	-8.22406 (1)
	HINT	-1.864700 (1)	-1.413397 (1)	-1.908767	0.197545 b	19.74522 (1)	-5.04517 (1)
	HINDEX	-2.096049 (1)	-1.889341 (1)	-1.751715	0.145615c	12.98101 (1)	-7.11301 (1)
First differences Intercept	HIP	-15.05856 a (0)	-1.352540 (5)	-14.63028 a	0.440854 c	0.705316 a (0)	-5.88981 c (5)
	HINF	-8.364418 a (0)	-8.225307 a (0)	-8.551451 a	0.074533	0.408812 a (0)	-61.0555 a (0)
	HINT	-9.871962 a (0)	-9.536944 a (0)	-9.932270 a	0.205256	0.394215 a (0)	-64.0459 a (0)
	HINDEX	-9.928625 a (0)	-2.229673 b (6)	-9.928625 a	0.114786	0.748212 a (0)	-4.11518 (6)
First differences Interceptand Trend	HIP	-15.55030 a (0)	-14.02627 a (0)	-15.30539 a	0.104951	1.701196 a (0)	-9.38777 (5)
	HINF	-8.350686 a (0)	-8.395564 a (0)	-8.540360 a	0.047130	1.474934 a (0)	-61.7803 a (0)
	HINT	-9.993376 a (0)	-10.06058 a (0)	-10.04078 a	0.036518	1.351483 a (0)	-67.7489 a (0)
	HINDEX	-9.883405 a (0)	-8.595824 a (0)	-9.883405 a	0.112040	1.979004 a (0)	-57.9666 a (0)

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Table 6: Unit Root Tests for Poland

	Variable	ADF	ADF-GLS	PP	KPSS	ERS-PO	Ng-Perron
Levels Intercept	OP	-1.425900 (1)	-0.246354 (1)	-1.319643	1.300620 a	25.12422 (1)	-0.50637 (1)
	PIP	-1.263605 (15)	-0.106901 (15)	-1.663567	1.421710a	91.87035 (15)	0.09004 (15)
	PINF	-1.636908 (13)	0.346970 (13)	-2.861568 c	1.357602 a	335.9928 (13)	-0.16567 (13)
	PINT	-1.376322 (5)	0.124469 (5)	-1.289955	1.293553a	38.14695 (5)	-0.16235 (5)
	PINDEX	-1.030986 (1)	-0.505978 (1)	-1.214304	1.103396a	22.71945 (1)	-0.91302 (1)
Levels Interceptand Trend	OP	-3.641190 b (3)	-3.599907 a (3)	-2.859052 c	0.067527	2.271303 a (3)	-37.5174 a (3)
	PIP	-2.260313 (15)	-2.442277 (15)	-6.156644 a	0.172961 b	0.011910 a (15)	-1.6E+07a (15)
	PINF	-3.903095b (12)	-2.006144 (13)	-2.590418	0.264295 a	18.54434 (12)	-34.3600a (13)
	PINT	-2.790189 (5)	-2.664433 (5)	-1.889140	0.188687 b	3.939229 a (5)	-23.8925 a (5)
	PINDEX	-1.800332 (1)	-1.731250 (1)	-1.556752	0.161017 b	15.62821 (1)	-5.75095 (1)
First differences Intercept	PIP	-2.181988 (14)	-1.721178 c (14)	-25.70214 a	0.101883	29.06988 (14)	0.30140 (14)
	PINF	-1.478685 (12)	-0.244592 (12)	-7.742301 a	0.549419 b	95.31448 (12)	0.22797 (12)
	PINT	-3.081534 b (4)	-2.501051 b (4)	-9.007458 a	0.094137	2.666442 b (4)	-10.6049 b (4)
	PINDEX	-8.947639 a (0)	-1.499098 (4)	-8.956056 a	0.121146	2.075269 b (0)	-6.32330 c (4)
First differences Interceptand Trend	PIP	-2.176517 (14)	-0.600210 (14)	-25.53988 a	0.101437	127.4192 (14)	0.09021 (14)
	PINF	-1.442116 (12)	-1.381165 (12)	-7.826630 a	0.222744 a	85.52156 (12)	-1.19144 (12)
	PINT	-3.060047 (4)	-2.856406 c (4)	-9.015920	0.062117	6.784641 c (4)	-12.1108 (4)
	PINDEX	-8.902477 a (3)	-2.736100 c (3)	-8.911133 a	0.117895	3.084716 (0)	-17.8790b (13)