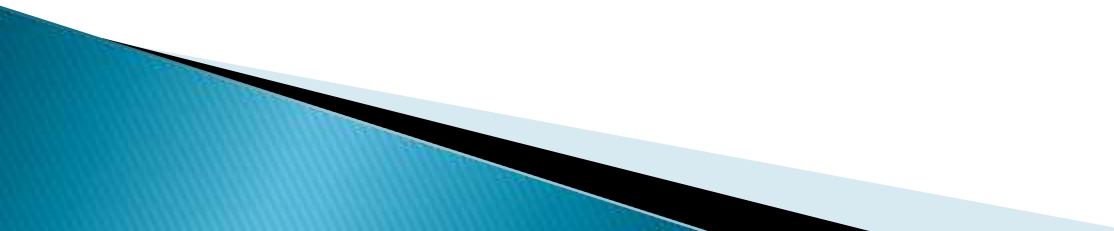


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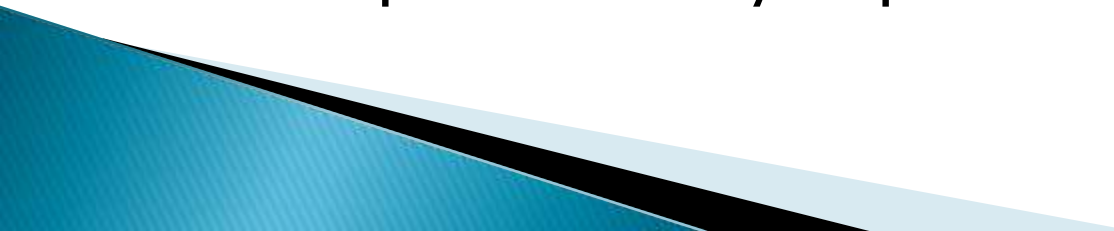
An Early Warning System of Economic Crisis

Supervisor: Prof. univ. dr. MOISA ALTAR
MSc Student IONITA RODICA OANA

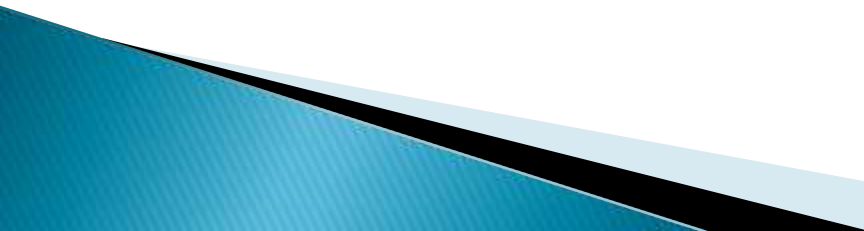
Topics

- ▶ Motivation
 - ▶ Objectives
 - ▶ Literature Review
 - ▶ International framework of current crisis
 - ▶ Data set
 - ▶ Early Warning System (composition, methodology, performance)
 - ▶ Results
 - ▶ Conclusions
- 

Motivation

- ▶ I choose to compose an Early Warning System because along with the recent economic crisis it was visible the need of improvement in this area in order to make decision factors to consider the signals as credible.
 - ▶ In order to identify an efficient EWS we must have a complete picture of the entire economy and we must permanently supervise its evolution.
- 

Objectives

- ▶ This research aim to observe which of a list of 13 potential leading indicators are significant in explaining the incidence of a crisis and give us a warning regardless any negative trend in the macroeconomic activity, affecting the national or the global situation.
 - ▶ The scope is to identify vulnerabilities to reduce the potential costs incurred during an economic crisis.
- 


Literature review

- ▶ The study of the EWS started with the work of John Bilson(1979)–“Leading Indicators of Currency Devaluations” , Paul Krugman (1979)– “A Model of Balance of Payments”.
- ▶ Graciela Kaminsky and Carmen Reinhart (1996) studied balance of payments problems.
- ▶ Jeffrey Alexander Frankel and Andrew Kenan Rose (1996) studied currency crashes.
- ▶ Graciela Kaminsky, Saul Lizondo and Carmen Reinhart (1998)– “Leading Indicators of Currency Crises”
- ▶ Carmen Reinhart, Kenneth Rogoff (2008)– “Banking crises: An equal opportunity menace”
- ▶ Stephen Cecchetti, Marion Kohler, Christian Upper (2009)– “Financial Crises and Economic activity”
- ▶ Jab Babecy,Tomas Havranek,Jakub Mateju, Marek Rusnak, Katerina Smidkova,Borek Vasicek (2011)–”Early Warning Indicators of Economic Crises”

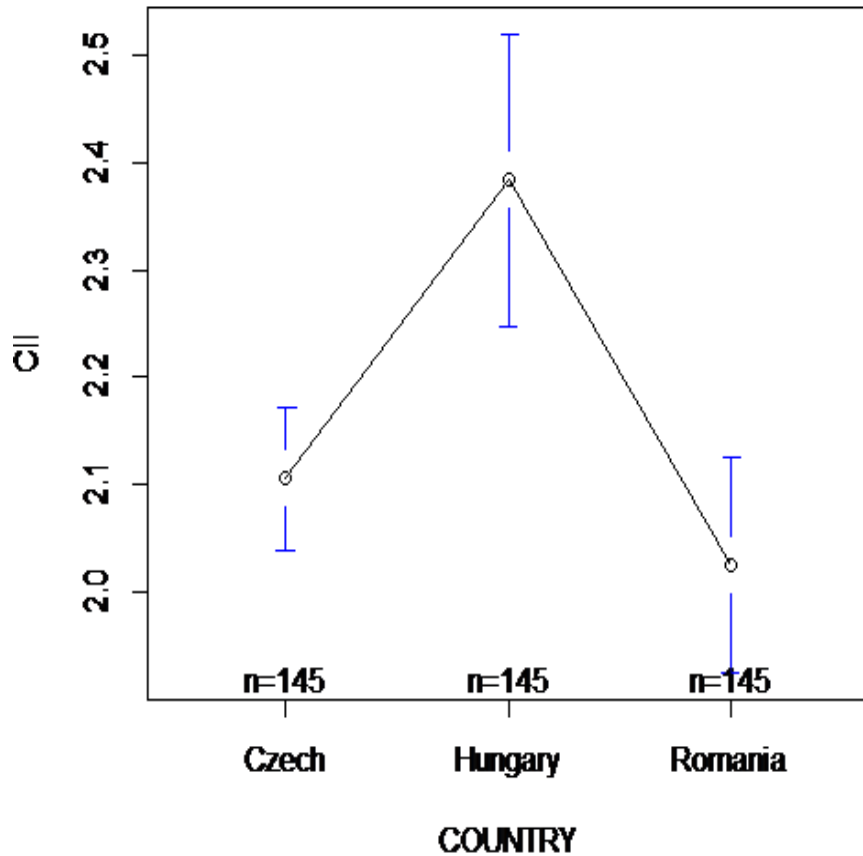
International framework of current crisis

- ▶ “Early Warning Systems and Their Role in Surveillance” – Keynote Address by Takatoshi Kato, Deputy Managing Director, International Monetary Fund, February 9, 2010
- ▶ “Initial Lessons of the Crisis for the Global Architecture and the IMF” – International Monetary Fund , Strategy, Policy and Review Department
- ▶ Anticipating the Next Crisis: What can early warning systems be expected to deliver? “, Atish R.Ghosh–Deputy Director in the IMF Research Department, Jonathan D.Ostry–Chief of the Systemic Issues Division IMF Research Department and Natalia Tamirisa–Assistant Director IMF Research Department
- ▶ “Initial Lessons of the Crisis for the Global Architecture and the IMF” – International Monetary
- ▶ “Vulnerabilities in Central and Southern Europe”, June 6, 2006 – Christian Menegatti, Nouriel Roubini Fund , Strategy, Policy and Review Department

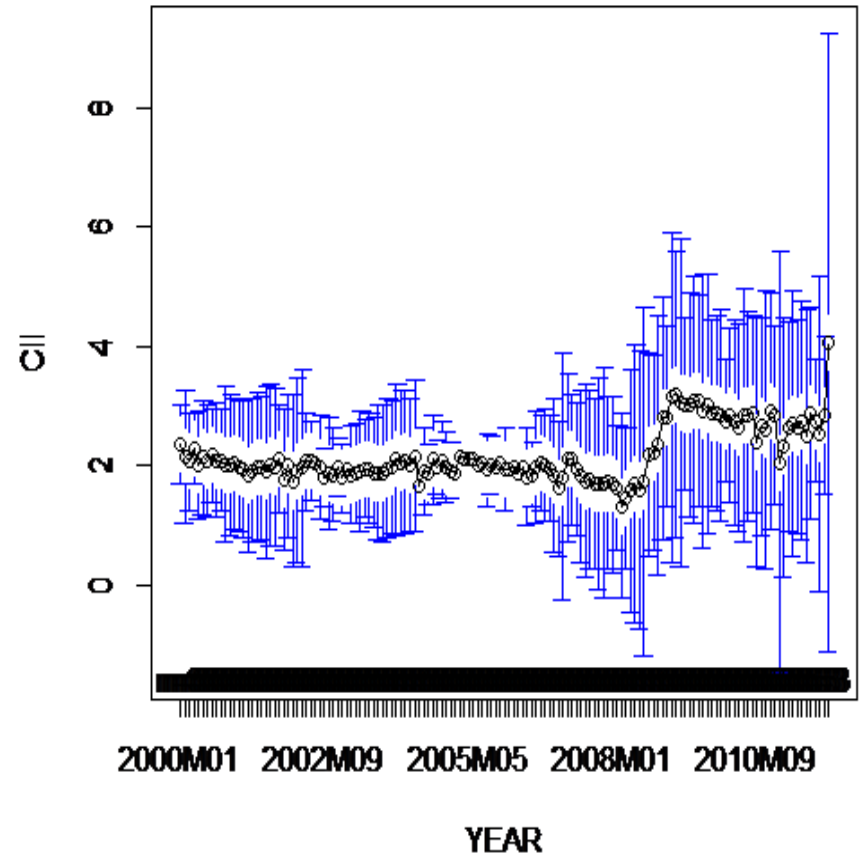
Data set

- ▶ The dataset used in this paper is obtained from Eurostat Database and Bucharest Stock Exchange, and is monthly collected, for a better efficiency of the early warning.
 - ▶ The period refers to 2000M01 – 2012 M01.
 - ▶ Countries included in the panel: Czech, Hungary and Romania.
 - ▶ For the comparability of the regressions results, the variables were standardized and seasonally adjusted.
 - ▶ The panel is balanced because for all the countries in the sample there is the same number of observations.
- 

heterogeneity across countries



heterogeneity across years



Early Warning System– Composition

- ▶ Potential leading indicators: economic sentiment indicator, money market interest rate, nominal effective exchange rate, real effective exchange rate, construction production index, domestic output price index, industry new orders, industry turnover index, retail trade turnover, market capitalization, harmonized index consumer price, 3 months interest rate.
- ▶ CII characterizes consequences of any type of crisis for the real economy.
- ▶ $CII = (\text{unemployment rate growth} - \text{external trade growth} - \text{monthly GDP growth}) / 3$

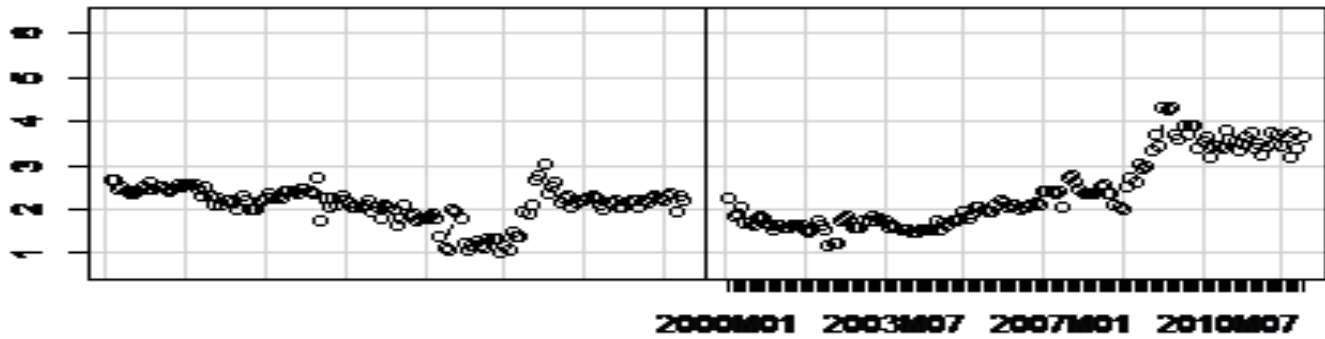
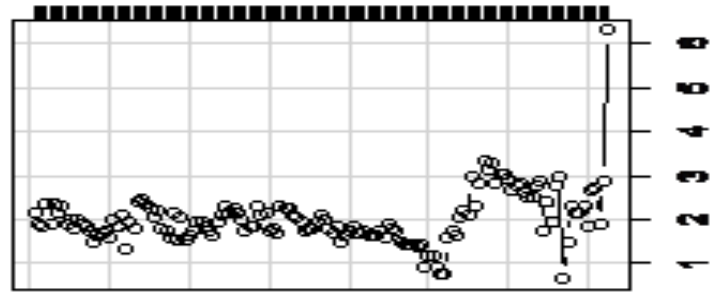
CII

Given : COUNTRY



CII

2000M01 2003M07 2007M01 2010M07



YEAR

Early Warning System – Methodology

Ols regression

- Call:
lm(formula = CII ~ ecsi + mmir + neer + REER + cpri + dopi + ino + iti + rtt + exchr + hicp + stockmc + ir3m, data = Panel)
- Residuals:
Min 1Q Median 3Q Max
-1.9235 -0.2667 0.0249 0.2486 3.6607
- Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) 5.7343093 0.3864085 14.840 < 2e-16 ***
ecsi -0.0286863 0.0026501 -10.825 < 2e-16 ***
mmir -0.0900163 0.0158821 -5.668 2.69e-08 ***
neer -0.0286221 0.0038491 -7.436 5.87e-13 ***
REER 0.0212578 0.0042226 5.034 7.12e-07 ***
cpri -0.0075265 0.0036187 -2.080 0.038143 *
dopi 0.0425303 0.0283744 1.499 0.134650
ino -0.0011233 0.0026518 -0.424 0.672066
iti 0.0017702 0.0062120 0.285 0.775814
rtt 0.0024196 0.0127207 0.190 0.849238
exchr 0.0018084 0.0002205 8.202 2.89e-15 ***
hicp 0.0381636 0.0097775 3.903 0.000111 ***
stockmc -0.0092300 0.0029162 -3.165 0.001663 **
ir3m 0.0842255 0.0163345 5.156 3.88e-07 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
- Residual standard error: 0.4603 on 421 degrees of freedom
- Multiple R-squared: 0.524, Adjusted R-squared: 0.5093
- F-statistic: 35.65 on 13 and 421 DF, p-value: < 2.2e-16

Dynamic Ols regression

- Call:
dynlm(formula = CII ~ L(CII, 12) + ecsi + mmir + neer + REER + cpri + dopi + ino + iti + rtt + exchr + hicp + stockmc + ir3m, data = Panel)
- Residuals:
Min 1Q Median 3Q Max
-3.083e-16 -1.250e-17 4.090e-19 1.064e-17 1.632e-16
- Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.000e+00 3.395e-17 0.000e+00 1.0000
L(CII, 12) 1.000e+00 3.470e-18 2.882e+17 <2e-16 ***
ecsi -1.231e-20 2.133e-19 -5.800e-02 0.9540
mmir 7.656e-19 1.173e-18 6.530e-01 0.5143
neer 1.691e-19 2.915e-19 5.800e-01 0.5621
REER -1.771e-19 3.095e-19 -5.720e-01 0.5676
cpri 6.692e-19 2.589e-19 2.585e+00 0.0101 *
dopi 3.456e-18 2.025e-18 1.706e+00 0.0887 .
ino -4.175e-19 1.888e-19 -2.211e+00 0.0275 *
iti 1.079e-19 4.423e-19 2.440e-01 0.8073
rtt -3.638e-20 9.056e-19 -4.000e-02 0.9680
exchr 5.442e-21 1.690e-20 3.220e-01 0.7476
hicp -3.590e-19 7.085e-19 -5.070e-01 0.6127
stockmc 5.239e-20 2.101e-19 2.490e-01 0.8032
ir3m -8.733e-19 1.199e-18 -7.280e-01 0.4668

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
- Residual standard error: 3.277e-17 on 420 degrees of freedom
- Multiple R-squared: 1, Adjusted R-squared: 1
- F-statistic: 1.246e+34 on 14 and 420 DF, p-value: < 2.2e-16

Fixed effects

```
Call:
lm(formula = CII ~ ecsi + mmir + neer + REER + cpri + dopi +
    ino + iti + rtt + exchr + hicp + stockmc + ir3m + factor(COUNTRY)
    - 1, data = Panel)

Residuals:
    Min       1Q   Median       3Q      Max
-1.7492 -0.2458  0.0452  0.2220  3.8816

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
ecsi      -2.089e-02  2.694e-03  -7.757 6.69e-14 ***
mmir      -6.304e-02  1.509e-02  -4.177 3.59e-05 ***
neer      -1.900e-02  3.833e-03  -4.958 1.03e-06 ***
REER       2.926e-02  5.263e-03   5.560 4.82e-08 ***
cpri      -7.046e-03  3.346e-03  -2.106 0.035838 *
dopi       2.120e-02  2.696e-02   0.786 0.432231
ino        6.246e-06  2.455e-03   0.003 0.997971
iti        1.740e-03  5.748e-03   0.303 0.762307
rtt        1.445e-03  1.184e-02   0.122 0.902883
exchr      2.319e-02  2.740e-03   8.465 4.35e-16 ***
hicp       3.627e-02  9.135e-03  3.970 8.46e-05 ***
stockmc   -2.123e-02  4.342e-03  -4.891 1.43e-06 ***
ir3m       5.332e-02  1.573e-02   3.389 0.000767 ***
factor(COUNTRY)Czech  3.145e+00  4.994e-01  6.298 7.64e-10 ***
factor(COUNTRY)Hungary -2.060e+00  9.774e-01  -2.108 0.035637 *
factor(COUNTRY)Romania 3.210e+00  5.571e-01  5.763 1.61e-08 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4256 on 419 degrees of freedom
Multiple R-squared:  0.9661,    Adjusted R-squared:  0.9648
F-statistic: 746.2 on 16 and 419 DF, p-value: < 2.2e-16
```

Random effects

```
Call:
plm(formula = CII ~ all, data = Panel.set, model = "random")

Balanced Panel: n=3, T=145, N=435

Effects:
            var  std.dev share
idiosyncratic 4.106e-01  6.408e-01  1
individual     4.901e-06  2.214e-03  0
theta: 0.0008642

Residuals :
    Min. 1st Qu.  Median 3rd Qu.  Max.
-1.530 -0.417 -0.091  0.243  4.160

Coefficients :
            Estimate Std. Error t-value Pr(>|t|)
(Intercept) 2.1716e+00  3.1607e-02  68.7047 <2e-16 ***
all         -7.5964e-15  3.7222e-14  -0.2041  0.8384
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:  187.36
Residual Sum of Squares: 187.34
R-Squared : 9.618e-05
Adj. R-Squared : 9.5737e-05
F-statistic: 0.0416498 on 1 and 433 DF, p-value: 0.83838
```

Early Warning System-Performance

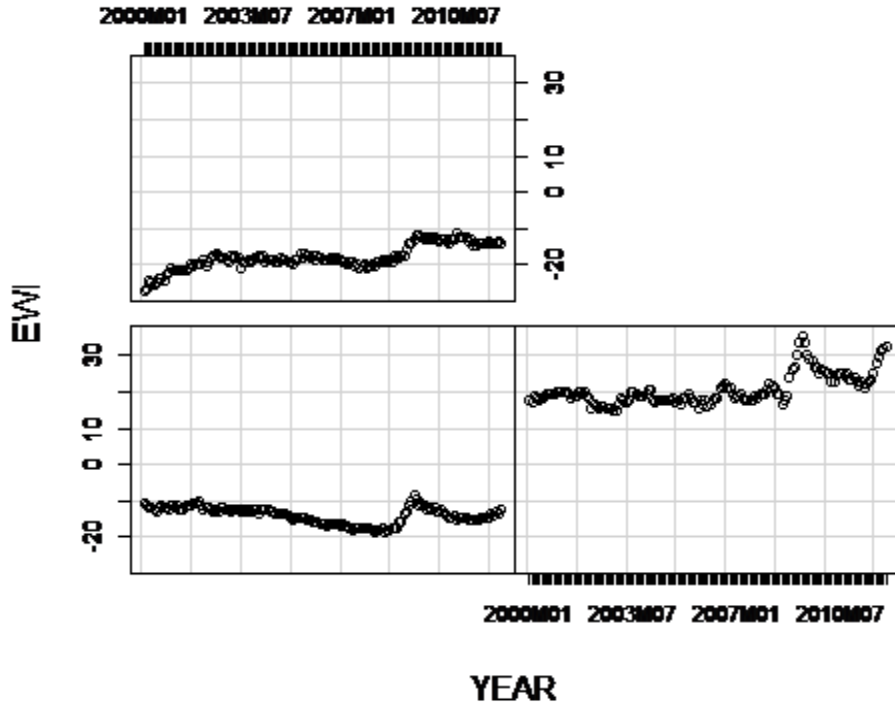
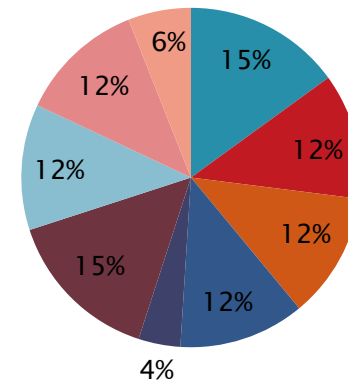
Given: COUNTRY



$$EWI < -0.15 * (-ecsi) - 0.12 * mmir - 0.12 * neer + 0.12 * REER - 0.04 * cpri + 0.15 * exchr + 0.12 * hicp - 0.12 * stockmc + 0.06 * ir3m$$

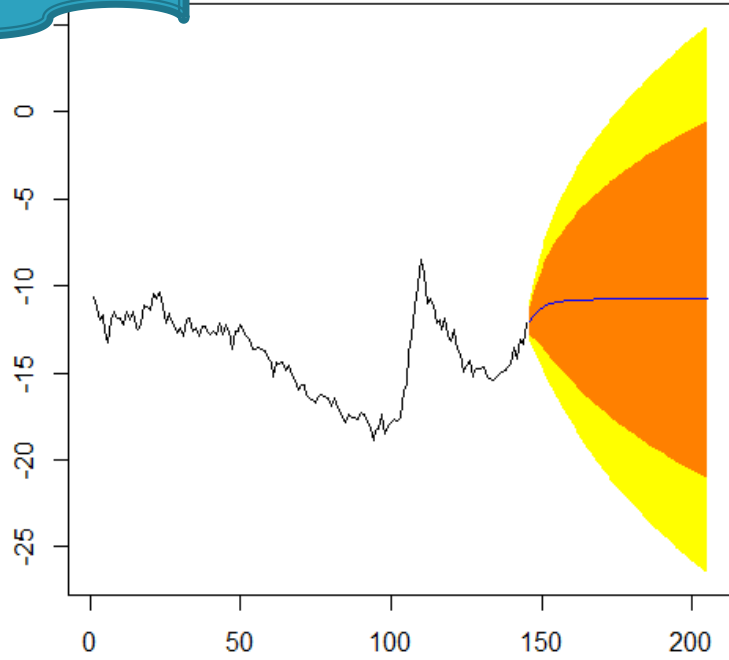
Contribution of significant indicators in explaining EWI

■ ecsi ■ mmir ■ neer ■ REER ■ cpri ■ exchr ■ hicp ■ stockmc ■ ir3m



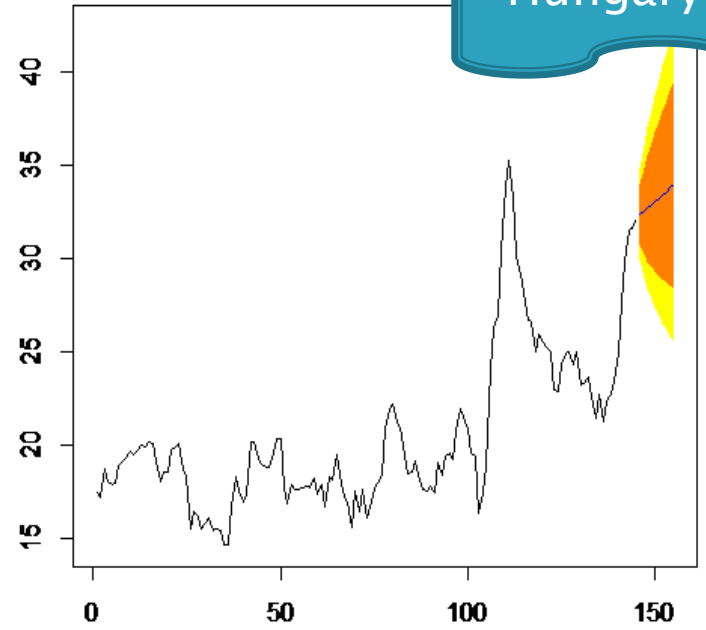
Czech

Forecasts from ETS(A,Ad,N)

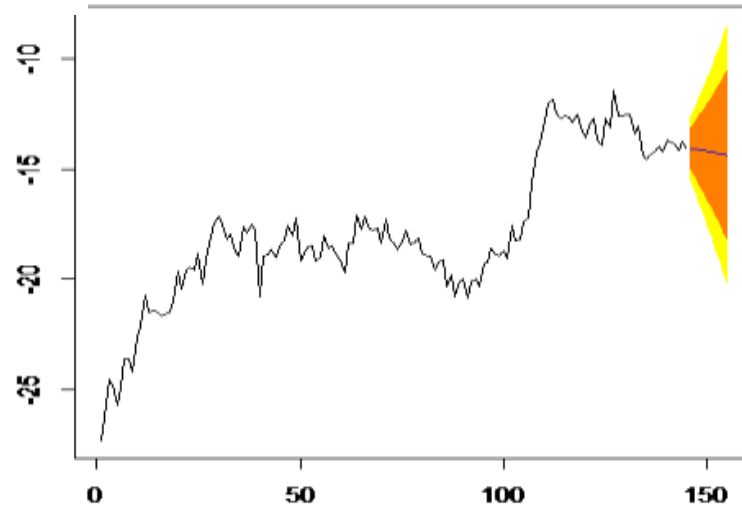


Forecasts from Holt-Winters

Hungary



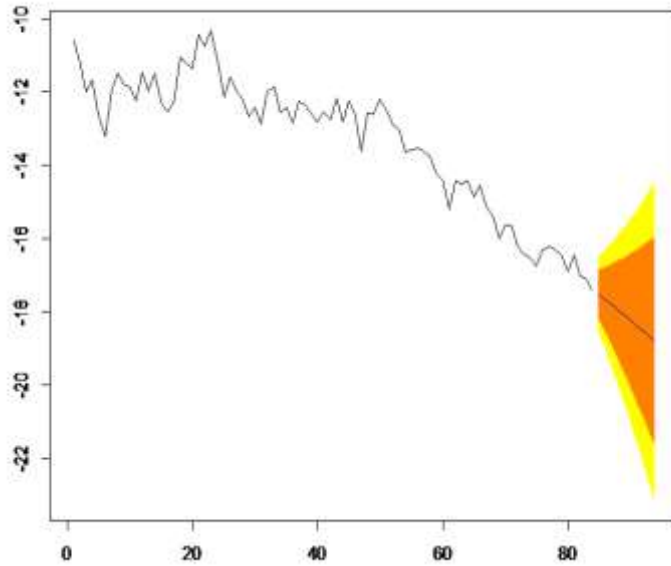
Forecasts from Holt-Winters



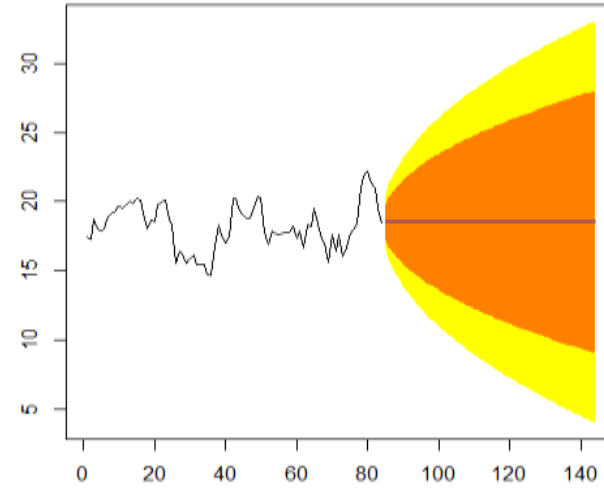
Romania

Czech

Forecasts from HoltWinters

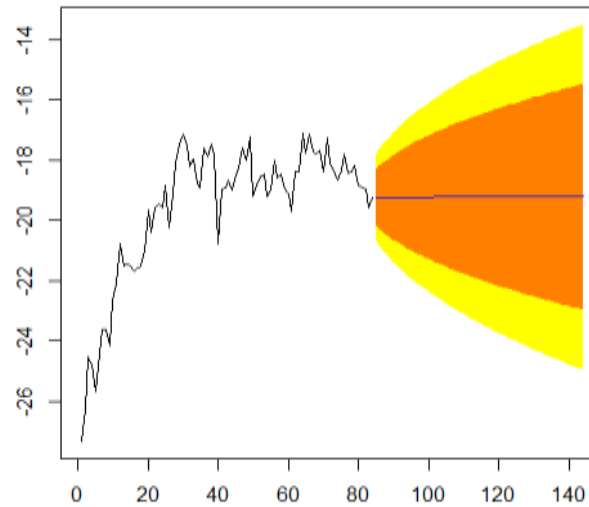


Forecasts from ETS(A,N,N)



Hungary

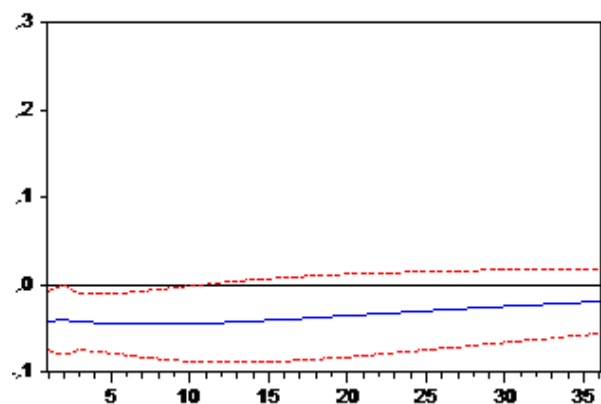
Forecasts from ETS(A,Ad,N)



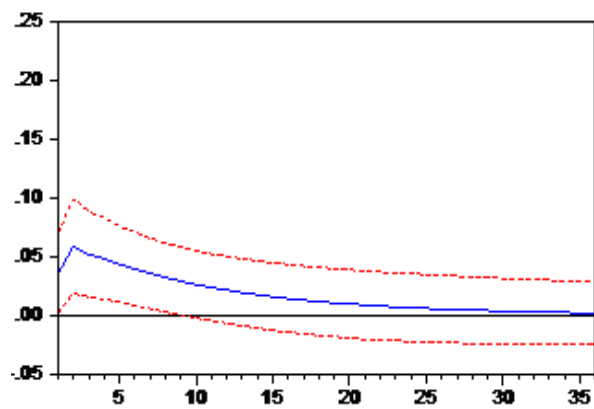
Romania

Czech

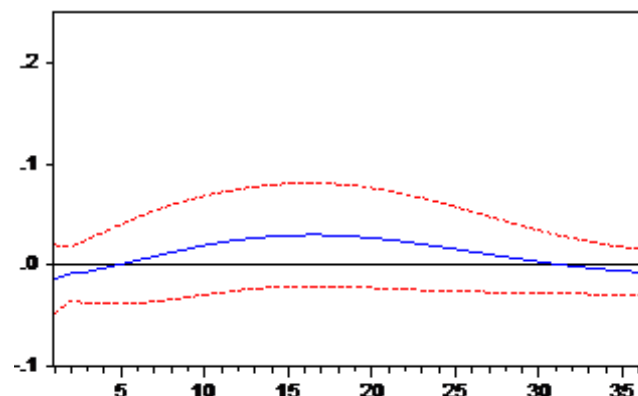
Response of CII to ECSI



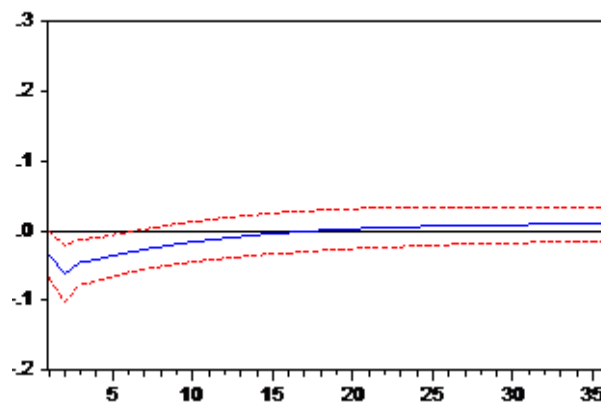
Response of CII to EXHR



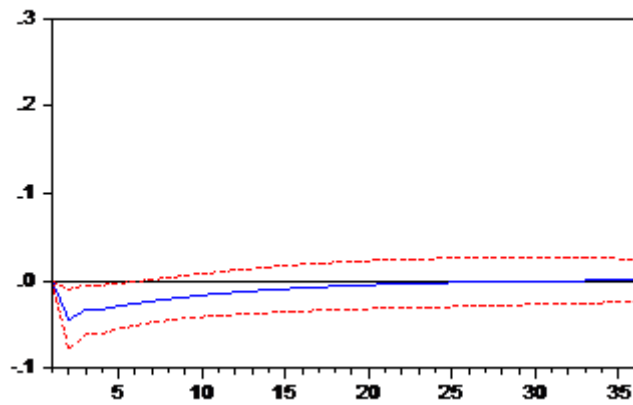
Response of CII to HICP



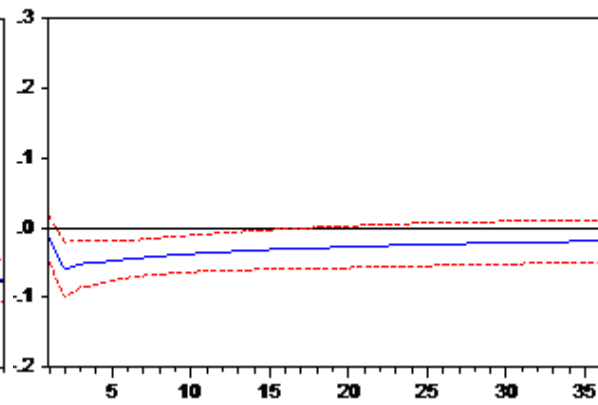
Response of CII to IIR



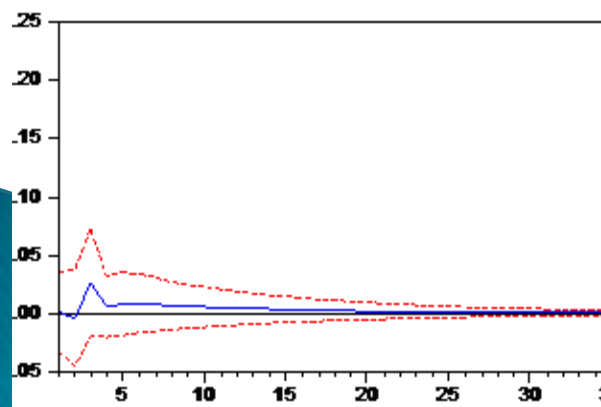
Response of CII to NEER



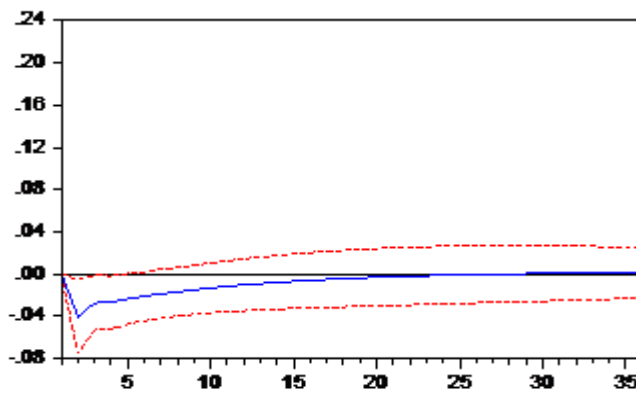
Response of CII to STOCKMC



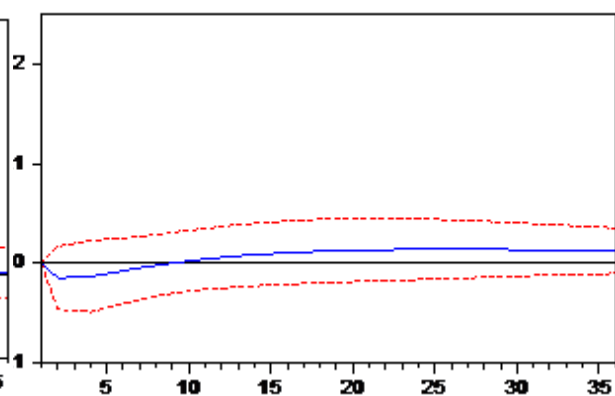
Response of CII to CPIR



Response of CII to REER

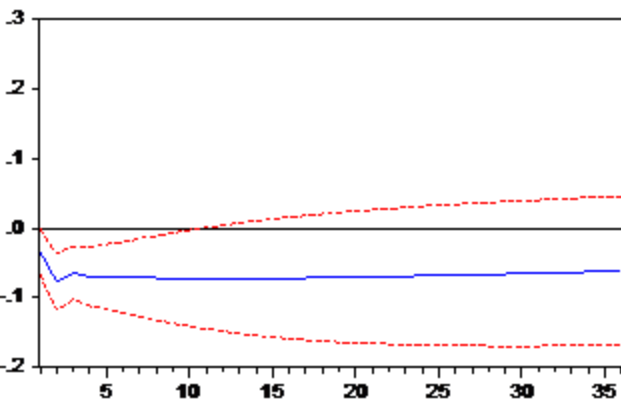


Response of CII to IR3M

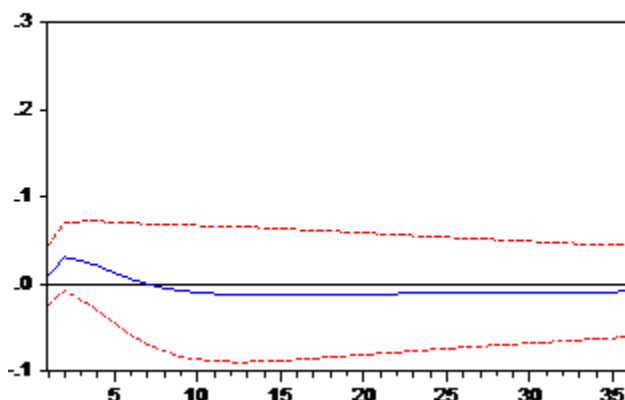


Hungary

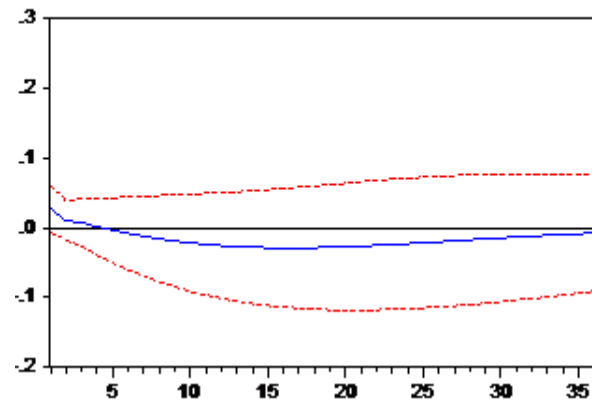
Response of CII to ECSI



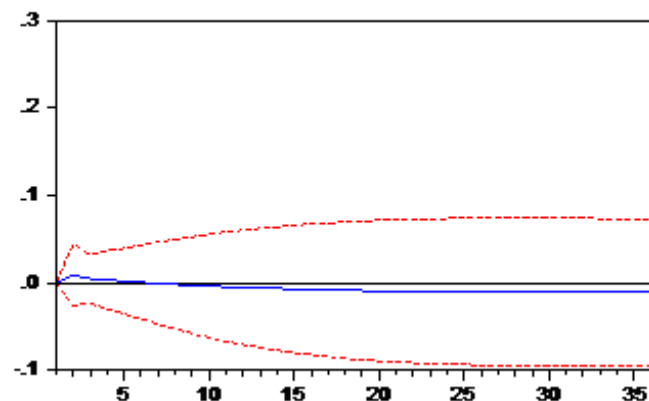
Response of CII to EXCHR



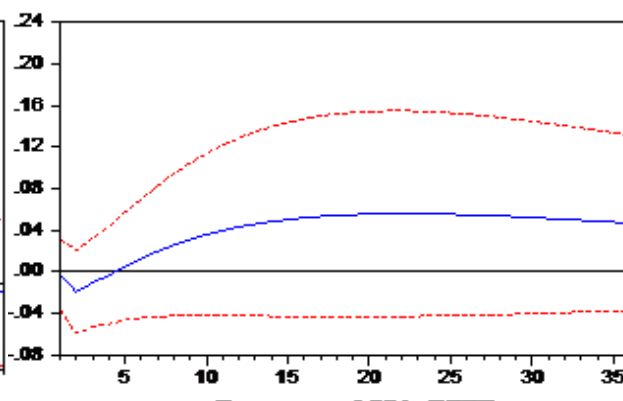
Response of CII to HICP



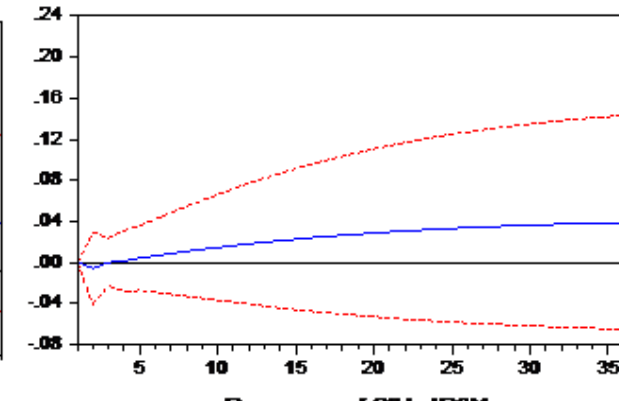
Response of CII to MMR



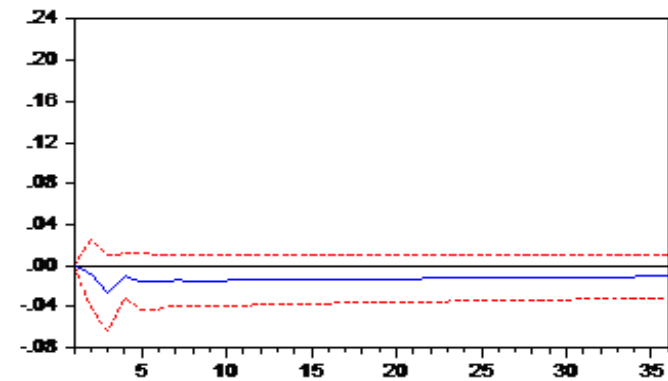
Response of CII to NEER



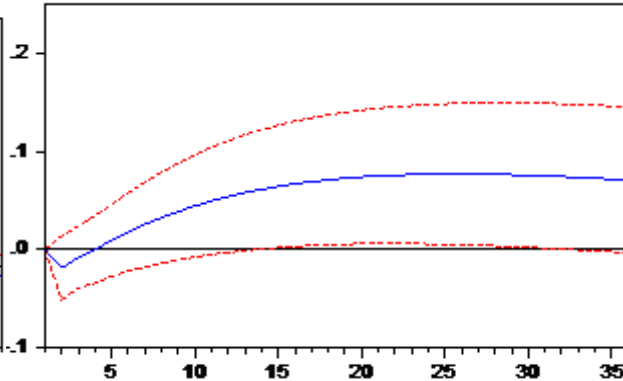
Response of CII to STOCKMC



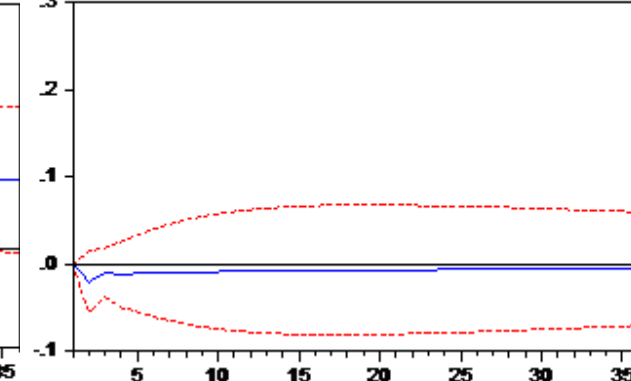
Response of CII to CPIR



Response of CII to REER

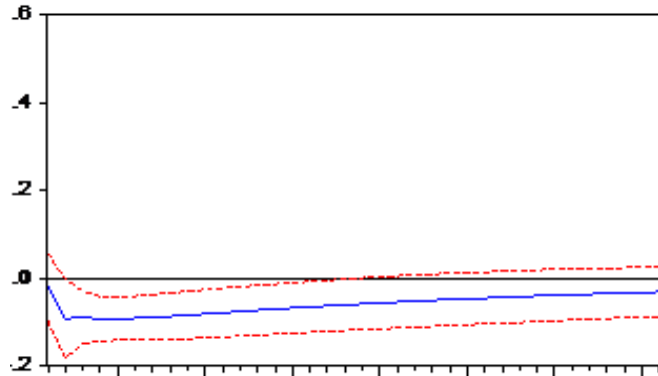


Response of CII to IR3M

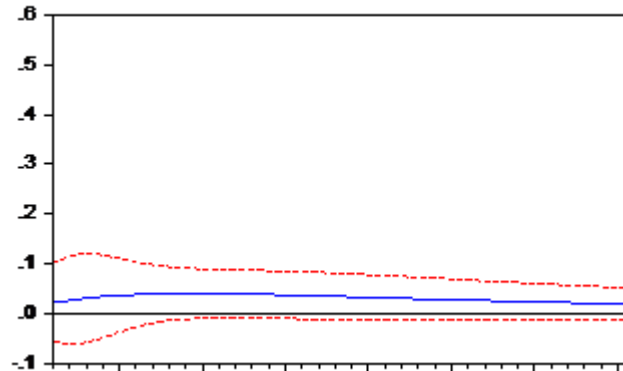


Romania

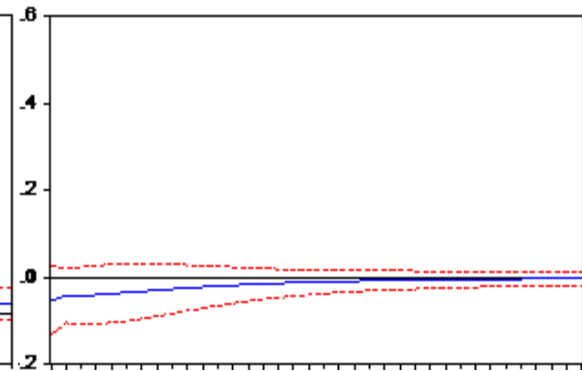
Response of CII to ECSI



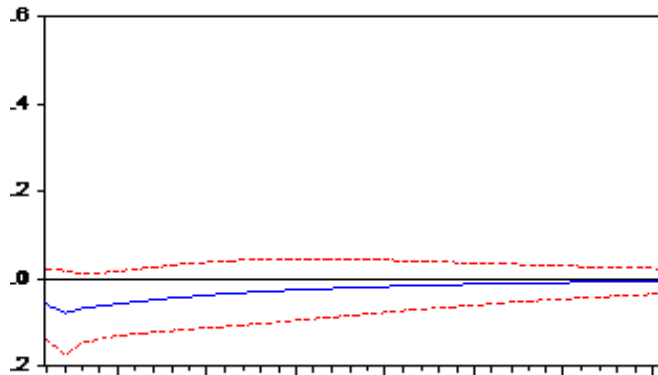
Response of CII to EXCHR



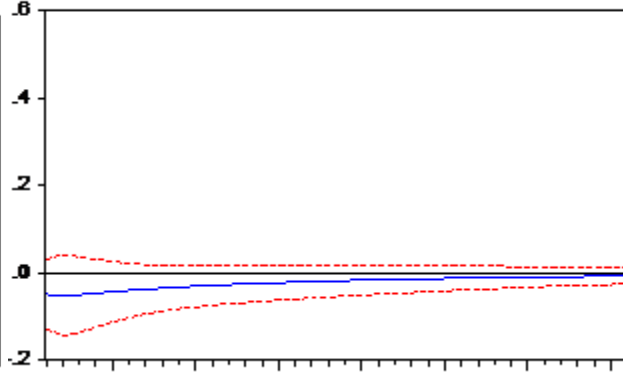
Response of CII to HICP



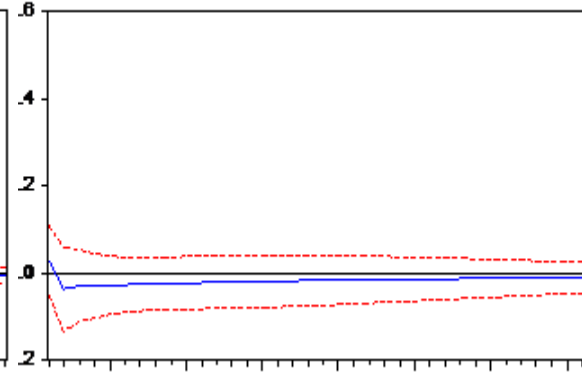
Response of CII to MMR



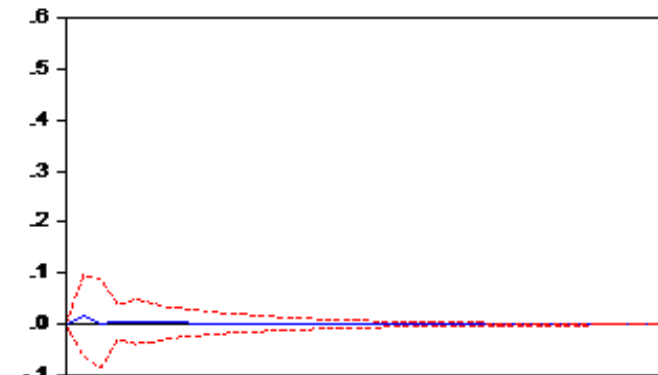
Response of CII to NEER



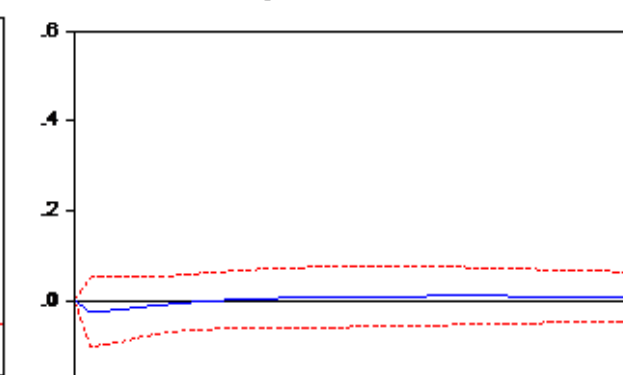
Response of CII to STOCMC



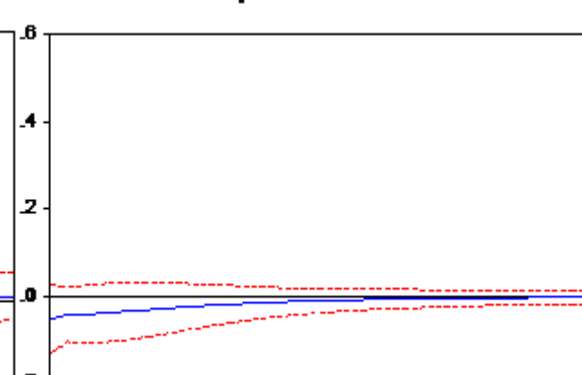
Response of CII to CPI



Response of CII to REER



Response of CII to HICP



Predictors of the crisis

Country	ecsi	exchr	hicp	Mmir	neer	stockmc	cpri	Reer	lr3m
Czech	15	3	15	3	2	2	3	2	3
Hungary	12	3	17	2	24	33	3	26	2
Romania	4	10	4	3	3	5	3	3	4

Early warning: 1–3 years

Late warning: less than 1 year

Conclusions

- ▶ The following variables are important risk factors: economic sentiment indicator, money market interest rate, nominal effective exchange rate, market capitalization, real effective exchange rate, stock market capitalization, harmonized index consumer price, exchange rates, 3 month interest rates.
- ▶ They explain 96,48% of the CII incidence.
- ▶ Crisis incidence signals come at various horizons.
- ▶ After completing the analysis of VAR the key idea is that even if the potential indicators are significant in explaining the crisis incidence, not all of them give important signals regarding its prediction.
- ▶ And also another important aspect is that this model hasn't the same efficiency for all the countries in the sample. For example in term of signals, it predicts well the crisis for Hungary, than for Romania.
- ▶ The utility of this research consists in the fact that if decision factors permanently supervise those significant indicators they can react in time by including them in their policy measures undertaken.

Thank you!

