

Drivers of Output Loss during the 2008-09 Crisis: A Focus on Emerging Europe

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The challenges of the Southeastern European countries in the enduring economic and financial turbulences in the Eurozone

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Outline of Presentation

- 1 Introduction: The global financial crisis and real output loss.
- 2 Econometric framework: Cross-country regressions using Bayesian model averaging.
- 3 Empirical results: Drivers of output loss in emerging Europe.

Introduction

- The global financial turmoil emanated from the US subprime crisis in summer 2007.
 - Since then it spilled first to other advanced economies, engulfing emerging Europe in late 2008.
 - It is the first global recession for decades and often compared to the "Great Depression" of the 30s.
 - It caught most forecasters and economic observers by surprise.
- ⇒ Need for a thorough *re-assessment* of potential crisis indicators.

Empirical Crisis Literature: The Early Stage

- *Rose and Spiegel* set the stage in studying crisis determinants in a series of papers employing cross-sectional regressions.
- Based on a large data set they conclude that basically *no variable proves* useful in explaining the severity of the recent crisis.
- The early crisis literature was very 'early' \Rightarrow instead of real data forecasts used to construct measure of crisis severity
- Forecasts at that time very noisy \Rightarrow casts some doubts on estimation / results

Recent Empirical Crisis Literature: Mixed Evidence

- Frankel and Saravelos (2010) reviewed more than 80 *pre-2008 empirical contributions* on crisis indicators.
- Based on this *literature survey* \Rightarrow central bank reserves and past movements in the real exchange rate \Rightarrow also for this crisis useful indicator
- Recent studies dealing with the effect of the crisis (e.g. Berkmen et al. 2009, Lane and Milesi-Ferretti, 2010, Cecchetti et al., 2011):
 - Use cross-sectional data
 - Linear regressions
 - Differ in country coverage
 - Differ in set of variables (explanatory and dependent) employed

\Rightarrow Not surprising that the literature points to mixed evidence

- Limited research on emerging Europe (Exceptions: Blanchard et al., 2010, Bergloef et al., 2009)

Our Contribution: Filling the Gap

- We use a coherent and systematic approach to empirically identify pre-crisis *macroeconomic and financial market conditions* that shaped the effects of the crisis on the real economy.
- We have collected over 60 potential explanatory variables with global coverage (150 countries)
- Questions we ask:
 - Did countries with growth financed via external funds fare worth on average during the crisis?
 - Did economies with fiscal room for maneuver suffer less than their peers?
 - ...
 - Are there region specifics? In particular, which crisis determinants matter for Central Eastern and South-Eastern Europe (CESEE)

Inference under Model Uncertainty

- *Problem:* Many potential explanatory variables

$$y = \alpha + X_s \beta_s + \varepsilon, \quad X_s \in \{\{x_i\}\}$$

X_s is any combination out of of K covariates $\Rightarrow 2^K$ models

- *Model selection:* Information criteria, cross validation, general to specific, etc., ...
- *Bayesian approach:* Average over models, weights according to 'goodness of fit' of models (marginal likelihood)

Bayesian Model Averaging (BMA) in a Nutshell

Weights via Bayes Rule \Rightarrow *Posterior Model Probability* (PMP):

$$p(M_s|y) = \frac{p(y|M_s)p(M_s)}{p(y)} \propto \underbrace{p(y|M_s)}_{\text{marginal lik.}} \underbrace{p(M_s)}_{\text{model prior}}$$

Any posterior statistic θ (e.g., regression coefficient, forecast, etc.):

$$E(\theta|y) = \sum_s^{2^K} E(\theta|y, M_s) p(M_s|y)$$

Posterior Inclusion Probabilities (*PIP*) for regressor i :

$$p(x_i|y) = \sum_s^{2^K} \mathbf{1}(x_i \in M_s) p(M_s|y) \quad i \in \{1, \dots, K\}$$

Markov Chain Monte Carlo methods typically used to navigate the model space

Prior Set-Up

Zellner's g prior on slope coefficients:

$$\beta_s | g, \sigma^2 \sim N(0, g\sigma^2(X'_s X_s)^{-1})$$

⇒ put a (hyper) prior on g (Feldkircher and Zeugner, 2009, Feldkircher and Zeugner, 2012)

Binomial-beta (Ley and Steel, 2009) on the model space:

$$p(M_s) = \theta^{k_s} (1 - \theta)^{K - k_s}, \theta = \bar{m}/K$$

Uniform prior on constant and variance:

$$p(\alpha) \propto 1; \quad p(\sigma) \propto \sigma^{-1}$$

Drivers of Output Loss: Empirical Set-Up

Linear regression model

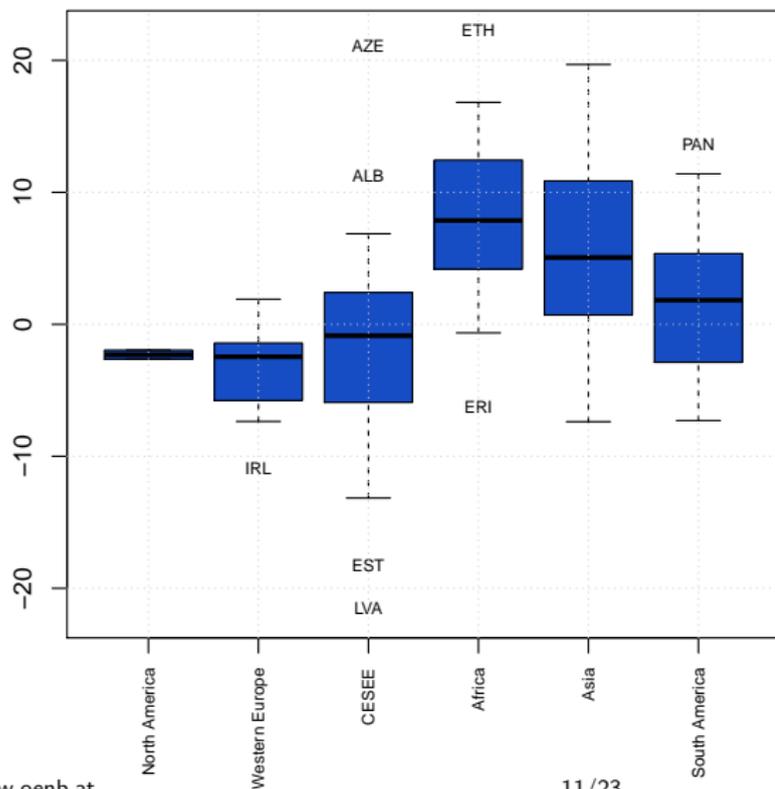
$$\frac{y_{09}}{y_{07}} = \alpha + X_s \beta_s + \varepsilon \quad \text{with } y_t \text{ denoting real GDP at time } t, \varepsilon \sim N(0, \sigma^2)$$

Data

- Data comprises 67 variables to covering a wide range of potential transmission channels
- Global country coverage (150 countries)
- All explanatory variables refer to pre-crisis period:
 - Stocks: end-2006
 - Flows: averages from 2000-06
- Missing values (< 5%) imputed using regression based multiple imputation

The Impact of the Crisis on the Real Economy

Real Output 2007-09



Vulnerabilities and Transmission Channels

Potential explanatory variables comprise:

- Trade channel (more open → more vulnerable)
- External imbalances (CA, ext. debt, real exchange rate)
- Reserves (reserve accumulation → buffer to the crisis)
- Growth above potential (boom bust cycle)
- Financial exposure to advanced economies
- Misalignments in the domestic credit market
- Fiscal discipline (sound fiscal footing → less vulnerable)
- Institutional quality (timely reform implementation)
- Other key macro-variables such as inflation, unemployment, exchange rate regime, population growth, investment and savings rate, globalization indicators, deposit rate, etc. . . .

Global Sample

<i>Variable</i>	PIP	Post Mean	Post SD
Baltics	1.000	-16.530	3.257
Real GDPCAP 06	0.891	-2.108	1.020
CESEE	0.876	-5.140	2.640
UA	0.840	-12.565	7.135
EU 15	0.729	-4.282	3.192
RER Mis. 06	0.606	-0.011	0.011
Trade Exp. to US / GDP 00-06	0.495	-0.053	0.966
Imp. from US / GDP 00-06	0.466	-0.167	0.976
Δ Real GDPCAP 00-06	0.398	0.229	0.329
Population 06	0.343	0.233	0.384
ΔReal GDPCAP 00-06 \times Net FDI infl. / GDP 00-06	0.587	0.022	0.021
Δ Real GDPCAP 00-06 \times Ext. Debt / GDP 06	0.152	0.000	0.001
Δ Real GDPCAP 00-06 \times CA / GDP 00-06	0.136	-0.003	0.009
Δ Real GDPCAP 00-06 \times Δ Dom. Credit 00-06	0.105	0.000	0.001
Δ Real GDPCAP 00-06 \times Inflation 00-06	0.097	0.002	0.010
Other variables.

CESEE - Modeling via Interaction Terms

CESEE Region (22 countries)

The region comprises:

Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, FYR Macedonia, Georgia, Hungary, Kazakhstan, Latvia, Lithuania, Moldova, Poland, Romania, Russia, Serbia, Slovakia, Slovenia and Ukraine.

CESEE Dummy (16) ×

- | | | |
|-----------------------------|---------------------------|---|
| △ Real GDPCAP 00-06 × | ■ RER Mis. 06 | ■ Output Gap 00-06 |
| ■ Net FDI infl. / GDP 00-06 | ■ Financial Openness 06 | ■ Claims of foreign banks (adv. economies) / GDP 06 |
| ■ Ext. Debt / GDP 06 | ■ CA / GDP 06 | ■ Legal Rights Index 06 |
| ■ CA / GDP 00-06 | ■ Floater | ■ Trade exp. to EU15 / GDP 00-06 |
| ■ ΔDom. Credit 00-0 | ■ Gen. Gov. Debt / GDP 06 | ■ ΔDom. Credit 00-0 |
| ■ Inflation 00-06 | ■ Int. Reserves / GDP 06 | |

Drivers of Real Output Loss in CESEE

<i>Variable</i>	PIP	Post Mean
Real GDPCAP 06	0.908	-2.098
ΔReal GDPCAP 00-06	0.655	0.415
EU 15	0.654	-3.726
UA	0.604	-8.890
Imp. from US / GDP 00-06	0.514	-0.152
CESEE	0.103	0.302
CESEE \times ΔReal GDPCAP 00-06 \times Ext. Debt / GDP 06	0.682	-0.019
CESEE \times ΔReal GDPCAP 00-06 \times Net FDI infl. / GDP 00-06	0.502	0.036
CESEE \times Δ Real GDPCAP 00-06 \times Δ Dom. Credit 00-06	0.092	0.000
CESEE \times Δ Real GDPCAP 00-06 \times Inflation 00-06	0.066	0.000
CESEE \times Δ Real GDPCAP 00-06 \times CA / GDP 00-06	0.117	0.007
CESEE \times Δ Real GDPCAP 00-06	0.300	-0.428
CESEE \times Fin. Openness 06	0.588	-5.342
CESEE \times RER Mis. 06	0.198	0.017
9 other CESEE interaction variables.
...

Our Results are Robust to...

alternative choices of the dependent variables

- cumLoss_0908: $\frac{y_{09}}{y_{08}}$
- cum_rev0907: $\frac{y_{09} - \hat{y}_{09}}{y_{07}}$ \hat{y}_{09} denoting forecasts for 2009 from the IMF WEO, April 2008

as well as...

- Model uncertainty.
- Alternative model prior (group wise prior) that deals with multicollinearity.
- Alternative data imputation method.
- Alternative indicator for financial openness variable (based on IMF definition)

⇒ *Results qualitatively not affected!*

Conclusions I - General Results

- 1 While the crisis was first confined to advanced economies, effect on real output of transition economies stronger.
- 2 Strong evidence for regional heterogeneity with the CESEE region and Western Europe being particularly affected.
- 3 Empirical evidence that pre-crisis overvaluation of the real exchange rate has amplified the real downturn.
- 4 Marginal evidence that economies with strong trade ties to the US have been less resilient.
- 5 Buoyant pre-crisis growth, in particular coupled with net FDI inflows provided a buffer to the crisis.

Conclusions II - CESEE

- 1 Pre-crisis growth financed via external funds turned out to be a robust source of risk for the region.
- 2 In a similar vein, the degree of capital account openness turned out to be a factor amplifying the real effects of the crisis.
- 3 Finally, while financial deepening empirically played a negligible role for the effect on real output, strong FDI inflows coupled with firm pre-crisis growth acted as a cushion to the global shock.

THANK YOU FOR YOUR ATTENTION

Crespo Cuaresma, J. and M. Feldkircher. 2012. Drivers of Output Loss during the 2008-09 Crisis: A Focus on Emerging Europe. In: *Focus on European Economic Integration*, forthcoming. Available soon at www.oenb.at.

Crisis Literature - Selected Readings



Bergloef E. and Y. Korniyenko and A. Plekhanov and J. Zettelmeyer (2009):
 Understanding the crisis in emerging Europe
EBRD Working Paper No. 109



Berkmen P. and G. Gelos and R. Rennhack and J. P. Walsh (2009):
 The Global Financial Crisis: Explaining Cross-Country Differences in the Output Impact.
IMF Working Paper No. 09/28



Blanchard, O., H. Faruquee and M. Das. 2010.
 The Initial Impact of the Crisis on Emerging Market Countries.
IMF, mimeo.



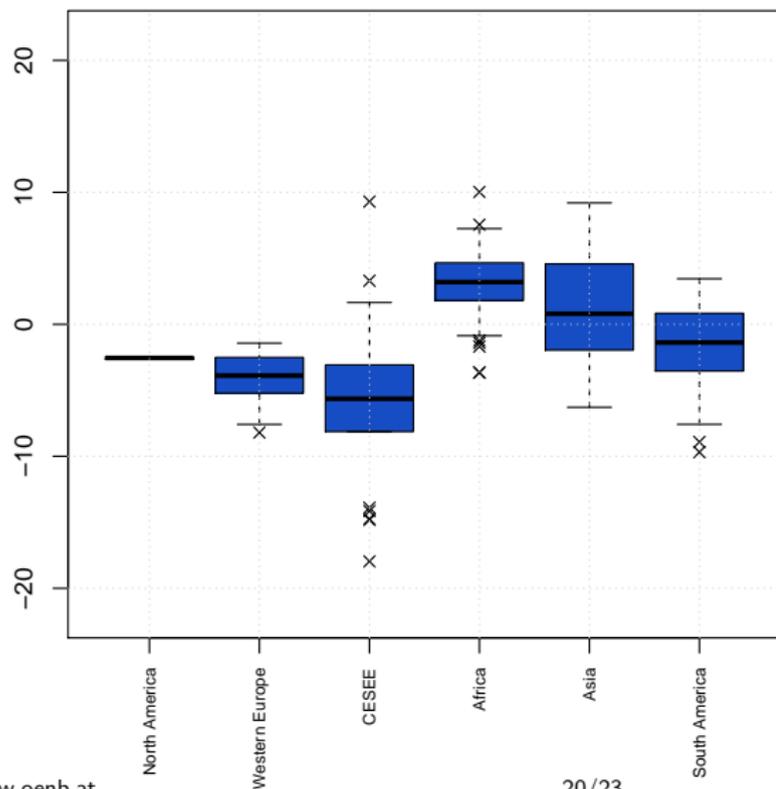
Frankel J.A. and G. Saravelos (2010):
 Are Leading Indicators of Financial Crises Useful for Assessing Country Vulnerability?
NBER Working Paper, 16047.



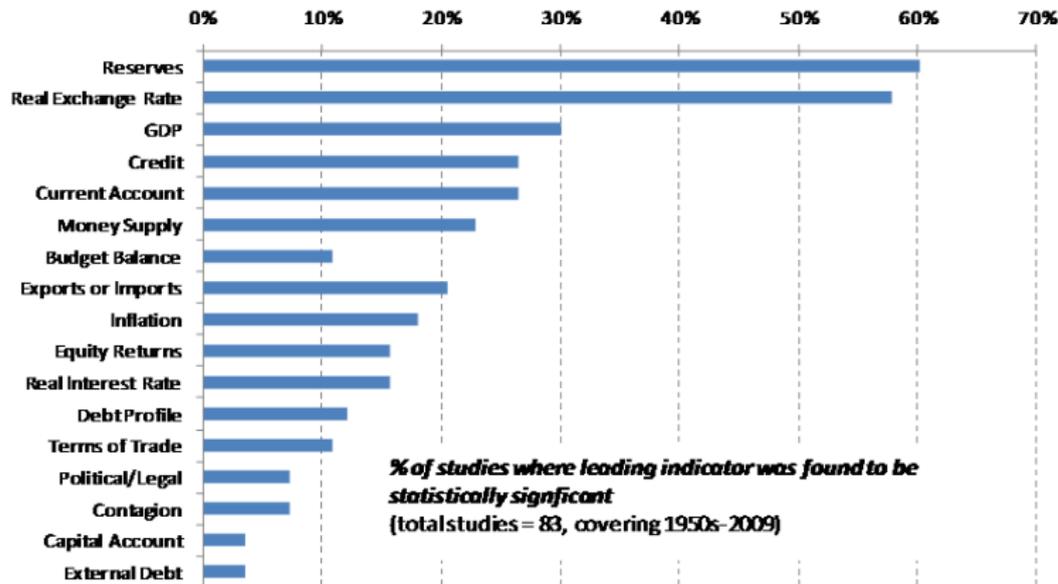
Rose A.K. and M.M. Spiegel (2012):
 Cross-Country Causes and Consequences of the 2008 Crisis: Early Warning.
Global Journal of Economics, forthcoming.

Real Output 2008-09

Real Output 2008-09



Frankel and Saravelos, 2010



Model uncertainty: Illustration

What is the effect of secondary schooling on economic growth (Sala-i-Martin, 1997)?

	(1)	(2)	(3)	(4)
Secondary School enrollment	0.0335*** [0.00770]	-0.00171 [0.00986]	-0.0224** 0.00972]	0.00427 [0.0117]
Equipment Investment		0.298*** [0.0660]	0.258*** 0.0602]	0.265*** [0.0560]
Non-equipment Investment		0.0600* [0.0332]	0.0561* [0.0293]	0.00692* 0.0275]
Latin American Dummy			-0.0115*** [0.00370]	-0.00833** [0.00355]
Sub-Saharan African Dummy			-0.028***	-0.0227*** [0.00429]
Initial income per capita				-0.00942*** [0.00262]
Constant	0.0113*** [0.00234]	-0.00124 [0.00418]	0.0140*** [0.00489]	0.0754 [0.0177]
Observations	105	82	82	82

The Hyper-g Prior

Integrated likelihood under fixed g :

$$p(M_s|y) \propto \left(1 - \frac{g}{1+g}\right)^{\frac{k_s}{2}} \left(1 - \frac{g}{1+g} R_s^2\right)^{-\frac{N-1}{2}} p(M_s)$$

Difficulty in choosing Zellner's g -prior: Ideally, g / shrinkage should be chosen to reflect beliefs on noise in the data:

- Lots of noise (σ) in data: set prior on coefficients close to zero to avoid overfitting – small g
- Less noise (σ): loose prior on coefficients, trust the data – large g

Let the data choose: Take a *hyper-prior distribution on g* (Liang et. al, 2008, Feldkircher and Zeugner, 2009, Ley and Steel, 2010)

- Take $\frac{g}{1+g} \sim B(1, \underline{a})$, hyper-parameter $\underline{a} \in (0, 1)$

$$\Rightarrow p(M_s|y) \propto \frac{\underline{a}}{\frac{1}{2}k_s + \underline{a}} {}_2F_1\left(\frac{N-1}{2}, 1, \frac{k_s}{2} + 1 + \underline{a}, R_s^2\right)$$