

The Determinants of Vulnerability to the Global Financial Crisis 2008 to 2009: Credit Growth and Other Sources of Risk

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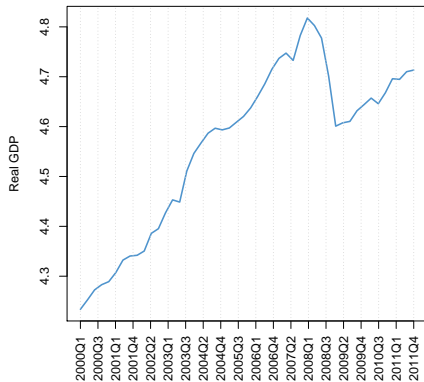
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Outline of Presentation

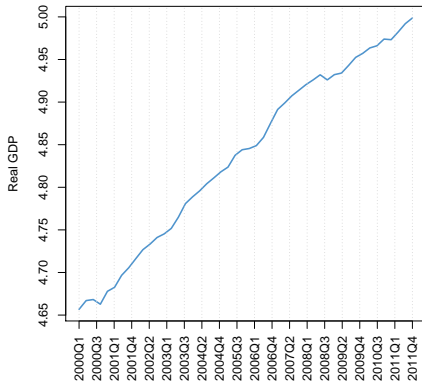
- 1 Introduction: Motivation and literature survey on crisis determinants.
- 2 How can the impact of the crisis on the real economy be measured?
- 3 Econometrics: How can the determinants of vulnerability be estimated?
- 4 Empirical results.

The Impact of the Crisis on the Real Economy

Ukraine



Australia



Research Questions

- 1 Why did some countries perform better during the global financial crisis than their peers?
- 2 Can we find some variables that acted as a shelter or catalyst for the global shock?

Empirical Crisis Literature: Mixed Evidence

- Rose and Spiegel in a series of papers \Rightarrow *no variable proves* useful in explaining the severity of the recent crisis
- Frankel and Saravelos (2010) reviewed more than 80 *pre-2008 empirical contributions* on crises indicators \Rightarrow central bank reserves acted as a shelter, also valid for this crisis
- Recent studies dealing with the effect of the crisis (e.g., Berkmen et al., 2009, Lane and Milesi-Ferretti, 2010, Cecchetti et al., 2011):
 - Differ in country coverage
 - Differ in set of variables (explanatory and dependent) employed

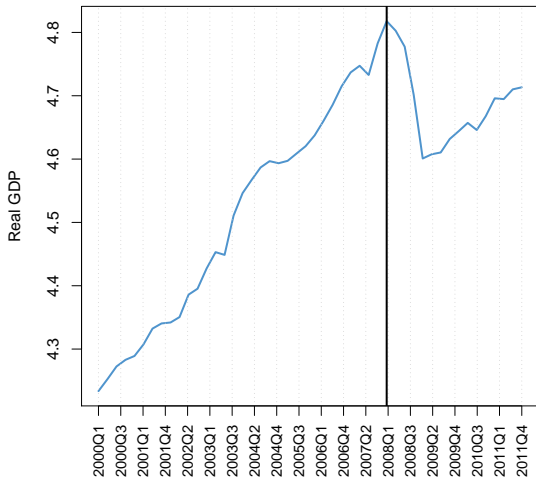
\Rightarrow Not surprising that the literature points to mixed evidence

Our Contribution: Filling the Gap

- 1 We use a coherent and systematic approach to empirically identify precrisis *macroeconomic and financial market conditions* that help explain the effects of the crisis on the *real economy*.
- 2 We use a unique data set that covers over 90 potential explanatory variables.
- 3 We are the first ones to address the issue of the different timing of the crisis across countries.
- 4 Our aim is to disentangle the long-run impact of the crisis from its short-term impact on the real economy.

Measures of Crisis Severity: The Short Run

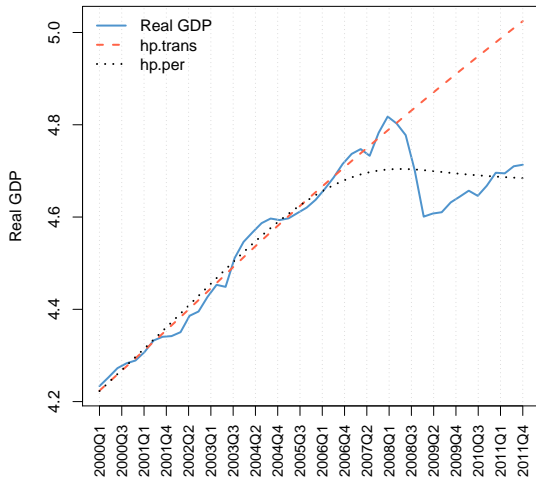
Ukraine



- Cumulative loss, in % of precrisis peak (**cum.loss**)
- Depth of the crisis, in % of precrisis peak (**depth**)

Measures of Crisis Severity: The Long Run

Ukraine



- Cumulated deviations from trend output based on precrisis information (**hp.trans**), in % of total transitory trend output
- Cumulated deviations from trend output based on information including the crisis period (**hp.per**), in % of total permanent trend output

■ Macroeconomic Risks

- GDP per capita prior to the crisis, investment/GDP, population growth
- inflation, money growth, output gap, monetary independence
- monetary regime, exchange rate stability, financial freedom
- openness, trade balance, trade composition
- business environment, labor market freedom, unemployment rate
- institutional quality, corruption index, legal rights

■ External Risks

- current account, savings, exchange rate misalignment
- external debt, capital controls
- net FDI flows, portfolio debt or equity flows, NFAs
- international reserves

■ Fiscal Risks

- government debt, budget balance, twin fiscal deficit
- fiscal freedom

- Financial Risks
 - value of stocks traded, market capitalization
 - foreign bank competition, foreign ownership restrictions
 - domestic credit, credit depth information
 - credit market regulation, deposit rates
- Contagion and Spillover Risks
 - trade with EU-15, trade with US
 - trade and tariff barriers
 - foreign claims of banks in advanced economies
 - foreign claims of US banks
- Regional Dummy Variables
 - oil exporter, oil producer
 - dummy for Ukraine and Belarus

Determinants of Vulnerability

Linear regression model - cross section

$$y = \alpha + X_{s,06}\beta_s + \varepsilon \quad \text{with } \varepsilon \sim N(0, \sigma^2)$$

$$y \in \{\mathbf{cum.loss}, \mathbf{depth}, \mathbf{hp.trans}, \mathbf{hp.per}\}$$

and $X_{s,06}$ measured at 2006 (or earlier) to capture precrisis state

- *Problem:* Many potential explanatory variables
 $X_{s,06}$ is any combination out of $K = 90$ covariates, i.e., 2^K models which are defined by the variables they contain
- *Bayesian approach:* Average over models, any posterior statistic θ (e.g., regression coefficient, forecast, etc.):

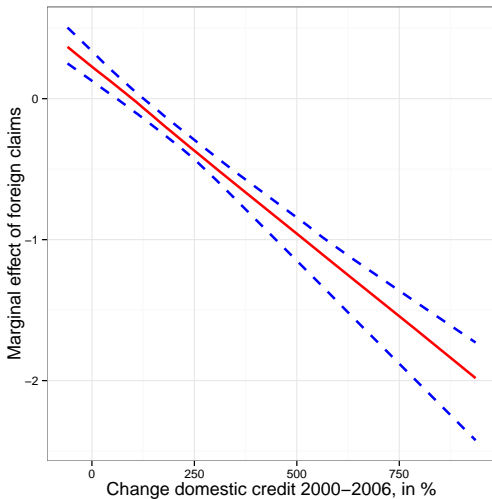
$$E(\theta|y) = \sum_s^{2^K} E(\theta|y, M_s) p(M_s|y)$$

Cumulative Loss

	<i>Uncond. Model</i>		<i>Cond. Model</i>	
	PIP	PM	PIP	PM
Δ Dom. credit 2000-2006	0.99	-0.196	1.00	-0.023
Foreign claims adv. banks, 2006	0.03	-0.005	0.88	0.201
Ukraine	0.08	-5.559	0.87	-138.508
Food exports/tot. exp. 2000-2006	0.04	0.027	0.71	0.912
Belarus	0.50	57.470	0.15	23.250
...
Δ Dom. credit, 2000-2006 \times Foreign claims adv. banks, 2006	-	-	0.87	-0.002
...

Note: PIP=posterior inclusion probability, PM=posterior mean.

Marginal Effect of Foreign Claims on Cumulative Loss

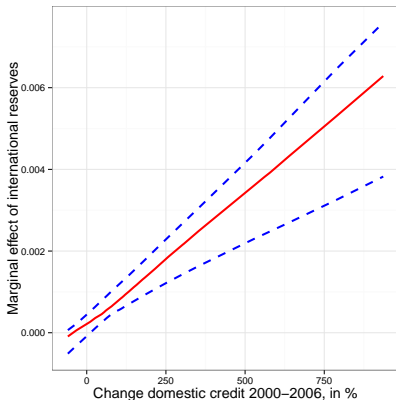
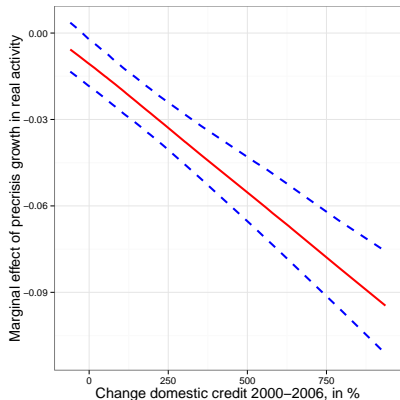


Trend Output (Transitory Impact)

	<i>Uncond. Model</i>		<i>Cond. Model</i>	
	PIP	PM	PIP	PM
Δ Dom. credit, 2000-2006	0.75	0.000	1.00	0.000
Inflation, 2000-2006	0.12	0.000	0.73	-0.011
Real GDP growth rate, 2000-2006	0.39	-0.011	0.63	-0.008
Food exports/total exp., 2000-2006	0.30	0.001	0.58	0.002
Int. reserves/ext. debt, 2006	0.07	0.000	0.57	0.000
Belarus	0.75	0.237	0.45	0.239
...
Δ Dom. credit, 2000-2006 \times inflation, 2000-2006	-	-	0.57	0.000
Int. reserves/ext. debt, 2006	-	-	0.52	0.000
Real GDP growth rate, 2000-2006	-	-	0.47	0.000
...

Note: PIP=posterior inclusion probability, PM=posterior mean.

Marginal Effects on Trend Output (Transitory Impact)



Conclusions I - General Results

- 1 Strong evidence that precrisis growth in domestic credit has amplified the real downturn.
- 2 Fast-growing countries (in terms of real GDP) prior to the crisis are on average more affected.
- 3 Regional dummies for Ukraine (negative) and Belarus (positive)
- 4 In the same vein, countries with a large component of foods in their export shares are more resilient (Latin America).

Conclusions II - Nonlinearities

- Effects that vary with precrisis credit growth play an important role in explaining crisis severity:
 - 1 *Funding via foreign banks*, given strong precrisis growth in lending, has exacerbated the effects of the crisis (simultaneous risk of contagion and overheating in the credit market).
 - 2 *Precrisis growth in real output* coupled with strong precrisis credit growth has amplified the impact of the crisis (boom-bust).
 - 3 The effect of *international reserve accumulation* as a shelter to the crisis rises with precrisis credit growth.

Thank you for your attention!

Crisis Literature - Selected Readings



BMS - Software Package

BMA Software available as R package: <http://bms.zeugner.eu> with hands-on tutorials and extensions of BMA to other types of regression models and various prior settings explained.



Bergloef, E., Y. Korniyenko, A. Plekhanov and J. Zettelmeyer. 2009.

Understanding the crisis in emerging Europe.

EBRD Working Paper No. 109.



Berkmen, P., G. Gelos, 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.



Cecchetti, S.G., M. Kohler and C. Upper. 2009.

Financial Crises and Economic Activity.

NBER Working Papers.

Crisis Literature - Selected Readings



Crespo Cuaresma, J. and M. Feldkircher. 2012.

Drivers of Output Loss during the 2008-09 Crisis: A Focus on Emerging Europe.
Focus on European Economic Integration, Q2 issue.



Feldkircher M. 2012.

The Determinants of Vulnerability to the Global Financial Crisis 2008 to 2009:
Credit Growth and Other Sources of Risk.
BOFIT Discussion Paper No. 26/2012.



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.

BMA in a Nutshell

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

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

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:

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

Strong heredity prior on the model space.

Strong Heredity Prior

Consider a model that is composed of three variables (A, B and the linear interaction term AB):

$$Pr(\vartheta_{AB} = 1 | \vartheta_A, \vartheta_B) = \begin{cases} p_{00}, & \text{if } (\vartheta_A, \vartheta_B) = (0, 0) \\ p_{01} = & \text{if } (\vartheta_A, \vartheta_B) = (0, 1) \\ p_{10} = & \text{if } (\vartheta_B, \vartheta_A) = (1, 0) \\ p_{11} = & \text{if } (\vartheta_A, \vartheta_B) = (1, 1) \end{cases}$$

That is the probability of inclusion for the linear interaction terms ($Pr(\vartheta_{AB} = 1 | \vartheta_A, \vartheta_B)$) depends on the inclusion of its main terms (ϑ_A, ϑ_B).

\Rightarrow we set $(p_{00}, p_{01}, p_{10}, p_{11}) = (0, 0, 0, 1)$, which ignores all models that included interaction terms but not the corresponding parent variables.

Nonlinearities via Interaction Terms

△ Domestic credit 2000-2006 ×

- Net FDI infl./GDP 00-06
- Real GDP per capita 06
- Average annual growth rate of real GDP 00-06
- Domestic credit 06
- Inflation 00-06
- Real exch. rate misal. 06
- Financial openness 06
- Credit depth info 06
- Openness 02-06
- Business reg. index 06
- Int. reserves/ext. debt 06
- Output gap 00-06
- Foreign claims of banks in (adv. economies) / GDP 06
- Exchange rate stab. 06
- Monetary indep. 06
- Twin deficit (CA & budget)
- budget balance 00-06 × budget debt 06
- Gross savings/GDP 06
- Δ equity stocks 00-06
- deposit rate 00-06
- Money/GDP 06
- Inflation targeter
- Fin. exposure to US/ext. debt 06
- Trade with EU-15 & US in % of total trade

Marginal effects

$$y = \beta_1 x_1 + \beta_2 (x_1 \times x_2) + \beta_3 x_2 + \varepsilon \quad \text{marginal effect of } x_1 \text{ on } y \Rightarrow \beta_1 + \beta_2 | x_2$$

Depth

	<i>Uncond. Model</i>		<i>Cond. Model</i>	
	PIP	PM	PIP	PM
Δ Dom. credit, 2000-2006	0.30	-0.004	0.90	-0.004
Δ Stocks/GDP, 2000-2006	0.63	0.001	0.66	0.001
Financial openness, 2006	0.30	-2.331	0.59	-4.865
Money/GDP, 2006	0.08	0.001	0.56	0.011
Twin deficit (fiscal), 2006	0.16	0.001	0.54	0.004
Population growth, 2000-2006	0.16	0.041	0.53	0.194
Int. reserves/ext. debt, 2006	0.08	-0.001	0.48	0.000
Inflation, 2000-2006	0.07	-0.001	0.45	-0.163
Real GDP growth rate, 2000-2006	0.19	-0.205	0.44	-0.155
Output gap, 2000-2006	0.50	-11.096	0.43	-7.214
...

*Note: PIP=*posterior inclusion probability*, PM=*posterior mean*.*

Trend Output (Permanent Impact)

	<i>Uncond. Model</i>		<i>Cond. Model</i>	
	PIP	PM	PIP	PM
Trade freedom, 2006	0.98	-0.030	0.98	-0.030
Δ Dom. credit, 2000-2006	0.40	-0.001	0.73	0.000
Real GDP growth rate, 2000-2006	0.22	-0.041	0.45	-0.071
Belarus	0.27	0.402	0.41	0.704
Δ Real GDP per cap., 2000-2006	0.67	-0.024	0.39	-0.012
Gross savings/GDP, 2006	0.08	-0.002	0.22	-0.007
Foreign claims adv. banks, 2006	0.03	0.000	0.15	0.000
FX pressure index, 2000-2006	0.06	0.003	0.15	0.007
...

Note: PIP=posterior inclusion probability, PM=posterior mean.