Cross-Country Causes and Consequences of the 2008 Crisis

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Our views are our own and do not necessarily represent those of the Federal Reserve
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Financial Crisis has Renewed Calls for Early Warning Systems

- "we agree … that the FSB [Financial Stability Board] should collaborate with the IMF to provide early warning of macroeconomic and financial risks and the actions needed to address them"
    - Final Communiqué G-20 Summit April 2, 2009
- "Any early warning system to detect impending dangers to the world economy must find a way of bringing together the scatter of international and national macrofinancial expertise. We at the Fund have already begun intensifying our early warning capabilities and will be strengthening our collaboration with others involved in this area."
    - Dominique Strauss-Kahn

Many calls …

- "An early warning system must be established to identify upstream increases in risks..."
  - Heads of State or Government of European Union, November 7 2008.
- "The Group recommends that the IMF … is put in charge of developing and operating a financial stability early warning system … to deliver clear messages to policy makers and to recommend pre-emptive policy responses ..."
  - De Larosiere Report, February 25 2009.

But *are* Early Warning Models Likely to have been able to predict this crisis?

- Models typically do better at predicting cross-country *incidence* of crisis than *timing*

- We therefore examine ability of early warning systems (EWS) to predict relative performance *across countries* in the current crisis

- Also interested in examining which causes of the financial crisis perform well as predictors of relative future performance

Non-Structural Methodology

- MIMIC (multiple-indicator, multiple cause) model explicitly incorporate difficulties in observing relative crisis severity
  - Treats crisis as a latent variable
  - Observed with error as function of observable manifestations
- Sample is cross-section of 107 countries

Crisis Performance is Latent Variable Mapping Observable Causes to Observable Manifestations

- 4 Manifestations: equity market collapse, exchange rate devaluation, economic growth, and change in creditworthiness

- Compare these to a large set of potential causal variables

- Also obtain estimates of latent variable, relative performance during financial crisis

Results

- Plausible estimates of relative *severity* of crisis
  - Ex: Iceland and Estonia identified as exceptionally bad
- Less success linking crisis to *causal* variables
  - Very few variables (e.g., size of equity run-up) consistently enter at statistically significant levels
  - Other equally-plausible variables, such as real estate appreciation, fail to enter
- Conclusion: *we can model the severity of the crisis, but not its causes*

Results Bode Poorly for EWS

- Successful EWS must predict *both* incidence and timing of crisis
- Our analysis fails even to predict *incidence* of 2008 crisis, which should be (relatively) easy
- Potential reasons for poor performance
  - Causes differ across countries
  - Crisis might stem from a common "global shock"
- Both problematic for EWS!

Potential Causes of Crisis

Size and Income included throughout

- Size common in literature as crisis correlates
  - Reinhart and Reinhart (2009), Calvo and Loo-Kung (2009)
  - Commonly believed small countries more exposed (Ex.: Iceland)
  - Small countries also more open
- Income less obvious
  - Crisis hit developed and EMEs alike
  - Still, EMEs more risky and less potential for counter-cyclical policies due to fiscal constraints

Financial Policies

- Crisis widely perceived as demonstrating regulatory flaws [e.g. Bernanke (2009)]
  - Improper incentives within institutions
- Basel capital requirements
  - Contributed to lending pro-cyclicality
  - Codified role for rating agencies [Coval, et al (2009)]
  - Encouraged opaqueness through securitization and moving assets off balance sheets [Demirguc-Kunt and Serven (2009)]

Ex-Ante Measures of Financial Policy Included as Potential "Causes"

- Economic Freedom of the World data base
  - *Bank Ownership: s*hare of bank deposits in private banks
  - *Foreign Bank Competition:* foreign bank license denial rates
  - *Interest Rate Controls/ Negative Real Interest Rate:* credit market controls
  - *Credit Market Regulation:* quality of credit market regulation
- Barth, Caprio and Levine (2005) data
  - *Overall Capital Stringency*
  - *Ability to Take Prompt Corrective Action*
  - *Capital Regulatory Index*
  - *Official Supervisory Power*
  - *Restructuring Power*
  - *Power to Declare Insolvency*

Financial Conditions

- Degree of maturity mismatch, due to short-term debt obligations [e.g. Cecchetti (2008)]
- Risky lending practices
  - Feldstein (2009): Appraised value of US mortgage contracts grew from 70-80 % to 90-100 %
  - Community Reinvestment Act encouraged lending to broader set of borrowers [White (2008)]
- Exploding leverage of firms and households

Measures of Financial Conditions

- Conditions products of policies (endogenous)
  - Interested in prediction
- Measures included in specification:
  - *Private Sector Domestic Credit* as share of GDP
  - *Domestic Bank Credit* as share of GDP
  - Share of domestic credit consumed by *Private Sector*
  - *Bank Liquid Reserves* as a share of assets
  - Share of *Non-Performing Loans*
  - *Bank Capital* as a share of assets
  - *Bank Claims* as a share of deposits

Asset Price Appreciation

- Widely cited as a source of fragility, in US and elsewhere [e.g. Feldstein (2009), Teslik (2009)]
- Buiter (2009): Investment diverted to real estate from "productive uses"
- Doms, et al (2007): US mortgage delinquencies highest in areas that experienced highest amount of appreciation
- Mian and Sufi (2008): U.S. areas with high latent housing demand had highest decreases in denials
  - Sub-prime lending fed appreciation
- Real estate appreciation mirrored in other financial markets, particularly equity markets

Measures of Real Estate and Equity Price Appreciation

- Real estate
  - *Percentage Change in Real Estate Prices*
    - Based on data from the BIS and augmented by an Asia-specific study by Glindro, et al (2008).

- Equity market appreciation
  - *Market Capitalization* as a share of GDP
  - *Value of Stocks Traded relative to GDP*
  - *Stock Market Growth*.

International Imbalances

- Many countries built up deficit international financial positions over boom
- Arguments over source of "global imbalances"
  - Asian and other country efforts to build up foreign exchange reserves [e.g. Buiter (2007)]
  - Lax policies in west [Buiter (2009)]
- Fratscher (2009): Countries with high CA deficits had larger exchange rate depreciations
  - High exposure to U.S. also led to depreciation

Measures of Imbalances and International Reserve Adequacy

- Measures of the external balance position
  - *Net External Position* as % of GDP
  - *Current Account* as % of GDP
  - *External Debt* as % of GNI
  - *Gross Financing in International Capital Markets* as % of GDP
  - *Real Effective Exchange Rate*
- Measures of the adequacy of foreign reserve holdings
  - *Total Reserves* as % of external debt
  - *Short-Term Debt* as % of Reserves
  - *Total Reserves over value of a Month of Imports*
  - *M2* as % of Total Reserves minus Gold
  - *M2* as % of Central Bank Foreign Assets

Macroeconomic Policies

- Easy monetary policy
  - Taylor-rule indicated Fed Funds rate below levels consistent with 2% inf. target 2003-2006
  - "Greenspan put" exacerbated asset appreciation [de Long (2009)]
- Lax fiscal policy
  - Countries pursued unsustainable deficits
  - Poor fiscal positions hindered counter-cyclical policies during crisis [Buiter (2009)]

Macro Policy Measures included

- Monetary policy
  - *Currency Union* dummy
  - *Aggregate GDP of Monetary Zone*
  - *EU, but not EMU* dummy
  - *Inflation Targeter*
  - *M2* as % of GDP
  - *M3* as % of GDP
- Fiscal policy
  - *Government Budget Surplus/Deficit* as % of GDP
  - *Central Government Debt* as % of GDP
  - *Total Debt* as % of GDP
  - *Debt Service Burden* as % of GDP.
- Macro conditions
  - *CPI inflation*
  - *GDP growth*

Institutional Features

- Inferior institutional features associated with greater macro volatility [e.g. Acemoglu, et al (2003)]
- Measures of institutional quality
  - *EFW index of Credit/Labor/Business Regulation*
  - *Polity* index
  - *Constraints on the Executive* (Polity data set)
  - *Overall Economic Freedom*
  - *Common Law* dummy
  - *Control of Corruption* index
  - *Regulatory Quality* index
  - *Rule of Law* index
  - *Political Rights* index
  - *Civil Liberties* index
  - *Government Size*
  - *Security of Property Rights* (EFW index)
  - *Sound Money Access* (EFW index)

Geography

- Geographic features may have played a role in relative performances
  - Ex.: Iceland proximity to UK and Neth. enhanced expansion of its financial sector
- Geography controls
- *Log of Latitude*
- *East Asian* dummy
- *Central/Eastern Europe, Central Asian* dummy
- *Commodity Exporter* dummy
- *English Speaking* dummy

Empirics

Methodology

- International cross section
  - All information *country-specific* initially
    - Then add Linkages between countries *ignored* (contagion)
  - National characteristics may influence vulnerability to foreign shocks (medical analogy)

Empirical Strategy

- As crisis hit all types of countries, we include both developed and EMEs
  - All countries >$10,000 per capita GDP
  - All countries >$4,000 per capita GDP, plus population > 1 million
  - Maximum of 107 countries in sample
- Use only publicly-available series available for reasonable span of countries, time
  - Necessary to be part of EWS

Differences in Crisis Severity (Manifestations/Consequences)

- Crisis intensity only observed with error [e.g. Berg, et al (2004)]
  - Abundant measurement error likely
- We therefore model severity as a latent variable linked to four observable indicators **for 2008**
  1. GDP growth (%)
     - Insensitive to using 2009 growth (collected in 3/09, 9/09)
  2. Change in National Equity Markets (stocks, %)
  3. Change in multilateral SDR exchange rate (%)
  4. Change in *Institutional Investor* credit rating
     - March 2008 - March 2009
     - Also use *Euromoney* index to check robustness

Table 1: Consequences and Manifestations of the Crisis
(Bottom Quartile)

% Changes, 2008:	Real GDP	II Rating	Stock Market	Price of SDR
Iceland	-4.7	-32.5	-90.0	90.0
Ukraine	2.1	-12.1	-74.3	48.6
Estonia	-2.8	-9.4	-63.0	1.7
Argentina	6	-13.6	-49.8	6.9
Latvia	-4.6	-8.3	-55.1	-.3
Ireland	-2.8	-7.8	-66.1	3.1
Korea	2.6	-7.3	-40.7	30.9
New Zealand	-.9	-5.4	-37.4	30.4
UK	.7	-5.5	-31.5	33.9
Hungary	.4	-7.6	-53.2	6.1

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Latvia	-4.6	-8.3	-55.1	-.3
Ireland	-2.8	-7.8	-66.1	3.1
Korea	2.6	-7.3	-40.7	30.9
New Zealand	-.9	-5.4	-37.4	30.4
UK	.7	-5.5	-31.5	33.9
Hungary	.4	-7.6	-53.2	6.1
Luxembourg	.6	-2.6	-59.5	3.1
Denmark	-.9	-2.6	-48.6	1.5
Singapore	1.2	-3.8	-48.9	-2.7
Swaziland	2.7	-2.6	3.9	33.2
Finland	1.4	-2.6	-53.4	3.1
Japan	-.5	-5.7	-42.1	-22.4
France	.7	-2.6	-42.7	3.1
Netherlands	2	-2.5	-52.3	3.1
Thailand	3	-3.5	-47.6	1.3
Poland	4.8	-1.5	-51.1	18.6

Bottom quartile — Iceland through Hungary

Upper quartile — Luxembourg through Poland

Preliminary Factor Analysis

- Extract a common component from four observables
- Estimate a single factor using factor analysis
- Default factor estimated using principal factors with regression scoring
- Three alternatives for sensitivity analysis
  - *Euromoney* credit rating substituted
  - Drop exchange rate
  - Maximum likelihood estimation

Table 2: First Principal Factor
(bottom quartile)

	Default	EuroMoney not II	Drop Exchange Rate	MLE Estimate
Iceland	-5.5	-3.3	-4.2	-6.7
Ukraine	-1.9	-.7	-1.4	-2.0
Estonia	-1.1	-2.	-1.4	-1.4
Argentina	-1.1	.4	-.9	-2.3
Latvia	-1.0	-1.5	-1.3	-1.1
Ireland	-1.0	-1.2	-1.2	-1.0
Korea	-.9	-.1	-.4	-.9
New Zealand	-.8	-1.0	-.5	-.5
UK	-.7	-.8	-.3	-.5
Hungary	-.7	-1.2	-.8	-1.0

Results

- Variables strongly positively correlated with each other and obtain similar rankings
- List of countries hit hard by crisis plausible
  - Iceland
  - Baltics and Eastern Europe (Estonia, Latvia, Lithuania, Hungary, Ukraine)
  - Others: Korea, Ireland, UK
- Some surprises
  - Japan characterized as unaffected
    - Exchange rate performance subsequent to carry trade unwinding
  - Provides initial caution about heterogeneity
    - Difficult to quantify crises mechanically – well-known but forgotten

Incidence and causes: First pass

- Link cross-country estimates of incidence to potential causes

- To avoid endogenity as much as possible, restrict causal data **to 2006** or earlier

- Begin by comparing principal factor against size and income
  - Repeat with alternative measures

Crisis Intensity Weakly Linked to Size

Default

Euromoney, not II

Drop Exchange Rate

Maximum Likelihood, not PF
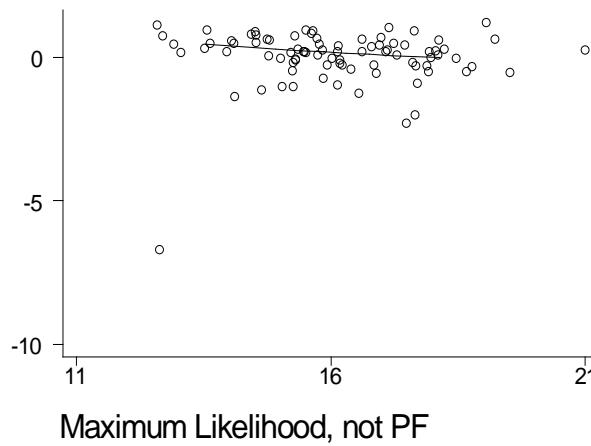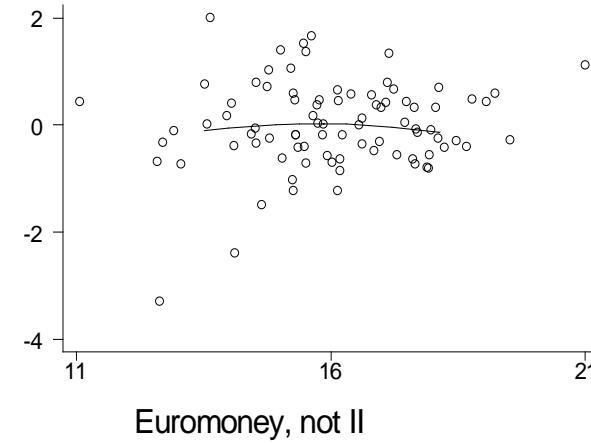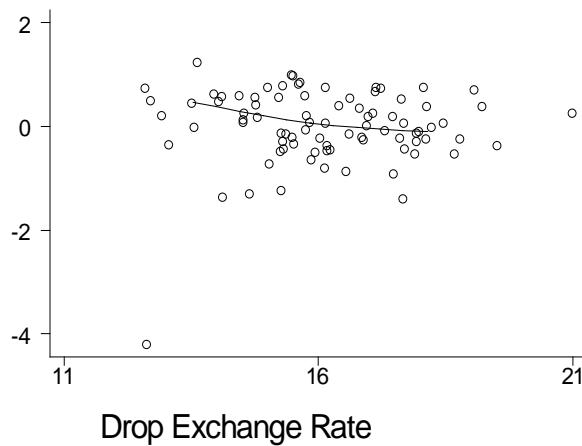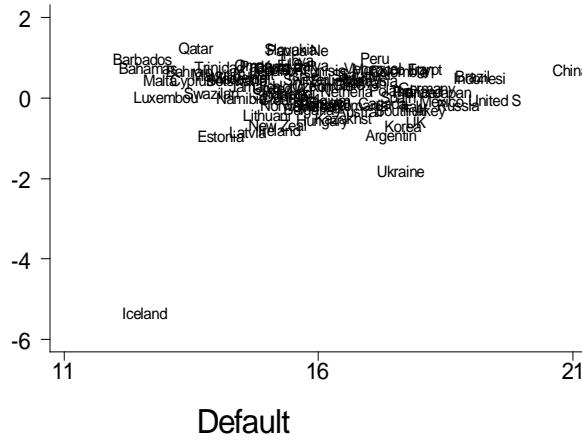
Principal factors (y) against log Population (x)

Stronger *Negative* Correlation with Income
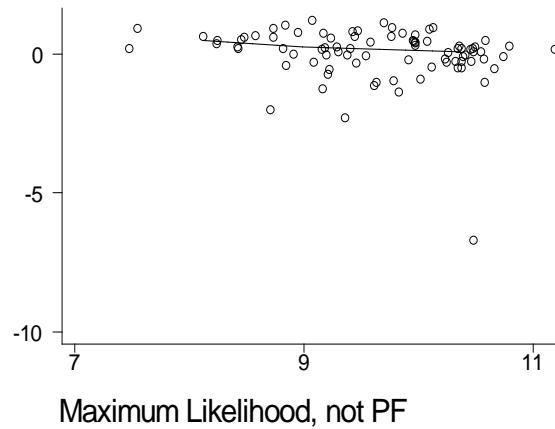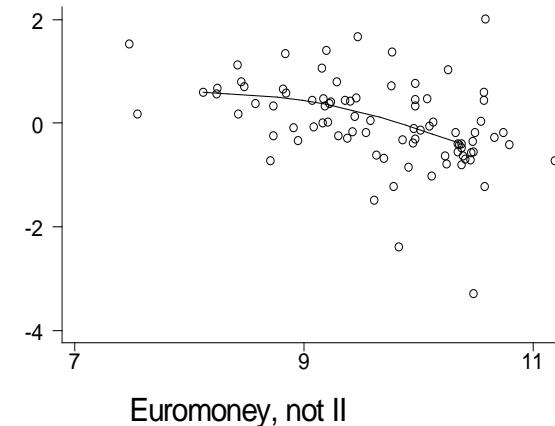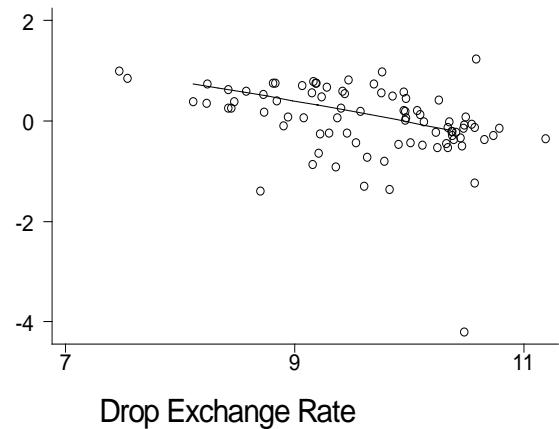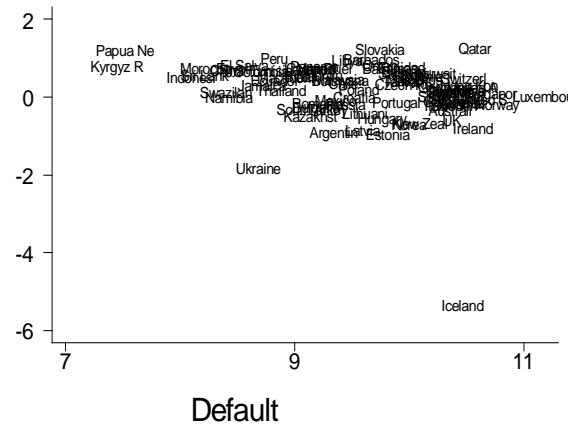
Principal factors (y) against log real GDP per capita (x)

Table 3: Regressions of Principal Factor on Size and Income

Crisis Measure:	Default	EuroM	No ER	MLE	Default	Default
Log (2006 Population)	-.01	.01	-.02	-.00		.03
	(.08)	(.05)	(.06)	(.10)		(.08)
Log (2006 Real GDP per capita)	-.28**	-.44**	-.37**	-.26**		-.38**
	(.08)	(.08)	(.07)	(.10)		(.10)
OECD Dummy					-1.08**	
					(.24)	
High-Income, non-OECD Dummy					-.22*	
					(.09)	
Developing East Asia, Pacific Dummy					-.13	
					(.16)	
Developing Eastern Europe, Central Asia Dummy					-.93**	
					(.19)	
Developing Latin American, Caribbean Dummy					-.23	
					(.14)	
Developing South Asia Dummy					-.17**	
					(.03)	
Developing Sub-Saharan Africa Dummy					-.58**	
					(.15)	
Stock Market Growth, 2003-6						-.23
						(.12)

Principal Factor Regression Results

- Income robustly enters negatively
  - Intuitive: rich countries hit badly
- Size insignificant
- Eastern Europe countries worst hit
- Also obtain significant negative coefficients for Sub-Saharan and developing South-Asia

MIMIC model

- MIMIC model consists of two sets of equations:

$$y_{i,j} = \beta_j \xi_i + \upsilon_i \qquad (1)$$

$$\xi_i = \gamma_k x_{i,k} + \zeta_i \qquad (2)$$

where $y_{i,j}$ is crisis indicator, $x_{i,k}$ is an observation for potential crisis cause; ξ_i is latent variable representing severity of the crisis (or lack thereof in our case), and υ_i and ζ_i are well-behaved disturbances

- Equation (1) links observable *manifestations* of the crisis to latent variable

- Equation (2) links latent variable to *causes* of crisis

Characteristics of MIMIC Model

- Substitute (2) into (1), eliminate latent variable
- MIMIC model is then a system of J equations with right hand sides restricted to be proportional
- With normalization, system is identified
  - We normalize on equity returns
- Desirable feature of MIMIC model is ability to systematically address measurement error
- Estimate with STATA using GLLAMM model [Rebe-Hesketh, et al (2004)]

Table 4: MIMIC Model Estimates with Only Size and Income as Causes

	Default	**Euromoney instead of Institutional Investor**	**Drop SDR Exchange Rate**
Log(2006 Population)	-.98 (.95)	-1.05 (.98)	-2.08 (1.12)
Log(2006 Real GDP per capita)	-7.79** (2.44)	-7.80** (2.46)	-10.1** (2.66)

MIMIC Results: How Easily Can One Model the Causes of the Crisis?

Methodology

- First, add each potential additional causal variable one at a time
- Size and income included throughout
- Also include four columns of sensitivity analysis
  - Euromoney index
  - Drop exchange rate depreciation
  - Alternative MIMIC model estimator
    - (replace adaptive quadrature with Gauss-Hermite quadrature)
  - Substitute income and regional dummies for size and income

Table 5: Add Causes to the MIMIC Model, One by One

Extra Cause	Default	Euromoney, not II	Drop Exchange Rate	Different Estimator	Region/Income Dummies
Financial Policies					
Overall Capital Stringency, 2003	1.87 (1.40)	1.26 (1.31)	.82 (1.35)	1.04 (1.22)	1.00 (1.25)
Capital Regulatory Index, 2003	1.19 (1.25)	.78 (1.42)	.84 (1.19)	.51 (1.26)	-.55 (1.11)
Official Supervisory Power, 2003	.62 (.61)	-.0006 (.0010)	.13 (.61)	.65 (.51)	-.0004 (.0007)
Ability to Take Prompt Corrective Action, 2003	.70 (.91)	.58 (.81)	.16 (.87)	.66 (.78)	1.57** (.54)
Restructuring Power, 2003	1.11 (2.41)	.98 (2.40)	.68 (2.26)	1.85 (1.94)	2.01 (2.22)
Declaring Insolvency Power, 2003	-1.65 (3.06)	-1.70 (3.05)	-1.84 (2.95)	-.34 (3.71)	-.25 (2.80)
Credit Market Regulation, 2006	.35 (2.44)	.65 (2.47)	1.38 (2.59)	.45 (2.31)	3.74 (2.16)
Private Bank Ownership, 2006	.04 (.94)	.11 (.95)	.30 (1.12)	.04 (.95)	1.38 (.84)
Foreign Bank Competition, 2006	.81 (1.63)	.87 (1.64)	1.77 (1.69)	1.05 (1.49)	1.13 (1.52)
Interest Rate Controls/negative real interest rate, 2006	.72 (2.82)	.83 (2.86)	.48 (3.08)	-.55 (2.52)	1.22 (2.48)

Table 5: Continued

Extra Cause	Default	Euromoney, not II	Drop Exchange Rate	Different Estimator	Region/Income Dummies
Financial Conditions					
Domestic Credit Private Sector, %GDP 2006	-.06 (.05)	-.05 (.04)	-.05 (.04)	-.05 (.03)	-.091* (.045)
Domestic Bank Credit, %GDP 2006	-.06 (.04)	-.06* (.03)	-.02 (.04)	-.056* (.025)	-.09* (.04)
Private Sector Credit Access, 2006	-.34 (1.66)	-.15 (1.68)	.25 (1.80)	-.28 (2.63)	.68 (1.51)
Bank Non-Performing Loans, % Loans 2006	-1.00 (.53)	-1.04 (.53)	-1.00 (.53)	-1.10* (.42)	n/a
Bank Liquid Reserves, %Assets 2006	.03 (.11)	.05 (.06)	.01 (.10)	.05 (.06)	-.06 (.08)
Bank Capital, %Assets 2006	.21 (.69)	.24 (.62)	.61 (.89)	.21 (.60)	-.19 (.76)
Bank Claims, %Deposits 2006	-9.1* (4.3)	-6.39* (2.92)	-8.53* (3.94)	-6.2* (2.7)	.01 (.01)

Table 5: Continued

Extra Cause	Default	Euromoney, not II	Drop Exchange Rate	Different Estimator	Region/Income Dummies
Asset Price Appreciation					
% Chg Real Estate Prices, 2003-6	-2.96 (5.37)	-3.28 (5.41)	-11.4 (5.8)	-2.96 (5.37)	-3.42 (5.34)
% Chg Market Cap, %GDP 2003-6	-10.20** (1.99)	-10.5** (1.90)	-10.5** (2.1)	-10.6** (1.84)	-7.2** (2.0)
Stock Market Growth, 2006	-.06 (.10)	-.11 (.07)	-.08 (.13)	-.11 (.06)	-.03 (.08)
Market Cap, %GDP 2006	.01 (.03)	-.00 (.03)	.01 (.04)	-.00 (.03)	-.02 (.03)
Stocks Traded, %GDP2006	.02 (.03)	.02 (.03)	.02 (.03)	.02 (.03)	-.02 (.03)

Table 5: Continued

Extra Cause	Default	Euromoney, not II	Drop Exchange Rate	Different Estimator	Region/Income Dummies
International Imbalances					
Net External Position, %GDP 2004	4.23 (2.58)	5.07* (2.11)	3.36 (2.66)	5.07* (2.12)	2.1 (3.6)
Current Account, %GDP 2006	.56** (.17)	.57** (.18)	.41** (.17)	.54** (.16)	-.08 (.16)
Debt Service, % Exports 2006	-.17 (.42)	-.17 (.41)	-.36 (.38)	-.01 (.16)	n/a
External Debt, %GNI 2006	-.01 (.18)	-.01 (.17)	n/a	.24** (.06)	n/a
Gross Financing via international capital markets, % GDP 2006	2.32** (.31)	.0000 (.0002)	-.84 (.63)	2.20** (.31)	n/a
Real Effective Exchange Rate 2006 (2000=100)	-.22 (.13)	-.22 (.13)	-.23 (.15)	-.19 (.10)	n/a
Total Reserves, %external debt 2006	-.00 (.01)	-.028** (.007)	.01 (.01)	-.002 (.004)	-.013* (.005)
Short-Term Debt, %Reserves 2006	.36** (.08)	.00010* (.00002)	-.10 (.10)	.13** (.03)	.36** (.04)
Total Reserves, import months 2006	.36 (.43)	.40 (.33)	.14 (.38)	.40 (.35)	-.15 (.36)
M2, %(total reserves–gold) 2006	0	-.000001 (.00003)	.26 (.17)	-.00001 (.00006)	.02 (.14)
M2, %(Central Bank foreign assets) 2006	1.7e-7 (1.6e-6)	0	.09 (.05)	0	.-02 (.05)

Table 5: Continued

Extra Cause	Default	Euromoney, not II	Drop Exchange Rate	Different Estimator	Region/Income Dummies
Macroeconomic Policies					
Currency Union member, 2006	9.1 (5.1)	11.9* (4.4)	5.15 (4.97)	12.2** (4.23)	-.01 (.01)
GDP of Monetary Zone, 2006	-2.9e-13 (2.7e-13)	-3.0e-13 (2.0e-13)	0	2.9e-13 (2.7e-13)	-2.2e-13 (1.6e-13)
EU but non-EMU Member, 2006	-10.8 (5.8)	-11.4* (5.1)	-14.2** (5.1)	-10.6* (5.4)	-10.6* (5.3)
Inflation Targeter, 2006	.02 (.02)	.02 (.03)	.57 (4.9)	.02 (.02)	-5.9 (8.6)
M2, %GDP 2006	-9.8e-7 (6.3e-6)	n/a	-.00 (.05)	-.00002 (.00002)	-.04 (.06)
M3, %GDP 2006	-8.3e-7 (4.7e-6)	-1.1e-6 (6.1e-6)	-.01 (.05)	-.00001 (.00004)	n/a
Gov't Budget Surplus/Deficit, % GDP 2006	.22 (.52)	.23 (.52)	.12 (.52)	.65* (.31)	-.34 (.49)
Central Gov't Debt, %GDP 2006	-.01 (.07)	-.01 (.08)	-.03 (.08)	-.02 (.07)	-.00 (.09)
Debt, %GNP 2006	.09 (.20)	.08 (.20)	-.35** (.13)	.22** (.06)	n/a
Debt Service, % GDP 2006	-1.81* (.71)	-1.76* (.70)	-.97 (.56)	-2.61** (.29)	n/a
CPI Inflation, 2006	.32 (.72)	.36 (.72)	.11 (.69)	-.18 (.65)	.46 (.70)
GDP Growth, 2006	-.15 (.74)	-.10 (.74)	-1.25 (.81)	-.72 (.61)	-.29 (.81)

Table 5: Continued

Extra Cause	Default	Euromoney, not II	Drop Exchange Rate	Different Estimator	Region/Income Dummies
Institutions					
Credit/Labor/Business Regulation, EFW 2006	2.14 (2.73)	2.39 (2.75)	3.41 (2.82)	1.04 (2.33)	3.52 (2.20)
Polity, 2006	-.25 (.33)	-.36 (.24)	-.35 (.26)	-.34 (.23)	-.39 (.39)
Constraints on Executive, 2006	-1.58 (1.12)	-1.57 (1.12)	1.58 (1.12)	-1.49 (.89)	-1.75 (1.29)
Overall Economic Freedom, 2006	2.64 (1.53)	3.34 (3.61)	3.90 (3.77)	1.75 (2.92)	2.78 (3.09)
Common Law Country	2.98 (4.79)	5.57 (10.31)	8.49 (4.72)	3.21 (8.17)	.002 (.004)
Control of Corruption	.56 (3.34)	.44 (4.40)	6.20 (3.47)	-.35 (4.48)	-3.8 (4.8)
Regulatory Quality	.88 (3.53)	1.09 (4.98)	.21 (3.7)	1.27 (4.72)	-.97 (3.4)
Rule of Law	-.51 (3.80)	-.68 (3.80)	2,77 (3.98)	-.11 (4.30)	-3.40 (3.36)
Political Rights, 2006	1.22 (1.12)	1.24 (1.12)	.92 (1.15)	1.58 (.93)	1.36 (1.26)
Civil Liberties, 2006	1.36 (1.35)	1.40 (1.35)	.88 (1.38)	1.47 (1.08)	1.08 (1.49)
Government Size, 2006	2.64 (1.53)	2.85 (1.53)	3.26* (1.59)	2.69 (1.64)	1.68 (1.41)
Legal Security of Property Rights, 2006	.03 (2.24)	.21 (2.26)	1.33 (2.33)	-.04 (1.57)	-.15 (2.07)
Sound Money Access, 2006	-.24 (2.02)	-.20 (2.05)	-.78 (2.18)	.56 (1.71)	.80 (2.00)

Table 5: Continued

Extra Cause	Default	Euromoney, not II	Drop Exchange Rate	Different Estimator	Region/Income Dummies
Geography					
Log of Latitude	-4.8 (2.5)	-5.67* (1.95)	-7.54** (2.70)	-5.7** (1.9)	-.56 (2.45)
East Asian	3.9 (6.8)	.75 (7.9)	-3.6 (6.65)	-.004 (.003)	n/a
Central/Eastern European or Central Asian	-16.7** (5.2)	-16.9** (5.4)	-22.0** (4.73)	-16.2** (5.3)	n/a
Commodity Exporter	1.5 (4.7)	.73 (4.55)	5.58 (4.37)	-1.9 (4.8)	1.67 (4.11)
English Language	6.23 (4.71)	6.33 (4.70)	12.8** (4.3)	8.46 (6.76)	4.37 (4.61)

Table 6: Adding Causes to the MIMIC Model *Simultaneously*

Extra Cause	Default	Without ST Debt	Drop Poor (GDP p/c<$5k)	Drop Small (Pop<1m)
Financial Policies				
Overall Capital Stringency, 2003	1.8 (1.9)	1.1 (1.2)	.1 (1.8)	1.8 (1.9)
Financial Conditions				
Domestic Bank Credit, %GDP 2006	.04 (.07)	.00 (.04)	.01 (.06)	.04 (.07)
Bank Claims/Deposits, 2006	9.7 (8.9)	1.7 (4.4)	10.8 (7.6)	10.8 (8.9)
Asset Price Appreciation				
% Chg Market Cap, %GDP 2003-6	-5.6* (2.4)	-6.6** (2.0)	-2.3 (2.3)	-5.6 (2.4)
International Imbalances				
Current Account, %GDP 2006	.43 (.64)	.01 (.24)	.04 (.57)	.46 (.64)
Short-Term Debt, %/Reserves 2006	-.08 (.10)		-.07 (.08)	-.09 (.10)
Macroeconomic Policies				
Currency Union member, 2006	10.9 (9.3)	-2.8 (4.9)	18.5 (9.2)	12.3 (9.2)
EU but non-EMU member, 2006	1.0 (10.4)	-9.3 (6.4)	1.1 (9.7)	1.1 (10.4)
Institutions				
Polity, 2006	.19 (.56)	-.22 (.43)	.04 (.54)	.21 (.56)
Geography				
Log of Latitude	3.6 (4.4)	1.0 (2.7)	2.8 (4.1)	4.4 (4.4)
Central/Eastern European or Central Asian	-19.8 (10.8)	-15.4* (6.9)	-37.0** (10.1)	-20.3 (10.8)
Observations	40	68	32	39

Results Disappointing and Weak

- Few potential causes are robustly significant
- In particular, real estate appreciation cause insignificant
  - Widely cited as a principal "cause of crisis"
- Same is true for almost all other causal variables
- Not just an artifact of MIMIC framework
  - Shows up in scatter plots of each category of causal variables

Financial Policy Insignificant



2008 Crisis Manifestations against Capital Regulatory Index

Stock Market Change

Depreciation against SDR

Country Credit Rating Change
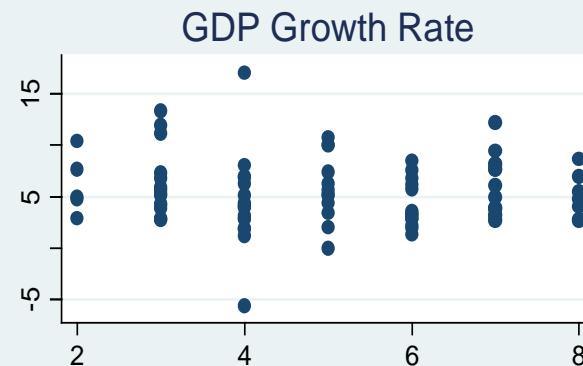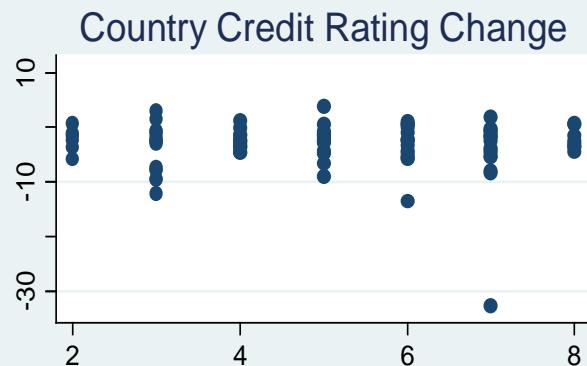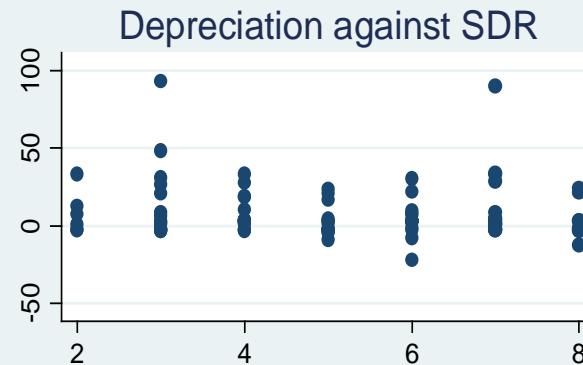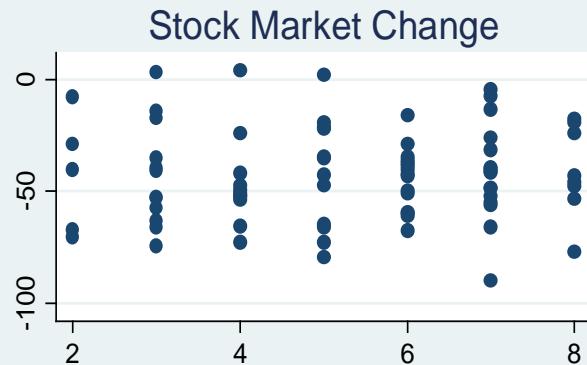
GDP Growth Rate

Barth, Caprio and Levine 2003 Capital Regulatory Index

Stock Market Run-up Does Best

2008 Crisis Manifestations against Stock Market Runup
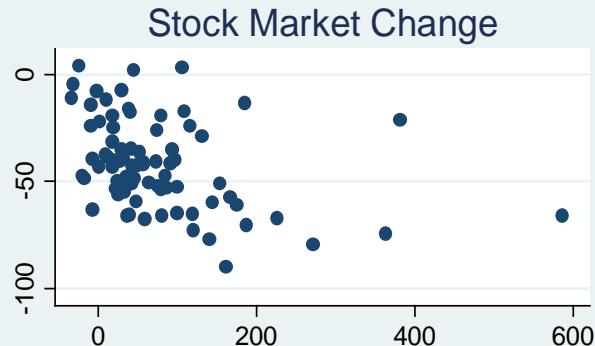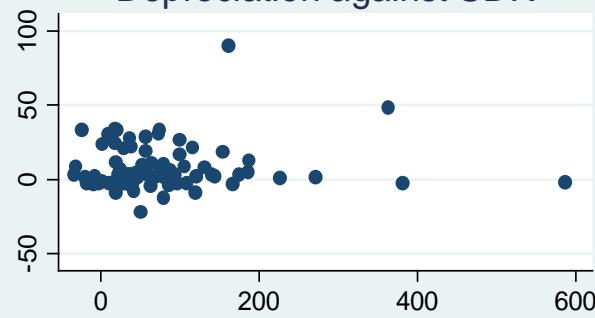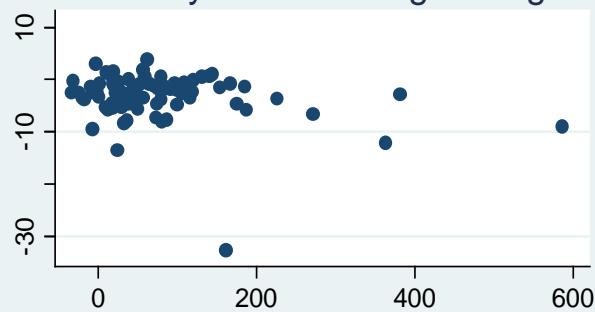
Stock Market Change — Depreciation against SDR — Country Credit Rating Change — GDP Growth Rate
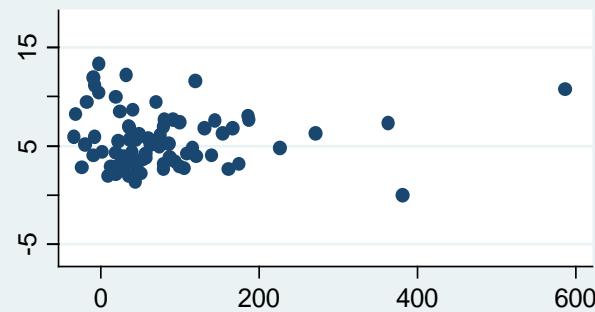
2003-06 Change in Market Capital (%GDP), WDI

Domestic Credit Growth Insignificant

2008 Crisis Manifestations against Domestic Credit Growth

Stock Market Change
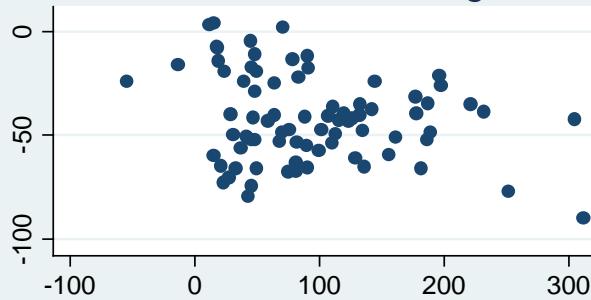
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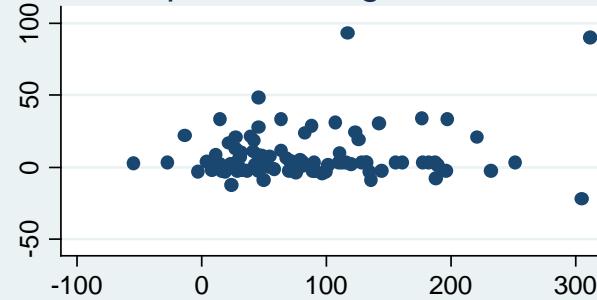
Country Credit Rating Change
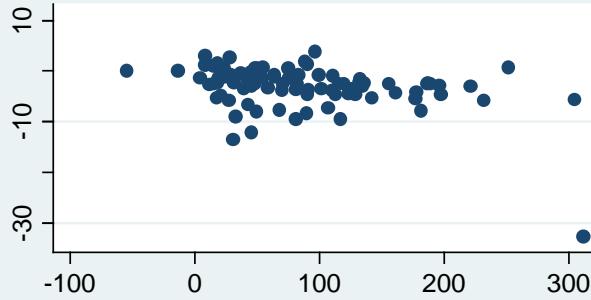
GDP Growth Rate
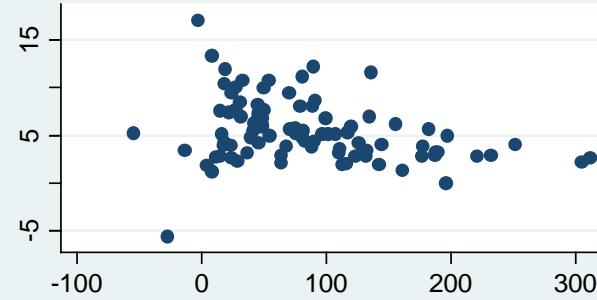
2006 Domestic Bank Credit (%GDP), WDI

Bank Claim/Deposits at 10% Confidence

2008 Crisis Manifestations against Bank Claim/Deposit Ratio

Stock Market Change — Depreciation against SDR — Country Credit Rating Change — GDP Growth Rate
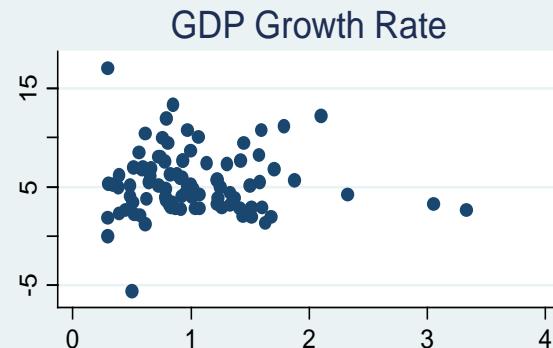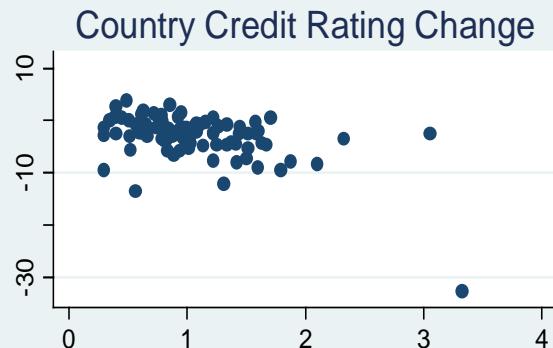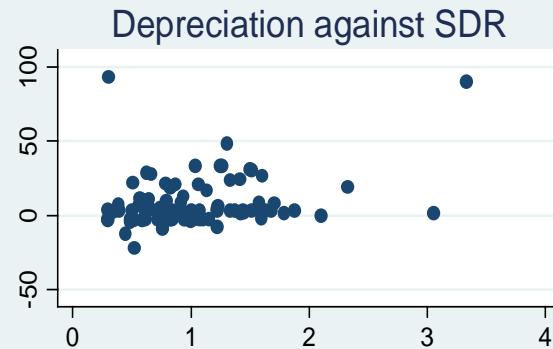
2006 Bank Claims (%Deposits), IFS

Real Estate Appreciation Insignificant

2008 Crisis Manifestations against Real Estate Price Runup

Stock Market Change · Depreciation against SDR · Country Credit Rating Change · GDP Growth Rate
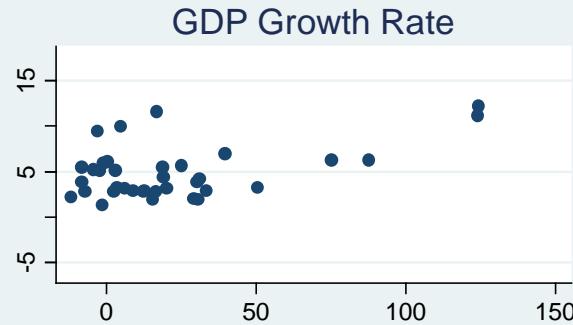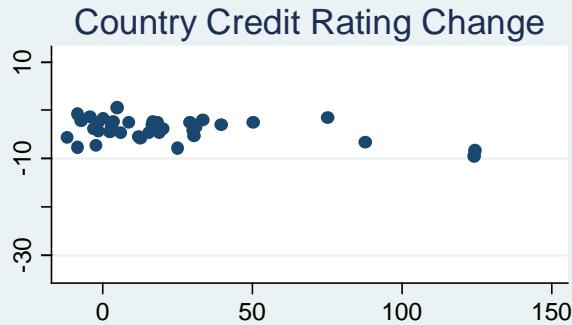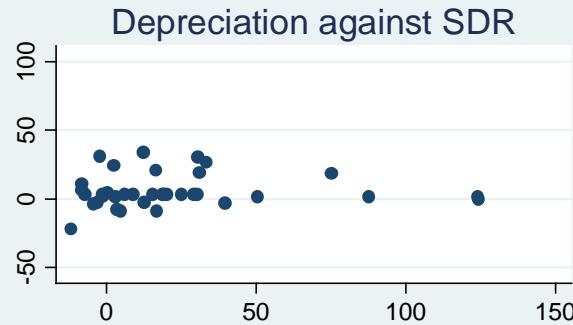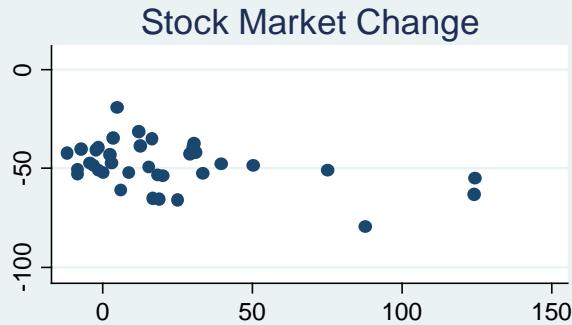
2003-06 Change in Real Real Estate Prices

Bank Leverage Insignificant

2008 Crisis Manifestations against Bank Capital Adequacy

Stock Market Change | Depreciation against SDR | Country Credit Rating Change | GDP Growth Rate
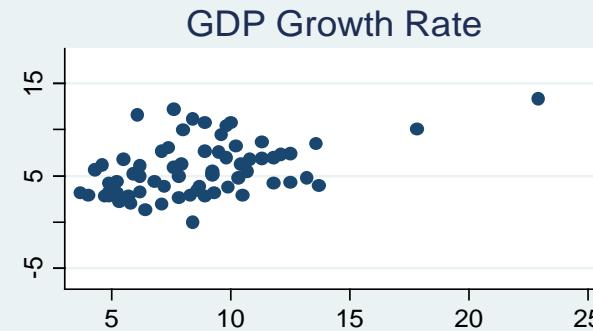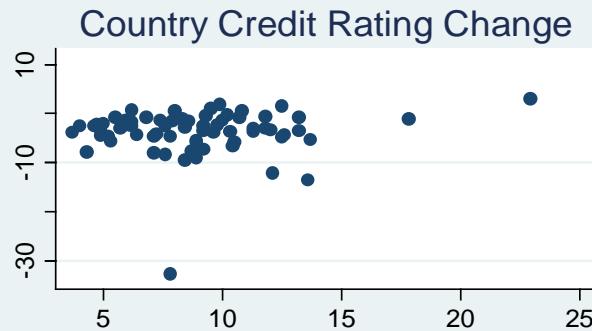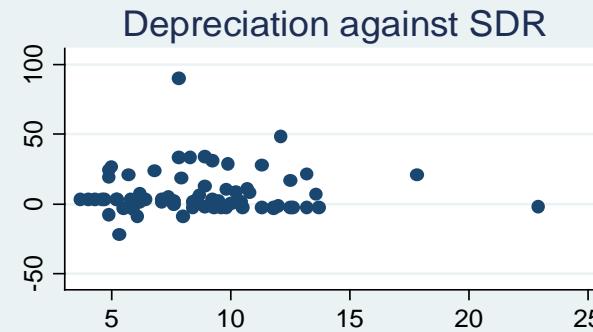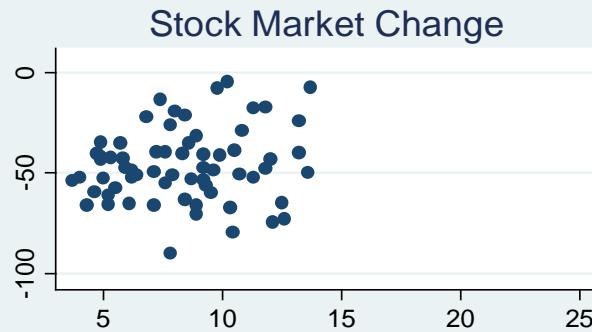
2006 Bank Capital (%Assets), WDI

Current Account Comes In, but not with regional dummies included


2008 Crisis Manifestations against Current Account
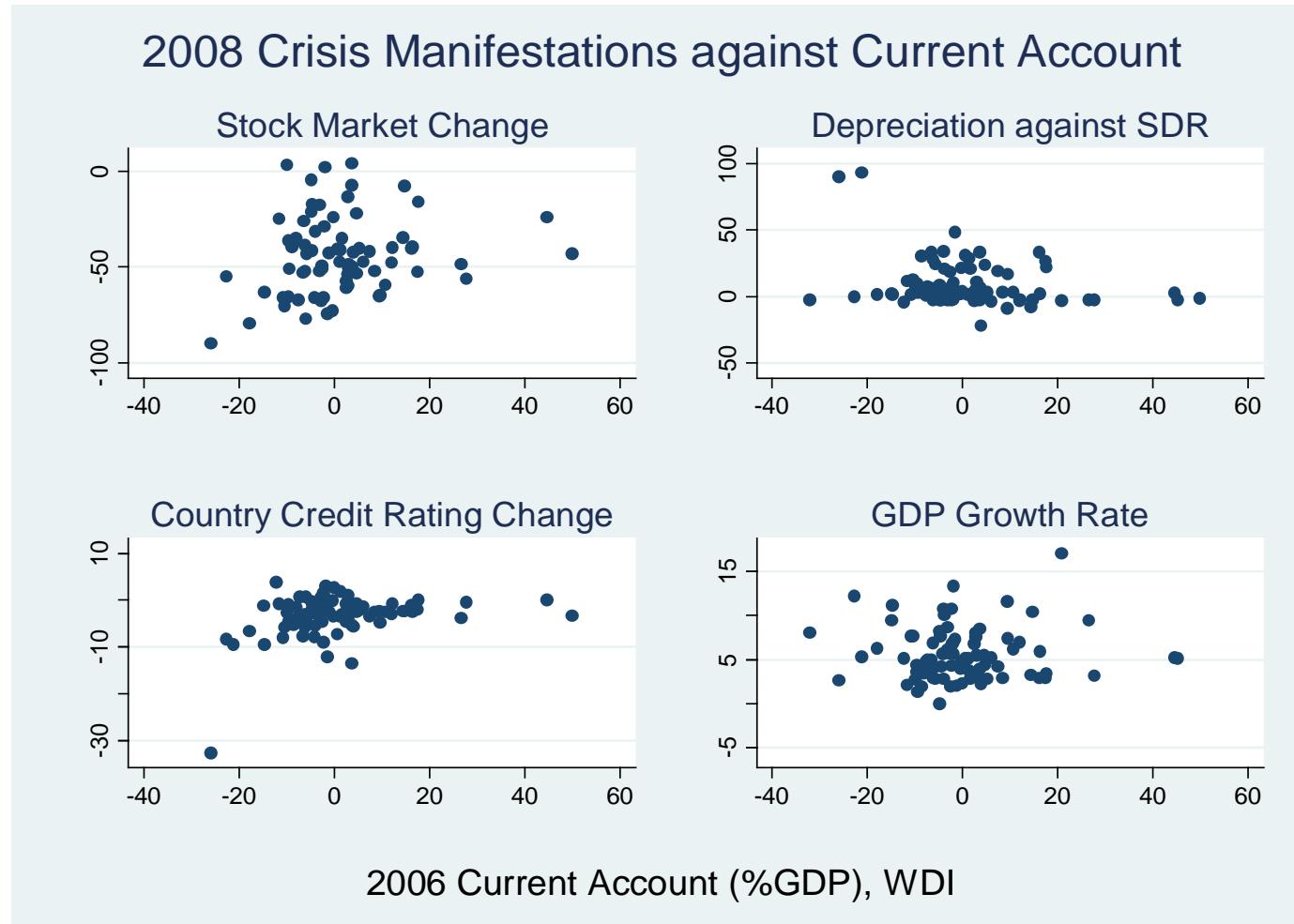
Budget Deficits Didn't Matter

2008 Crisis Manifestations against Government Budget
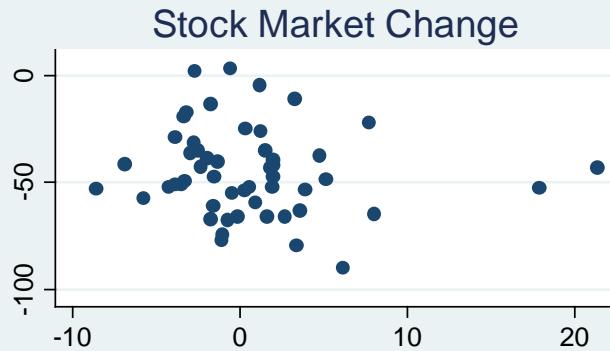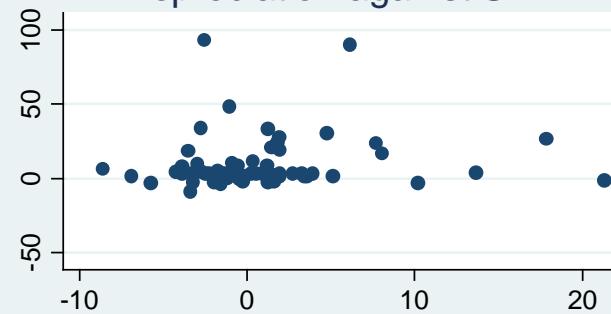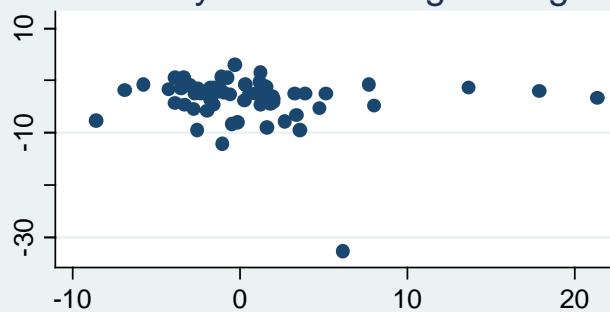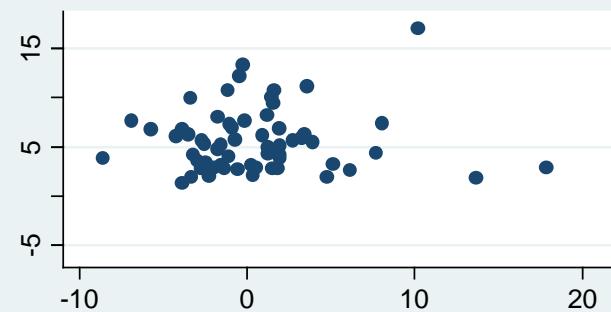
Also weak results relative to latent variable

Latent Crisis Variable against Potential Causes
2006 Causes unless noted
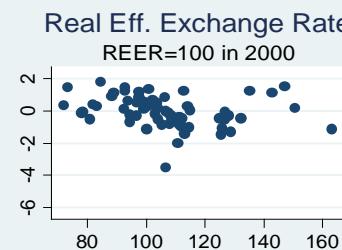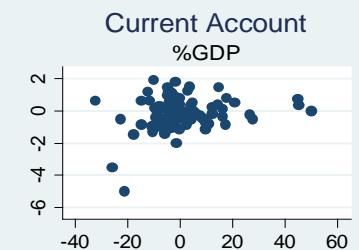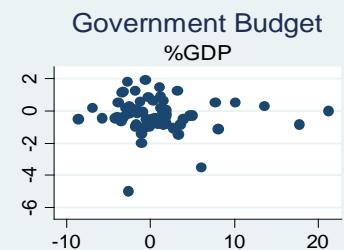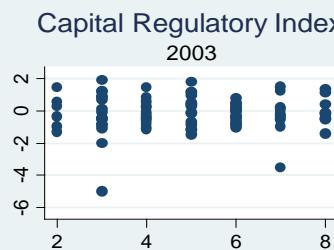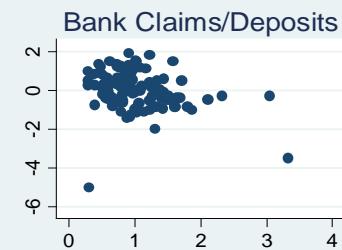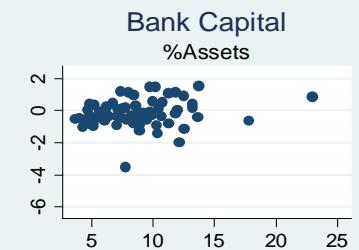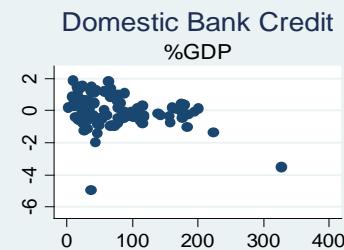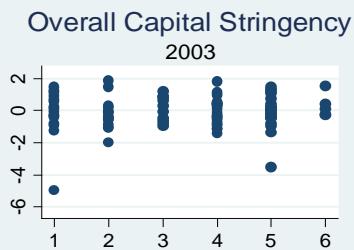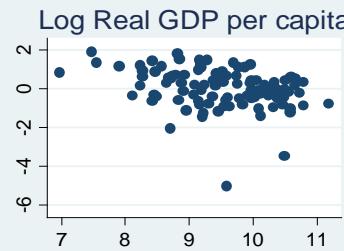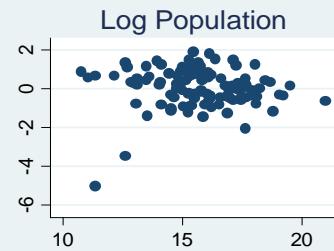
Results suggest that *Measurable* Pre-existing Conditions had Little Common Impact

- Few of the potential causes robust across slightly different specifications
- Some exceptions
  - Equity market appreciation
  - Current account deficits
  - Weaker evidence for high credit growth and banking sector leverage
- Still, these variables alone unlikely to generate acceptable EWS model
- Moreover, unlikely to dominate following these characteristics in a non-parametric way

What About Contagion/Cross-Country Influences?

Link Crisis Epi-Center to Other Countries

- Now go beyond *national* causes, allow international linkages
  - Not Simply *Common Shocks*
    - National characteristics make country more/less vulnerable to common shocks
    - Have already included *multilateral* features
  - Now incorporate *bilateral* linkages between crisis origins and other countries

Allow Two "Channels" of Linkage

- Real/Trade Channel
  - Country x devalues, gains competitiveness, induces others to devalue
    - Size of effect proportional to trade ties/GDP
    - Gerlach and Smets (1995); Eichengreen et al (1996)
- Asset Channel
  - Asset values in country x decline, others lose wealth if cross-holdings are substantial
    - Size of effect proportional to financial exposure/GDP
    - Forbes and Chinn (2004), Ehrmann and Fratzscher (2009)

Some channels stressed in literature left out

- Trade competitiveness channel
  - Country in crisis devalues, other countries lose competitiveness [e.g. Baig and Goldfajn (1999)]
  - Primary crisis impact lost export opportunities in U.S., not disadvantage in 3rd countries

- Common creditor channel
  - Crisis country defaults, weakens creditors' ability to lend to others [e.g. Kaminsky and Reinhart (2000)]
  - Crisis impacted entire global financial system

Allow for Multiple Epi-Centers

- USA seems most likely origin of crisis
  - But different possible epi-centers exist
- Allow for other potential centers:
  - UK, Germany, Spain
  - Japan, Korea in Asia
  - Small Europeans (Iceland, Ireland, Ukraine, Estonia, Latvia, and Lithuania)

(14) Measures of Trade Linkages

- Exports to USA (as proportion of all exports)
  - Also consider other epi-centers
  - Also consider 2-way trade (not just exports)

Curious Export Results

Linkage (2006)	Exposure to	Default	Drop Exchange Rate Cause	Euromoney, not II	Condition on Trade (%GDP), not size	Condition on Exports (%GDP), not size
Exports	USA	.28** (.10)	.32** (.10)	.29** (.10)	.31** (.09)	.30** (.09)
Exports	UK	-.55 (.35)	-.53 (.36)	-.66 (.35)	-.51 (.29)	.0002 (.0007)
Exports	Germany	-.42 (.25)	-.50 (.26)	-.44 (.25)	-.43 (.25)	-.45 (.24)
Exports	Japan	-.26 (.36)	-.24 (.37)	-.26 (.36)	-.27 (.34)	-.29 (.35)
Exports	Spain	.18 (.45)	.22 (.46)	.18 (.45)	.16 (.42)	.14 (.42)
Exports	Korea	.17 (.55)	.03 (.56)	.18 (.55)	-.0003 (.0008)	-.0002 (.0002)
Exports	Small Crises	-1.02** (.39)	-1.11** (.39)	-1.04** (.39)	-.91** (.35)	-.89** (.35)

Exposure to America *Helped!*

- No obvious explanation, but economically and statistically significant effect
  - Effect of Dollar Appreciation?
- Results broadly insensitive
- Export exposure to "Small Crisis" countries hurt, as expected
- Results broadly similar when total 2-way trade used instead of just exports

Similar Results for Trade

Linkage (2006)	Exposure to	Default	Drop Exchange Rate Cause	Euromoney, not II	Condition on Trade (%GDP), not size	Condition on Exports (%GDP), not size
Trade	USA	.38** (.12)	.43** (.12)	.38** (.12)	.39** (.11)	.38** (.11)
Trade	UK	-.68 (.50)	-.58 (.52)	-.69 (.51)	-.67 (.53)	-.61 (.57)
Trade	Germany	-.37 (.36)	-.45 (.26)	-.39 (.26)	-.37 (.26)	-.38 (.25)
Trade	Japan	-.36 (.44)	-.36 (.46)	-.35 (.44)	-.40 (.44)	-.45 (.45)
Trade	Spain	.21 (.49)	.21 (.51)	.20 (.50)	.20 (.42)	.22 (.42)
Trade	Korea	.05 (.74)	-.20 (.76)	.06 (.74)	.05 (.65)	-.0003 (.0004)
Trade	Small Crises	-1.29** (.48)	-1.39** (.50)	-1.30** (.49)	-1.11* (.41)	.0003 (.0003)

(29) Measures of Financial Linkage

- Share of overseas assets held in USA (as proportion of all overseas wealth)
  - Also consider other potential epi-centers
  - Also consider debt, long-term debt
  - Even more (*only for American exposure*): US TIC assets (as proportion of national *GDP*)
    - Also consider American equity/long debt/debt/treasuries/long treasuries
  - Also consider $PPG debt denominated in yen/$

Again, American Exposure *Helps!*

Linkage (2006)	Exposure to	Default	Drop Exchange Rate Cause	Euromoney, not II	Condition on C/acc (%GDP), not size	Condition on NFA (%GDP), not size
CPIS Asset Share	USA	.27* (.10)	.36** (.09)	.29* (.10)	.19* (.10)	.23* (.10)
CPIS Asset Share	UK	-.28 (.14)	-.15 (.16)	6e-6 (.00003)	-.28** (.10)	.0002 (.0002)
CPIS Asset Share	Germany	-.30 (.38)	-.68 (.38)	-.36 (.39)	-.25 (.33)	-.0007 (.0006)
CPIS Asset Share	Japan	.26 (.88)	1.02 (.95)	.32 (.91)	.0003 (.0007)	.0003 (.0007)
CPIS Asset Share	Spain	-.44 (.75)	-.70 (.88)	-.51 (.76)	-.0001 (.0003)	-.0002 (.0005)
CPIS Asset Share	Korea	.16 (1.97)	-1.01 (2.47)	.19 (1.98)	-1.06 (1.36)	.0008 (.002)
CPIS Asset Share	Small Crises	-.82 (.62)	-1.24 (.73)	-.87 (.63)	-.43 (.44)	.0001 (.0005)

Significant Result

Linkage (2006)	Exposure to	Default	Drop Exchange Rate Cause	Euromoney, not II	Condition on C/acc (%GDP), not size	Condition on NFA (%GDP), not size
CPIS Debt Share	USA	.19* (.09)	.28** (.08)	.21* (.09)	.10 (.09)	.13 (.09)
CPIS Long Debt Share	USA	-.64 (1.26)	.28** (.09)	.20* (.09)	.11 (.09)	.14 (.09)
US TIC Assets/GDP	USA	.19 (1.39)	-.04 (1.40)	.17 (1.39)	.10 (1.81)	.42 (1.61)
% PPG Debt in $	USA	.21* (.10)	.21* (.10)	.22* (.10)	.18** (.06)	.15* (.07)

Some Sensitivity, Bigger Mystery

- Why does exposure to America (most likely epi-center of 2008 crisis) seem to *help?*
  - Special Advantage of "Exorbitant Privilege"?
  - Interesting Future Research topic
- Still, results not very strong
  - Also, we *know* epi-center and timing of 2008 crisis
  - Doesn't help EWS much

Summary and Conclusion

Examine causes and consequences of 2008 financial crisis with MIMIC model

- Methodology allows us to explicitly confront fact that "crisis severity" observed with error

- Look at a broad set of potential causes commonly cited in literature

- Success in such a cross-sectional specification necessary, **but not sufficient**, condition for reliable EWS
  - Only trying to explain relative *incidence*, not *timing*

Results Disappointing for Proponents of Early Warning Systems

- We were able to model *incidence* of crisis well, but not link it to observable *causes*

- Not an artifact of MIMIC
  - Scatter plots and principal factor exercises yield similar results

- Disappointing, given voluminous analysis of causes of observed crisis

- Would be much harder *ex ante* for future crises

Why are results so weak?

- Data limitations
  - Collected in spring 2009; crisis was still developing
  - Still, measures of incidence of crisis plausible
- Focus mostly on *national* characteristics
  - Inappropriate if crisis international due to contagion or common shock – but few sensible signs of contagion when included (American exposure *helps!*)
  - Vulnerability to common shocks typically viewed as *dependent on national fundamentals*
- Causes may differ across countries
  - Japan: little financial exposure, but downturn in trade

Reasons for Failure Bode Poorly for EWS

- Difficult to create EWS model that accounts for global shocks or contagion
  - Need successful model
  - Don't know where next global shock will originate
- Also difficult for EWS models to allow for parameter heterogeneity across groups of countries
  - Ehrmann, et al (2009) demonstrate that exposure to U.S. partly explains (negatively) performance of equity portfolios in crisis
  - But difficult to identify idiosyncratic vulnerabilities in advance
- Since crisis still ongoing, would characterize as "early warning" about ability of EWS to predict performance in similar crises