

# Sovereign Risk and Bank Lending: Evidence from 1999 Turkish Earthquake

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- Sovereigns mostly borrow from their own citizens
- Sovereign crises and banking crises coincide
- A causal relationship might run from banks to sovereigns, where public sector intervenes after a banking crisis, putting its own solvency at risk
  - Iceland and Ireland.
- A causal relationship might also run from sovereigns to banks, where sovereign distress impact bank performance and loan supply
  - Greece.

Hard to pin down the direction of causality at the time of the crisis.

- Much Studied: Correlation between sovereign and bank CDS spreads.  
Sovereign debt crisis transmission across borders via global banks.
- Less Studied: Transmission of sovereign risk to real-own-sector via banks.

Once crisis unfolds (default and recession is expected):

Hard to dissect the sovereign-bank doom loop

- Banks can buy more government debt in the expectation of a bail out (moral hazard or reach for yield)
- Banks can get rid of the bonds
- Banks can anticipate low demand from private sector and switch to government bond market in advance

# Our approach: An unanticipated exogenous fiscal shock

- Use a natural disaster as a fiscal shock
- The fiscal shock is such that it leads to an increase in sovereign risk without affecting the macroeconomy in general

**Using an exogenous fiscal shock delivers estimates for the effect of public debt on financial sector performance where these estimates are free from endogenous—to the shock—portfolio choice of the banks.**

- 1 Sovereign and Banking Crises: Reinhart and Rogoff (2009); Borensztein, Eduardo, and Panizza (2009)
- 2 Sovereign-Bank Loop/Credit Supply: Holmstrom and Tirole (1998); Broner, Martin, and Ventura (2010); Aguiar and Amador (2013); Tomz and Wright (2013); Gennaioli, Martin and Rossi (2014a); Gennaioli, Martin and Rossi (2014b); Bofondi, Carpinelli, Lauren and Sette (2013); Brutti, and Saure (2013); Perez (2014); Jorda, Schlurick, and Taylor (2014)
- 3 Bailout/Risk Taking: Uhlig (2013); Acharya, Drechsler and Schnabl (2014); Acharya and Steffen (2014)

# 1999 Marmara Earthquakes: A Rare Disaster and A Big Fiscal Shock

- August 17, 1999; November 12, 1999: Two big earthquakes (7.6, 7.2) hit industrial heartland of Turkey: Kocaeli, Istanbul, Bursa, Sakarya, Yalova, Duzce, Bolu
- Marmara region's share in:
  - Population: 25 percent
  - GNP: 35 percent
  - Industrial production: 50 percent
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- Total cost is 20 billion USD: 11-12 percent of GDP as of 2000.



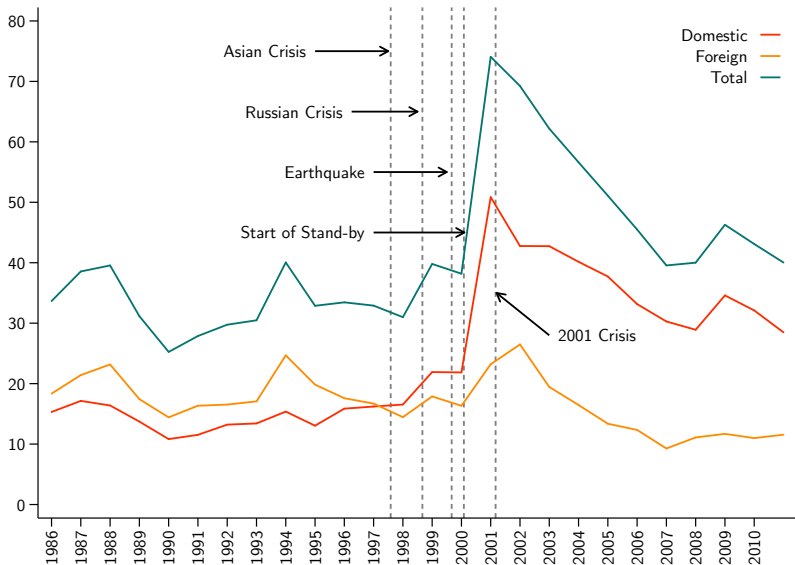
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- Ratio of damaged buildings (including key industrial/chemical factories) is 4 times higher than 1995 Kobe earthquake and 12 times higher than 1994 Northridge earthquake

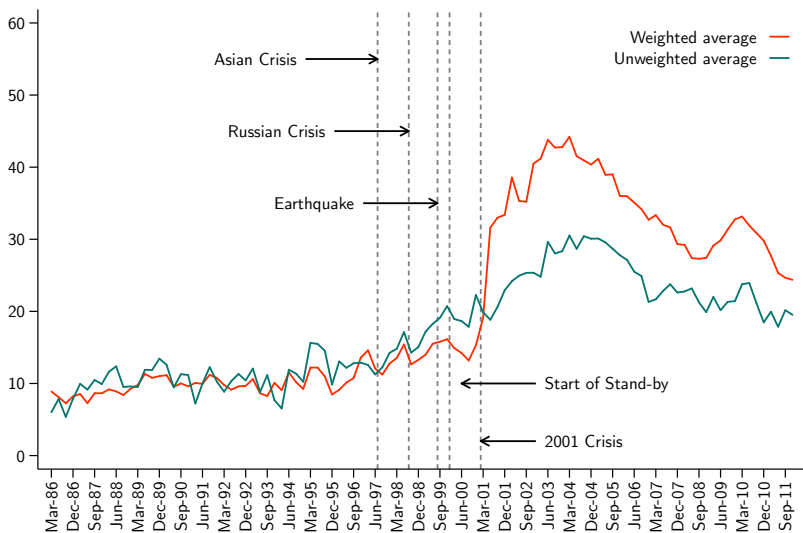
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- Top ten in the U.S. Department of Commerce Significant Earthquakes database

# Debt to GDP (%)

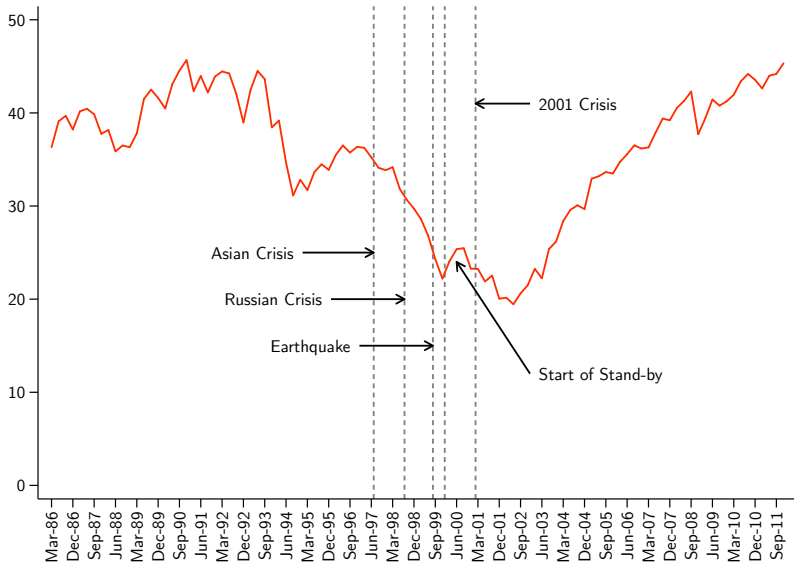


# Bank Exposure to Government Debt (% of Banks Assets)



Weighted average is the Ratio of Total Government Securities Held By Banks to Total Bank Assets, and unweighted average is the Average Ratio in Banks' Total Assets.

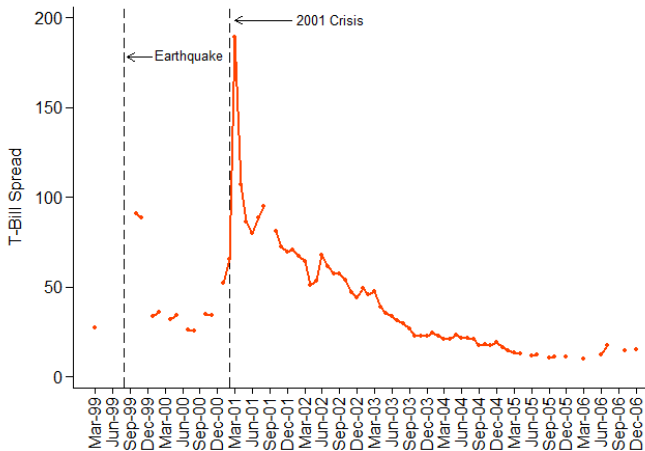
# Crowding Out of Private Sector Credit (Private Sector Loans/Government Bonds)



# Three Piece of Evidence for the Increase in Sovereign Risk

- Increasing spreads
- Increasing interest rates on T-Bill auctions
- Increasing share of short-term borrowing

# Increase in Sovereign Risk I: Spreads



# Increase in Sovereign Risk II: Interest Rates

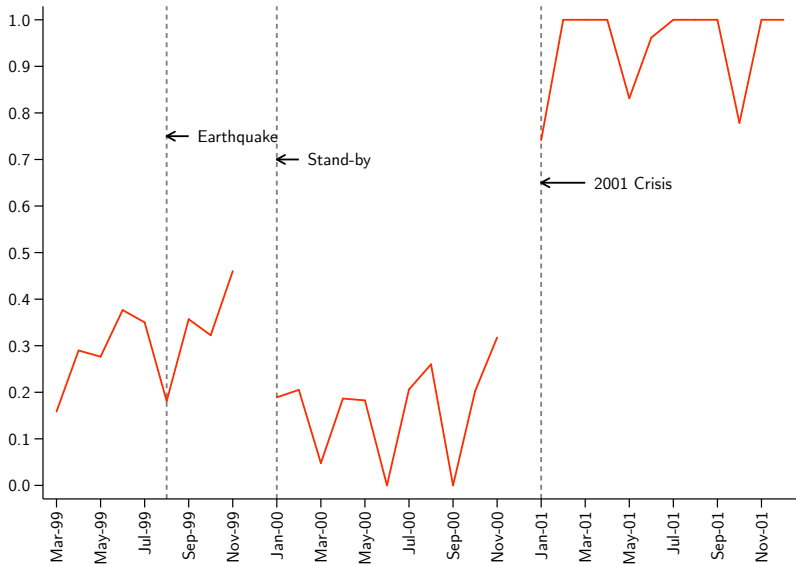
Table: Sovereign risk

	(1)	(2)	(3)
	Compounded Interest Rates on Government T-Bill Auctions (Percent)		Turkish Bond-Spreads
	For Bills with Approximately 550 Days to Maturity	For Bills with Approximately 1,050 Days to Maturity	EMBI+
July 1999	117.71	119.91	564
August 1999	123.80	127.62	665

Notes: Columns 1 and 2 show the annual compounded interest rates on auctions for 3-month coupons for floating rate government bonds of approximately 550 and 1050 days to maturity. Column 3 are the end-of month basis-point value of EMBI+ spread for Turkey.



# Increase in Sovereign Risk III: Share of Short Term Borrowing



- Universe of banks in Turkey
- Universe of Government Debt Market
- Monthly balance sheets showing all government debt exposure and private credit provision, both with respect to domestic and foreign currency and the source of borrowing and lending (domestic vs. external).
- Confidential items such as securities portfolios
- Collected via compulsory reportings of banks to Central Bank of Turkey and Banking Regulation and Supervision Agency as of last business day of each month.
- Long time series: 1986–2011 (Monthly after 1997)

# Framework: Multi-Period Version of Khawaja-Mian, 2008

Given  $\alpha_B$ , MC of bond financing,  $D_{it}$ , deposits, and marginal return on loan  $r - \alpha_L L_{it}$  and one time credit supply and demand shock:

$$L_{it} = \frac{1}{\alpha_L + \alpha_B} \bar{\eta} + \frac{\alpha_B}{\alpha_L + \alpha_B} D_{it} + \frac{1}{\alpha_L + \alpha_B} \eta_{ijt} + \frac{1}{\alpha_L + \alpha_B} \alpha_j$$

$$\begin{aligned} L_{it} &= \alpha_j + \lambda_t + \omega_{iq} \\ &+ \beta_1 \text{Gov Debt Exp}_{it-1} + \beta_2 \text{Earthquake}_t \times \text{GovDebtExp}_{it-1} \\ &+ \beta_3 X_{it-1} + \epsilon_{it} \end{aligned}$$

- $\alpha_j$ : Bank fixed effect: within estimator
- $\lambda_t$ : Month fixed effect: common shocks
- $\omega_{iq}$ : bank specific credit demand shock
- $L_{it}$ : Loan supply
- Government Debt Exposure: Gov. Security Holdings/Bank Assets=constant at July 1999.

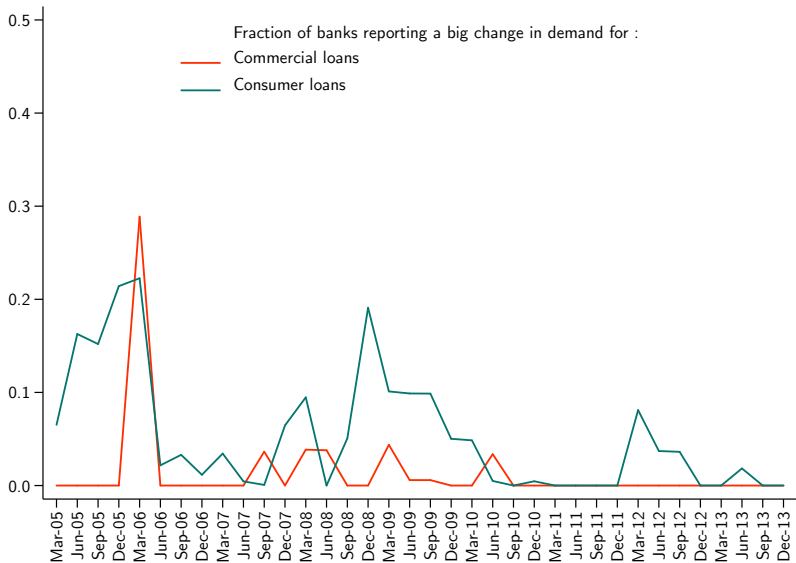


Table: Average Government Bond Holdings and Credit Supply

	(1) All	(2) Drop State	(3) Drop Foreign	(4) Drop State and Foreign
Avg Gov Bond Holdings Before EQ	-0.378*** (0.0167)	-0.400*** (0.0170)	-0.597*** (0.0182)	-0.641*** (0.0185)
Constant	0.306*** (0.00360)	0.309*** (0.00375)	0.387*** (0.00399)	0.399*** (0.00419)
Observations	9882	9228	7172	6518

Table: Government Bonds and Credit Supply

	(1)	(2)	(3)	(4)	(5)	(6)
Gov Bond Holdings <sub>t-1</sub>	-0.336*** (0.0118)	-0.336*** (0.0116)	-0.336*** (0.0113)	-0.0242*** (0.00151)	-0.0182*** (0.00187)	-0.0183*** (0.00160)
(Gov Bond Holdings <sub>t-1</sub> )*(EQ)	-0.0681*** (0.0243)	-0.0689*** (0.0246)	-0.0698*** (0.0252)	-0.0324*** (0.00884)	-0.0331*** (0.00814)	-0.0304*** (0.00576)
(Gov Bond Holdings <sub>t-1</sub> )*(Asia)		-0.0590 (0.0412)	-0.0608 (0.0421)	0.0354 (0.0287)	0.0336 (0.0282)	0.0336 (0.0313)
(Gov Bond Holdings <sub>t-1</sub> )*(Russia)			-0.0333 (0.0238)	-0.0102 (0.0204)	-0.0108 (0.0202)	-0.0108 (0.0194)
(Gov Bond Holdings <sub>t-1</sub> )*(2001)					-0.0421*** (0.00413)	-0.0420*** (0.00591)
Observations	10119	10119	10119	10119	10119	10119
BankFixedEffects	Yes	Yes	Yes	Yes	Yes	Yes
MonthFixedEffects	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFixedEffects	No	No	No	Yes	Yes	Yes
TripleCluster	Yes	Yes	Yes	Yes	Yes	Yes

Column 6 earthquake: August-October 1999; otherwise until November 1999; Asia: July 1997-December 1997; Russia: August 1998-January 1999; Turkish: February 2001-December 2001

**Table:** Government Bonds and Credit Supply: Survivors and Controls

	(1)	(2)	(3)	(4)
Gov Bond Holdings <sub>t-1</sub>	-0.0178*** (0.00208)	-0.0176*** (0.00216)	-0.0178*** (0.00233)	-0.0182*** (0.00318)
Capital Ratio <sub>t-1</sub>		-0.0187*** (0.00164)	-0.0188*** (0.00216)	-0.0183*** (0.00212)
Non-Performing Loans <sub>t-1</sub>				-0.609*** (0.188)
Cash Holdings <sub>t-1</sub>			0.258*** (0.0753)	0.252*** (0.0774)
(Gov Bond Holdings <sub>t-1</sub> )*(Earthquake)	-0.0202** (0.00802)	-0.0207*** (0.00736)	-0.0202*** (0.00718)	-0.0189*** (0.00526)
(Capital Ratio <sub>t-1</sub> )*(Earthquake)		0.00774 (0.0100)	0.00794 (0.00856)	0.00754 (0.00884)
(Non-Performing Loans <sub>t-1</sub> )*(Earthquake)				0.0798 (0.309)
(Cash Holdings <sub>t-1</sub> )*(Earthquake)			0.123 (0.101)	0.0983* (0.0585)
Observations	8590	8586	8578	8578
Bank Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Bank Quarter Fixed Effects	Yes	Yes	Yes	Yes
Triple Cluster	Yes	Yes	Yes	Yes

- The actual decline in loan provision is 3 percentage points.
- A bank with mean bond holdings (20 percent of its assets) will decrease loan supply by 1.7 percentage points (for 100 basis points increase)
- Our estimates can explain 58 percent of the actual decline of 2.6.
- Perspective: In Italy credit supply declined 2 percentage points for a 200 basis point increase in sovereign risk at the peak of European sovereign crisis.



# Any Other Demand Effect? Foreign Banks' Lending Outside Turkey

	(1)	(2)	(3)	
Gov Bond Holdings <sub>t-1</sub>	0.0157* (0.00931)	0.0157* (0.00841)	0.0237** (0.00941)	0.0237*** (0.00873)
(Gov Bond Holdings <sub>t-1</sub> )*(Earthquake)	-0.0170* (0.00936)	-0.0170** (0.00847)	-0.0205* (0.0113)	-0.0205** (0.0081)
Turkish Private Sector Loans <sub>t-1</sub>			0.225*** (0.0390)	0.225*** (0.0283)
Observations	878	878	878	878
R <sup>2</sup>	0.552	0.852	0.57	0.863
Bank Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Cluster	No	Yes	No	Yes

- A significant negative impact of public debt on banks' lending during a period of heightened default risk
- Highlight the channel from sovereign debt to low credit supply via weakened banks in an emerging market
- **Due to weakened banks ala balance sheet channel via their sovereigns, the lending channel cannot operate and private sector investment can be sluggish even in a low interest rate environment—as in Europe**

## Appendix Slides

# Is this really a shock to value of government bonds?

	(1) Valuation	(2) Valuation	(3) Profits	(4) Profits
Gov Bond Holdings <sub>t-1</sub>	-0.0425* (0.03)	-0.0251* (0.014)	0.0043* (0.003)	0.0045* (0.003)
(Gov Bond Holdings <sub>t-1</sub> )*(Earthquake)	-0.0455*** (0.0106)	-0.0640*** (0.0103)	-0.0159*** (0.00373)	-0.0163** (0.00645)
(Gov Bond Holdings <sub>t-1</sub> )*(2001 Crisis)		-0.134*** (0.0152)		-0.0279*** (0.0106)
Observations	10057	10057	10115	10115
Bank Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Bank Quarter Fixed Effects	No	No	Yes	Yes
Triple Cluster	Yes	Yes	Yes	Yes

# Two Period Lending Model of Khawaja-Mian, 2008

- In period  $t$ , bank  $i$ 's lending is  $L_{it}$ .
- The bank funds itself via deposits,  $D_{it}$  and also via other instruments such as bonds,  $B_{it}$ , with a marginal cost of  $\alpha_B$ .
- Deposits until an amount  $\bar{D}_{it}$  are costless.
- Bank has a marginal return on loan given by  $r - \alpha_L L_{it}$ .
- Bank's balance sheet is given by  $D_{it} + B_{it} = L_{it}$ .
- Next period, bank faces a credit supply shock and a credit demand shock.

$$\bar{D}_{it+1} = \bar{D}_{it} + \bar{\delta} + \delta_i$$

- The credit demand shock will affect the marginal return on loan as ( $j$  is firm):

$$\text{marginal return on loans in } t + 1 = r - \alpha_L L_{it} + \bar{\eta} + \eta_{ij}$$

$$\Delta L_i = \frac{1}{\alpha_L + \alpha_B} \bar{\eta} + \frac{\alpha_B}{\alpha_L + \alpha_B} \Delta D_i + \frac{1}{\alpha_L + \alpha_B} \eta_{ij}$$

Table: Determinants of Government Bond Holdings

	(1)	(2)	(3)
Capital Ratio $_{t-1}$	-0.0892*** (0.0108)	-0.143*** (0.0126)	-0.143*** (0.0509)
Non-Performing Loans $_{t-1}$	-0.964*** (0.129)	-1.175*** (0.136)	-1.175** (0.558)
Bank Size $_{t-1}$	0.00491*** (0.000997)	-0.0288*** (0.00344)	-0.0288* (0.0168)
Cash Holdings $_{t-1}$	-0.839*** (0.220)	-2.398*** (0.318)	-2.398* (1.263)
Interbank Balances $_{t-1}$	-0.127*** (0.00710)	-0.127*** (0.00934)	-0.127*** (0.0395)
Domestic Bank	-0.0269*** (0.00435)		
State Owned Bank	0.121*** (0.00754)		
Observations	10107	10107	10107
Bank Fixed Effects	No	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes
Double Cluster	No	No	Yes

**Table:** Determinants of Government Bond Holdings During Earthquake

	(1)	(2)	(3)	(4)
(Capital Ratio <sub>t-1</sub> )*(Earthquake)	0.201*** (0.0565)	0.186*** (0.0577)	0.186** (0.0828)	0.0321 (0.0486)
(Non-Performing Loans <sub>t-1</sub> )*(Earthquake)	-0.0765 (0.576)	-0.732* (0.426)	-0.732 (0.613)	0.191 (0.204)
(Bank Size <sub>t-1</sub> )*(Earthquake)	-0.00701 (0.00518)	-0.0106** (0.00432)	-0.0106 (0.00717)	-0.000984 (0.00273)
(Cash Holdings <sub>t-1</sub> )*(Earthquake)	4.100*** (0.953)	3.802*** (0.925)	3.802*** (0.918)	2.263*** (0.730)
(Interbank Balances <sub>t-1</sub> )*(Earthquake)	-0.0695** (0.0354)	-0.0616* (0.0343)	-0.0616 (0.0485)	-0.0142 (0.0402)
Observations	10107	10107	10107	10107
Bank Fixed Effects	No	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Bank Quarter Fixed Effects	No	No	No	Yes
Double Cluster	No	No	Yes	Yes
DIRECT EFFECTS	Yes	Yes	Yes	Yes

# What about Non-performing Loans?

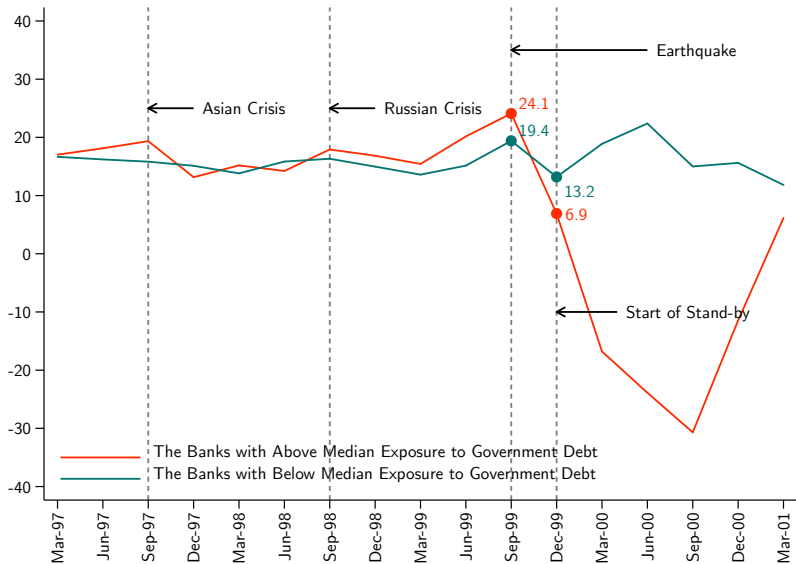
- The estimated credit risk to the total banking sector in the earthquake region was 1.5 billion USD in August 1999.
- However, the total amount of rescheduling as of August 2000 was only 26 million USD (1.6 percent of initial estimate).



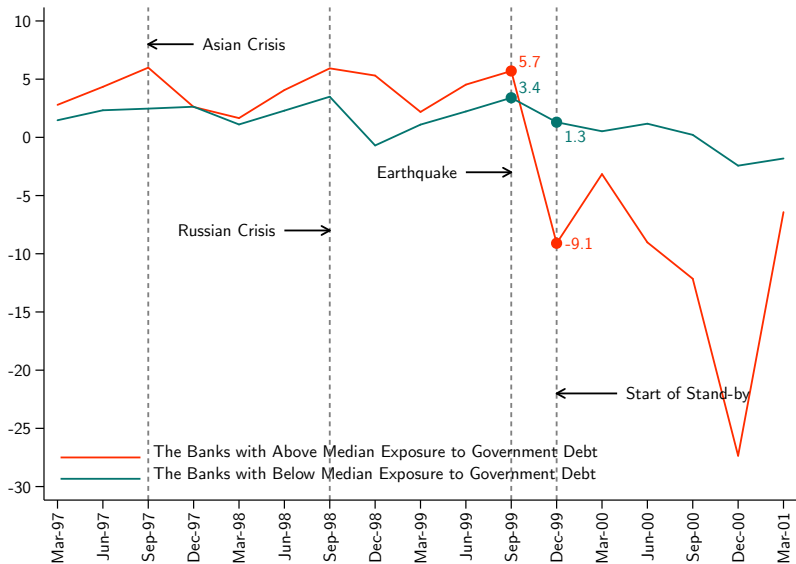
**Table:** Government Bonds and Credit Supply: Placebo Earthquake and Short Sample

	(1) Placebo	(2) Short Sample
Gov Bond Holdings <sub>t-1</sub>	-0.0185*** (0.00179)	-0.215*** (0.00982)
(Gov Bond Holdings <sub>t-1</sub> )*(Earthquake)		-0.0592*** (0.0124)
(Gov Bond Holdings <sub>t-1</sub> )*(Asia)	0.0337 (0.0281)	-0.0242 (0.0367)
(Gov Bond Holdings <sub>t-1</sub> )*(Russia)	-0.0108 (0.0197)	0.0125 (0.0145)
(Gov Bond Holdings <sub>t-1</sub> )*(2001 Crisis)	-0.0418*** (0.00520)	-0.0547* (0.0329)
(Gov Bond Holdings <sub>t-1</sub> )*(Placebo)	-0.00878 (0.00543)	
Observations	10119	5069
Bank Fixed Effects	Yes	Yes
Month Fixed Effects	Yes	Yes
Bank Quarter Fixed Effects	Yes	No
Triple Cluster	Yes	Yes

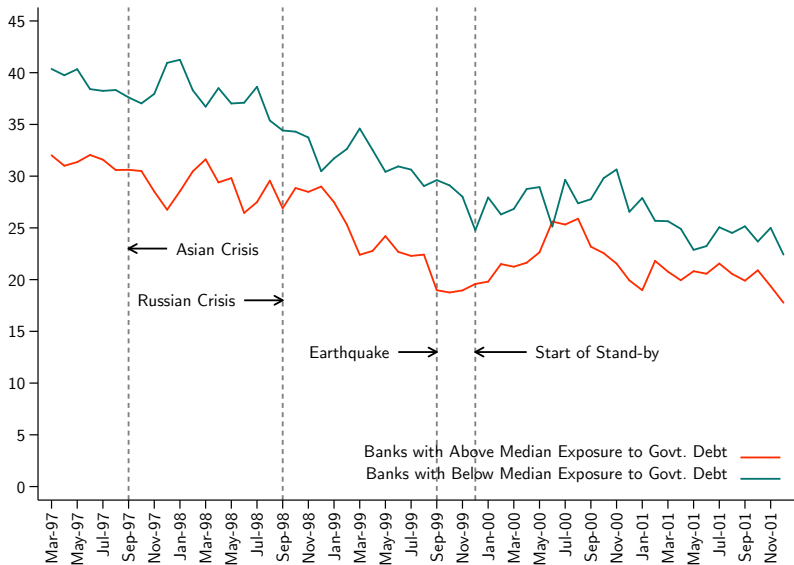
# Are there any differences in prior trends? Net Worth



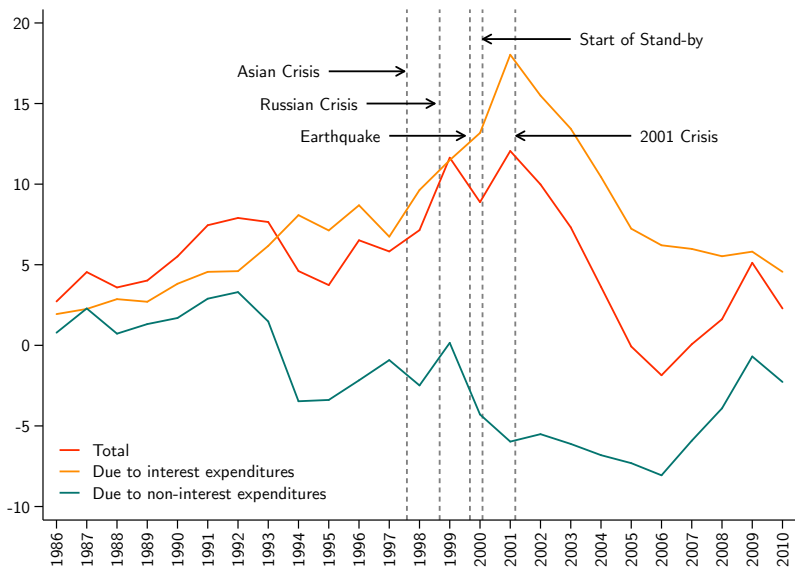
# Are there any differences in prior trends? Profits



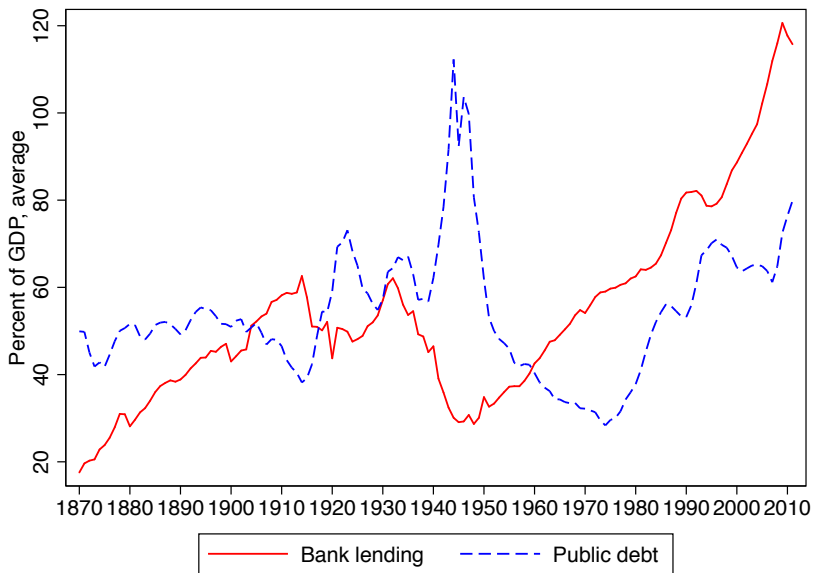
# Are there any differences in prior trends? Loan Provision



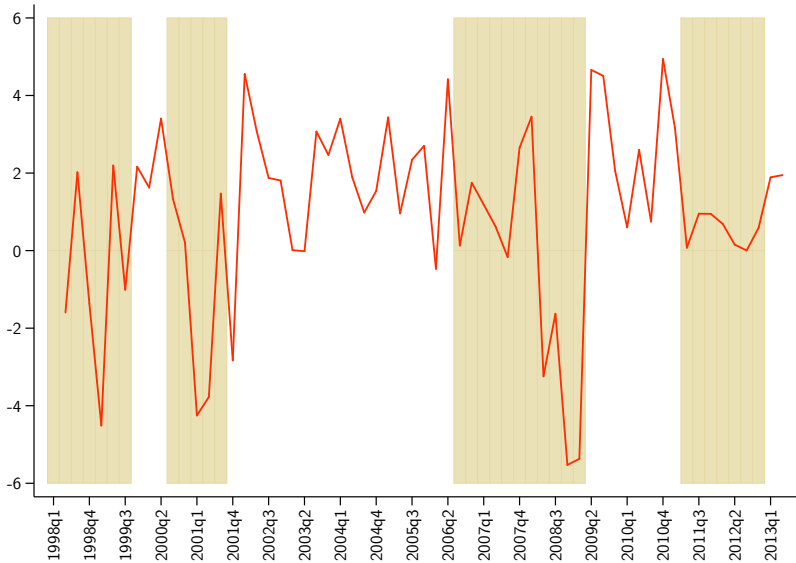
# Public Sector Borrowing Requirement (% GDP)



# Crowding Out of Private Sector Credit: Historical Evidence



Note: Jorda, Schularick, and Taylor, 2014



**Table:** Domestic Debt, External Debt, Credit Growth (%): 1995–2009

	(1)	(2)	(3)	(4)
Sample	1995Q1–1998Q1	1998Q2–2000Q4	2001Q1–2003Q4	Post-2003
Domestic Public Debt/GDP	14	20	43	35
External Public Debt/GDP	24	24	36	17
External Private Debt/GDP	11	19	21	21
Domestic/Total Public Debt	42	50	61	71
Private Credit/GDP	26	20	11	22
Bank Assets/GDP	42	70	50	60
Private Credit/Bank Assets	40	30	20	37
Government Bonds/Bank Assets	36	36	76	60



# Stand-By Agreement: 2000Q1

- 36 Month Stand-By Program announced on December 9, 1999 aiming at reducing inflation and restoring fiscal balances
- Entailed a planned crawling peg regime for Jan. 2000-June 2001 in line with inflation targets, and a crawling band regime with a widening band for July 2001 to Dec. 2002 as a gradual exit to floating exchange rate regime.
- Central Bank commitment to no sterilization, whereby changes in the net foreign assets of its balance sheet would be the main source of changes in the monetary base.
- Explicit austerity measures on government expenditures and explicit primary balance as performance criteria.
- Resulted in a liquidity crisis in November 2000, outflow of 6 billion USD as well as take-over of the control of a number of banks by Saving Deposit Insurance Fund.
- The grant of extra 7.5 billion USD by IMF as part of Supplementary Reserve Facility and a technical revision on the monetary policy side of the program in late December 2000.