# Three Sisters: The Interlinkage Between Sovereign Debt, Currency and Banking Crises

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# Introduction: Triple Crisis

- Occurrence of sovereign debt defaults together with banking and currency crises in close time intervals (within a year)
  - "Triple Crisis"
- Historical examples
  - Mexican Tequila Crisis (1994), Asian Crisis (1997-1998), Russian Crisis (1998), Argentinian Crisis (2001-2002)
  - The sequence is different in each crisis period

# Outline

- Causality: Debt and Currency/Banking Crises
  - Links: Currency and Debt Crises
  - Links: Banking and Debt Crises
  - Motivation
- Empirical Analysis
  - Methodology and Data
  - Sovereign Debt Crisis Estimations
  - Debt Crisis as an Indicator of Banking and Currency Crises
  - Simultaneity of Debt, Currency and Banking Crises
- Conclusion

# Links: Currency and Debt Crises

- Currency Crisis ⟶ Debt Crisis
  - "Original Sin" argument
  - Eichengreen and Hausmann (1999,2005), Jahjah and Montiel (2003), Dreher et al. (2006)
- Debt Crisis ⟶ Currency Crises
  - Capital flight as a result of sovereign debt crisis
  - Obstfeld (1994)
- Empirics
  - Reinhart (2002), Bordo and Meissner (2005): CC⟶ DC
  - Herz and Tong (2008): Contemporaneous CC & DC

# Links: Banking and Debt Crises

- Banking Crisis ⟶ Debt Crisis
  - Government bail-outs
  - Velasco (1987), Arellano and Kocherlakota (2008)
- Debt Crisis ⟶ Banking Crisis
  - Financial sector exposure to government debt
  - Gennaioli et al. (2014)
- Empirics
  - Reinhart and Rogoff (2011): BC ⟶ DC and contemp. correlation
  - Gennaioli et al. (2014): BC ⟶ DC , DC ⟶ BC

# Motivation

- Empirically establish the links between currency and debt, and banking and debt crises
  - Direct and indirect links
  - Simultaneity of banking, currency and debt crises
- Need for an analysis with high frequency data
  - Time gap between the three crises is rather narrow

# Empirical Analysis: Methodology and Data

- Period: January 1985 – December 2007

- 21 Emerging Economies:

Argentina, Bolivia, Brazil, Chile, China, Colombia, Dominican Republic, Ecuador, India, Indonesia, Jamaica, Korea, Malaysia, Mexico, Paraguay, Philippines, Russia, Thailand, Turkey, Uruguay, Venezuela

# Empirical Analysis: Methodology and Data

- Debt Crisis Identification (Artera & Hale, 2008): 46 crisis dates
  - Starting month: Renegotiation of the sovereign debt prior to any restructuring agreement.
- Currency Crisis Identification (Eijffinger & Karatas, 2012, and Kraay, 2003 ): 25 crisis dates
  - Starting month: large depreciation following moderately stable exchange rates.
- Banking Crisis Identification (Laeven & Valencia, 2008, 2012): 25 crisis dates
  - Starting month: financial distress of the banking system

# Crises Dates

| | Country | Banking Crisis | Debt Crisis | Currency Crisis |
|---|---|---|---|---|
| 1 | Argentina | 12.89, 01.95, 11.01 | 09.86, 01.01 | 01.02 |
| 2 | Bolivia | 09.86, 11.94 | 09.85, 04.93, 04.97, 02.00 | |
| 3 | Brazil | 02.90, 12.94 | 09.89, 01.93, 12.96 | 01.99, 10.02 |
| 4 | Chile | | 12.85, 01.88 | |
| 5 | China | 11.98 | | 07.86, 12.89, 01.94 |
| 6 | Colombia | 06.98 | 07.87, 03.90, 06.90 | |
| 7 | Dominican Republic | 04.03 | 03.90, 11.93, 04.04 | 06.87, 04.90 |
| 8 | Ecuador | 08.98 | 02.87, 09.92, 04.99 | 12.85, 09.92 |
| 9 | India | 09.93 | | 07.91 |
| 10 | Indonesia | 11.97 | 10.97, 04.02 | 09.86, 08.97 |
| 11 | Jamaica | 12.96 | 08.86, 04.88, 04.92 | |
| 12 | Korea | 08.97 | 08.97 | 12.97 |
| 13 | Malaysia | 12.97 | | 07.97 |
| 14 | Mexico | 12.94 | 06.85, 12.94 | 12.94, 09.98 |
| 15 | Paraguay | 12.86, 05.95 | 05.86, 02.03 | 03.89, 06.02 |
| 16 | Philippines | 07.97 | 02.85, 10.86, 04.87, 06.88, 07.90 | 09.97 |
| 17 | Russia | 08.98 | 01.91, 01.92, 08.98 | 09.98 |
| 18 | Thailand | 07.97 | | 07.97 |
| 19 | Turkey | 11.00 | 07.98 | 02.01 |
| 20 | Uruguay | 01.02 | 09.85, 03.03 | |
| 21 | Venezuela | 01.94 | 01.86, 12.88, 01.94, 01.05 | 12.86, 02.02 |

# Empirical Analysis: Indicators

- Public Debt/GDP
- Short-term Ext. Debt/FER
- Current Account/FER
- Exchange Rate Overvaluation
- GDP Growth
- Real Domestic Interest Rates
- Real International Interest Rates
- Inflation
- Elections
- Stock Prices
- Domestic Credit/GDP
- Domestic Cr. to Priv./GDP
- Capital Account Openness
- Institutional Indexes: Political and Market Environment

# Empirical Analysis : Methodology and Data

$$D_{i,t}^{*} = \beta_0 + \beta_1 X_{i,t-k} + \beta_2 C_{i,t} + \beta_3 B_{i,t} + \beta_4 C_{i,t-1 \text{ to } t-12} + \beta_5 B_{i,t-1 \text{ to } t-12} + \beta_6 C_{i,t-1 \text{ to } t-12}' X_{i,t-k} + \beta_7 B_{i,t-1 \text{ to } t-12}' X_{i,t-k} + \mu_{i,t}$$

- $D_{i,t}^{*}$ : Sovereign Debt Crisis
- $C_{i,t}$ : Currency Crisis
- $B_{i,t}$ : Banking Crisis
- $B_{i,t-1 \text{ to } t-12}$ : Twelve-month Composite Lagged Banking Crisis Onset
- $C_{i,t-1 \text{ to } t-12}$ : Twelve-month Composite Lagged Currency Crisis Onset
- $X_{i,t-k}$ : Macroeconomic and Institutional Controls
- $B_{i,t-1 \text{ to } t-12}' X_{i,t-k}$ : Lagged Banking Crisis X Control Variables (i.e. St. Ext. Debt)
- $C_{i,t-1 \text{ to } t-12}' X_{i,t-k}$ : Lagged Currency Crisis X Control Variables (i.e. Exchange Rate Overvaluation)

# Sovereign Debt Crisis Estimations

# Sovereign Debt Crisis Equation

| Dependent Variable: Debt Crisis Onset | (1) | | (2) | | (3) | | Interaction Terms | |
|---|---|---|---|---|---|---|---|---|
| Variables | Estimates | (z-stats) | Estimates | (z-stats) | Estimates | (z-stats) | Estimates | (z-stats) |
| Δ Public Debt $_{t-4}$ | 0.100** | (2.33) | *-0.081* | (-0.85) | 0.014 | (0.19) | | |
| Real International Interest Rate $_{t-6}$ | 0.775** | (2.54) | 0.818* | (1.93) | 0.824** | (2.42) | | |
| Real Domestic Interest Rate $_{t-1}$ | *-0.076* | (-0.71) | *-0.036* | (-0.30) | *-0.062* | (-0.59) | | |
| Exch. Rate Overvaluation $_{t-1}$ | **-2.616*** ** | (-2.63) | -2.847 | (-1.58) | -3.251** | (-2.43) | | |
| Current Account Position $_{t-1}$ | -0.315 | (-1.31) | *0.055* | (0.16) | -0.180 | (-0.64) | | |
| GDP Growth $_{t-1}$ | -0.520** | (-2.19) | -0.309 | (-1.10) | -0.462* | (-1.82) | | |
| Short-term External Debt $_{t-8}$ | **0.067*** ** | (3.32) | 0.070** | (2.52) | **0.078*** ** | (3.38) | | |
| Inflation $_{t-1}$ | **4.515*** ** | (6.45) | 2.320* | (1.91) | **4.321*** ** | (4.46) | | |
| Currency Crisis $_{t}$ | | | 0.941** | (2.02) | | | | |
| Banking Crisis $_{t}$ | | | **1.756*** ** | (4.67) | | | | |
| Currency Crisis $_{t-1 \text{ to } t-12}$ | | | | | *-0.126* | (-0.28) | | |
| Banking Crisis $_{t-1 \text{ to } t-12}$ | | | | | **0.528*** ** | (2.63) | | |
| Election $_{t-1}$ | 0.033 | (0.08) | *-0.341* | (-0.75) | 0.118 | (0.26) | | |
| Political Environment $_{t-1}$ | **-0.424*** ** | (-2.66) | -0.443** | (-2.11) | **-0.468*** ** | (-2.61) | | |
| Market Environment $_{t-1}$ | **-0.255*** ** | (-3.35) | **-0.386*** ** | (-3.55) | **-0.280*** ** | (-3.11) | | |
| $CC_{t-1 \text{ to } t-12}$ X Exch. Rate Overval. $_{t-1}$ | | | | | | | **-13.542*** ** | (-3.78) |
| $BC_{t-1 \text{ to } t-3}$ X St. External Debt $_{t-8}$ | | | | | | | **0.520*** ** | (3.36) |
| Pseudo-$R^2$ | 0.167 | | 0.256 | | 0.185 | | | |
| Number of Observations | 3211 | | 2754 | | 2954 | | | |
| Log-Likelihood | -125.943 | | -84.438 | | -109.683 | | | |

# Sensitivity Analyses

- Correction for rareness of the crises events in the total sample: Rare Events Logit Estimation
- Correction for the country-specific characteristics: Conditional Logit Estimation
- Alternative currency crisis definition: Exchange Market Pressure (EMP) index (Eichengreen et al., 1996)
  - Weighted average of changes in the exchange rates and foreign exchange reserves (Kaminsky and Reinhart, 1999)
  - Currency Crisis does not help predicting Sovereign Debt Crisis.

# Debt Crisis as an Indicator of Banking and Currency Crisis

# Currency and Banking Crises Estimations

| Dependent Variable: Currency Crisis Onset | | | Dependent Variable: Banking Crisis Onset | | |
|---|---|---|---|---|---|
| Variables | Estimates | (z-stats) | Variables | Estimates | (z-stats) |
| Debt Crisis $_{t-1 \text{ to } t-12}$ | 0.227 | (0.65) | Debt Crisis $_{t-1 \text{ to } t-12}$ | -0.084 | (-0.14) |
| Real International Interest Rates $_{t-1}$ | *-0.036* | (0.07) | Exchange Rate Overvaluation $_{t-1}$ | -3.176** | (-2.36) |
| Exchange Rate Overvaluation $_{t-1}$ | -2.412** | (-2.23) | Capital Account Openness $_{t-1}$ | -0.094 | (-0.81) |
| Current Account Position $_{t-1}$ | -1.318 | (-2.23) | Current Account Position $_{t-1}$ | -1.879 | (-1.23) |
| Stock Prices$_{t-3}$ | **-2.363*** ** | (-2.96) | Inflation$_{t-6}$ | **7.732*** ** | (2.65) |
| Capital Account Openness $_{t-1}$ | *-0.009* | (-0.10) | Stock Prices $_{t-2}$ | -2.014** | (-2.17) |
| Δ Public Debt $_{t-1}$ | 0.224** | (2.47) | Δ Public Debt $_{t-6}$ | **0.345*** ** | (2.89) |
| GDP Growth $_{t-1}$ | -0.263 | (-1.19) | GDP Growth$_{t-1}$ | **-0.711*** ** | (-2.64) |
| Δ Domestic Credit by Banking Sector $_{t-3}$ | **0.487*** ** | (4.46) | Election$_{t-1}$ | **1.131*** ** | (4.15) |
| Election $_{t-1}$ | 0.503 | (1.22) | Real International Interest Rate$_{t-4}$ | 0.370** | (2.30) |
| Political Environment $_{t-1}$ | -0.052 | (-0.28) | Real Domestic Interest Rate$_{t-1}$ | -0.030 | (-0.22) |
| Market Environment $_{t-1}$ | -0.032 | *(-0.21)* | Δ Domestic Credit to Private Sector $_{t-1}$ | 0.155 | (0.78) |
| | | | Political Environment $_{t-1}$ | *0.188** | (1.74) |
| | | | Market Environment $_{t-1}$ | *0.377** | (1.77) |
| Pseudo-$R^2$ | 0.235 | | Pseudo-$R^2$ | 0.278 | |
| Number of Observations | 2922 | | Number of Observations | 2364 | |
| Log-Likelihood | -67.927 | | Log-Likelihood | -61.948 | |

# Simultaneity of Debt, Currency and Banking Crisis

| Dependent Variable: Sovereign Default | Estimates (z-stats) | Dependent Variable: Banking Crisis | Estimates (z-stats) | Dependent Variable: Currency Crisis | Estimates (z-stats) |
|---|---|---|---|---|---|
| ΔPublic Debt $_{t-4}$ | 0.011 | ΔPublic Debt $_{t-6}$ | 0.279 | ΔPublic Debt $_{t-1}$ | 0.314** |
| | (0.06) | | (1.32) | | (2.23) |
| Real Inter. Interest Rate $_{t-6}$ | 0.947** | Real Intern. Interest Rate $_{t-4}$ | 0.298* | Real Inter. Interest Rate $_{t-1}$ | *-0.246* |
| | (2.16) | | (1.75) | | (-0.42) |
| Real Dom. Interest Rate $_{t-1}$ | 0.043 | Real Dom. Interest Rate $_{t-1}$ | *0.002* | ER Overvaluation $_{t-1}$ | -1.361 |
| | (1.50) | | (0.02) | | (-0.85) |
| ER Overvaluation $_{t-1}$ | -4.307** | ER Overvaluation $_{t-1}$ | -3.122** | Current Account Pos. $_{t-1}$ | -1.895 |
| | (-2.39) | | (-2.02) | | (-1.30) |
| Current Account Pos. $_{t-1}$ | *0.213* | Current Account Pos. $_{t-1}$ | -1.148 | GDP Growth $_{t-1}$ | -0.683 |
| | (0.30) | | (-0.70) | | (-1.50) |
| GDP Growth $_{t-1}$ | -0.357 | GDP Growth $_{t-1}$ | -0.791** | Election $_{t-1}$ | 0.653 |
| | (-1.17) | | (-2.35) | | (1.57) |
| Inflation $_{t-1}$ | *-1.771* | Inflation $_{t-6}$ | 6.743** | Political Env. $_{t-1}$ | -0.340 |
| | (-0.29) | | (2.37) | | (-1.24) |
| Election $_{t-1}$ | 0.276 | Election $_{t-1}$ | **1.098*** ** | Market Env. $_{t-1}$ | -0.032 |
| | (0.69) | | (3.19) | | (-0.25) |
| Political Env. $_{t-1}$ | -0.454 | Political Env. $_{t-1}$ | *0.367** | Stock Prices $_{t-3}$ | -1.676 |
| | (-1.42) | | (1.74) | | (-1.56) |
| Market Env. $_{t-1}$ | **-0.457*** ** | Market Env. $_{t-1}$ | *0.366* | KA Openness $_{t-1}$ | 0.029 |
| | (-2.65) | | (1.52) | | (0.20) |
| St External Debt $_{t-8}$ | 0.072** | Stock Prices $_{t-2}$ | **-2.634*** ** | ΔDomestic Credit $_{t-3}$ | 0.316* |
| | (2.52) | | (-2.82) | | (1.90) |
| | | KA Openness $_{t-1}$ | -0.222 | | |
| | | | (-1.50) | | |
| | | ΔDom. Crd. to Prv. Sect. $_{t-1}$ | 0.077 | | |
| | | | (0.40) | | |
| Number of Observations | 1926 | | | | |
| Rho (12) | 0.550*** | Rho (23) | 0.325 | Rho (13) | 0.006 |
| Likelihood ratio test of rho (12) = rho (23) = rho (13) = 0: chi2(3) = 4.709 | | | Prob > chi2 = 0.194 | | |

# Conclusions

- Strong leading and contemporaneous effect of banking crises on sovereign debt crises
- Strong indirect links between banking/currency and debt crises:
  - CC ⟶ Overvalued Exchange Rates ⟶ DC
  - BC ⟶ Short-term External Debt ⟶ DC

# Conclusions

- Banking sector problems go hand in hand with sovereign problems:

  " …even in favorable external environments, banking crises are detrimental for the government deficit and hence for government debt " (Baldacci and Gupta, 2009)

  - As long as the financial sector is sound, government postpones the default decision.

# Discussion