

Sovereigns going bust: estimating the cost of default

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To default or not to default



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Motivation

- ▶ Goal: better understand the incentives behind sovereign default decision
- ▶ Default costs central to these
 - ▶ Punishment mechanism; facilitate borrowing
- ▶ Gaps in knowledge:
 1. How large is the default cost?
 2. What makes default costly?
- ▶ This paper:
 1. Best-practice empirical estimate of sovereign default cost
 2. Assess cost amplification and transmission channels

Existing literature

- ▶ Theory: punishment can take form of
 - ▶ Financial autarky (Eaton and Gersovitz, 1981)
 - ▶ Output penalty (e.g. Aguiar and Gopinath, 2006)
 - ▶ Trade disruption (Mendoza and Yue, 2012)
 - ▶ Financial sector disruption (Gennaioli et al., 2014a)
- ▶ Empirical estimates of overall cost have a very broad range
 - ▶ Historical correlations: 1.5 – 5% of GDP in medium term (Reinhart and Rogoff, 2011a; Tomz and Wright, 2007)
 - ▶ Recent data, conditional estimates: 0 – 20% of GDP in medium term (Borensztein and Panizza, 2008; De Paoli et al., 2009; Furceri and Zdzienicka, 2012; Levy-Yeyati and Panizza, 2011)
- ▶ Empirical evidence for individual channels:
 - ▶ Higher borrowing cost; market exclusion (Cruces and Trebesch, 2013)
 - ▶ Costs for exporters (Borensztein and Panizza, 2010; Rose, 2005)
 - ▶ Banking distress (Gennaioli et al., 2014b)

Our Contribution

- ▶ Key issues for existing literature:
 1. Endogeneity: default \longleftrightarrow GDP
 2. Transmission: Linking micro evidence on channels and macro cost estimates

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 1. Endogeneity: default \longleftrightarrow GDP
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- ▶ Our solution: IPSW + LPs (Jordà and Taylor, 2015)
 1. Endogeneity: Re-randomise defaults using inverse propensity score weighting (IPSW)
 2. Transmission: Look at events that can amplify the cost (default + other crises), and impact on GDP components (investment, trade...) within the same empirical framework

Preview of Findings

- ▶ Magnitude: Cost significant and persistent, but not permanent
 - ▶ 2.9% of GDP on impact, 4.3% at peak (Year 5), dissipates by Year 10
- ▶ Amplification: Cost rises dramatically if default → banking crisis
 - ▶ 9.4% of GDP at peak
- ▶ Transmission: Large macroeconomic adjustment away from investment and imports

Empirical methodology: IPSWRA

1. Re-randomise default (IPSW)

- Model the default decision

$$\widehat{PD}_{i,t} = \Lambda(Z_{t-1}, \tilde{Z}_{t-1}, \tilde{Z}_{t-2}, \hat{\beta})$$

- Rebalance the sample using default probabilities (higher weight to less likely defaults)

2. Estimate potential outcomes in case of default and no default (LP)

$$\Delta y_{i,t+h} = \alpha_i + \theta_h \delta_{i,t} + \Gamma_{h,1} X_{i,t-1} + \tilde{\Gamma}_{h,1} \tilde{X}_{i,t-1} + \tilde{\Gamma}_{h,2} \tilde{X}_{i,t-2} + \varepsilon_{i,t} \quad h \in \{0, \dots, 9\};$$

3. Compare potential outcomes (ATE)

$$ATE_h(\delta)^{\text{IPSWRA}} = \frac{1}{n_{\text{Def}}} \sum_i \sum_t \frac{\Delta \hat{y}_{i,t+h} * \delta_{i,t}}{\widehat{PD}_{i,t}} - \frac{1}{n_{\text{NoDef}}} \sum_i \sum_t \frac{\Delta \hat{y}_{i,t+h} * (1 - \delta_{i,t})}{1 - \widehat{PD}_{i,t}}.$$

► Interpretation

Why IPSWRA?

- ▶ IPSWRA features:
 - ▶ Allows for non-linearities in selection
 - ▶ Non-linearities in time response
 - ▶ Doubly robust
 - ▶ Highly flexible
- ▶ Identifying assumption: selection on observables
 - ▶ Conditional on controls, decision to default independent of potential outcomes

Data

- ▶ Treatment – defaults ($\delta_{i,t}$)
 - ▶ External default (dummy = 1 in first year)
 - ▶ “Failure to meet a principal or interest payment on the due date contained in the original terms of the debt issue.” (S&P)
- ▶ Outcomes ($y_{i,t+h}$)
 - ▶ Cumulative growth in real GDP per capita
 - ▶ GDP components
- ▶ Controls and Predictors ($X_{i,t}, Z_t$)
 - ▶ Macro: debt size and service, macro-fundamentals (growth, inflation), external dimension (openness, terms of trade)
 - ▶ Political: wars, coups, governance quality
 - ▶ Crises: financial, currency
- ▶ Final sample: unbalanced panel, 114 countries, 91 defaults, 1970-2010

Main Result

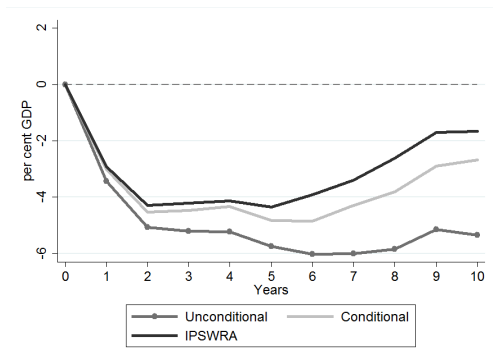


Figure: Impact of sovereign default on GDP

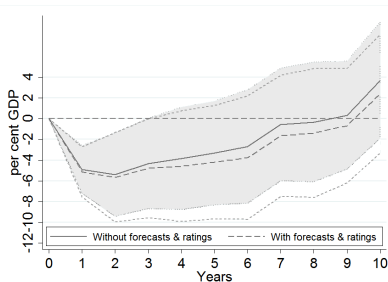
Notes: Cumulative treatment effect, GDP per capita growth. Unconditional: country fixed effects only. Conditional and IPSWRA: country fixed effects + full list of controls.

- ▶ Sovereign default is costly
- ▶ Cost persistent, but not permanent
- ▶ Controlling for selection matters

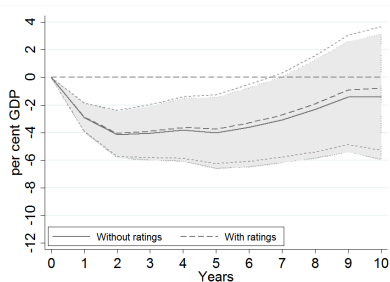
Dealing with Endogeneity

- ▶ Identifying assumption: “selection on observables”
 - ▶ Conditional on controls, decision to default independent of potential outcomes
- ▶ To check this: add sovereign credit ratings and GDP forecasts to predictors and controls
 - ▶ Best real-time estimate of default probability
 - ▶ Capture effect of unobservables and expectations
- ▶ Two specifications:
 1. Add Institutional Investor Magazine ratings, IMF growth forecasts (smaller sample than baseline)
 2. Add synthetic ratings based on determinants identified by Cantor and Packer (1996) (same sample as baseline)

Ratings & Forecasts



(a) Ratings + Forecasts



(b) Synthetic ratings

Figure: Controlling for sovereign credit ratings and growth forecasts

Notes: Cumulative treatment effect. Shaded bands indicate 90% confidence intervals.

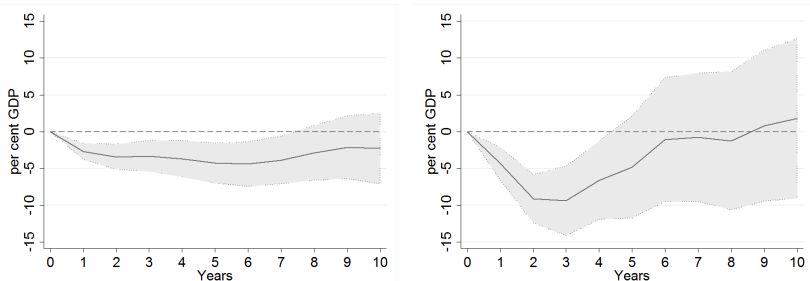
Other considerations

- ▶ Default Definition [▶ Link](#)
- ▶ Default Magnitude [▶ Link](#)
- ▶ Good and Bad times [▶ Link](#)
- ▶ Alternative control groups/propensity scores [▶ Link](#)

Amplification of the cost

- ▶ Sovereign defaults often coincide with other crises
- ▶ Questions:
 - ▶ Are defaults *only costly* if they coincide with other crises?
 - ▶ Do defaults become *more costly* if followed by other crises?
- ▶ We explore:
 - ▶ Systemic banking crises happening after defaults
 - ▶ Currency crises (one year window)
 - ▶ Political crises (one year window)

Sovereign Default and Systemic Banking Crises



(a) Default + No systemic banking crisis

(b) Default + Systemic banking crisis

Figure: Treatment Effect of Sovereign Default and Systemic Banking Crises

Notes: Cumulative treatment effect. Shaded bands indicate 90% confidence intervals.

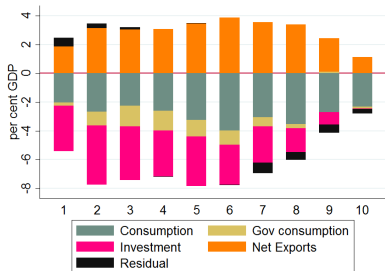
- Currency or political crises: no significant difference between “standalone default” and “default + another crisis” scenarios

[► Detail](#)

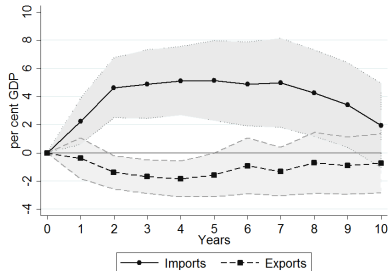
Transmission: cost components

- ▶ Decompose our cost estimate into the components of GDP: consumption, investment, gov. spending and net exports
- ▶ Evidence for individual channels or modelling approaches
 - ▶ Autarky should be linked with an increase in net exports
 - ▶ Damage to the banking sector ought to be accompanied by a collapse in investment

Components of the Default Cost



(a) Decomposition of the treatment effect

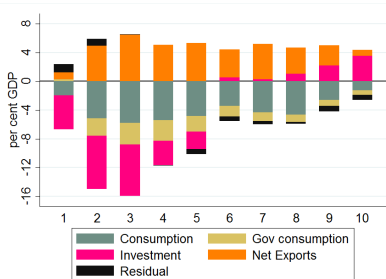


(b) Exports and Imports

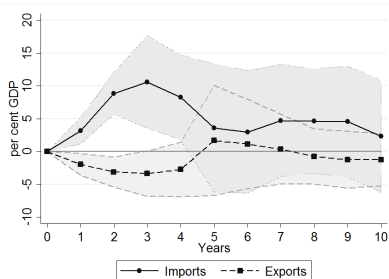
Figure: The effect of default on the components of GDP

Notes: Cumulative contribution of individual components to GDP after a sovereign default. Calculated as the absolute change in a GDP component between t and $t + h$, scaled by the GDP level at t . Here t is the year before default, and h is the horizon, plotted on the x axis. Shaded bands indicate 90% confidence intervals.

Components: Sovereign-banking crises



(a) Decomposition of the treatment effect



(b) Exports and Imports

Figure: Joint default and financial crisis: effect on components of GDP

Notes: Cumulative contribution of individual components to GDP after a default that is followed by a systemic banking crisis within two years. Calculated as the absolute change in a GDP component between t and $t + h$, scaled by the GDP level at t . Here t is the year before default, and h is the horizon, plotted on the x axis. Shaded bands indicate 90% confidence intervals.

Implications

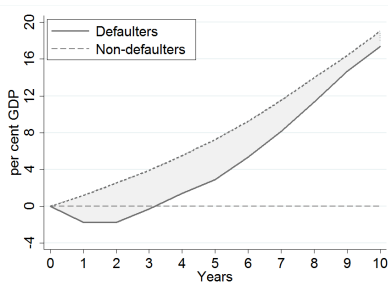
- ▶ Sovereign's incentives: defaulting is costly
 - ▶ Cost higher than that of “normal” recession, but lower than more severe crisis events (e.g. financial or political crises in Cerra and Saxena, 2008)
 - ▶ Cost somewhat higher than 2% endowment penalty assumed in many theoretical models
 - ▶ Equivalent to 4-6% GDP austerity (using Jordà and Taylor, 2015)
- ▶ What generates the cost?
 - ▶ Autarky accompanied by substantial macroeconomic adjustment
 - ▶ Banking distress and falling investment are key drivers

Summary

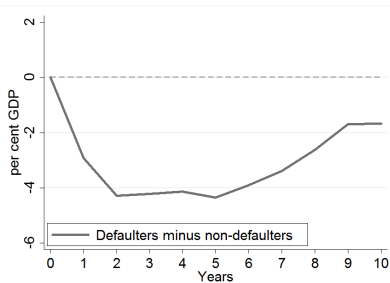
- ▶ Sovereign default carries a cost: 4.3% GDP loss in medium run
- ▶ Defaults followed by banking crises are very costly: 9.4% GDP loss in medium run
- ▶ After default, investment and trade collapse, net exports increase
- ▶ Understanding sovereign-banking linkages crucial for policy and theoretical models of default

Appendix

Interpreting the estimates



(a) Expected GDP path for defaulters and non-defaulters



(b) Average treatment effect of default

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Main Result: table

Table: Local projections: impact of sovereign default on GDP

Year	1	2	3	4	5	6	7	8	9	10
Unconditional LP	-3.44*** (0.64)	-5.07*** (0.98)	-5.21*** (1.08)	-5.24*** (1.26)	-5.76*** (1.35)	-6.02*** (1.53)	-6.00*** (1.67)	-5.85*** (1.89)	-5.16*** (2.14)	-5.35** (2.49)
Conditional LP	-3.01*** (0.59)	-4.52*** (0.94)	-4.48*** (1.04)	-4.33*** (1.16)	-4.82*** (1.23)	-4.84*** (1.39)	-4.30*** (1.50)	-3.82** (1.7)	-2.89 (2.1)	-2.67 (2.29)
IPSWRA LP	-2.93*** (0.62)	-4.29*** (1.03)	-4.22*** (1.19)	-4.13*** (1.39)	-4.35*** (1.56)	-3.91** (1.74)	-3.39* (1.88)	-2.63 (2.16)	-1.69 (2.44)	-1.66 (2.77)
Observations	2546	2546	2546	2546	2546	2546	2546	2546	2546	2546
Defaults	91	91	91	91	91	91	91	91	91	91

Notes: Expected differences in cumulative real GDP per capita growth between defaulters and non-defaulters. Clustered standard errors in parentheses. Unconditional specification controls for country fixed effects only. Conditional and IPSWRA specifications control for country fixed effects and the full list of variables.

*, **, ***: Significant at 10%, 5% and 1% levels respectively

Comparison to empirical literature

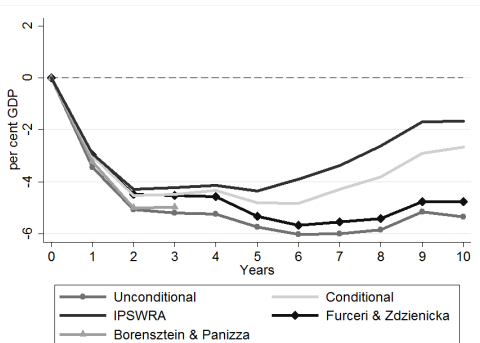


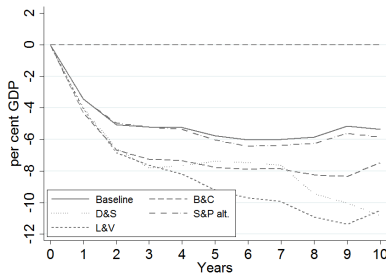
Figure: Impact of sovereign default on GDP under alternative estimation methods

Notes: The Furceri & Zdzienicka specification has past GDP growth and HP-filtered time trend as controls. The Borensztein & Panizza specification has investment/GDP, government spending/GDP, population growth, civil rights index, change in terms of trade, openness, banking crisis dummy as controls, and country fixed effects. Unconditional specification controls for country fixed effects only. Conditional and IPSWRA specifications contain the full list of controls and country fixed effects.

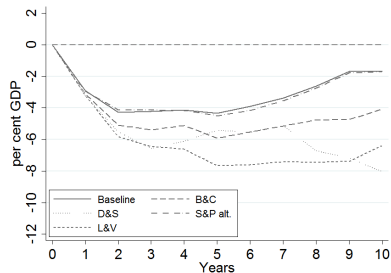
Sovereign default definitions

- ▶ Potential issues:
 - ▶ Dating sovereign defaults is difficult
 - ▶ Choose least endogenous definition
 - ▶ Technical defaults
 - ▶ Endogenously choose the “big ones”
- ▶ Alternative definitions:
 - ▶ Beim & Calomiris: group subsequent defaults together, drop defaults coinciding with coups
 - ▶ Detragiache & Spilimbergo: arrears threshold
 - ▶ Laeven & Valencia: sovereign debt crisis definition
 - ▶ S&P alternative: adds defaults that occurred while still negotiating another default

Sovereign default definitions



(a) Unconditional LP



(b) IPSWRA LP

- ▶ But, high-magnitude defaults or political crises do not drive our result \Rightarrow other definitions endogenously choose costly defaults

▶ Back

Default Magnitude

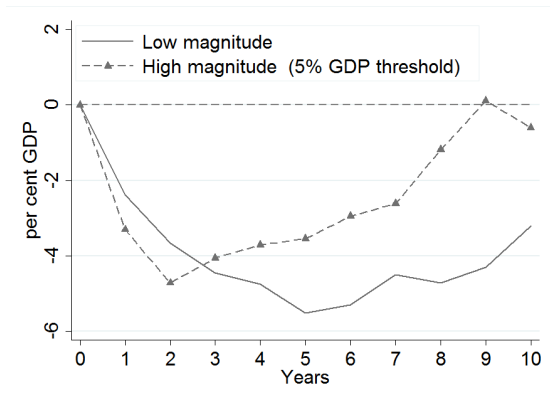


Figure: Treatment Effect of Sovereign Default by size

Notes: Cumulative treatment effect. High-magnitude defaults are those where debt in default exceeds 5% GDP in the first year.

Good and Bad times

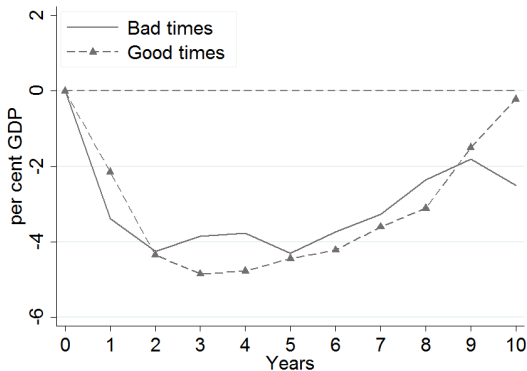


Figure: Defaulting in good and bad times

Notes: Cumulative treatment effect. Default in good times means GDP growth is above HP-filtered trend on average over the previous three years.

Alternative regression specifications

Table: Alternative propensity scores and control groups

Year	1	2	3	4	5	6	7	8	9	10	Obs.
Baseline (defaults: 91)	-2.93*** (0.62)	-4.29*** (1.03)	-4.22*** (1.19)	-4.13*** (1.39)	-4.35*** (1.56)	-3.91** (1.74)	-3.39* (1.88)	-2.63 (2.16)	-1.69 (2.44)	-1.66 (2.77)	2546
Less Truncation (defaults: 91)	-2.84*** (0.64)	-4.20*** (1.09)	-4.34*** (1.33)	-4.34*** (1.57)	-4.57*** (1.76)	-4.08** (1.96)	-3.52* (2.11)	-2.67 (2.40)	-1.73 (2.72)	-1.55 (3.10)	2546
Low weight in default (defaults: 88)	-2.91*** (0.64)	-4.18*** (1.08)	-4.43*** (1.30)	-4.46*** (1.52)	-4.83*** (1.68)	-4.41*** (1.85)	-3.77* (2.05)	-3.00 (2.35)	-2.00 (2.63)	-1.71 (3.00)	2546
Clean Control Group (defaults: 88)	-3.25*** (0.66)	-4.61*** (1.13)	-4.76*** (1.40)	-4.92*** (1.68)	-5.35*** (1.89)	-4.83** (2.08)	-4.24* (2.34)	-3.50 (2.65)	-2.61 (2.93)	-2.49 (3.33)	1895

Notes: Expected differences in cumulative real GDP per capita growth between defaulters and non-defaulters. Clustered standard errors in parentheses. Unconditional specification controls for country fixed effects only. IPSWRA specifications control for country fixed effects and the full list of variables in Table ??.

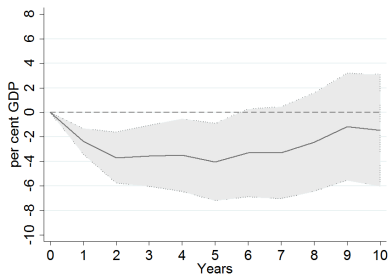
Less truncation: inverse propensity score weights truncated at 20 instead of 10.

Zero probability: alternative S & P default definition, IPS-weights equal to one during default.

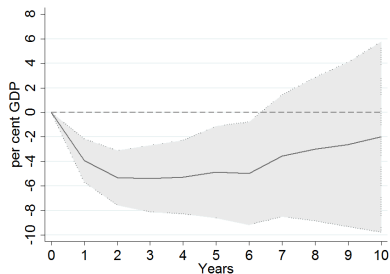
Clean control group: countries negotiating a past default excluded from the control group.

*, **, ***: Significant at 10%, 5% and 1% levels respectively

Sovereign Default and Currency Crises



(a) Default and no currency crisis

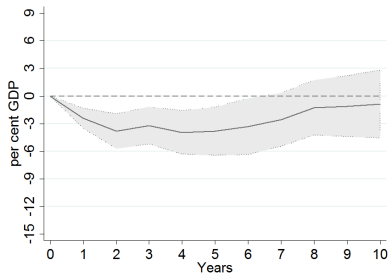


(b) Default and currency crisis

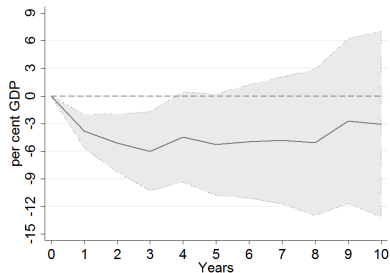
Figure: Treatment Effect of Sovereign Default and Currency Crises

Notes: Cumulative treatment effect. Shaded bands indicate 90% confidence intervals.
Sample split based on a one-year window.

Sovereign Default and Political Crises



(a) Default and no political crisis



(b) Default and political crisis

Figure: Treatment Effect of Sovereign Default and Political Crises

Notes: Cumulative treatment effect. Shaded bands indicate 90% confidence intervals.
Sample split based on a one-year window.