

Debt Tolerance with Potentially Permanent Costs of Default

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its Executive Board, or its management.

Motivation

- Default costs are key determinants of debt **tolerance** and borrowing **terms**.
- Rogoff made several key contributions to the sovereign debt literature
... Bulow & Rogoff (1989a, 1989b); Reinhart, Rogoff & Savastano (2003), . . .
- Unclear **nature** of these costs
 - Growth **slowdowns** around time of restructurings
- This paper follows the literature and assumes an output cost of default.
 - Focus on how the **possibility** of permanent costs affects the choice to restructure.

Are default costs permanent?

- Standard theory: after default
 - ... temporary credit market exclusion (Cruces & Trebesch, 2013)
 - ... output reduction **while** excluded
- Empirical studies find a **wide** range of estimates for the output costs.
 - Some estimate a short-lived effect on growth
 - ... e.g. Borensztein & Panizza (2009)
 - Others find sizable and persistent losses
 - ... e.g. Cerra & Saxena (2008), Farah-Yacoub et al (2022), Asonuma et al (2023)
- Tangible risk of a **permanent** loss with no catch-up to the pre-crisis trend
- Range of estimates could also **amplify** the cost for a risk and ambiguity averse debtor

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Our approach

- Standard quantitative model of sovereign default with long-term debt
 - ... Aguiar & Gopinath (2006), Arellano (2008), Hatchondo & Martinez (2009), Chatterjee & Eyigungor (2012), Aguiar, Chatterjee, Cole & Stangebye (2016)
- *Uncertainty* about the nature of default costs
 - Can be **transitory** or **permanent**, with probability p
- Government concerned about *model misspecification*
 - ... fears that probability of transitory cost might **not** be p
 - ... seeks **robust** decision rules
 - ... Hansen & Sargent (2001), Pouzo & Presno (2016), Roch & Roldán (2023)
- Disciplined by **evidence** on output dynamics around restructurings
 - Output in deviations from a pre-restructuring **trend**, at different horizons
 - Other standard moments from sovereign debt/default literature

Main findings

1. Model **matches** output dynamics around restructurings well
... including targeted and untargeted dynamics
2. Indirect inference/calibration points to **size** of default costs in line with the literature
... both causal empirical estimates and typical calibrated costs
3. Large uncertainty about persistence + significant uncertainty aversion
... We calibrate that costs are persistent about **65%** of the time
... but that the robust government acts as if it actually was **80-85%**

Roadmap

- Stylized facts
- Model
- Calibration and Quantitative Results
- Concluding remarks

Stylized facts

Growth outcomes around debt restructurings

- Panel of market-access countries with a restructuring in 1990–2020
... Asonuma & Trebesch (2016)

- Construct a pre-restructuring **trend** for output as

$$\log Y_{i,t-j} = \alpha_i + \beta_i(t-j) + \epsilon_{i,t-j}$$

estimated on $1 \leq j \leq 6$

- Detrend realized output with the fitted values
- Compute deviations from trend at different horizons: calibration **targets**
... medians of **8.3%** and **7.6%** below pre-restructuring trend after 1 and 5 years

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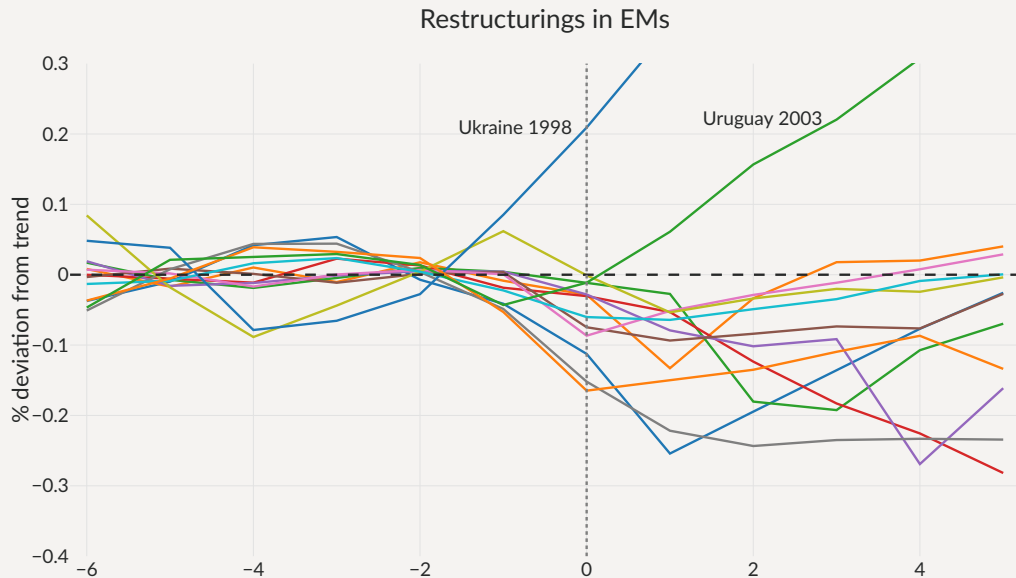
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Growth outcomes around debt restructurings

► Calendar time



Model

Environment

- Small open economy receives **endowment** Y_t

$$Y_t = \exp(z_t)\Gamma_t$$

$$z_t = \rho z_{t-1} + \sigma \varepsilon_t^z$$

AR(1) cycle

$$\log(\Gamma_t) = \log(\Gamma_{t-1}) + \log(g_t)$$

Random-walk trend

... Non-stationary endowment to enable permanent costs

... Denote normalized variables (using Γ_t) with lowercase

- Government issues **debt** with long-term bonds
 - Promise to repay $\kappa, (1 - \rho)\kappa, (1 - \rho)^2\kappa, \dots, (1 - \rho)^{j-1}\kappa, \dots$
 - ... Leland (1998), Hatchondo & Martinez (2009), Chatterjee & Eyigungor (2012)
- Default entails market exclusion (reentry with prob ψ) and output costs
 - ... on default, **nature** of costs is revealed
 - ... transitory with probability p , permanent otherwise
 - ... full default

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Decisions and default costs

- In **repayment**, government chooses debt issuance h

$$v_R(b, z) = \max_h u(c) + \beta \mathbb{E} [(g')^{1-\gamma} v(h/g', z') \mid z]$$

$$\text{subject to } c + \kappa b = y(z) + q(h, z)(h - (1 - \rho)b)$$

- Default reduces output from Y to Y^D

$$Y_t^D = (1 - \Delta) Y_t = (1 - \Delta) \exp(z_t) \Gamma_t$$

... factor Δ applies to z when **transitory** and to Γ when **permanent**

- Value functions for default

$$v_D(z) = p v_D^T(z) + (1 - p) (1 - \Delta)^{1-\gamma} v_D^P(z)$$

$$v_D^k(z) = u(y(z)(1 - \mathbb{1}_{(k=T)} \Delta)) + \beta \mathbb{E} [(g')^{1-\gamma} (\psi v(0, z') + (1 - \psi) v_D^k(z')) \mid z]$$

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- Government **mistrusts** the specification for permanent or transitory costs
... seeks **robust** decision rules to guard against misspecification
- *Multiplier preferences* (Hansen & Sargent, 2001)

$$v_D(z) = -\frac{1}{\theta_c} \log \left(p \exp \left(-\theta_c v_D^T(z) \right) + (1 - p) \exp \left(-\theta_c (1 - \Delta)^{1-\gamma} v_D^P(z) \right) \right)$$

- ... leads to an endogenous **distorted** 'worst-case' probability $\tilde{p}(z)$
- ... value and choice of default are based on $\tilde{p}(z)$ rather than p
- ... θ_c controls **distance** between p and $\tilde{p}(z)$

Calibration and Quantitative Results

Calibration

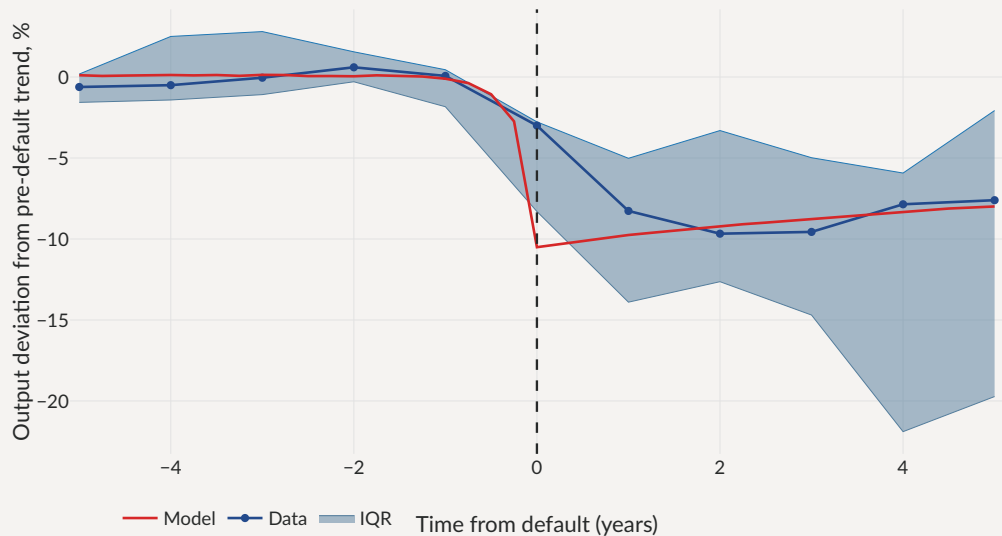
| | Parameter | Value |
|-------------------------------------|------------|--------|
| Sovereign's risk aversion | γ | 2 |
| Preference shock scale parameter | χ | 0.01 |
| Risk-free interest rate | r | 0.01 |
| Robustness parameter: income shocks | θ_s | 0 |
| Duration of debt | ρ | 0.05 |
| Reentry probability | ψ | 0.0385 |
| Income autocorrelation coefficient | ρ_z | 0.9256 |
| Standard deviation of z_t | σ_z | 0.0231 |
| Standard deviation of g_t | σ_g | 0.0211 |

Model fit

| | Parameter | Value |
|-------------------------------------|------------|--------|
| Sovereign's discount factor | β | 0.902 |
| Default cost | Δ | 0.0411 |
| Probability of transitory shock | p | 0.339 |
| Robustness parameter: default costs | θ_c | 7.6 |

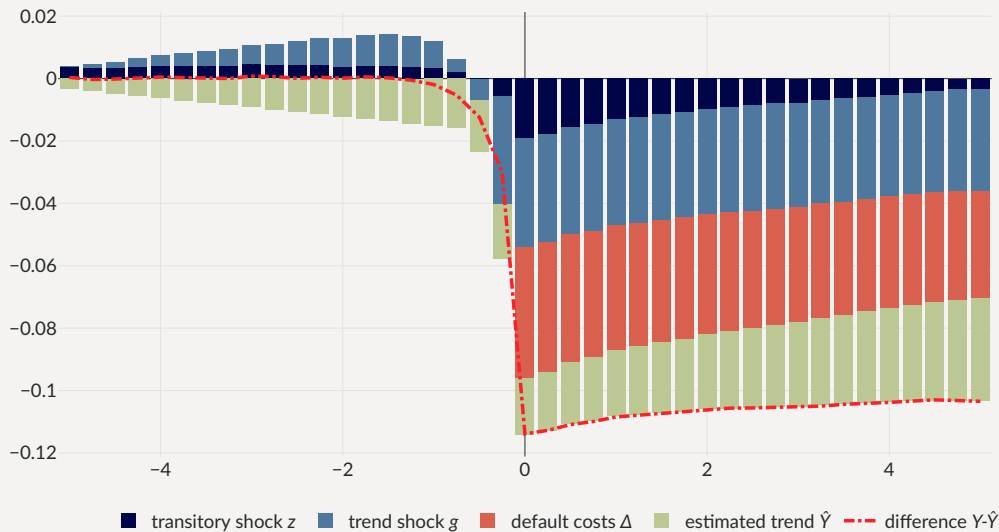
| | Data | Model |
|---------------------------------------|------|-------|
| Output deviation, 1-year horizon, % | 8.27 | 9.75 |
| Output deviation, 5-year horizon, % | 7.6 | 7.99 |
| Average external debt-to-GDP ratio, % | 23.4 | 21.3 |
| Average spread, bps | 793 | 813 |

Output dynamics around restructurings

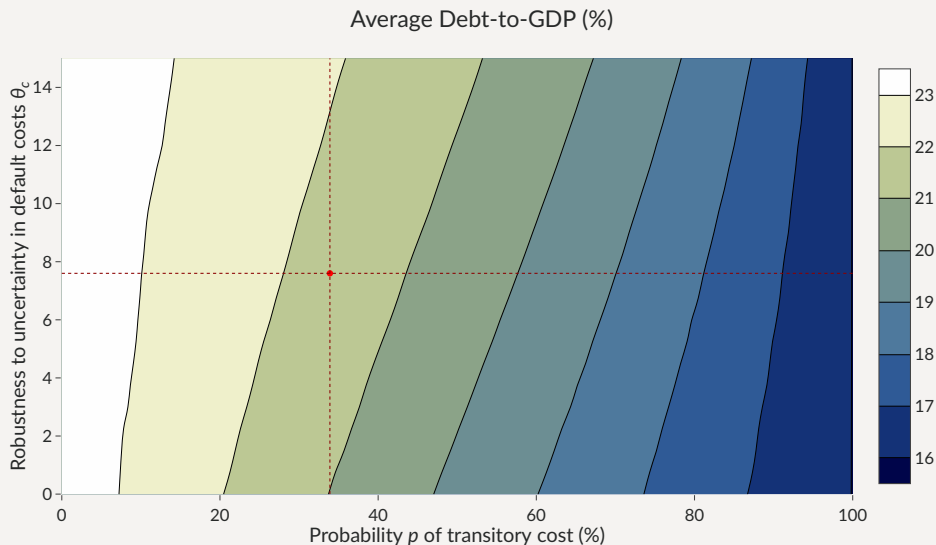


Decomposition of output deviations from trend

$$\log Y_t - \log \hat{Y}_t = z_t + \log \Gamma_t + \log(1 - \Delta) \mathbb{1}_{(D_t=1)} - \log \hat{Y}_t$$

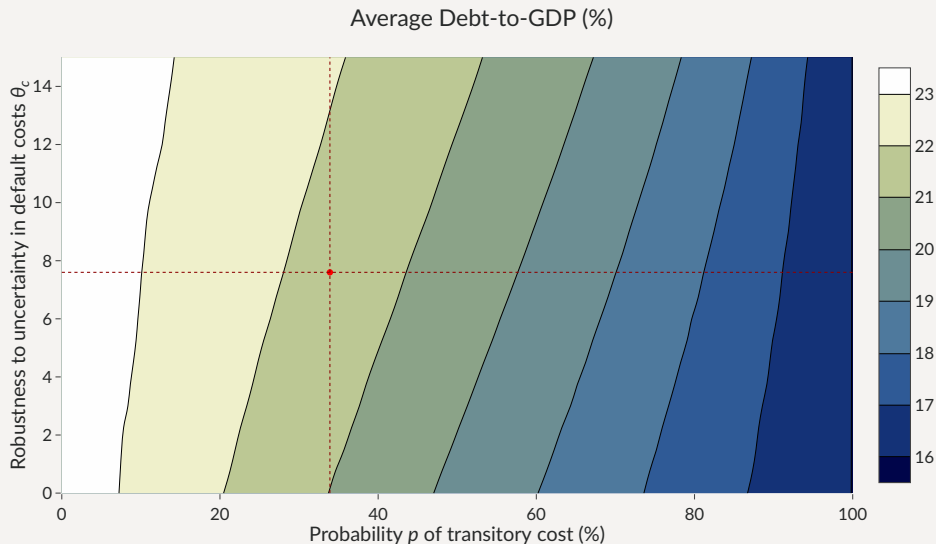


Debt Tolerance



In same model with pure transitory costs, avg debt = 15.9% \implies 25% of debt from (p, θ)

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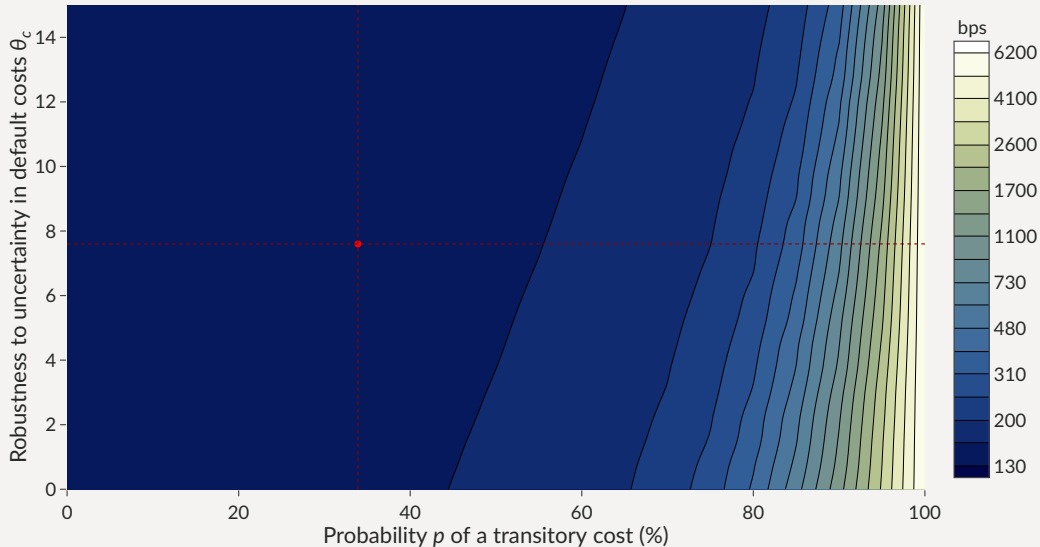


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Spreads

- Both robustness and persistence lower borrowing costs

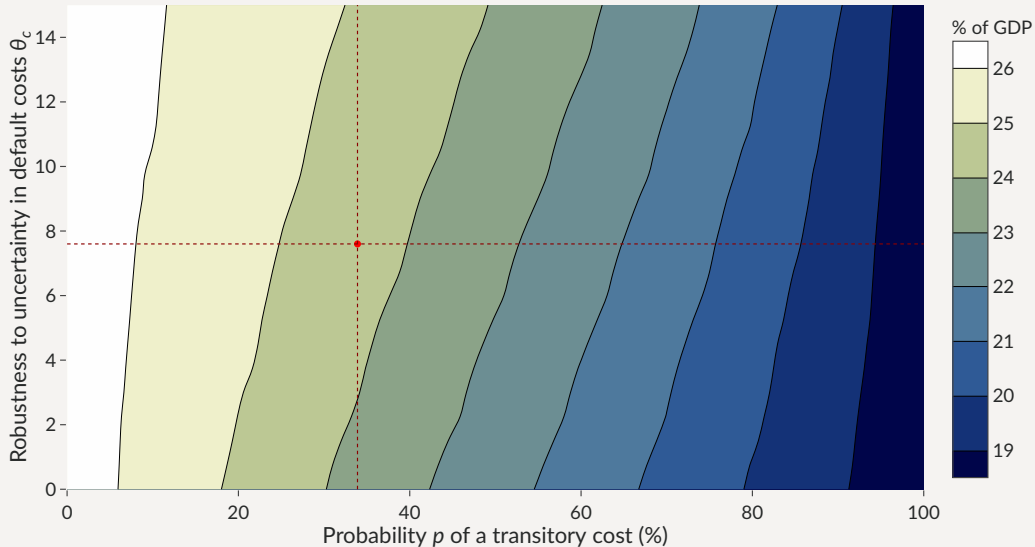
Debt prices at 19% of mean income



Spreads (cont'd)

- Both robustness and persistence lower borrowing costs

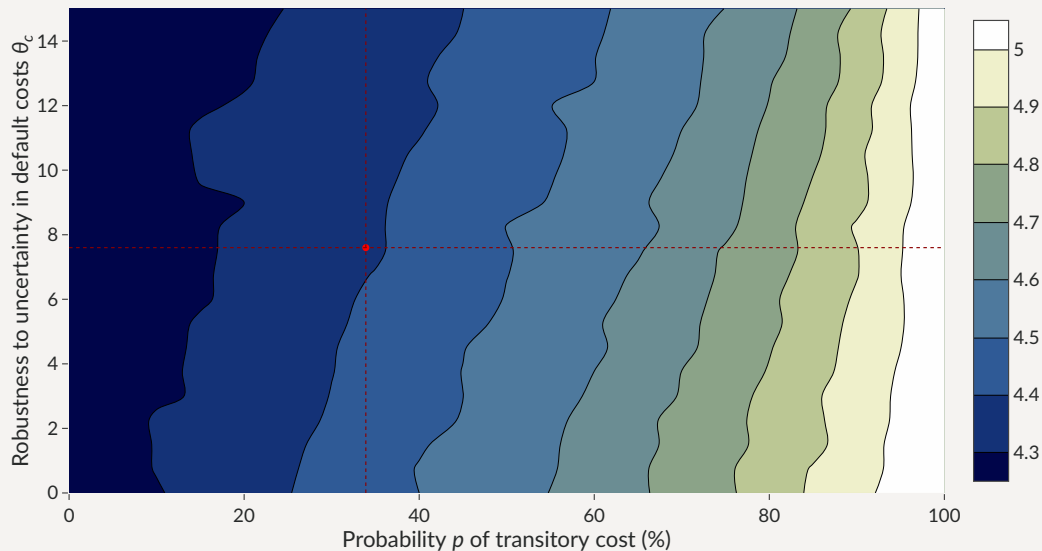
Debt at which spreads cross 1000 bps



Default frequency

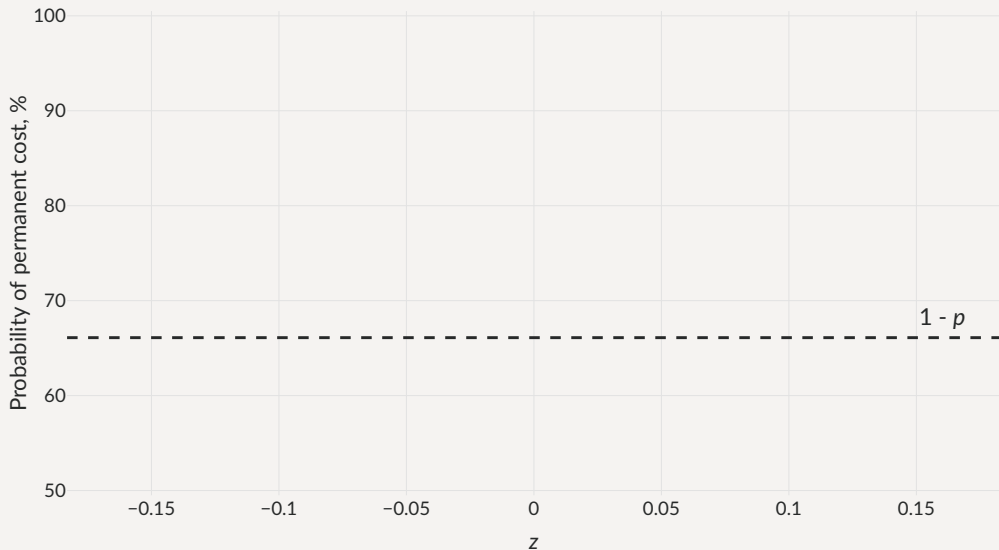
... but robustness does not decrease the default frequency

Default frequency (% per year)



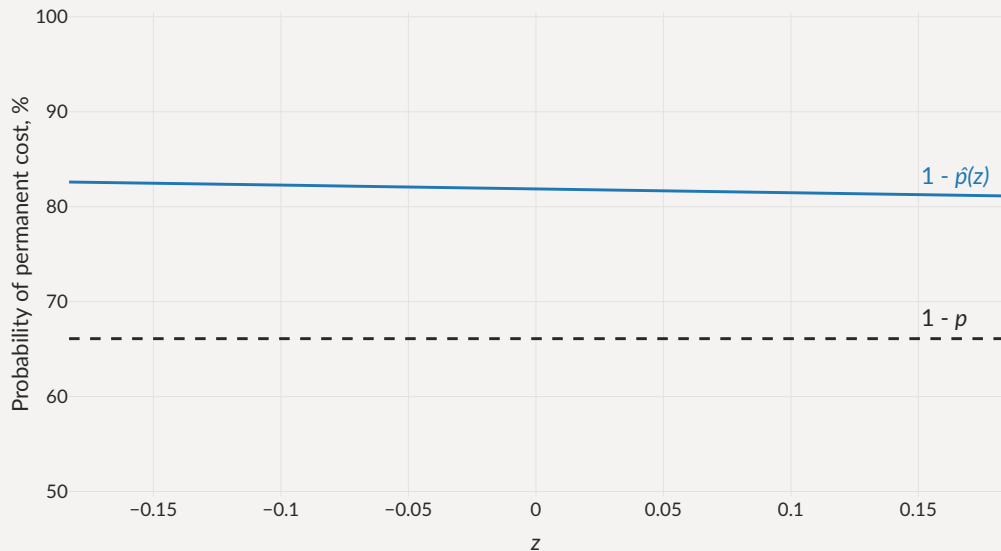
Belief distortion

- Magnification of costs in bad state: key to higher debt with same default rate



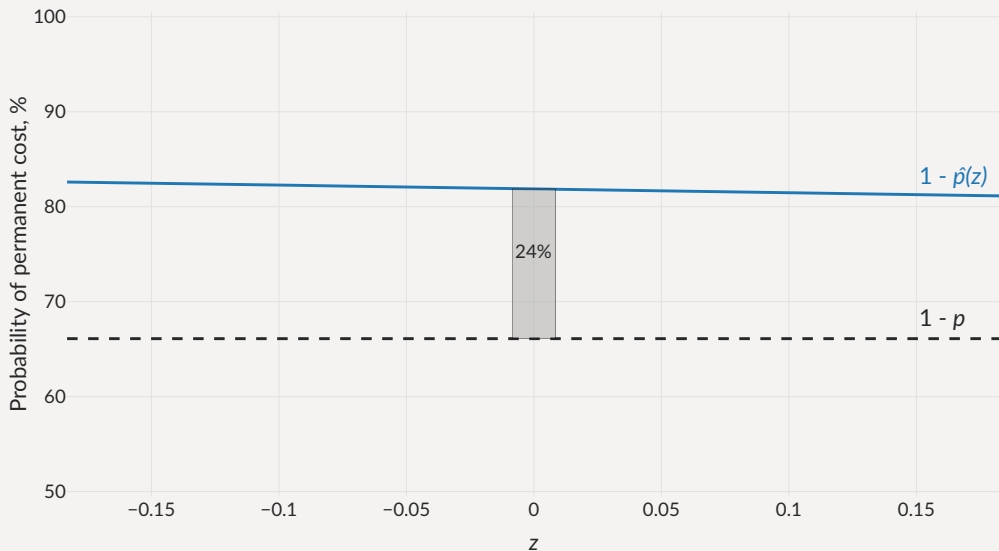
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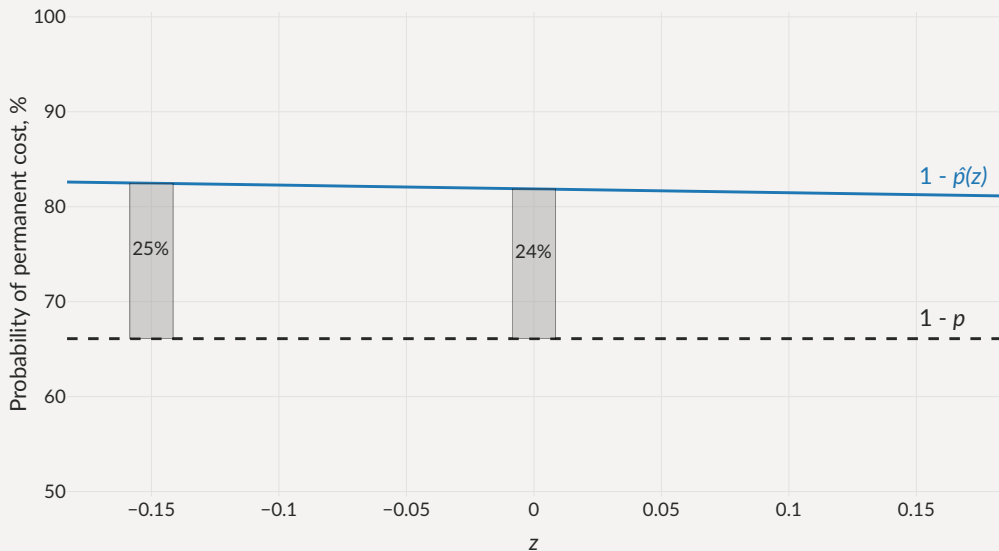
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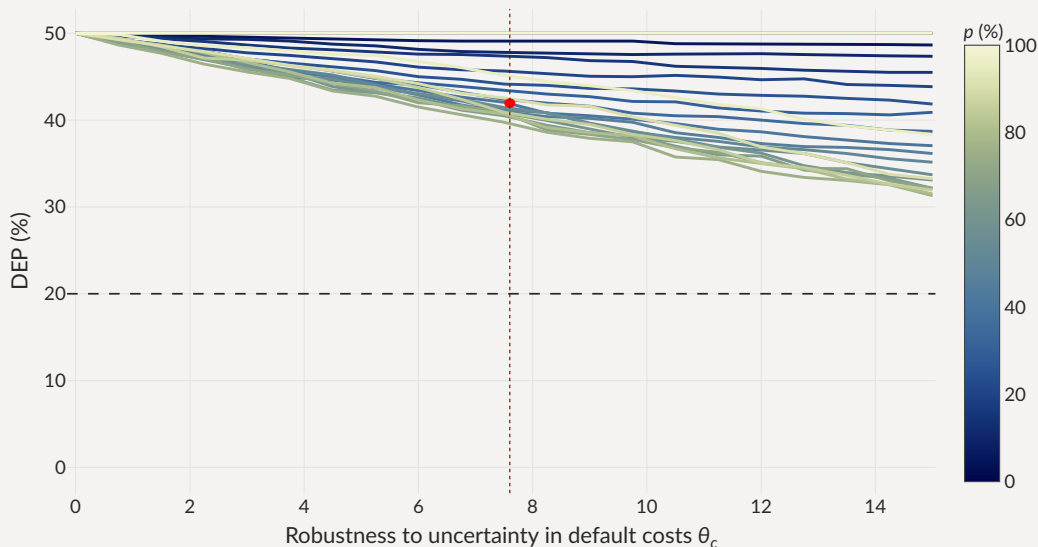
Concluding remarks

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- Model of sovereign debt/default
 - Uncertainty about **nature** of costs of default
 - Embracing this uncertainty crucial to match data **patterns**
- Calibration: significant uncertainty + uncertainty aversion
- Robustness increases debt tolerance (but does not decrease default)
- Uncertainty responsible for about **$1/4$** of debt tolerance

Detection-error probabilities

- Calibrated robustness: $\sim 40\text{-}45\%$ prob. of **misclassifying** data from both models



Growth outcomes around debt restructurings

