

# Debt Tolerance with Potentially Permanent Costs of Default

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# Motivation

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- Default costs are key determinants of debt **tolerance** and borrowing **terms**  
... Size, shape, persistence of costs all matter for equilibrium
- Unclear **nature** of these costs – Large empirical challenge
  - Growth **slowdowns** around time of restructurings
  - Long literature highlighting different sources of costs
- Quantitative models of sovereign debt do not use information on **output**
  - Calibrate default costs to match dynamics of debt and spreads
- This paper – Focus on how the **possibility** of permanent costs affects the equilibrium

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## Are default costs permanent?

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- 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

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- 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

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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

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

## Stylized facts

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## Growth outcomes around debt restructurings

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- Panel of emerging-market economies 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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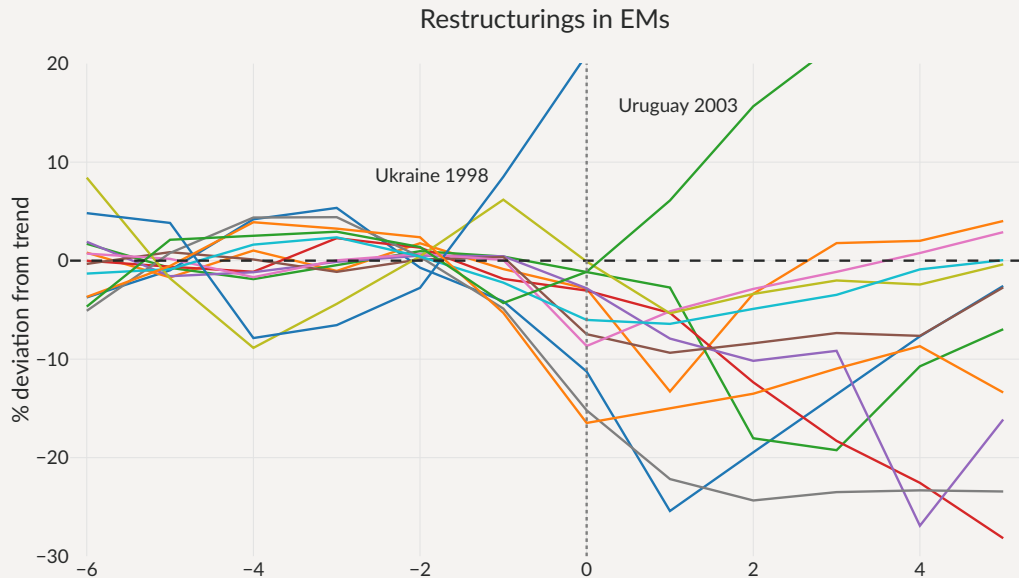
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# Growth outcomes around debt restructurings

► Calendar time



Model

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# 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  $\Gamma_t$ ) 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  $\psi$ ) 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  $h$

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

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

- Default reduces output from  $Y$  to  $Y^D$

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

... factor  $\Delta$  applies to  $z$  when **transitory** and to  $\Gamma$  when **permanent**

- Value functions for default

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

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

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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  $p$
- ...  $\theta_c$  controls **distance** between  $p$  and  $\tilde{p}(z)$

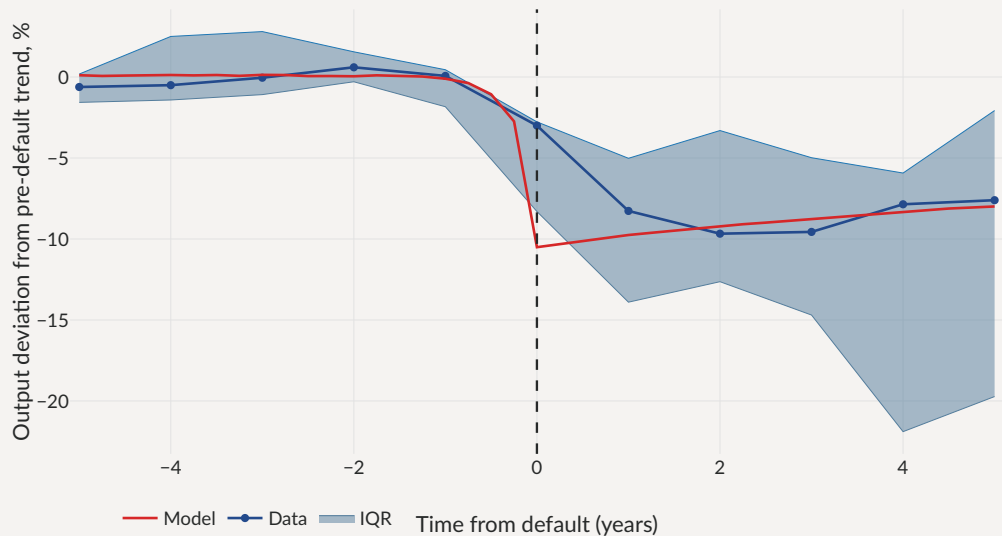
# Calibration and Quantitative Results

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	Parameter	Value
Sovereign's discount factor	$\beta$	0.902
Default cost	$\Delta$	0.0411
Probability of transitory shock	$p$	0.339
Robustness parameter: default costs	$\theta_c$	7.6

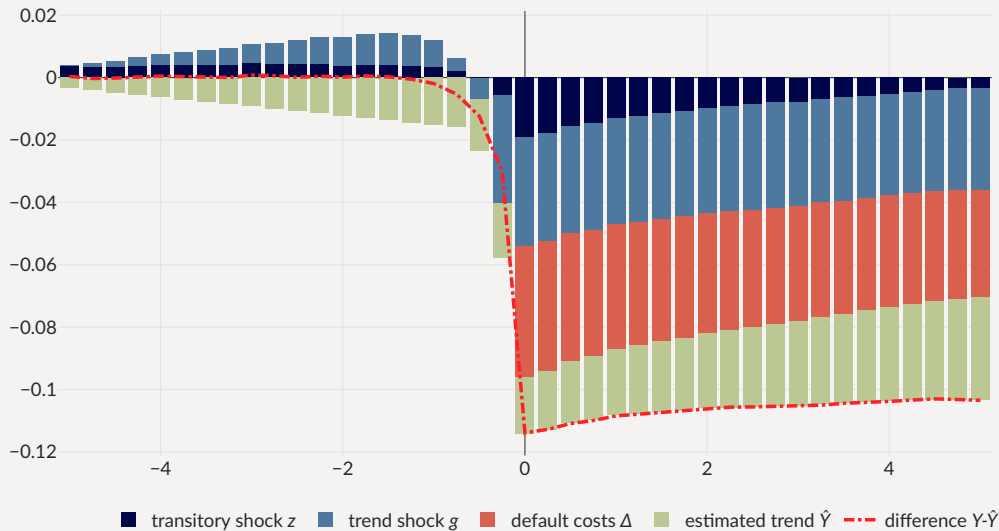
	Data	Model
Output deviation, 1-year horizon, %	8.27	9.75
Output deviation, 5-year horizon, %	7.6	7.99
Average external debt-to-GDP ratio, %	23.4	21.3
Average spread, bps	793	813

# Output dynamics around restructurings



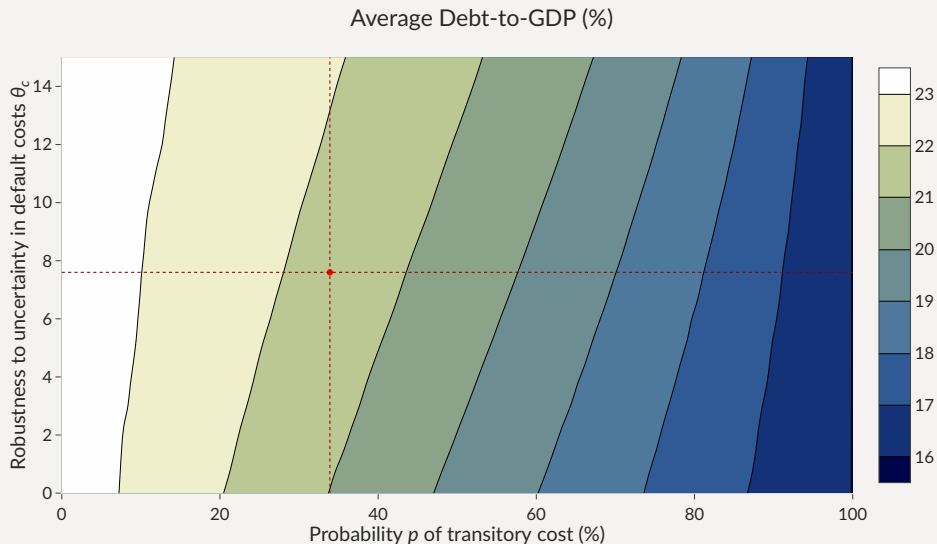
# Decomposition of output deviations from trend

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



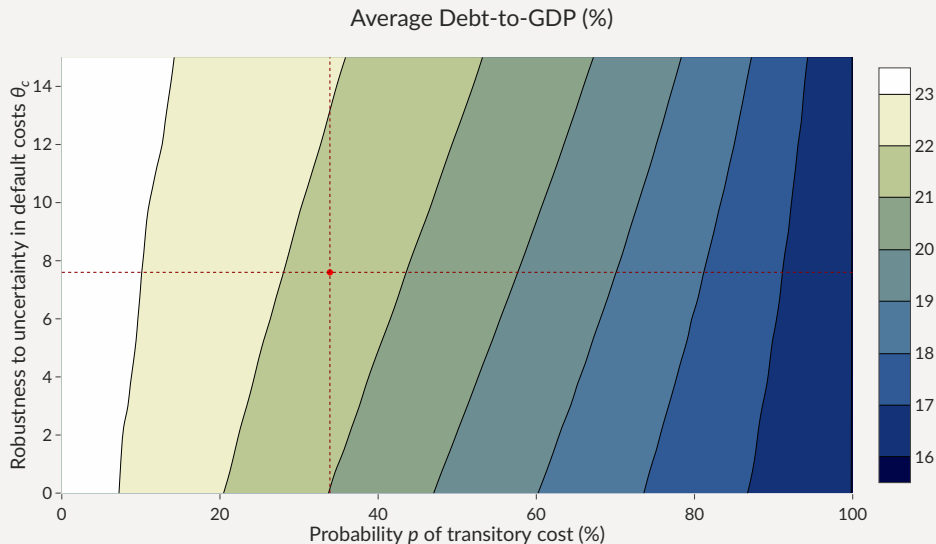


# Debt Tolerance



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

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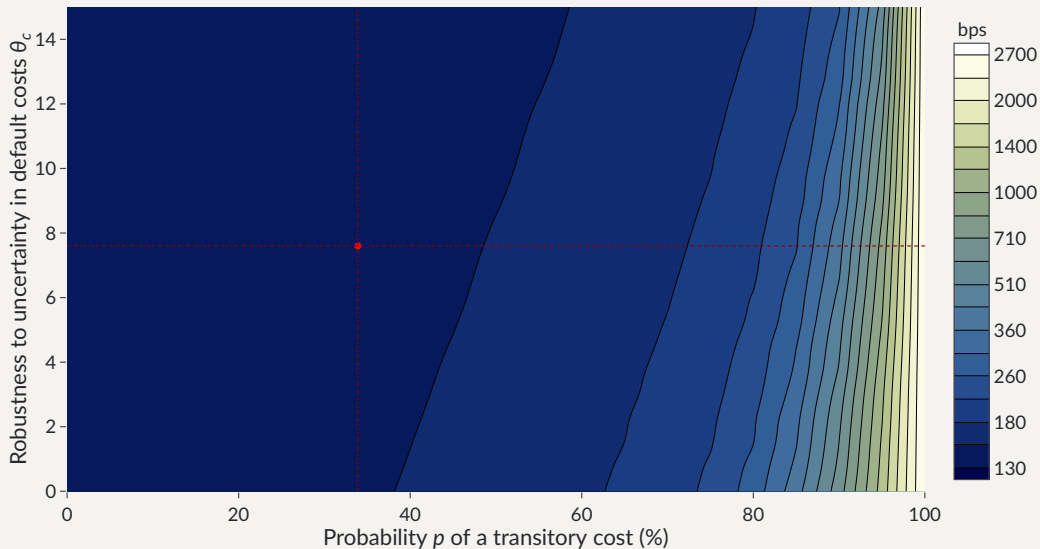


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# Spreads

- Both robustness and persistence lower borrowing costs

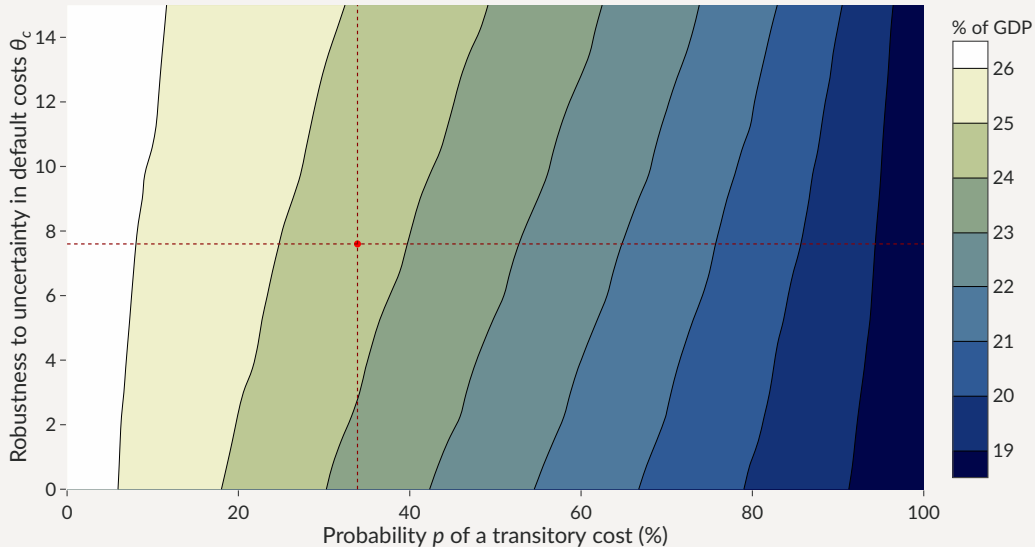
Debt prices at 19% of mean income



## Spreads (cont'd)

- Both robustness and persistence lower borrowing costs

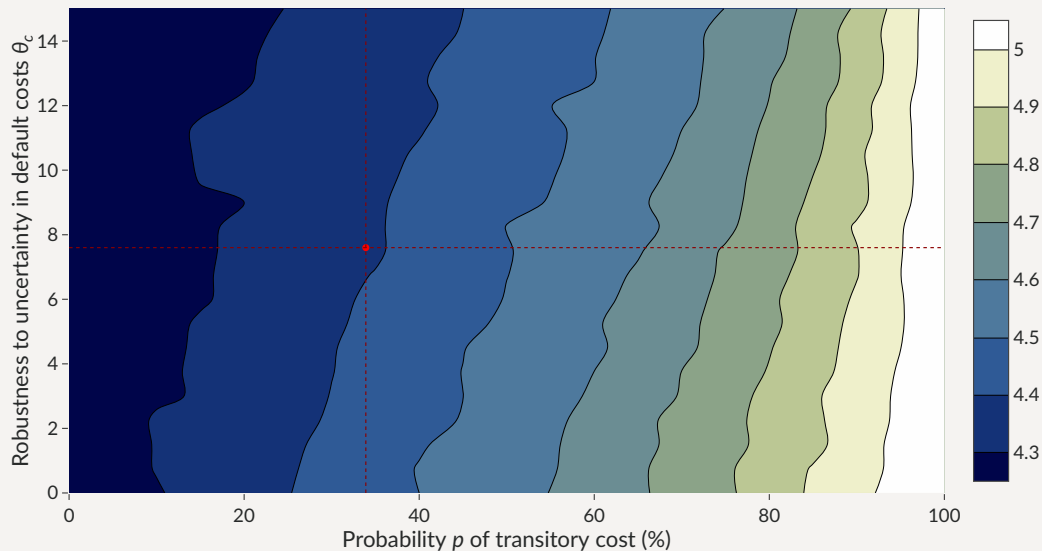
Debt at which spreads cross 1000 bps



## Default frequency

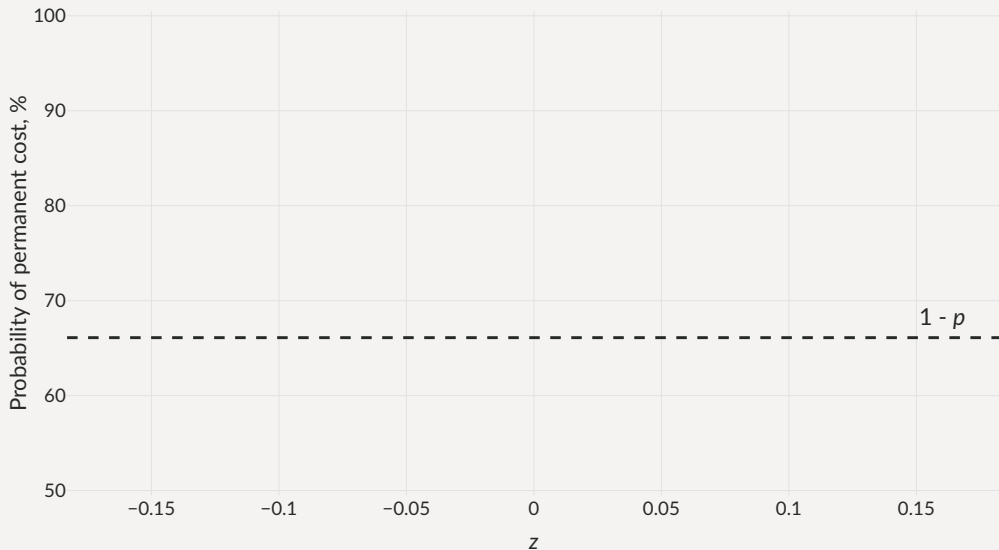
... but robustness does not decrease the default frequency

Default frequency (% per year)



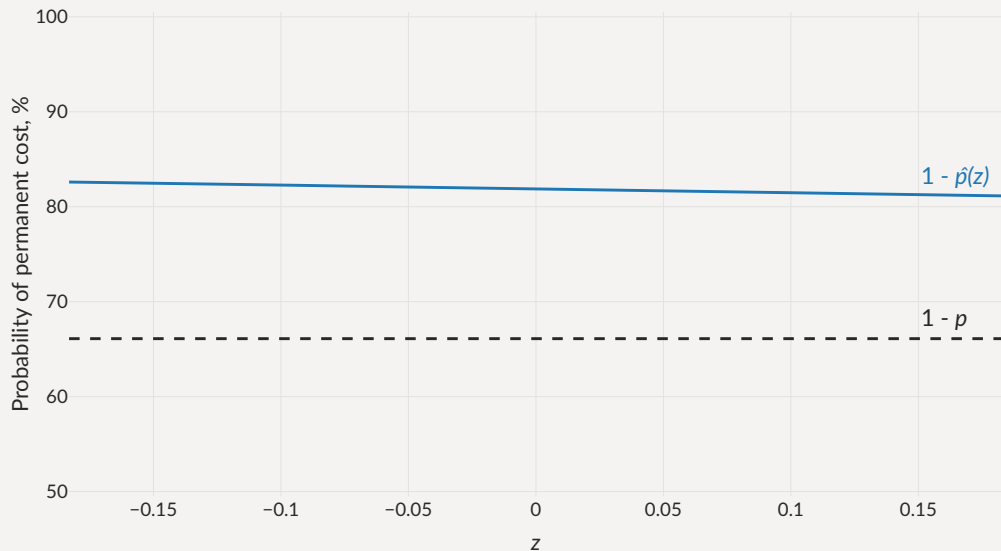
## Belief distortion

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



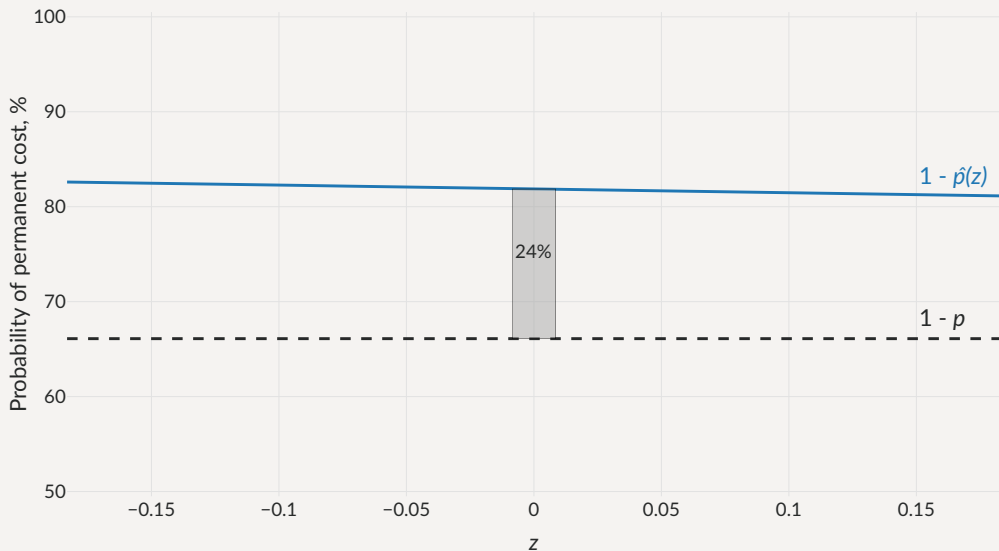
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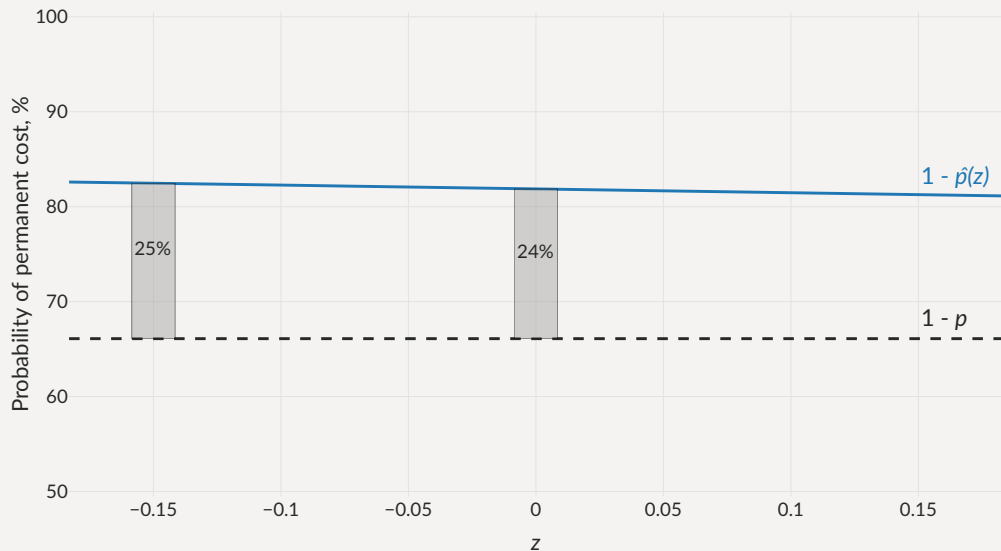
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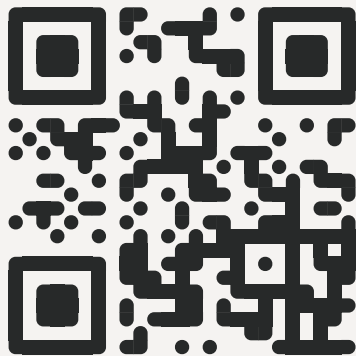
## Concluding remarks

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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  $\frac{1}{4}$  of debt tolerance



*Scan to find the paper*

	Parameter	Value
Sovereign's risk aversion	$\gamma$	2
Preference shock scale parameter	$\chi$	0.01
Risk-free interest rate	$r$	0.01
Robustness parameter: income shocks	$\theta_s$	0
Duration of debt	$\rho$	0.05
Reentry probability	$\psi$	0.0385
Income autocorrelation coefficient	$\rho_z$	0.9256
Standard deviation of $z_t$	$\sigma_z$	0.0231
Standard deviation of $g_t$	$\sigma_g$	0.0211

# Detection-error probabilities

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



# Growth outcomes around debt restructurings

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