Debt Tolerance with Potentially Permanent Costs of Default

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Motivation

- Default costs (actual and perceived) are key determinants of debt tolerance and the terms at which countries can borrow.

- Rogoff made several key contributions to the sovereign debt literature

  ... Bulow & Rogoff (1989a, 1989b); Reinhart, Rogoff & Savastano (2003), ...

- The nature of these costs is not entirely clear, but we do see growth slowdowns around the time of restructurings and countries go to great lengths to avoid a default

- 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?

- The theoretical literature assumes temporary credit market exclusion and output reduction, typically focusing on stationary models

- 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 60% of the time
   ... but that the robust government acts as if it actually was 75-80%

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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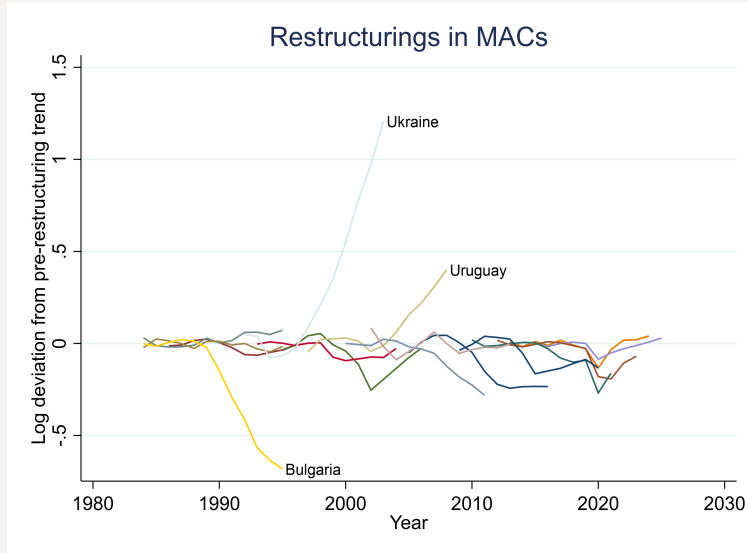- Construct a pre-restructuring trend for output as

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Growth outcomes around debt restructurings

- In the whole database

Restructurings in MACs

Model

Environment

- Small open economy receives endowment Y_t

$$Y_t = \exp(z_t)\Gamma_t$$
$$z_t = \rho z_{t-1} + \sigma \varepsilon_t^z \qquad\qquad \text{AR(1) cycle}$$
$$\log(\Gamma_t) = \log(\Gamma_{t-1}) + \log(g_t) \qquad\qquad \text{Random-walk trend}$$

... 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 $\kappa, (1-\rho)\kappa, (1-\rho)^2\kappa, \ldots, (1-\rho)^{j-1}\kappa, \ldots$
      ... 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 (for simplicity; possible extension with recovery)

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Decisions and default costs

- In repayment, government chooses debt issuance h

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

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

- 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

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

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

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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

  ... 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 y_t	σ_z	0.0231
Standard deviation of g_t	σ_g	0.0211

Model fit

	Parameter	Value
Sovereign's discount factor	β	0.9007
Default cost	Δ	0.0425
Probability of transitory shock	p	0.3972
Robustness parameter: default costs	θ_c	6.667

	Data	Model
Output deviation, 1-year horizon, %	8.27	9.06
Output deviation, 5-year horizon, %	7.6	7.45
Average external debt-to-GDP ratio, %	23.4	22.1
Average spread, bps	793	800

Output dynamics around restructurings

Output deviation from pre-default trend, %

Time from default (years)

Model — Data ■ IQR
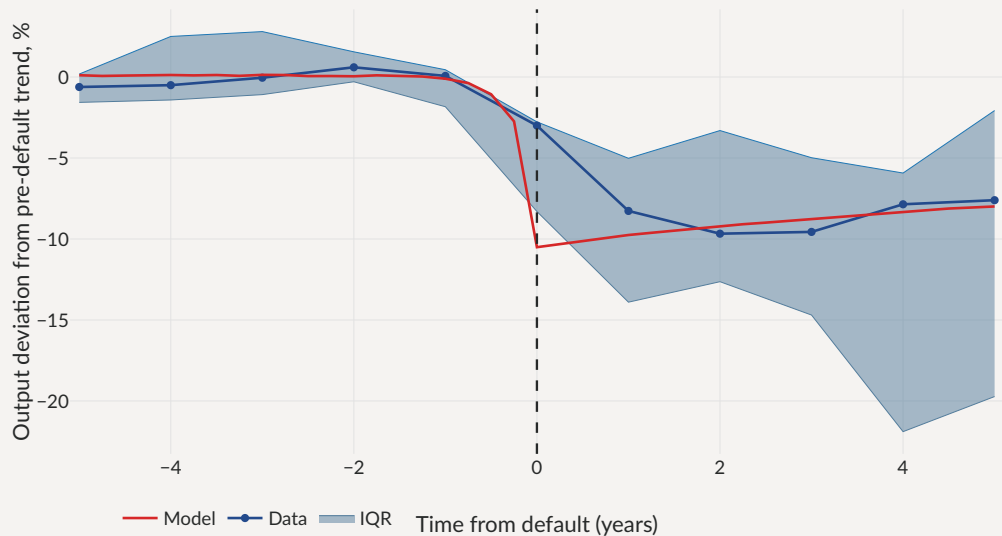
Decomposition of output deviations from trend

$$\log Y_t - \log \hat{Y}_t = z_t + \log \Gamma_t + \log(1 - \Delta)\mathbb{1}_{(D_t=1)} - \log \hat{Y}_t$$
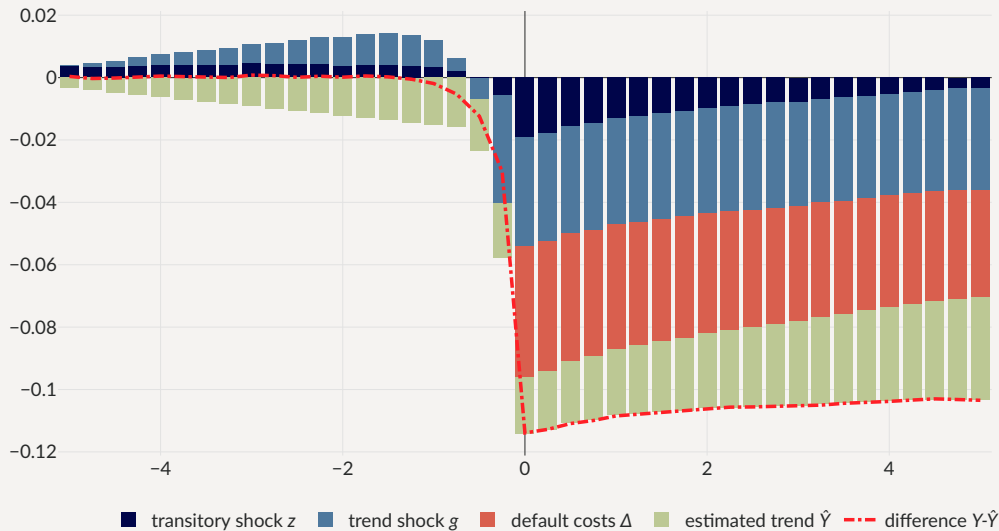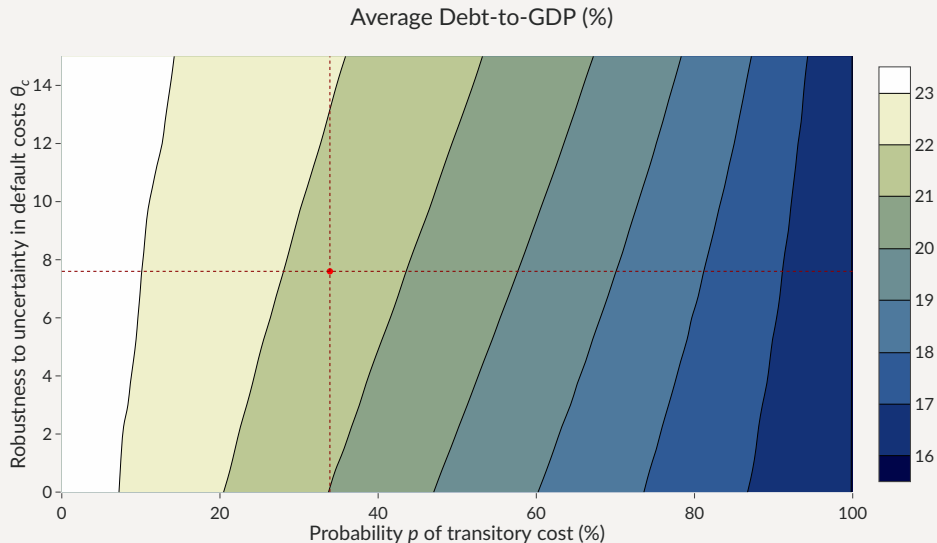
transitory shock z trend shock g default costs Δ estimated trend $\hat{Y}$ difference Y-$\hat{Y}$

Debt Tolerance

Average Debt-to-GDP (%)

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

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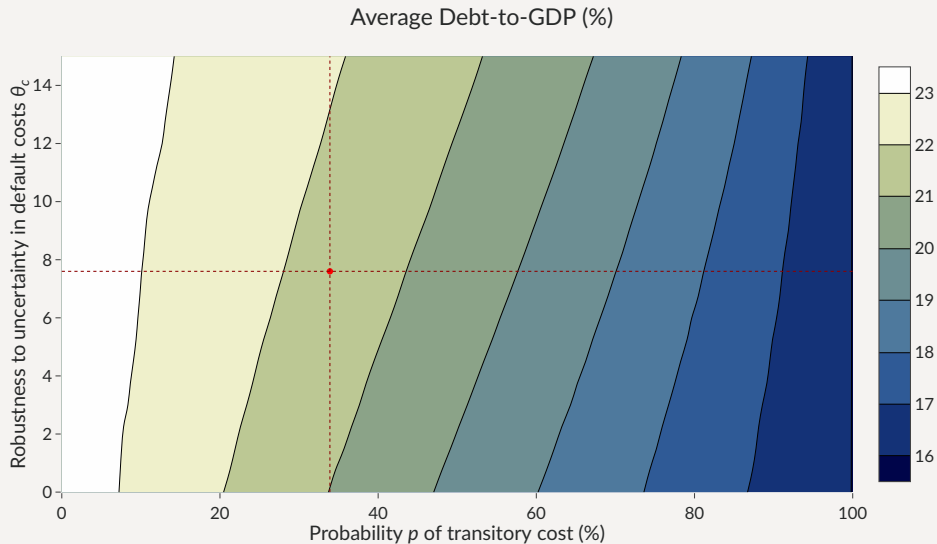
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Spreads

- Both robustness and persistence lower borrowing costs

Debt prices at 19% of mean income
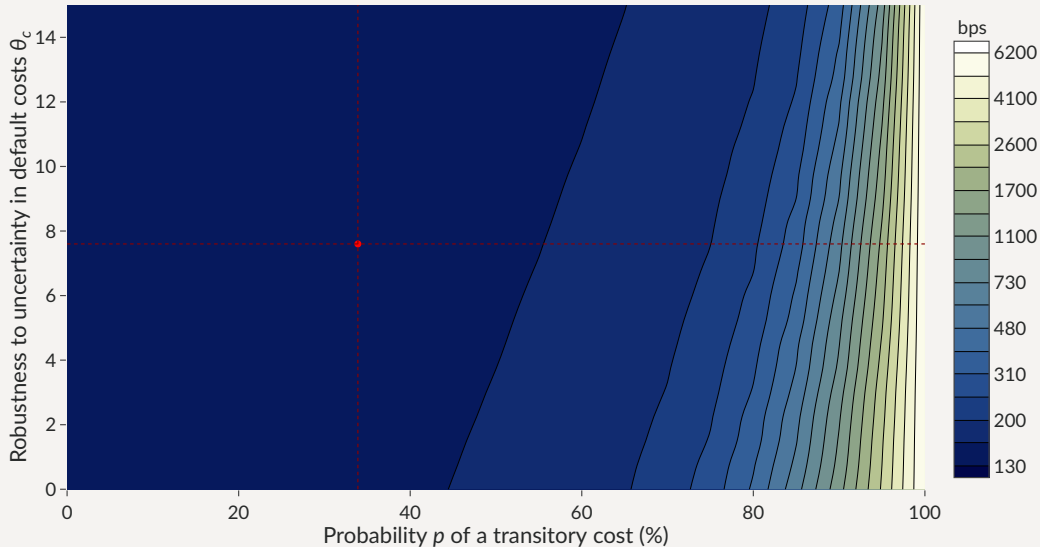
Spreads (cont'd)
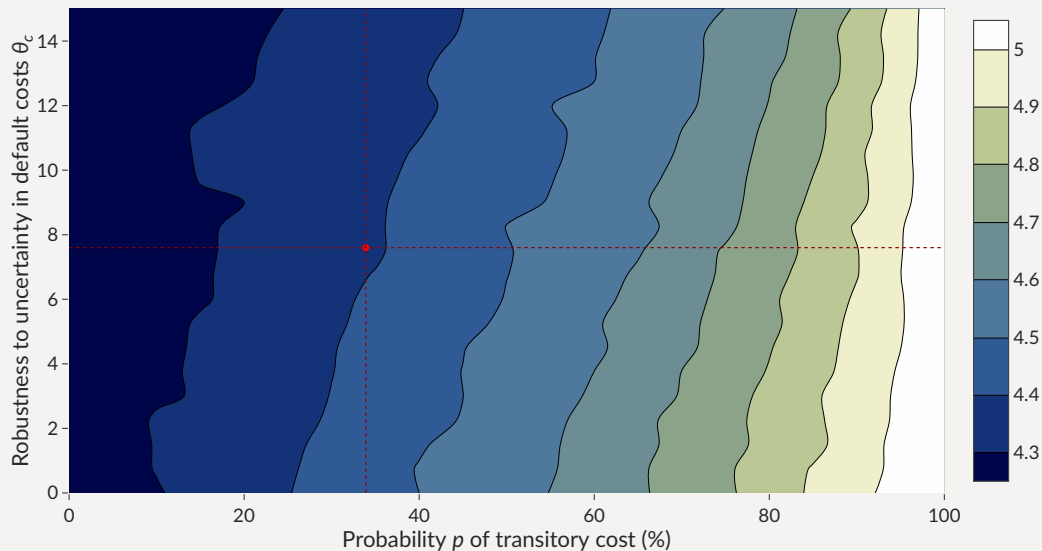
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Debt at which spreads cross 1000 bps
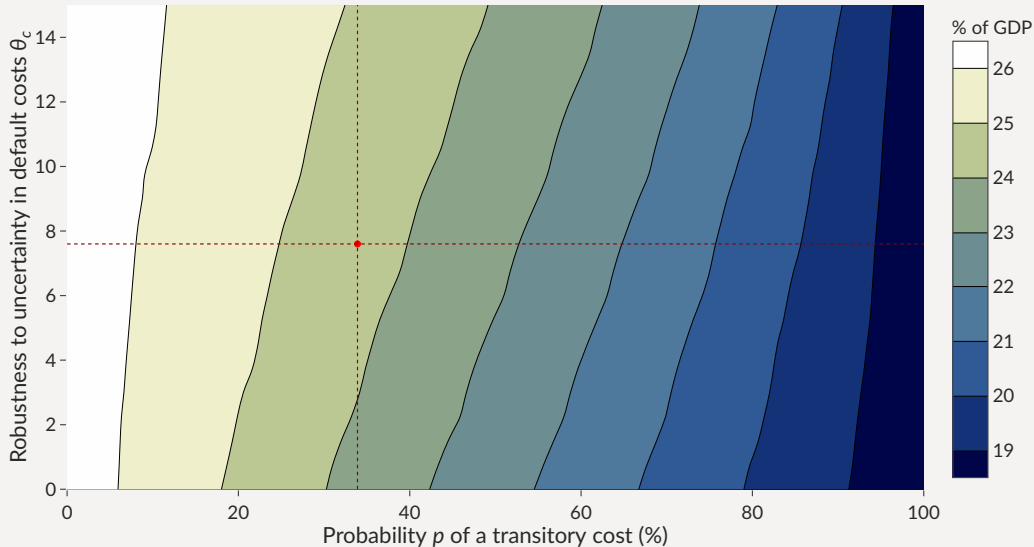
... but robustness does not decrease the default frequency
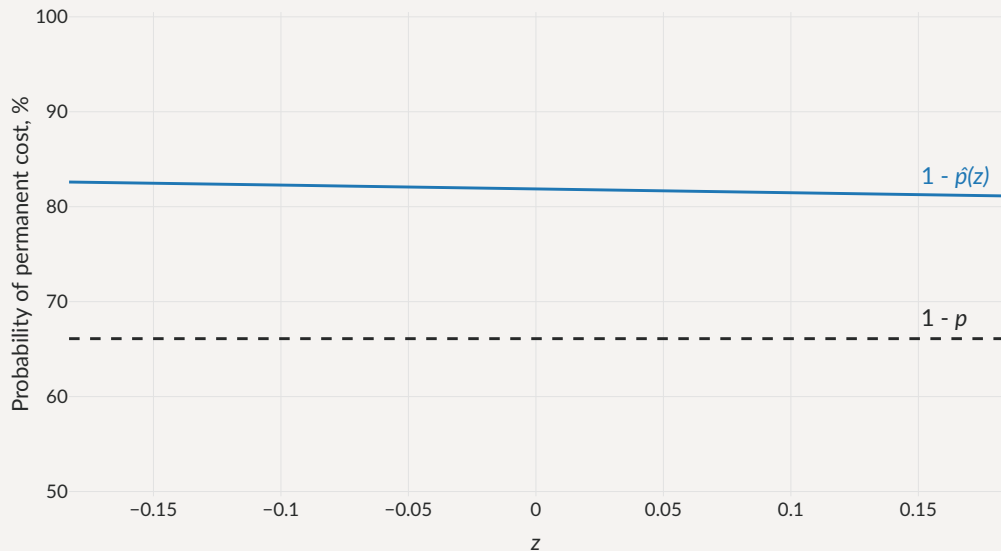
Default frequency (% per year)

Belief distortion

· Magnification of costs in bad state: key to higher debt with same default rate
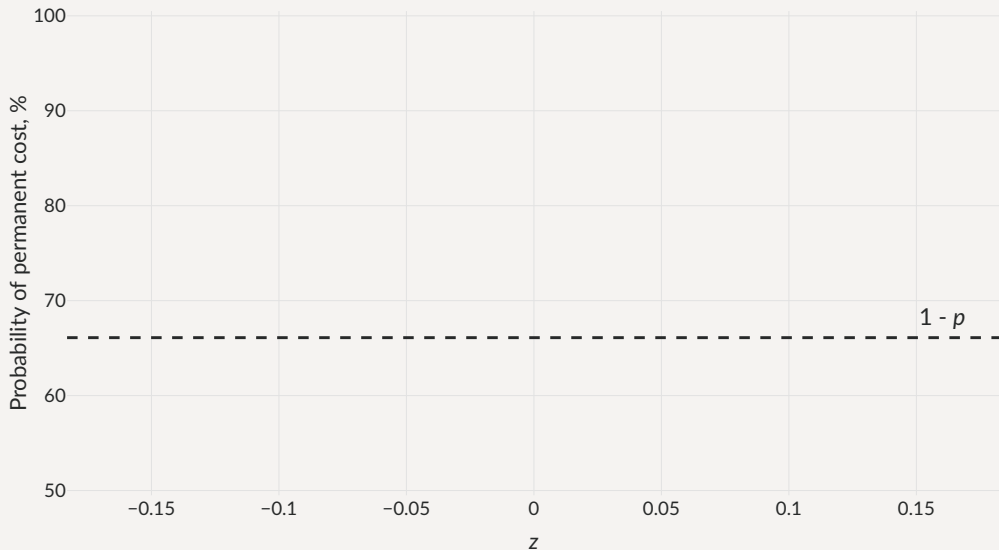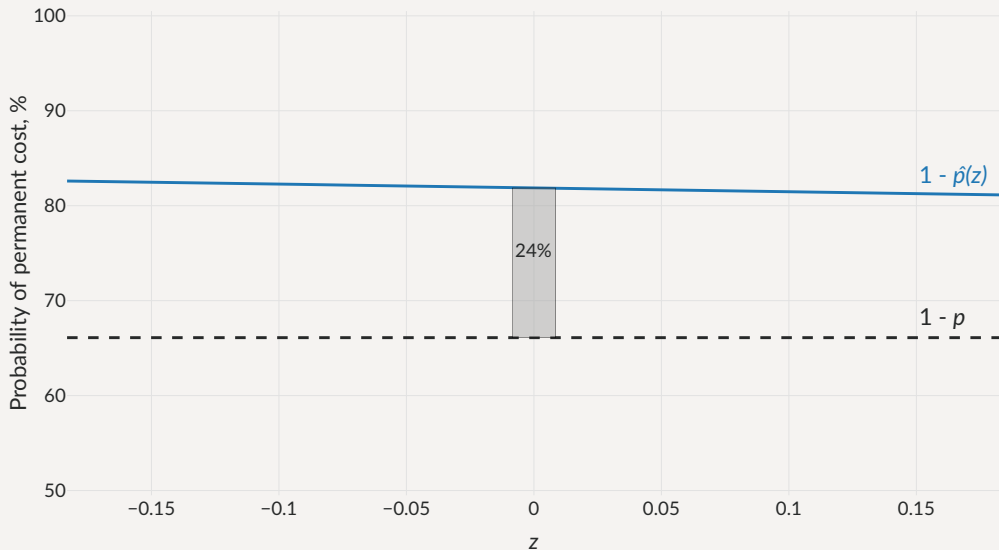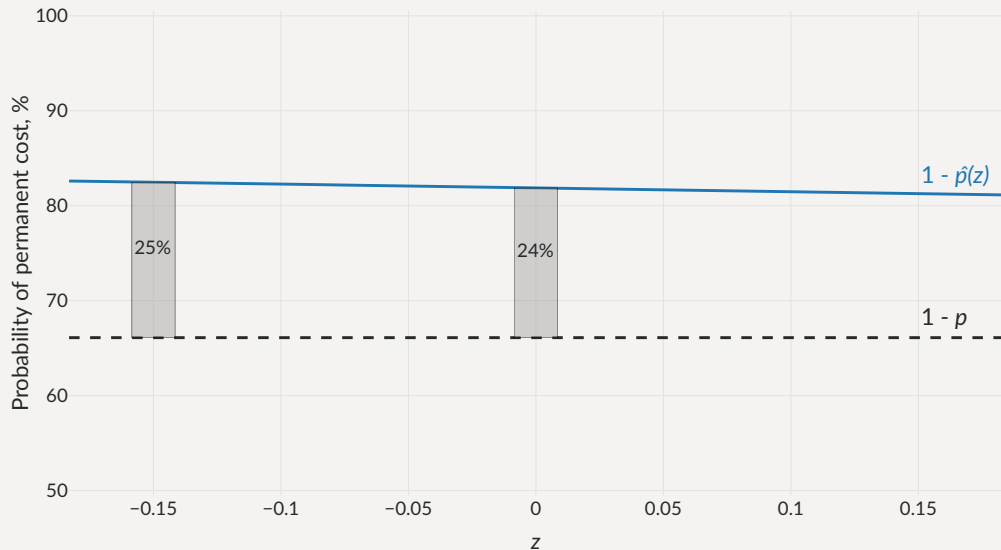
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Concluding remarks

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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 $1/3$ of debt tolerance

Detection-error probabilities

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