# 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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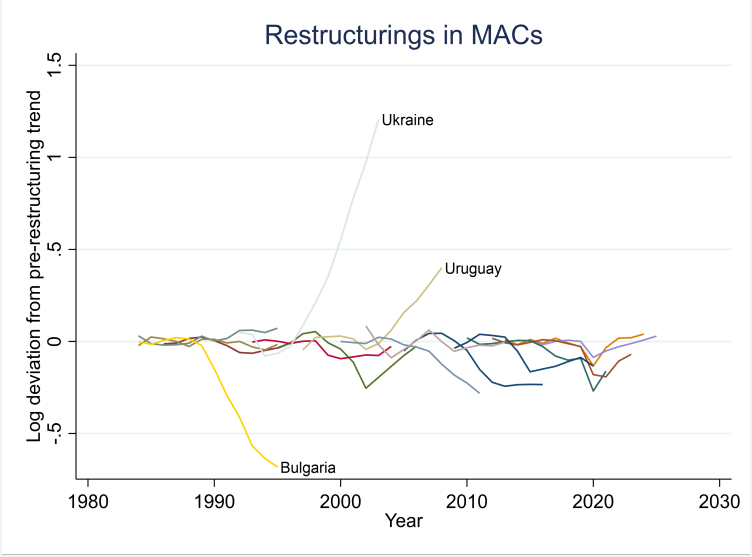
# Growth outcomes around debt restructurings

- In the whole database



# Model

# Environment

- Small open economy receives endowment $Y_t$

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

  - ... 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 $\kappa, (1-\rho)\kappa, (1-\rho)^2\kappa, \ldots, (1-\rho)^{j-1}\kappa, \ldots$
    - ... 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
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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 $\Delta$ applies to $z$ when transitory and to $\Gamma$ when permanent

- Value functions for default

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

- 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

# Calibration

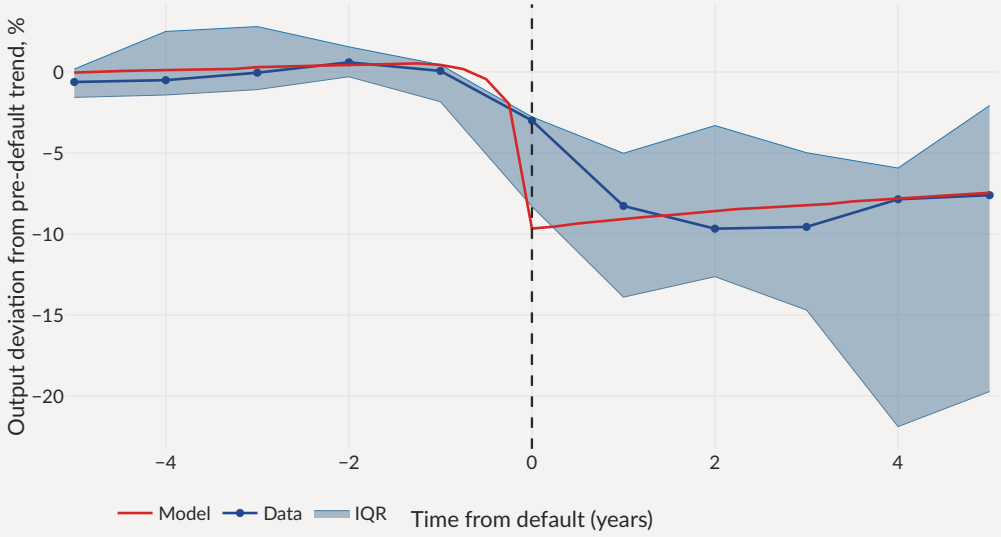
| | Parameter | Value |
|---|---|---|
| Sovereign's risk aversion | $\gamma$ | 2 |
| Preference shock scale parameter | $\chi$ | 0.01 |
| Risk-free interest rate | $r$ | 0.01 |
| Robustness parameter: income shocks | $\theta_s$ | 0 |
| Duration of debt | $\rho$ | 0.05 |
| Reentry probability | $\psi$ | 0.0385 |
| Income autocorrelation coefficient | $\rho_z$ | 0.9484 |
| Standard deviation of $y_t$ | $\sigma_z$ | 0.02 |

# Model fit

| | Parameter | Value |
|---|---|---|
| Sovereign's discount factor | $\beta$ | 0.9007 |
| Default cost | $\Delta$ | 0.0425 |
| Probability of transitory shock | $p$ | 0.3972 |
| Robustness parameter: default costs | $\theta_c$ | 6.667 |

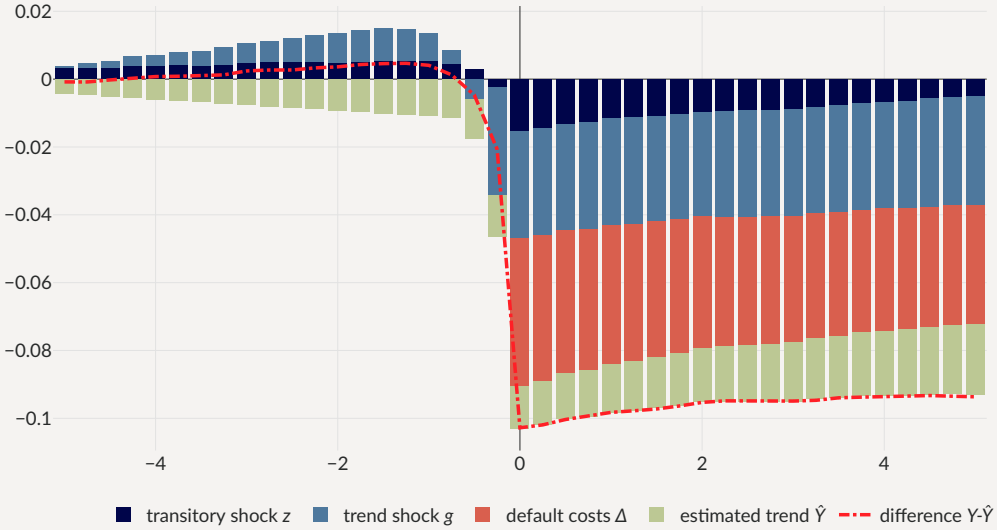
| | Data | Model |
|---|---|---|
| Output deviation, 1-year horizon, % | 8.27 | 9.06 |
| Output deviation, 5-year horizon, % | 7.6 | 7.45 |
| Average external debt-to-GDP ratio, % | 23.4 | 22.1 |
| Average spread, bps | 793 | 800 |

# Output dynamics around restructurings

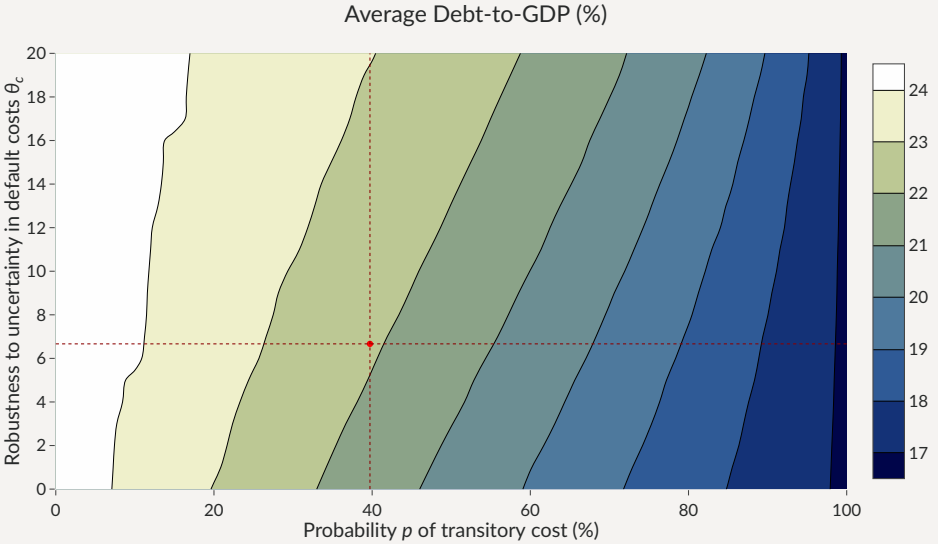


# Decomposition of output deviations from trend

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



# Debt Tolerance

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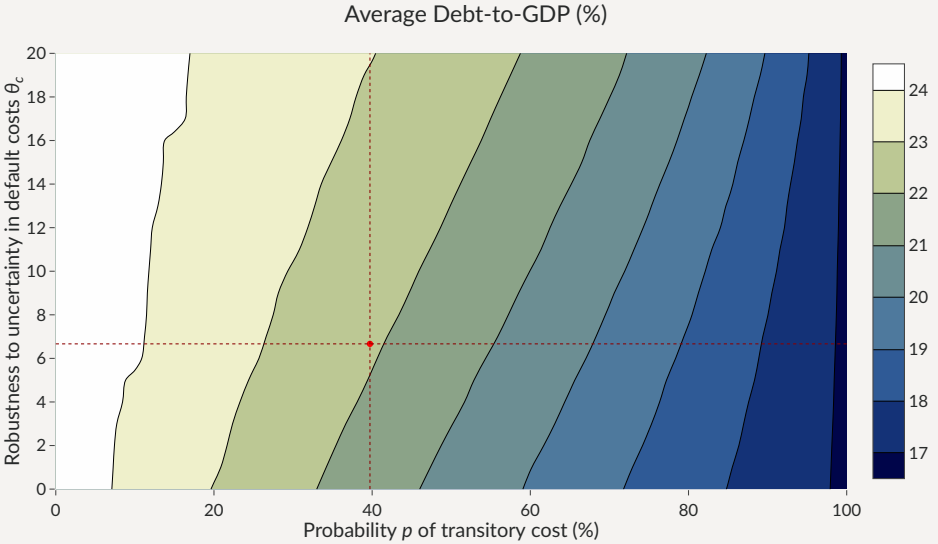


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# Spreads

- Both robustness and persistence lower borrowing costs

# Spreads (cont'd)

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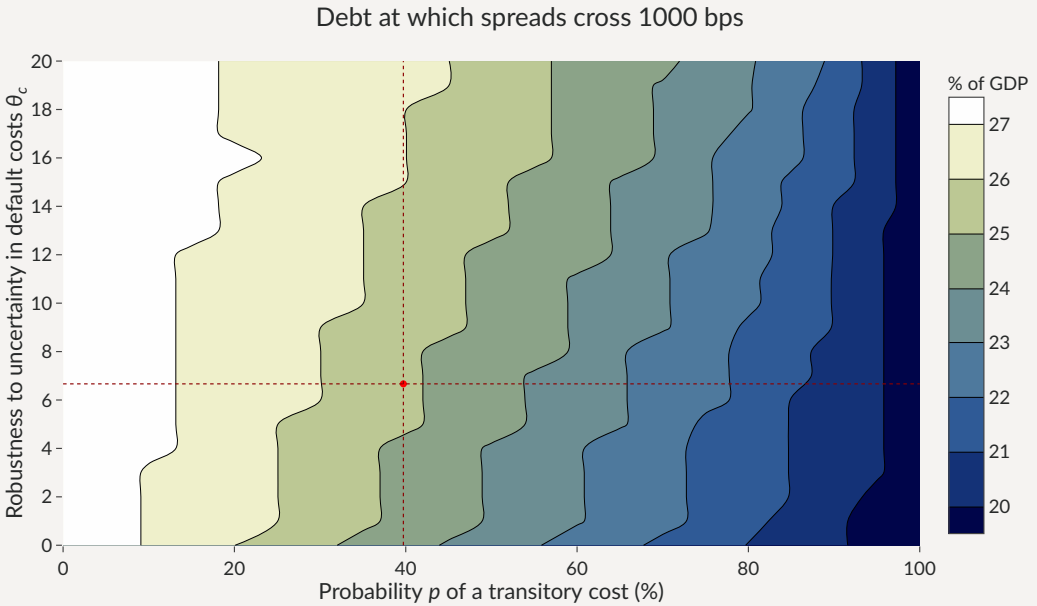
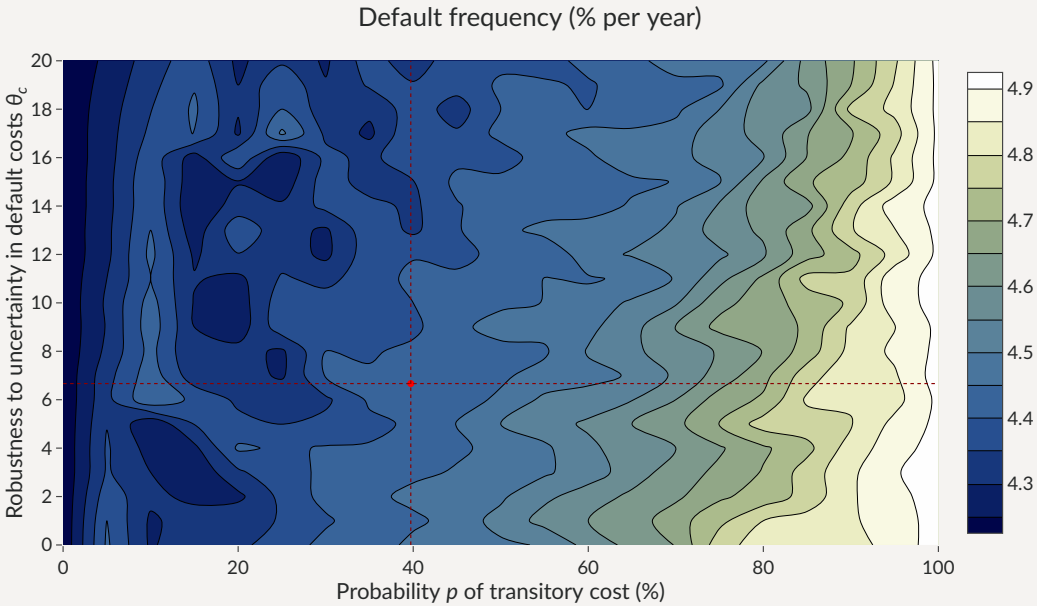


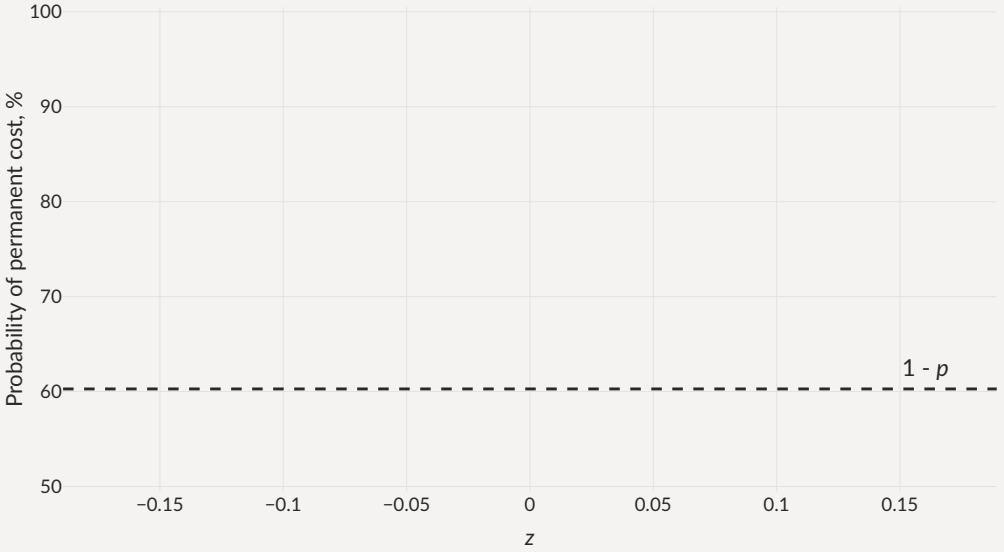
# Default frequency

… but robustness does not decrease the default frequency



# Belief distortion

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



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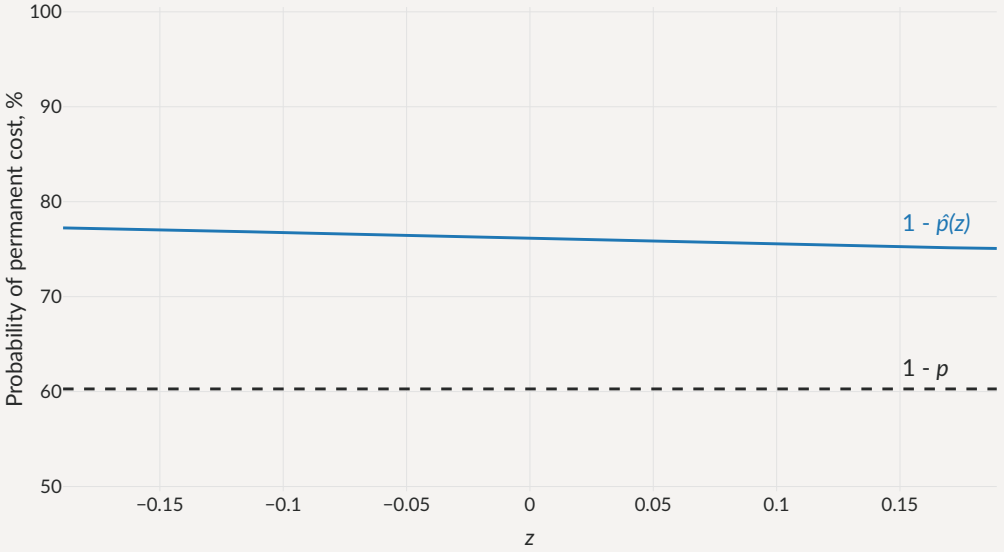

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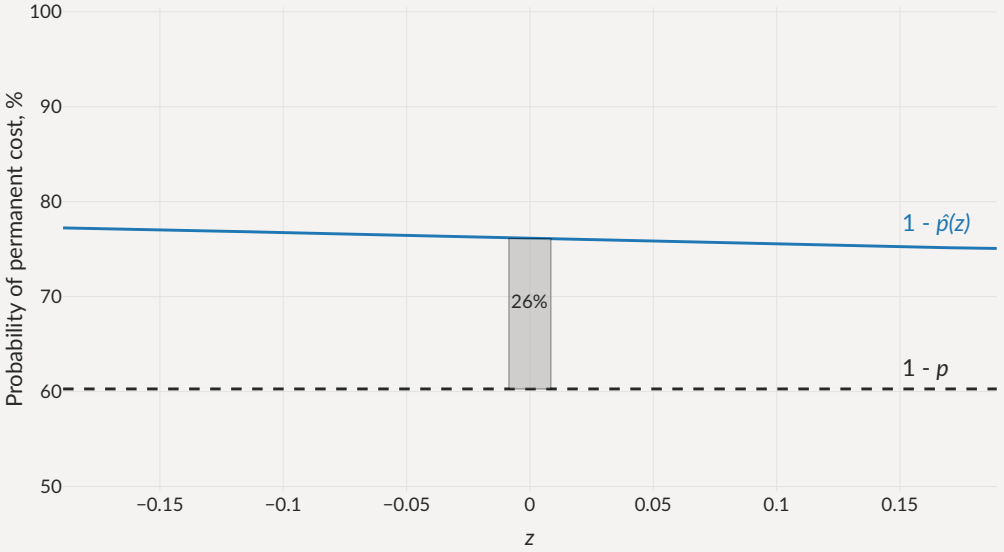

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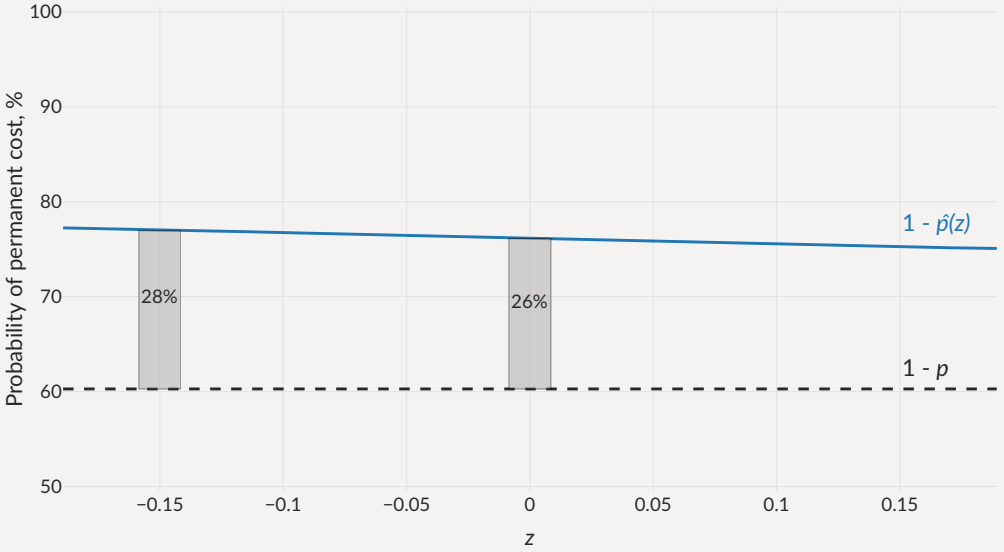

# Concluding remarks

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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 $1/3$ of debt tolerance

# Detection-error probabilities

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