

Debt Tolerance with Potentially Permanent Costs of Default

Marcos Chamon
IMF

Francisco Roldán
IMF

13° Conferencia Anual de Graduados de UdeSA
December 2023

The views expressed herein are those of the authors and should not be attributed to the IMF,
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

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

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

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

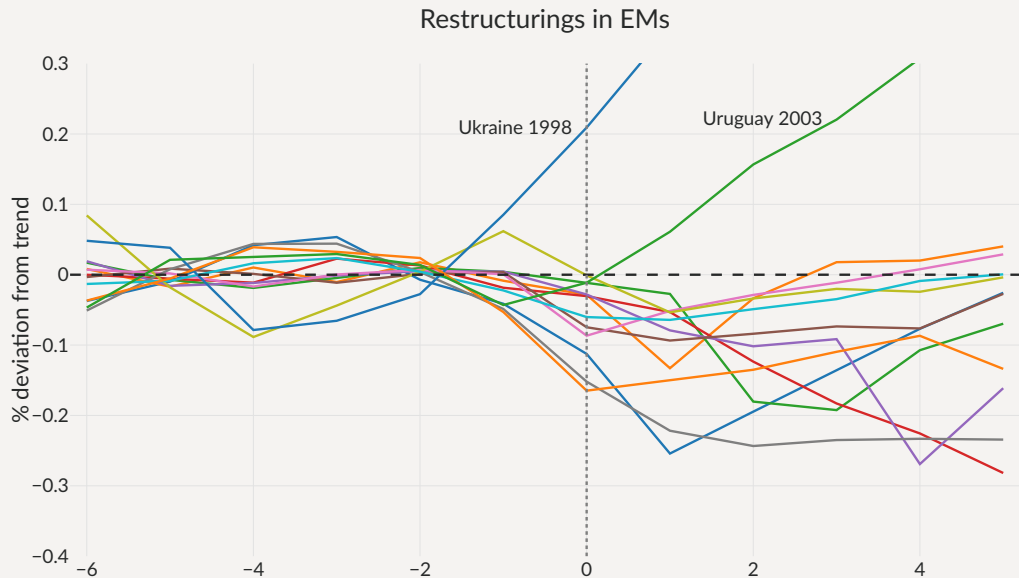
$$\log Y_{i,t-j} = \alpha_i + \beta_i(t-j) + \epsilon_{i,t-j}$$

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

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

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

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

- Value functions for default

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

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

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

- Value functions for default

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

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

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

- Value functions for default

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

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

- 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

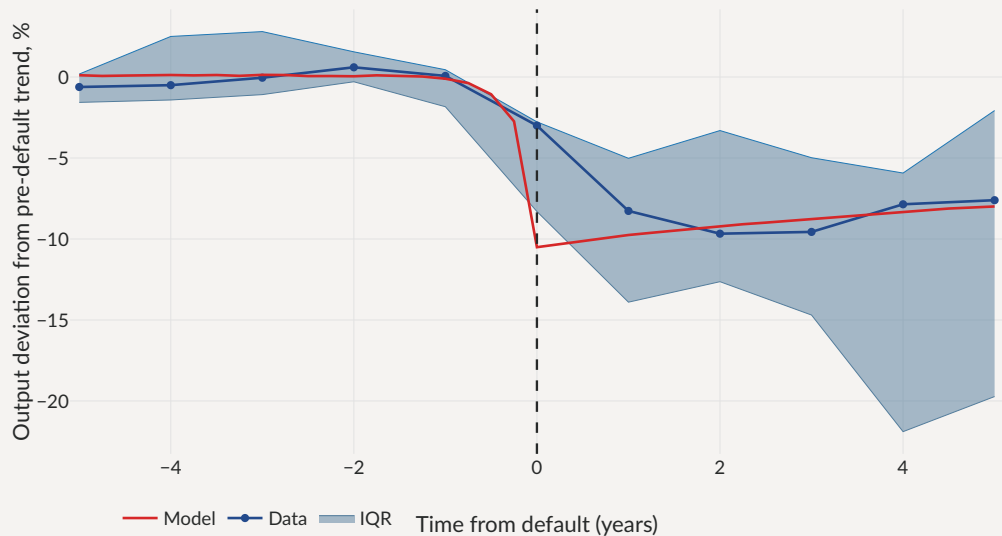
	Parameter	Value
Sovereign's risk aversion	γ	2
Preference shock scale parameter	χ	0.01
Risk-free interest rate	r	0.01
Robustness parameter: income shocks	θ_s	0
Duration of debt	ρ	0.05
Reentry probability	ψ	0.0385
Income autocorrelation coefficient	ρ_z	0.9256
Standard deviation of z_t	σ_z	0.0231
Standard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

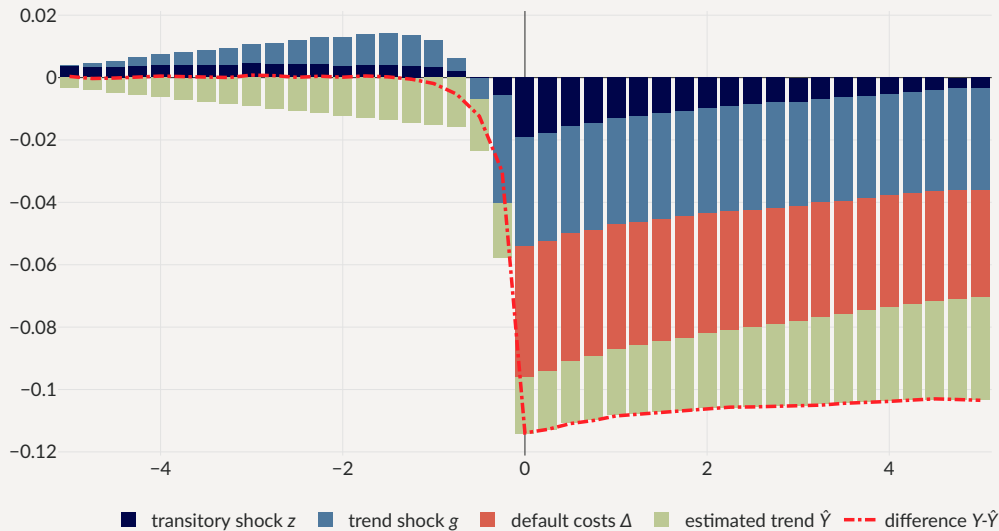
	Data	Model
Output deviation, 1-year horizon, %	8.27	9.75
Output deviation, 5-year horizon, %	7.6	7.99
Average external debt-to-GDP ratio, %	23.4	21.3
Average spread, bps	793	813

Output dynamics around restructurings

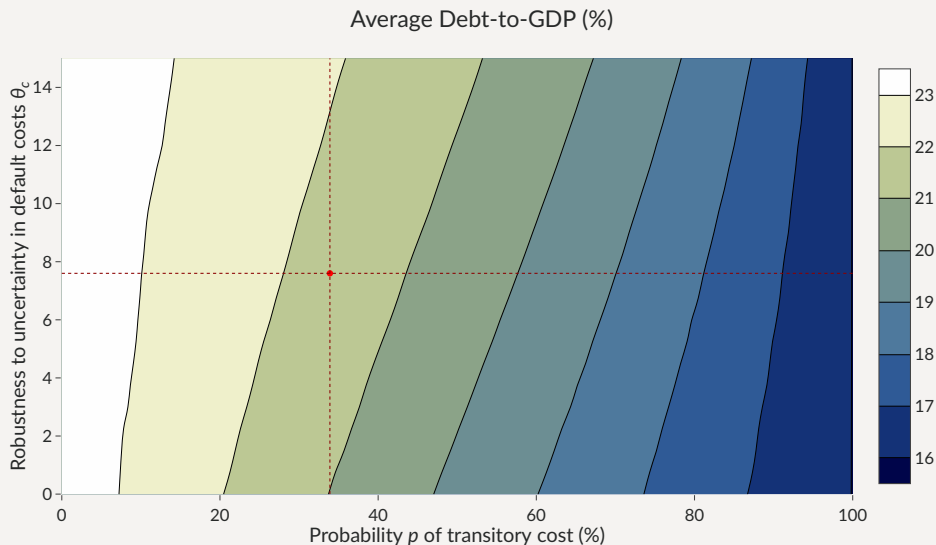


Decomposition of output deviations from trend

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

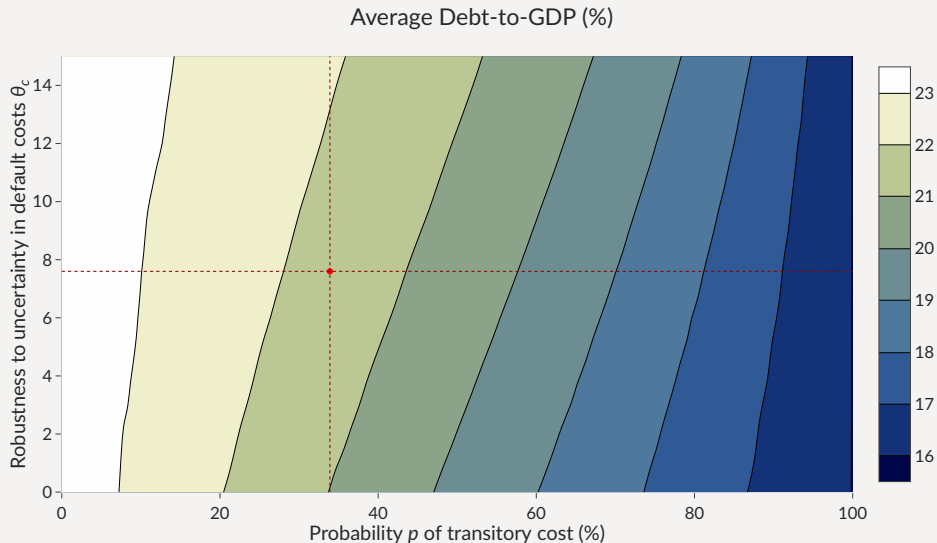


Debt Tolerance



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

Debt Tolerance

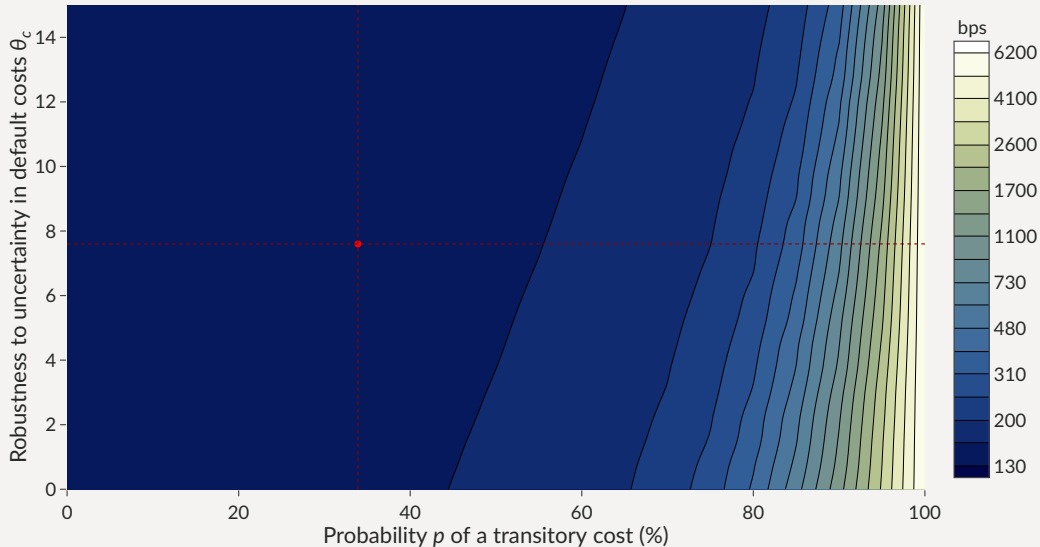


In same model with pure transitory costs, avg debt = 15.9% \implies 25% of debt from (p, θ)

Spreads

- Both robustness and persistence lower borrowing costs

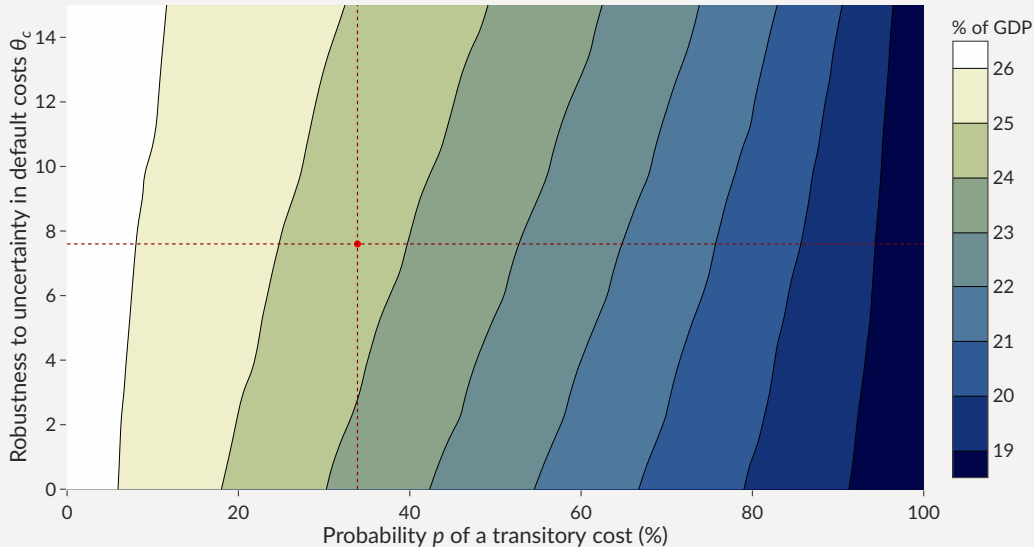
Debt prices at 19% of mean income



Spreads (cont'd)

- Both robustness and persistence lower borrowing costs

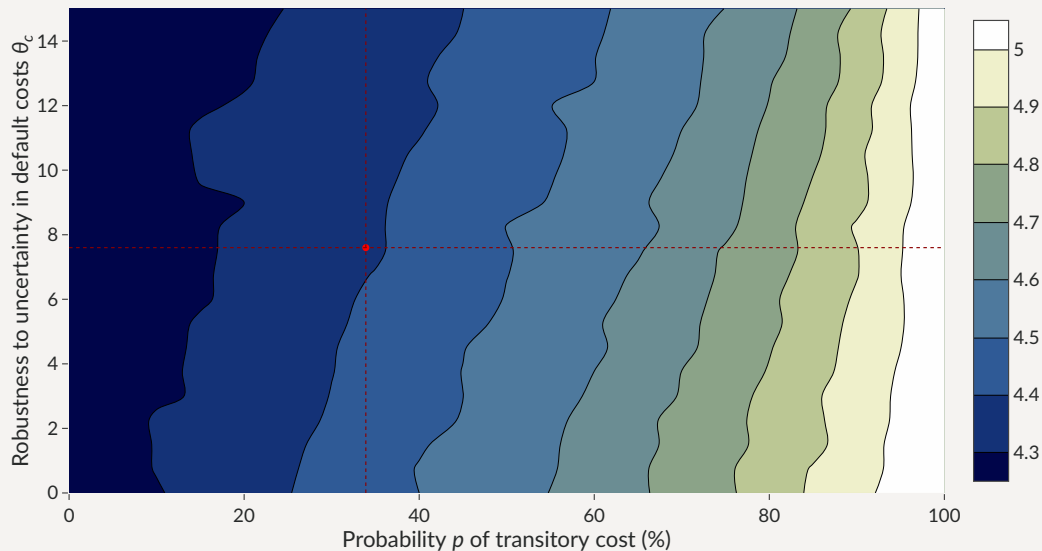
Debt at which spreads cross 1000 bps



Default frequency

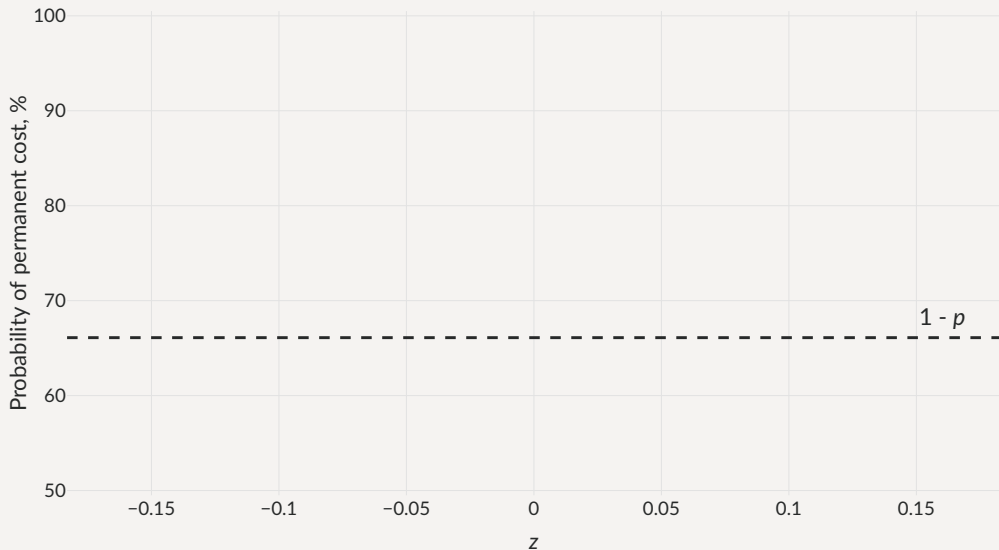
... but robustness does not decrease the default frequency

Default frequency (% per year)



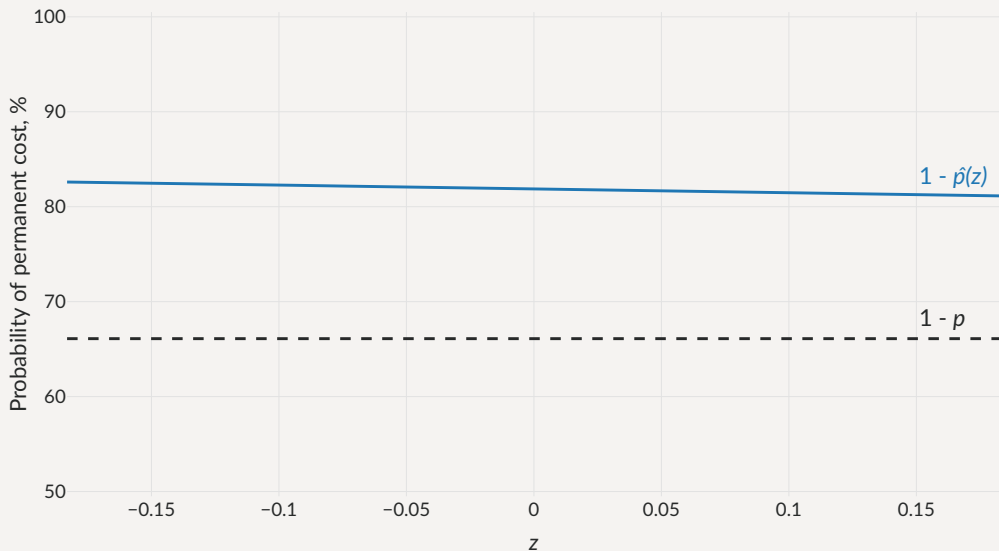
Belief distortion

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



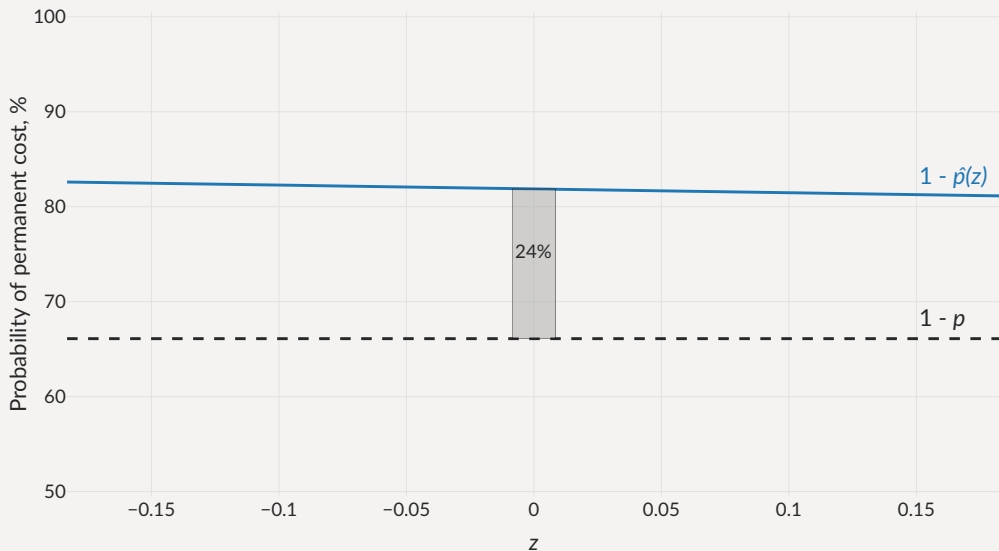
Belief distortion

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



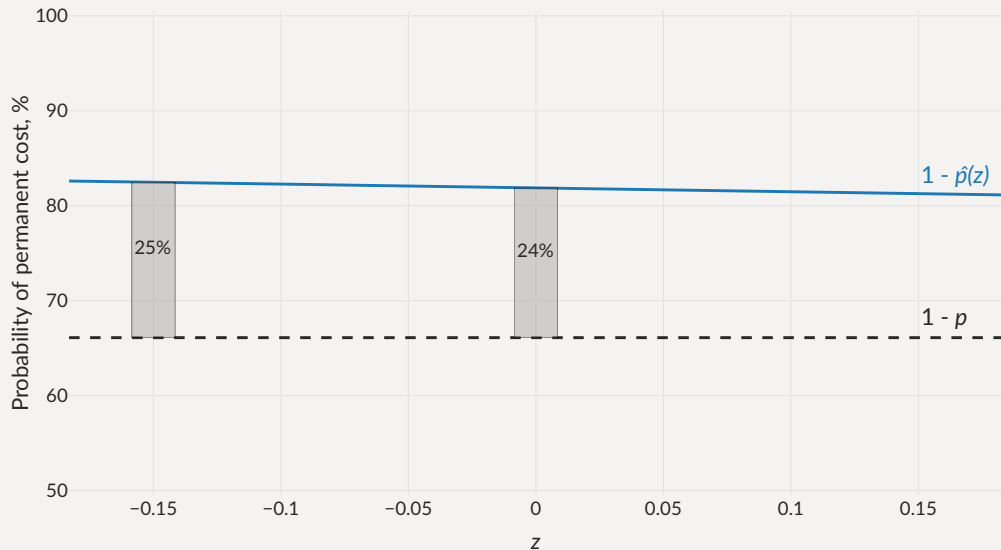
Belief distortion

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



Belief distortion

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



Concluding remarks

Concluding remarks

- 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

Detection-error probabilities

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



Growth outcomes around debt restructurings

