Fiscal Rules and the Sovereign Default Premium

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OUTLINE

1. Motivation
2. Three-period model
3. Quantitative model
4. Conclusions

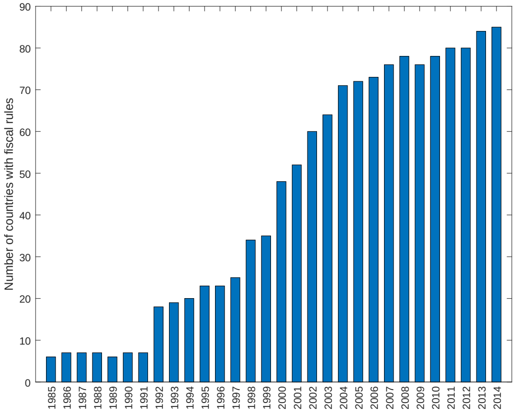
1. Motivation

Fiscal anchors

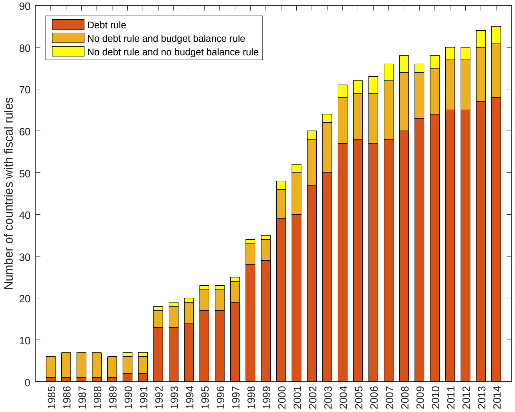
- Fiscal policy frameworks do not have an **anchor to manage expectations about future policies** (unlike frameworks used for monetary analysis; Leeper 2010).
- **Fiscal anchors** could prevent a **deficit bias** that arises because of
  - **Moral hazard** because of the possibility of bailouts
  - Government **myopia**
  - **Time inconsistency** problems (debt dilution)

Fiscal rules could provide fiscal anchors

A large and increasing number of countries have fiscal rules with numerical targets.



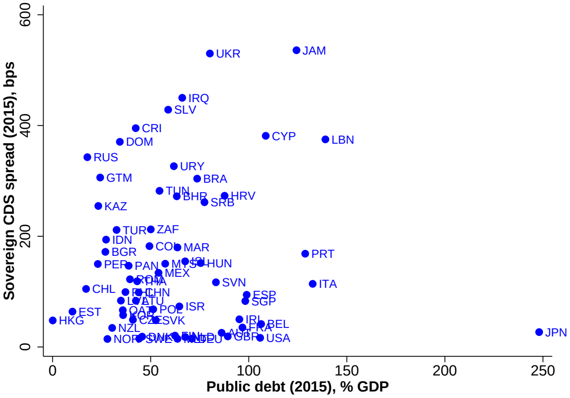
MOST FISCAL RULES TARGET DEBT LEVELS



What is the optimal debt level?

- Blanchard (IMFdirect 2011): "Are **old rules of thumb**, such as trying to keep the debt-to-GDP ratio below 60 percent in advanced countries, still reliable?"
- The Fiscal Monitor (2013): "The **optimal-debt** concept has remained at a **fairly abstract level**... **adjustment needs** scenario has used benchmark **debt ratios of 60 percent of GDP**... **But the appropriate debt target need not be the same for all countries**..."
- Eberhardt and Presbitero (2015): **impossibility of finding common debt thresholds** across countries for the relationship between debt levels and long-run growth.

Debt intolerance



More **debt intolerance** ⇒ higher spreads for lower debt (Reinhart et al., 2003).

A common and robust fiscal anchor

1. **Political constraints** lead to **common** fiscal-rule targets for several governments (e.g. Maastricht) that may face different levels of **debt intolerance.**

2. The level of **debt intolerance vary** both across countries and over time, and is difficult to **identify**.

   - What is the debt level consistent with acceptable fiscal risk in Greece? Brazil? Spain?
   - We would like policy advice to be **robust** to this uncertainty.

Debt brake vs. spread brake

- A spread (debt) brake imposes a **ceiling on the fiscal balance** when the sovereign spread (debt) is above a **threshold**.

We show that

- In dynamic quantitative models where **expectations about future endogenous debt levels** determine the **endogenous sovereign spread**:
    - A **"common spread-brake"** fiscal rule mitigates the deficit bias in economies with different levels of **debt intolerance**.
    - A **"common debt-brake"** fiscal rule does not.
    - Why? The spread incorporates information about **debt intolerance.**
    - Thus, the sovereign spread may work better than the debt level as a **common and robust fiscal anchor**.

2. Three-period model

Environment

- Government's income in period $t = y_t$.
  - $y_1 = y_2 = 0$.
  - $y_3 > 0$ and stochastic.
- The government makes its decisions on a **sequential basis** and maximizes $u(c_1) + u(c_2) + \beta \mathbb{E}[u(c_3)]$
- A bond issued at $t = 1$ promises the payment sequence $\{\delta, 1 - \delta\}$.
- A bond issued at $t = 2$ implies a payment of 1 at $t = 3$.
- Foreign risk-neutral lenders' discount factor = 1.
- Lenders are atomistic and bond market is competitive.
- Cost of defaulting: Lose fraction ϕ of y_3 (no default in first two-periods)

Equilibrium default decision

- b_t = number of bonds issued by the government in period t.
- Default rule in period 3:

$$\hat{d}(b_1, b_2, y_3) = \begin{cases} 1 & \text{if } y_3 < \frac{b_1(1-\delta)+b_2}{\phi}, \\ 0 & \text{otherwise.} \end{cases}$$

Bond pricing equations

- Bond price menu at $t = 2$:

$$q_2(b_1, b_2) = 1 - F\left(\frac{b_1(1-\delta) + b_2}{\phi}\right)$$

- Bond price menu at $t = 1$:

$$q_1(b_1, b_2) = \underbrace{\delta}_{\substack{\text{Sure repayment} \\ \text{at } t=2}} + (1-\delta)\underbrace{\left[1 - F\left(\frac{b_1(1-\delta) + b_2}{\phi}\right)\right]}_{\text{Repayment prob. at } t=3}$$

Long-term debt: need a fiscal rule

Proposition

Suppose $\delta < 1$; i.e., the government issues long-term debt in period 1. Then, a fiscal rule limiting the government's choices in period 2 is needed to maximize the government's expected utility in period 1.

Why is a fiscal rule needed?

- The government's expected utility in period 1 is maximized by b_2^* such that

$$u'\left(c_2^*\right)\left[q_2(b_1^*, b_2^*) + b_2^* \frac{\partial q_2(b_1^*, b_2^*)}{\partial b_2}\right] =$$
$$\mathbb{E}\left[u'\left(c_3^*\right)\left[1 - \hat{d}(b_1^*, b_2^*, y_3)\right]\right] - u'\left(c_1^*\right) b_1^* \frac{\partial q_1(b_1^*, b_2^*)}{\partial b_2}$$

- But the government in period 2 follows

$$u'\left(c_2\right)\left[q_2(b_1, b_2) + b_2 \frac{\partial q_2(b_1, b_2)}{\partial b_2}\right] = \mathbb{E}\left[u'\left(c_3\right)\left[1 - \hat{d}(b_1, b_2, y_3)\right]\right]$$

Idiosyncratic debt brake = Idiosyncratic spread brake

- Idiosyncratic debt brake imposes a ceiling on the debt level, $(1-\delta)b_1 + b_2 \leq \bar{b}$.
- Idiosyncratic spread brake imposes a ceiling on the spread paid by the government and thus a floor on the sovereign bond price, $q_2(b_1, b_2) \geq \underline{q}$.

Proposition

The allocation that maximizes the government's expected utility in period 1 can be attained by limiting the government choices in period 2 with either a debt brake with threshold $\bar{b}^* = (1-\delta)b_1^* + b_2^*$ or a spread brake with threshold $q^* = q_2(b_1^*, b_2^*)$.

OPTIMAL "COMMON" FISCAL RULES

- Consider a set of heterogenous economies indexed by the value of the parameter $\theta \in \{\phi, \beta\}$
- $v(x;\theta)$ = expected utility in period 1 of an economy with a fiscal rule with threshold x.
- $h(\theta)$ = density function for θ in the set.
- The **optimal common fiscal rule threshold** X^* maximizes

$$\max_x \int v(x;\theta)h(\theta)d\theta.$$

Why a "common" fiscal rule?

- X^* would be chosen by a planner that maximizes the expected utility in period 1 of
  1. **a set of different economies** while giving weight $h(\theta)$ to economies with parameter value θ.
  2. **a single economy** when the planner is **uncertain** about the value of the parameter θ and assigns the likelihood $h(\theta)$ to θ.

Common debt brake < common spread brake

- **Assumption 1:** $\zeta_q(b) = \frac{bf(b)}{\phi[1-F(b)]}$ is increasing with respect to b and $\lim_{b\to\infty} \zeta_q(b) \geq 1$.

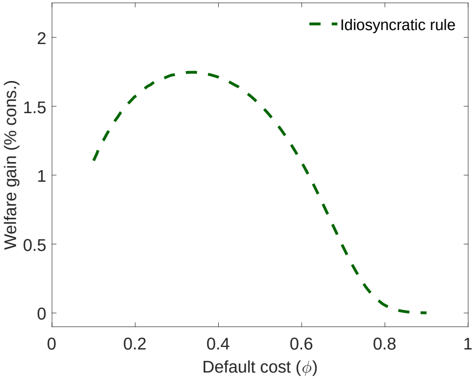
Proposition

Suppose $\delta = 0$, $u(c) = c$, and Assumption 1 holds. Then, for any economy with cost of defaulting ϕ, the optimal debt brake threshold is $\bar{b}^* = \eta\phi$ and the optimal spread brake threshold is $\underline{q}^* = 1 - F(\eta)$, with $\eta > 0$. Therefore, for any set of economies that differ in the level of debt intolerance (i.e., for economies with different values of ϕ), the optimal common spread-brake threshold is $\underline{Q}^* = 1 - F(\eta)$, and generates larger welfare gains than any common debt-brake threshold $\bar{B}$.

Numerical example

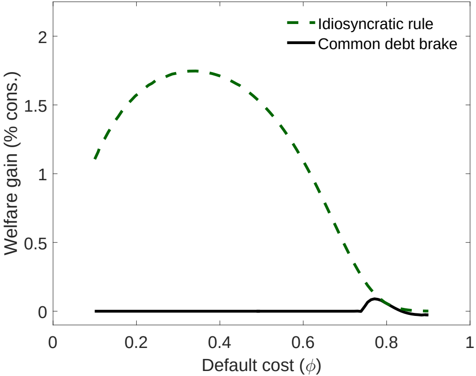
- Assume:
  - $u(c) = -c^{-1}$
  - $\beta = 1$,
  - $log(y_3) \sim N(0, 0.1)$,
  - $\delta = 0$.
  - $\phi \sim h(\phi) = U[0.1, 0.9]$.
- Debt levels between 25 and 169 percent of average period 3 income,
- Spreads between 1 and 12 percent.

WELFARE GAINS FROM IDIOSYNCRATIC RULE



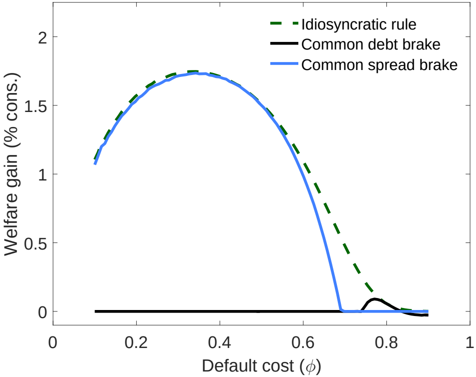
Same welfare gains with either optimal **idiosyncratic** debt brake or optimal **idiosyncratic** spread brake

COMMON DEBT BRAKE DOESN'T WORK WELL



The optimal common debt brake does not impose an excessive constraint in **low-debt-intolerance** economies and thus is not binding in most economies.

Common spread brake > common debt brake



The optimal common spread brake does not impose an excessive constraint in **low-debt-intolerance** economies but it is still binding in **high-debt-intolerance** economies.

3. Quantitative model

TECHNOLOGY

- Linear technology in labor

$$y = e^z l$$

TFP shock z follows a Markov process.

PREFERENCES

- Benevolent government

$$\max\ E_t \left[\sum_{j=0}^{\infty} \beta^j u\left(c_{t+j}, g_{t+j}, l_{t+j}\right) \right]$$

  taking into account private consumption and labor decisions.

- g =public consumption.
- Government decides on a sequential basis.

If the government pays its debt obligations

- Issues **long-term debt.**
  - Bonds are perpetuities with geometrically decreasing coupon obligations
  - Important for the quantitative performance of the model (Hatchondo and Martinez 2009; Chatterjee and Eyigungor 2012).
- Chooses provision of public good: g
- Chooses labor tax: τ

DEFAULTS

- Two costs of defaulting:
  1. Exclusion from credit market for a stochastic number of periods.
  2. Fall in TFP in every period in which the government is in default.
- With constant probability, the government can exit the default by exchanging α new bonds per bond in default (debt restructuring).
- $1 - \alpha =$ haircut
- Chooses g and labor tax τ while in default.

Lenders

- Foreign.
- Risk-neutral (later, same results with **shock to the lenders' risk aversion)**
- Opportunity cost of lending: risk-free bonds paying r.

Simulations match targets

	Data	No-rule benchmark
Mean debt-to-income ratio (in %)	61.8	61.5
Debt duration (years)	6.0	6.0
Annual spread (in %)	2.0	2.0
Mean g/c (in %)	36.5	36.5
$\sigma(g)/\sigma(y)$	0.9	0.9
$\sigma(c)/\sigma(y)$	1.1	1.1

Debt brake

$$b' \leq \max\{\bar{b}, (1-\delta)b\}$$

- Find the optimal value for $\bar{b}$.

Debt brake

$$\underbrace{q(b',z)}_{\substack{\text{Price at which}\\ \text{bonds are issued}}} \quad \geq \bar{q} \quad \text{if } b' > b.$$

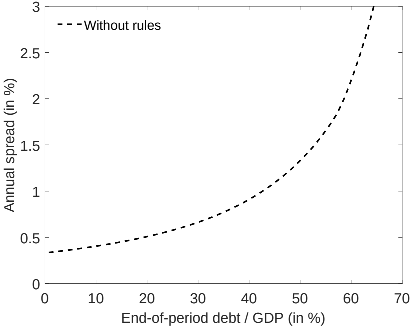
- Find the optimal value for $\bar{q}$.
- We first assume an **initial state** with mean TFP and no debt (other initial states are also investigated in the paper).

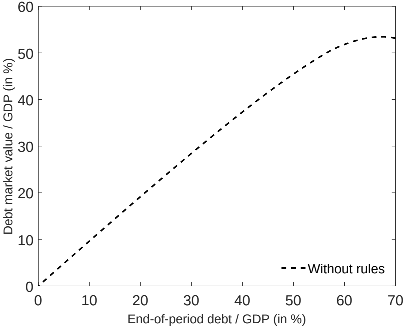
Debt brake similar to spread brake

	Without rule	Debt brake (52.5%)	Spread brake (0.45%)
Mean debt-to-income ratio	61.5	54.9	59.4
Annual spread (in %)	2.0	0.5	1.0
Mean g/c (in %)	36.5	37.1	36.9
$\sigma(g)/\sigma(y)$	0.9	0.9	1.0
$\sigma(c)/\sigma(y)$	1.1	1.1	1.1
Defaults per 100 years	2.9	0.8	1.1
Welfare gain (in %)		0.5	0.4

Borrowing without a fiscal anchor

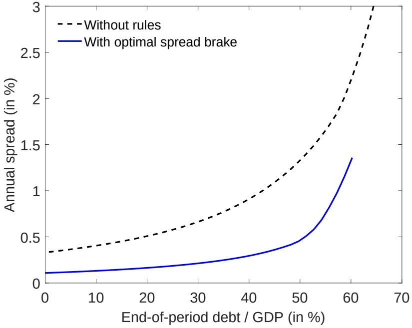
- More **debt** increases the interest rate **spread** imposing an **endogenous borrowing constraint**.

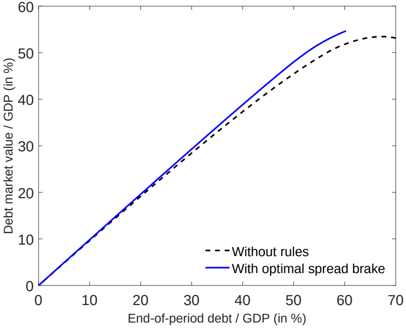




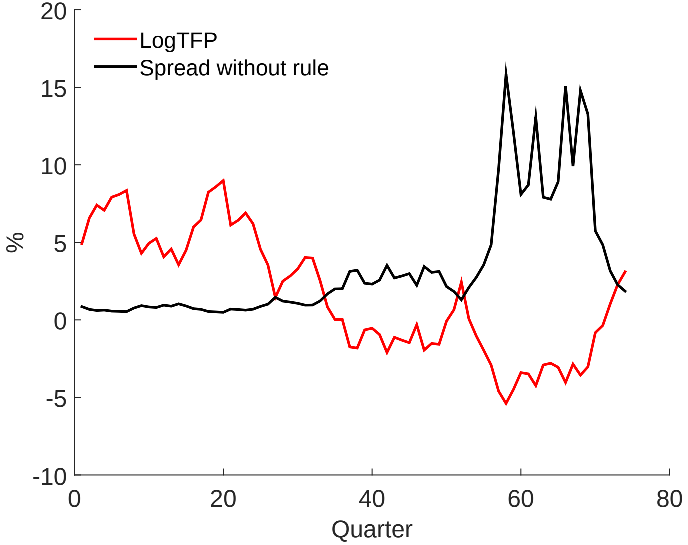
Borrowing with a fiscal anchor

The fiscal **anchor** allow for **less debt** (lower face value) but may allow for **more borrowing** (because of the higher interest rate)

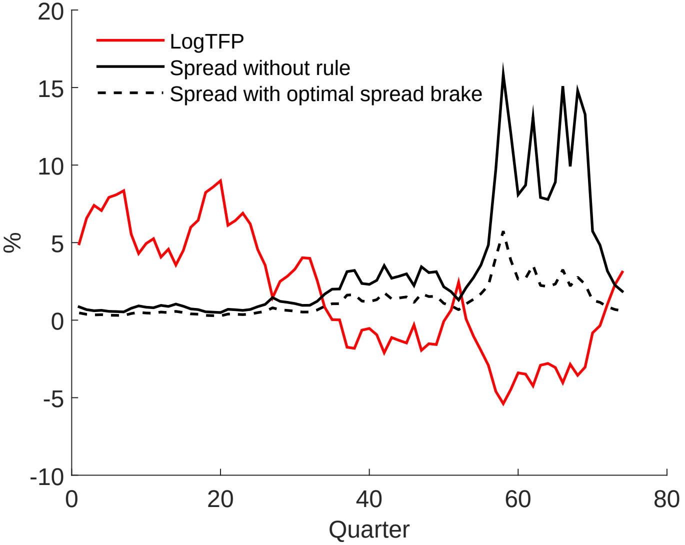




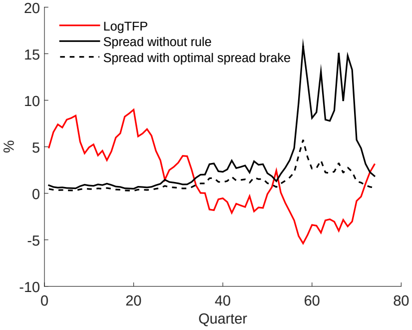
NEGATIVE SHOCK WITHOUT A FISCAL ANCHOR

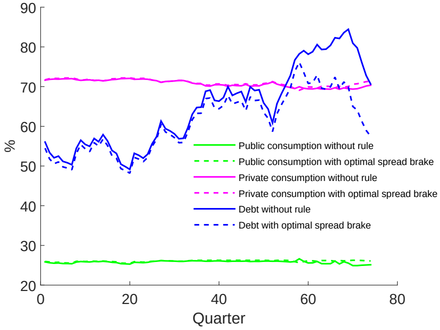


Negative shock with a fiscal anchor



ANCHOR ⇒ LOWER DEBT WITHOUT SACRIFICE





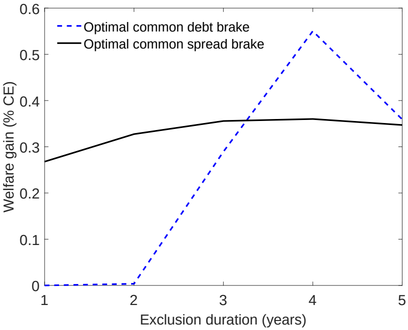
Common rules

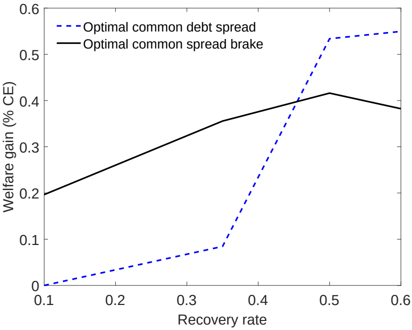
- Longer exclusion $\Rightarrow \uparrow$ cost of defaulting $\Rightarrow$ more debt.
- Higher recovery $\Rightarrow \downarrow$ benefit of defaulting $\Rightarrow$ more debt.
- We assume exclusions between 1 and 5 years (benchmark = 3), recovery rates between 10% and 60% (benchmark = 35%), and discount factor between 0.96 and 0.985 (benchmark = 0.97).
- Thus, we study economies with average debt levels between 30% and 90%, and average spreads between 0.5% and 5.5%.

Common debt brake < common spread brake

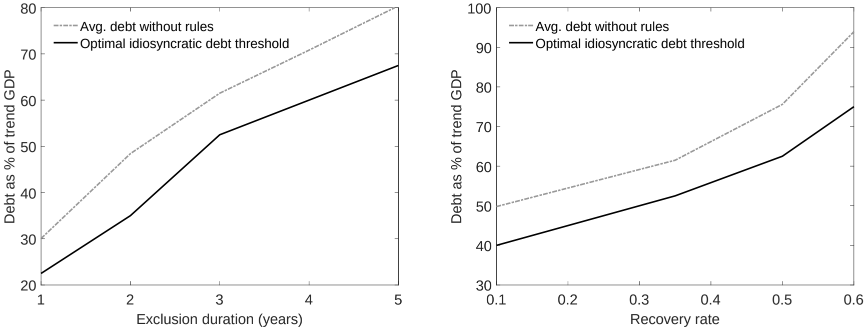
	Exclusion	Recovery	β
$\bar{B}^*$	0.60	0.60	0.50
$\underline{Q}^*$ (spread, in %)	0.45	0.40	0.50
	Welfare gains with $\bar{B}^*$		
Average (in %)	0.24	0.23	0.16
Maximum (in %)	0.55	0.48	0.41
Minimum (in %)	0.00	0.00	0.00
	Welfare gains with $\underline{Q}^*$		
Average (in %)	0.34	0.34	0.17
Maximum (in %)	0.36	0.45	0.45
Minimum (in %)	0.28	0.20	0.01

Welfare gains across debt intolerance



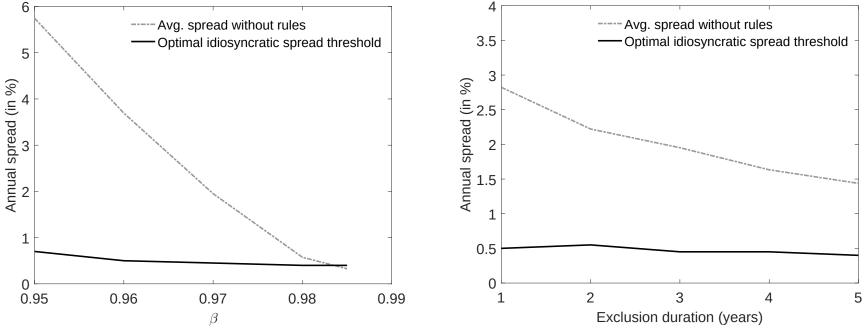


OPTIMAL IDIOSYNCRATIC BRAKE THRESHOLDS



The optimal **idiosyncratic debt threshold** changes almost one to one with the average debt level in the no-rule economy.

OPTIMAL IDIOSYNCRATIC BRAKE THRESHOLDS



Optimal **idiosyncratic spread threshold** is less sensitive to parameter values.

Shocks to the lenders' risk aversion

- Potential concern of using interest rates to anchor fiscal policy: they move for reasons that are beyond the government's control.
- We assume that the stochastic discount factor $M(z', z, p)$ satisfies

$$M(z', z, p) = exp(-r - p\varepsilon' + 0.5p^2\sigma_\epsilon^2)$$

- $p \in \{0, p_H\}$ denotes the risk-premium shock.
- Parametrization based on the EMBI global spread: Three high-risk-premium episodes every twenty years ($\pi_{LH} = 0.0375$). Each episode lasts on average for two years ($\pi_{HL} = 0.125$). Increase in spread during high-premium episode = 2.2% ($p_H = 70$).
- Recalibrate cost of default to get average debt level of 62%.

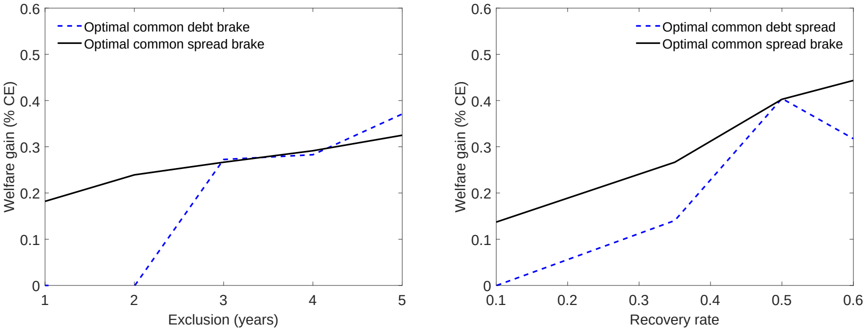
Debt brake similar to spread brake (p)

	Without rule	Debt brake (50%)	Spread brake (1%)
Mean debt-to-income ratio	62.0	49.5	58.3
Annual spread (in %)	2.7	1.1	1.9
Spread increase with p_H	2.1	1.0	1.6
Mean g/c (in %)	36.6	37.3	36.9
$\sigma(g)/\sigma(y)$	1.0	0.9	1.0
$\sigma(c)/\sigma(y)$	1.1	1.1	1.1
Defaults per 100 years	0.9	0.1	0.3
Welfare gain (in %)		0.3	0.3

$\bar{B}^* < \underline{Q}^*$ (p)

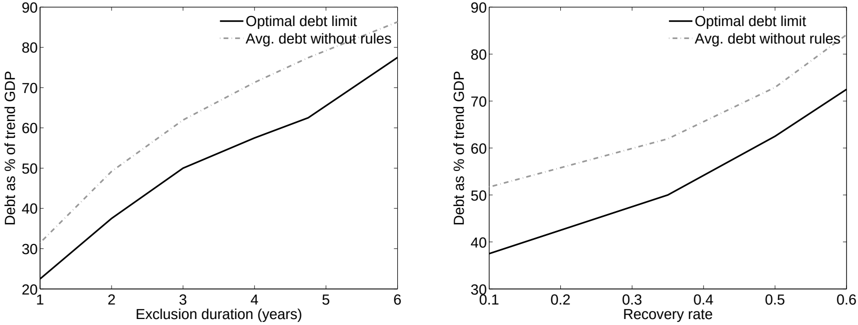
	Exclusion	Recovery	β
$\bar{B}^*$	0.50	0.58	0.50
$\underline{Q}^*$ (spread, in %)	1.00	1.00	1.20
	Welfare gains with $\bar{B}^*$		
Average (in %)	0.20	0.18	0.35
Maximum (in %)	0.39	0.40	0.80
Minimum (in %)	0.00	0.00	0.09
	Welfare gains with $\underline{Q}^*$		
Average (in %)	0.28	0.29	0.37
Maximum (in %)	0.36	0.42	0.91
Minimum (in %)	0.20	0.17	0.08

Welfare gains across debt intolerance (p)



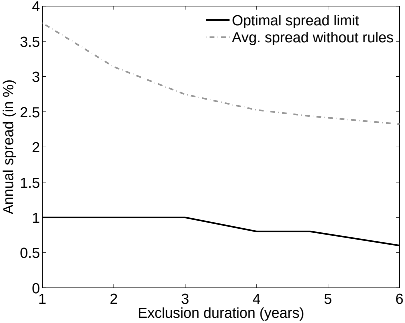
Optimal individual debt thresholds (p)

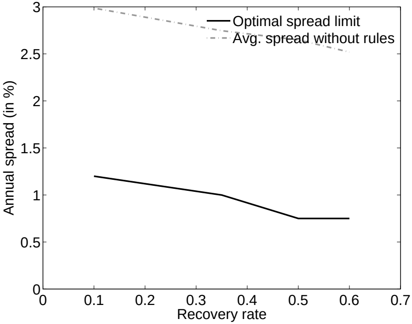
Optimal debt threshold changes almost one to one with the average debt level in the no-rule economy.



OPTIMAL INDIVIDUAL SPREAD THRESHOLDS (p)

Optimal spread threshold is less sensitive to debt intolerance.





Cyclicality of fiscal policy

- Debt limit $\bar{b}(z) = \bar{y}[a_0 + a_1(e^z - e^{\mu_z})]$
- a_0 determines mean debt threshold.
- If $a_1 < 0$ debt limit increases in bad times.
- Optimal slope (a_1) = 0.
- Optimal debt threshold = 52.5% of mean output.

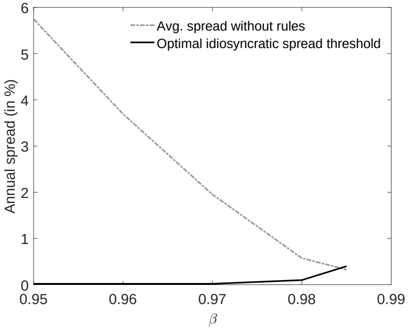
Simulations with a state-contingent $\bar{b}$

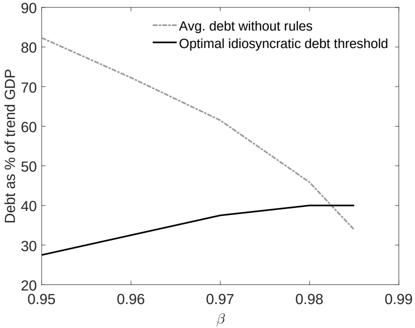
Trade-off: Countercyclical policy is good for insurance (lowers volatility of g) but increases default risk.

	$a_1 = -1$	$a_1 = 0$	$a_1 = 1$
Mean debt-to-income ratio	53.3	54.9	54.0
Annual spread (in %)	0.8	0.5	0.4
Mean g/c (in %)	37.0	37.1	37.2
$\sigma(g)/\sigma(y)$	0.8	0.9	1.1
$\sigma(c)/\sigma(y)$	1.0	1.1	1.1
Defaults per 100 years	1.2	0.8	0.6
Welfare gain (in %)	0.2	0.5	0.4

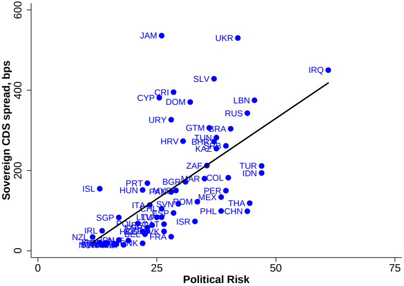
POLITICAL MYOPIA

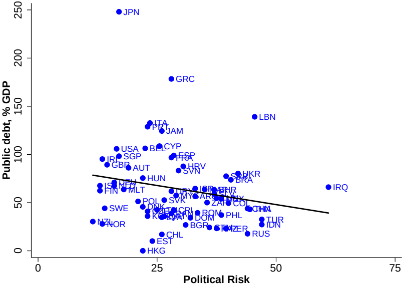
- Stricter fiscal rules and larger welfare gains.





Political myopia and debt intolerance

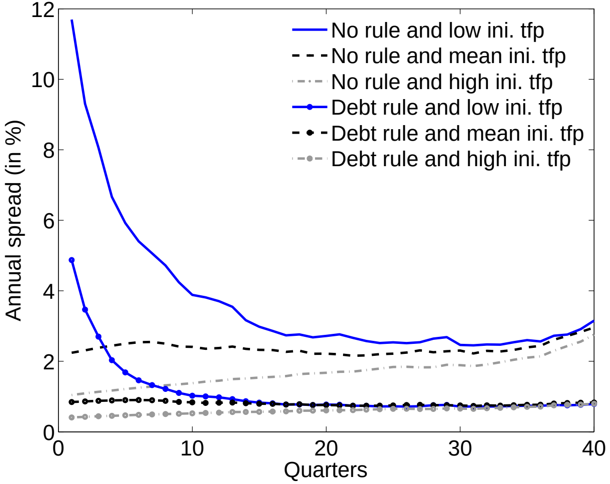




Indebted governments

- Debt threshold $\bar{b}$ to be imposed in every period after T.
- Initial debt level = 62% of $\bar{y}$
- $\bar{b}^*$ = 60% of $\bar{y}$
- T^* between 5 and 8 quarters
- welfare gains between 0.6% and 0.8%

POSSIBILITY OF A FREE LUNCH



No-default rule

- Gain from abandoning the rule between 11 and 12% of $\bar{y}$

4. Conclusions and extensions

Conclusions

- Maybe sovereign spreads should play a more prominent role in **anchoring discussions of fiscal policy**
  - Economies should be allowed to issue more debt when they suffer less the **debt intolerance** problem.
- Also
  - better **ownership**
  - a market-determined fiscal anchor could be less susceptible to **creative accounting**
  - more **comprehensive** measure of fiscal risks (e.g., debt maturity and currency composition)

NEED FOR FUTURE WORK?

- What should the spread-brake **threshold** be? Should it be **reduced gradually** (mimicking the gradual reduction of inflation targets during disinflation periods)?
- Which **interest rates** should fiscal rules use (global factors; maturity)?
- The average spread over **which period** should be used to trigger the spread brake?
- How should a spread brake be **complemented with other numerical targets?**

One-period debt: no need for fiscal rule

Proposition

Suppose $\delta = 1$; i.e., bonds issued in period 1 pay off in period 2 alone. Then, the government's expected utility in period 1 cannot be improved with a fiscal rule that limits debt choices in period 2.

- The period-2 government chooses the borrowing level b_2^* that maximizes the government's expected utility in period 1.

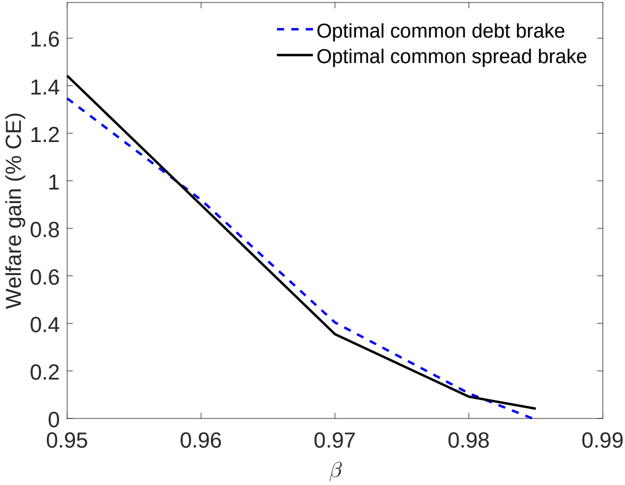
Across β

Proposition

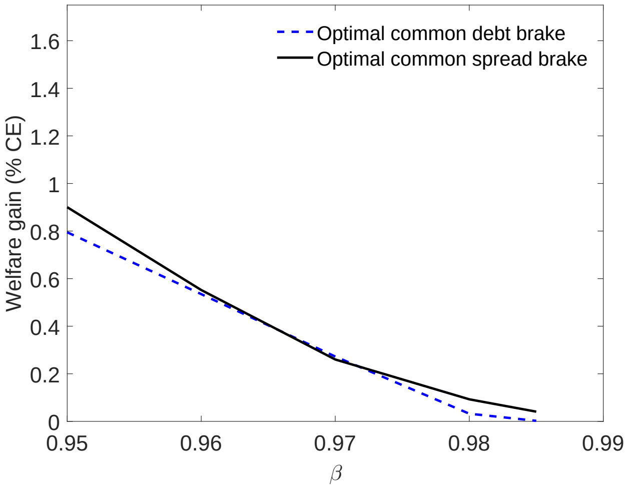
For any set of economies that differ only in the value of β, the optimal common debt-brake threshold $\bar{B}^*$ generates the same welfare gain than the optimal common spread-brake threshold $\underline{Q}^* = 1 - F\left(\frac{\bar{B}^*}{\phi}\right)$ in every economy in the set.

$$q_2(b_1, b_2) = 1 - F\left(\frac{b_1(1-\delta) + b_2}{\phi}\right)$$

SIMILAR WELFARE GAINS ACROSS β



SIMILAR WELFARE GAINS ACROSS β (p)



VALUE FUNCTIONS

- Repay/default decision

$$V(b,z) = \max\left\{V^R(b,z), V^D(b,z)\right\}$$

- Value of repaying

$$V^R(b,z) = \max_{b' \geq 0, c \geq 0, g \geq 0, \tau \geq 0} \left\{u\left(c,g,1-l\right) + \beta \mathbb{E}_{z'|z} V(b',z')\right\},$$

subject to

$$g = \tau e^z l - b + q(b',z)\left[b' - (1-\delta)b\right],$$

$$c = (1-\tau)e^z l,$$

$$l = \hat{l}\left(z,\tau,c,g\right),$$

$$q\left(b',z\right) \geq \underline{q} \text{ if } b' > b.$$

Value of defaulting

$$
\begin{aligned}
V^D(b,z) &= \max_{c\geq 0, g\geq 0, \tau\geq 0} u\left(c, g, 1-l\right) \\
&+ \beta \mathbb{E}_{z'|z}\left[(1-\xi)V^D(b(1+r), z') + \xi V(\alpha b(1+r), z')\right], \\
&\text{subject to} \\
&g = \tau\left[e^z - \phi(z)\right] l, \\
&c = (1-\tau)\left[e^z - \phi(z)\right] l, \\
&l = \hat{l}\left(log(e^z - \phi(z)), \tau, c, g\right).
\end{aligned}
$$

Bond price

$$
\begin{aligned}
q(b',z)(1+r) &= \mathbb{E}_{z'|z}\Big[\hat{d}\left(b',z'\right)q^{D}(b',z') \\
&+ \Big[1-\hat{d}\left(b',z'\right)\Big]\Big[1+(1-\delta)\,q(\hat{b}(b',z'),z')\Big]\Big],
\end{aligned}
$$

$$
\begin{aligned}
q^{D}(b',z)(1+r) &= \mathbb{E}_{z'|z}\Big[(1-\xi)(1+r)q^{D}(b'(1+r),z') \\
&+\xi\alpha\Big[d'q^{D}\left(\alpha b',z'\right)+\left(1-d'\right)\left[1+(1-\delta)\,q(b'',z')\right]\Big]\Big],
\end{aligned}
$$

where $d' = \hat{d}\left(\alpha b',z'\right)$, and $b'' = \hat{b}(\alpha b',z')$.

Equilibrium concept

- Markov Perfect Equilibrium.
  - Each period the government decides taking as given bond prices and future defaulting, spending, taxing, and borrowing strategies.
  - Current optimal choices are consistent with future government strategies.
  - Bond holders make zero expected profits.

Calibration

- Preferences: $u(c,g,l) = \pi\frac{g^{1-\gamma_g}}{1-\gamma_g} + (1-\pi)\frac{\left[c-\psi l^{1+\omega}/(1+\omega)\right]^{1-\gamma}}{1-\gamma}$
- TFP process: $z_t = (1-\rho)\,\mu_z + \rho z_{t-1} + \varepsilon_t,$ with $\varepsilon_t \sim N\left(0,\sigma_\epsilon^2\right)$.
- Output loss while in default: $\phi\left(z\right) = max\left\{\lambda_0 e^z + \lambda_1 e^{2z}, 0\right\}$
- 1 period = 1 quarter

Calibration strategy

- Preference parameters for private consumption and leisure decisions: taken from prior literature
- Remaining parameters: based on data from a small-open economy that pays a default premium (Spain).
- $(\delta, \beta, \lambda_0, \lambda_1, \pi, \gamma_g)$ chosen to match: (i) average duration of government debt, (ii) average spread, (iii) average level of government debt, (iv) volatility of c, (v) average level of g, and (vi) volatility of g.

Calibrated without the simulations

Domestic income autocorrelation coefficient	ρ	0.97
Standard deviation of domestic innovations	σ_ϵ	1.04%
Mean productivity	μ_y	$(-1/2)\sigma_\epsilon^2$
Risk aversion of private consumption	γ	2
Inverse of labor elasticity	ω	0.6
Weight of labor hours	ψ	$2.48/(1+\omega)$
Risk-free rate	r	0.01
Recovery rate of debt in default	α	0.35
Duration of defaults	ξ	0.083
Minimum issuance price without fiscal rule	$\underline{q}$	$0.3\bar{q}$

Calibrated with the simulations

Duration of long-term bond	δ	0.0275
Discount factor	β	0.97
Income loss while in default	λ_0	-0.731
Income loss while in default	λ_1	0.9
Risk aversion for public consumption	γ_g	3
Weight of public consumption	π	0.182

Procyclical fiscal policy