A Theory of Debt Accumulation and Deficit Cycles

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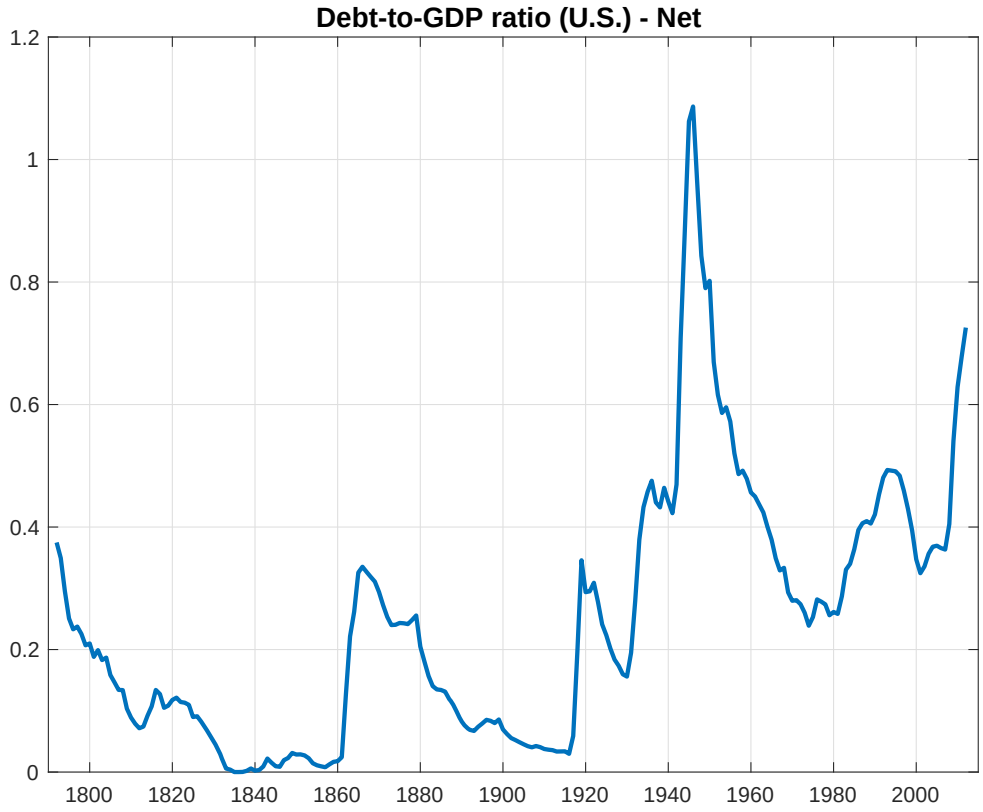
"Our 2010 paper found that, over the long term, growth is about 1 percentage point lower when debt is 90 percent or more of gross domestic product."

Carmen Reinhart and Kenneth Rogoff, April 26, 2013, The New York Times

Why do nations accumulate debt?

- Enormous literature
- Tax smoothing arithmetics explains they shouldn't (Barro, 1979)

But they do


Debt-to-GDP ratio (U.S.) - Net
1.2
1
0.8
0.6
0.4
0.2
0
1800
1820
1840
1860
1880
1900
1920
1940
1960
1980
2000

Fiscal tipping points?

Some explanations

- Both *welfare state* and *laissez faire* may be the obvious reason
  - Buchanan and Wagner (1977): fiscal illusion doctrine—electors have limited knowledge about the intertemporal implications of their preferences for deficits
- New political economy theories: governments face fully rational voters (Alesina and his co-authors)
  - To illustrate, a policymaker in office may not fully internalize the debt burden while facing a probability of not being re-elected, or in the presence of political polarization
- Deficit bias

This paper

- "Austerity" (Alesina, Favero and Giavazzi, 2019)
- The missing piece: When do governments implement austerity?
- This paper develops a model where governments display preferences for deficits but are also rationally concerned about costly default
  - Costs of implementing austerity are determined endogenously

Predictions

1. When debt is small compared to the size of the economy, governments accumulate debt for some period

2. Fiscal austerity may arrive too late—at about 80-90% from default

3. Lenght of debt accumulation regime increases with

   (a) growth rate of the economy
   (b) government short-sightedness
   (c) macroeconomic stability
   (d) expected time defaulted governments may re-gain access to capital markets
   (e) expected severity of austerity measures
   (f) debt market liquidity

Predictions cont'd

4. Probability of default increases with

   (a) governments short-sightedness
   (b) ease at which defaulted governments re-gain access to capital markets (leading to serial defaulting)
   (c) debt markets illiquidity

5. New puzzle: Probability of default decreases with macroeconomic uncertainty

   - Higher macro volatility leads governments to anticipate austerity
   - This effect is very strong and dominates mechanical effects (high vol $\longrightarrow$ high default prob)

Additional links to the literature

- Analysis of fiscal tipping points: related to liquidity management and dividend policy problems in the corporate finance literature
  - Jeanblanc-Picqué and Shirayev (1995); Radner and Shepp (1996); Biais, Mariotti, Plantin and Rochet (2007); Décamps, Mariotti, Rochet, and Villeneuve (2011)

  To draw an analogy, whereas, in this literature, problem is one of a private firm managing cash distribution under liquidity constraints, our problem is one of a government managing primary deficits under liquidity constraints

- A variant of our model also deals with strategic default
  - default boundaries dealt then with as in the standard literature started by Leland (1994)—problem is compounded with fiscal tipping points though

Outline of the rest of this talk

1. National debt as a real option
2. Fiscal tipping points
3. Spreads

1. National debt as a real option

Output and debt

- Output growth is I.I.D.:

$$\frac{dy_t}{y_t} = \mu dt + \sigma dW_t,$$

  where W_t is a standard BM

- Government issues short-term debt to finance deficits. Constraint is $\dot{D}_t = -S_t + iD_t$, where i is the short-term rate and S_t is government surplus
  - Debt-to-GDP ratio, δ_t, is solution to

$$d\delta_t = -\left(s_t + \kappa\right)\delta_t dt - \sigma\delta_t dW_t, \tag{1}$$

  where $\kappa \equiv \mu - i - \sigma^2$, and s_t is the surplus-to-debt ratio, $s_t = \frac{S_t}{D_t}$

Government preferences and policy

- Preferences for primary deficits—may result from
  - attempt to respond to electoral basis—to illustrate, voters may neglect the effects that a debt burden may impose in the future
  - voters would value governments that assign high weight to deficits
    - up to an (endogenous) probability of default (determined in the paper)

- Government seeks to maximize deficits for any given level of debt

$$V(\delta_t) = \inf_{s_u \in [s^1, s^2]} E_t \left[\int_t^{\infty} e^{-\rho(u-t)} s_u du \right], \tag{2}$$

under the debt accumulation constraint in Eq. (1)

Some comments

- In this presentation, i is exogenously fixed, but I am making it state-dependent
- Deficits can be high either due to large government expenses or low taxation
- s^1 and s^2: bounds on the government feasible actions, e.g., international compacts

Comments cont'd

- Time preference ρ determines how myopic the government is. Might result from political competitiveness
  - For example, at any instant of time, government faces a joint probability of being confronted in a snap election and losing that election equal to a constant p
  - Value function satisfies $\mathcal{L}V + s - kV + p(\underline{V} - V)$, where k is the discount rate and $\underline{V}$ is the value from losing the snap election
  - Under reg conditions, this is Eq. (2) with $\rho = k + p$

Policy

- Bellman equation

$$\begin{aligned} 0 &= \inf_{s} \left[\mathcal{L}V(\delta) - \rho V(\delta) + s \right] \\ &= \frac{1}{2}\sigma^2\delta^2 V''(\delta) - \kappa\delta V'(\delta) - \rho V(\delta) + \inf_{s} \left[s\left(1 - V'(\delta)\,\delta\right) \right], \end{aligned}$$

  subject to a number of boundary conditions

- Technically it's a Stefan problem
  - Need find value for δ that triggers a switch in the equation satisfied by $V(\delta)$
- Economically this value is the **fiscal tipping point**—austerity trigger

Proposition I. (Fiscal tipping point and government utility costs). *There exists a threshold value of the debt-to-GDP ratio* $\hat{\delta}$ *such that the government runs a deficit* $s_t = s^1$ *for all* $\delta_t < \hat{\delta}$, *and a surplus* $s_t = s^2$ *for all* $\delta_t > \hat{\delta}$. *The utility costs satisfy* $V(\delta_t) = V_{\mathcal{D}}(\delta_t)\,\mathbf{1}_{\delta_t<\hat{\delta}} + V_{\mathcal{S}}(\delta_t)\,\mathbf{1}_{\delta_t>\hat{\delta}}$, *where*

$$V_{\mathcal{D}}(\delta) = \frac{s^1}{\rho} + A_{\mathcal{D}2}\delta^{m_{\mathcal{D}2}}, \quad V_{\mathcal{S}}(\delta) = \frac{s^2}{\rho} + A_{\mathcal{S}1}\delta^{m_{\mathcal{S}1}} + A_{\mathcal{S}2}\delta^{m_{\mathcal{S}2}},$$

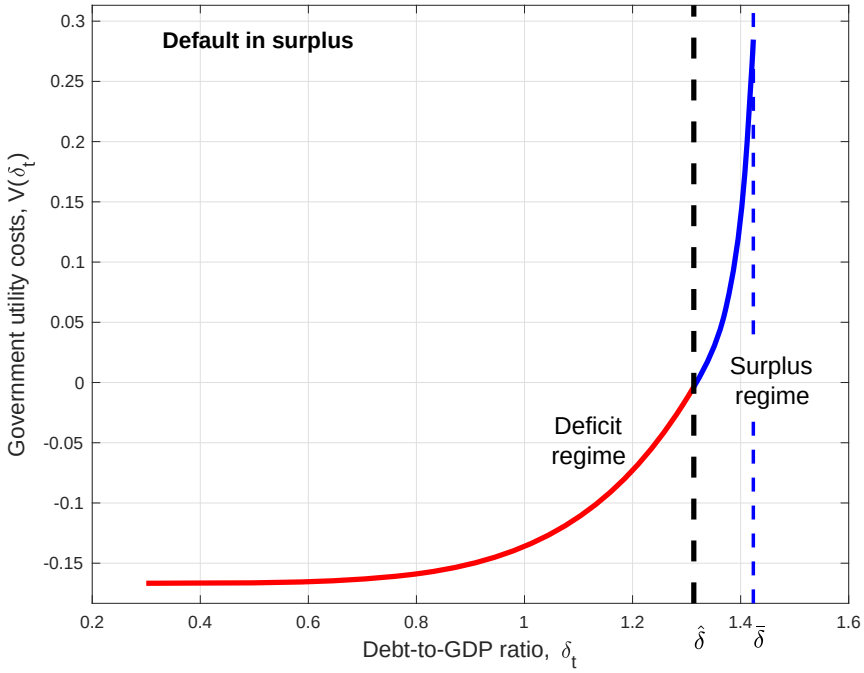
for some constants $\hat{\delta}$, $m_{\mathcal{D}2}$, $m_{\mathcal{S}1}$, $m_{\mathcal{S}2}$, $A_{\mathcal{D}2}$, $A_{\mathcal{S}1}$, $A_{\mathcal{S}2}$.

- Result is general
- How to get to default?
- What happens after default?

Default and re-entry

- **Default**
  - Assume exogenously given liquidity crisis
  - Also solve a model combining liquidity crisis + strategic default (in this case Prop I changes a bit)
- **After default**
  - Will re-entry with some exogenously given probability

Utility costs



- Governments enter into austerity when the marginal costs of running debt become too large—these costs are endogenous in the model

Some evidence

α	A_α	B_α	R^2	N obs
95%	0.088	0.842	0.27	
	(7.21)	(9.06)		
90%	0.178	0.743	0.06	
	(7.149)	(3.72)		
85%	0.168	0.679	0.05	
	(6.922)	(3.41)		
80%	0.220	0.671	0.03	
	(8.01)	(2.86)		
75%	0.211	0.605	0.01	
	(7.82)	(2.59)		
70%	0.280	0.420	0.01	
	(9.30)	(1.60)		

TABLE 1. Estimation of an asymmetric Fiscal Reaction Function for the U.S. The table reports estimates of the coefficients A_α and B_α (with t-stats in parenthesis) and R^2 in the following regression: $Tip_t(\alpha) = A_\alpha + B_\alpha\left(\delta_t - Q_{\delta,t}(\alpha)\right) + e_t(\alpha)$, where $Tip_t(\alpha) \equiv \mathbb{I}_{S_t > Q_{S,t}(\alpha)}$, $\mathbb{I}_{S_t > Q_{S,t}(\alpha)}$ is an indicator that takes a value equal to one when S_t, the primary surplus over GDP, is larger than $Q_{S,t}(\alpha)$, δ_t is the debt-to-GDP ratio, $e_t(\alpha)$ is an error term and, finally $Q_{X,t}(\alpha)$ denote the α-quintile of a variable X at time-t, estimated through the previous ten years of data. Data are yearly and cover the sample from 1792 to 2012.

Some tech details

Default

- Governments may finance total deficit through new debt issuance, provided additional debt is less than a fixed proportion ℓ of GDP. Assume investors are stuck into debt for an arbitrary $\bar{\varepsilon} > 0$. Default boundary is

$$\bar{\delta} = \frac{\ell e^{(s^1+\kappa-\bar{\iota})\bar{\varepsilon}}}{i+\bar{\iota}-s^1}$$

- Also consider alternative measures of fiscal limits: the Natural Public Debt Limit

$$\bar{\delta}_o = \frac{\bar{s}}{\bar{\iota}-\bar{\mu}}$$

  Conclusions are similar but not the same

Re-entry

- After default, government is stuck into a no-deficit policy
- May re-entry with constant intensity $= \vartheta$
- Upon re-entry, a fraction $1 - \gamma$ is forgiven
- Default costs
  - A proportional one, $\xi\bar{\delta}$ at default for some constant ξ—burden while dealing with bankruptcy: litigation costs, international stigma, loss in popularity
  - During the exclusion period, cost $= \epsilon$ per unit of time—burden inherent in building up the new image needed to re-entry the markets
    - For example, ϵ may be a small surplus-over-debt at default stored and distributed to creditors

- We have (bound condition)

$$\bar{V} = \lim_{\delta \to \bar{\delta}} \mathcal{C}(\delta), \quad \mathcal{C}(\delta) \equiv \underbrace{\frac{\epsilon}{\rho + \vartheta} + \frac{\vartheta}{\rho + \vartheta} V(\gamma\delta)}_{\equiv \mathcal{C}_d(\delta)} + \xi\delta \tag{3}$$

Strategic default

Government plans

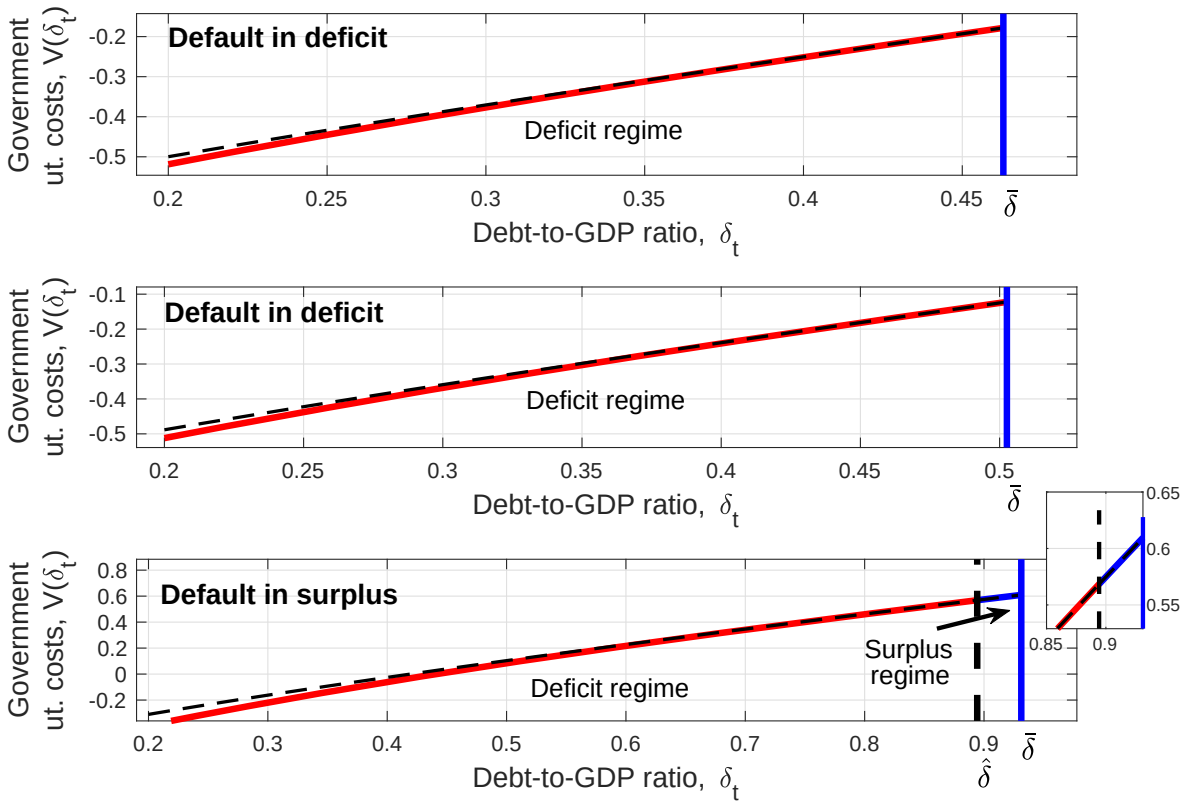
- Government now minimizes future expected surplus-to-debt ratios while also timing default,

$$V\left(\delta_t\right) = \inf_{\tau} \inf_{s_u \in [s^1, s^2]} E_t \left[\int_t^{\tau} e^{-\rho(u-t)} s_u du + e^{-\rho(\tau - t)} \mathcal{C}\left(\delta_\tau\right) \right],$$

  where $\mathcal{C}\left(\delta_\tau\right)$ are the costs of defaulting, taken to be the same as in the exogenous default model (see Eq. (3))

Proposition II. (Default boundaries). *Government utility costs are given by the same function $V(\delta_t)$ in Proposition I subject to boundary conditions. Under parameter restrictions, the government optimal policy is to default at some finite $\overline{\delta}_o < \overline{\delta}$, where $\overline{\delta}$ is the exogenous default boundary.*

Utility costs - strategic default

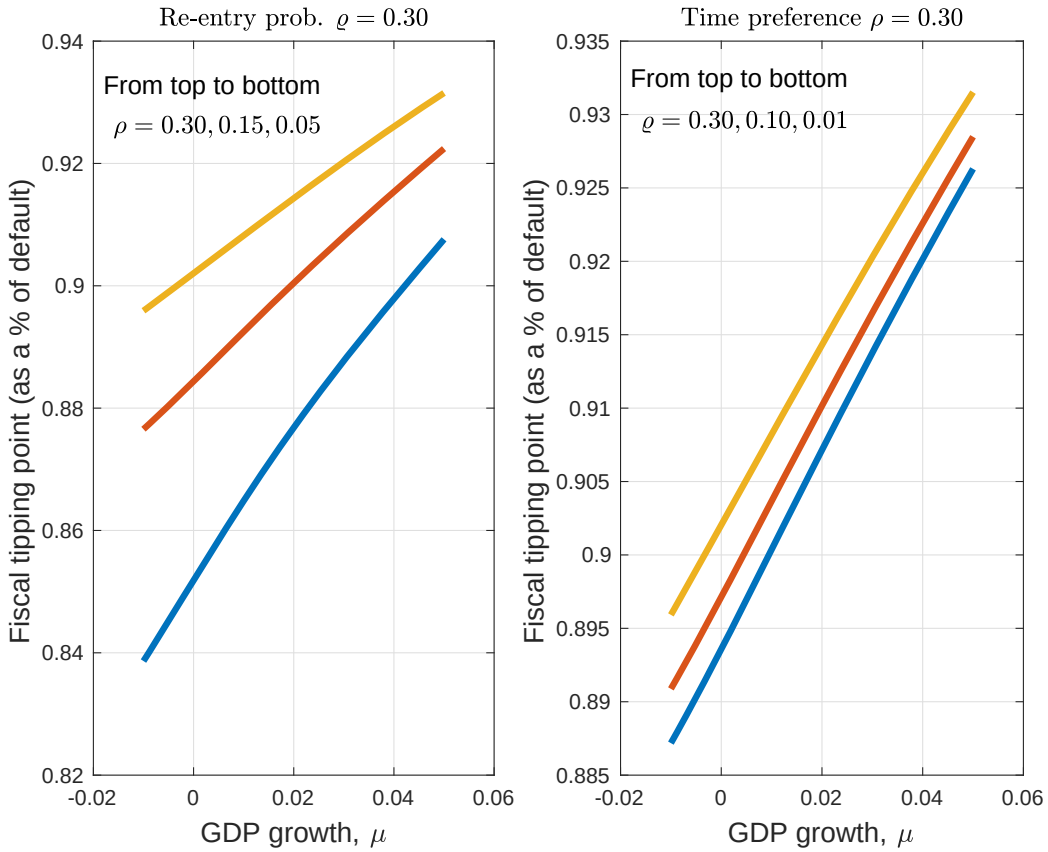


Some predictions

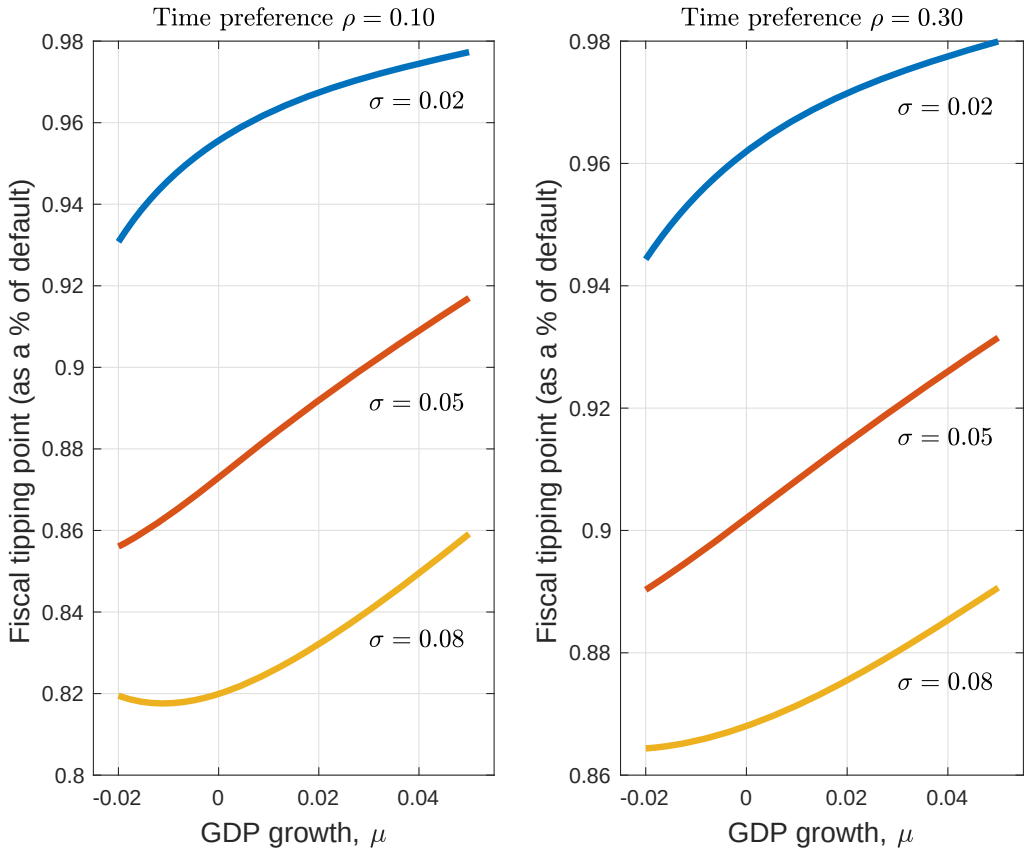
- Default boundary increases with austerity costs (as in the previous graph)
- Default boundary lowers with prob of re-entry: channel of "serial defaulting"

2. Fiscal tipping points

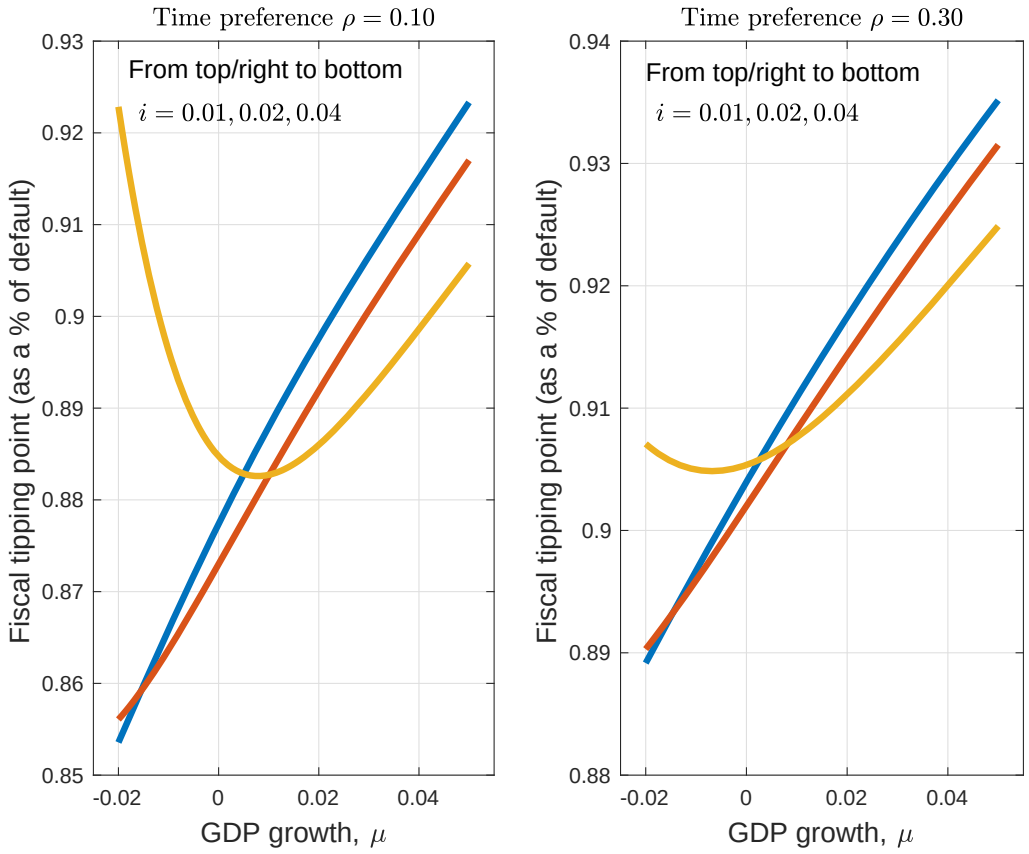
Short-sightedness and re-entry probs



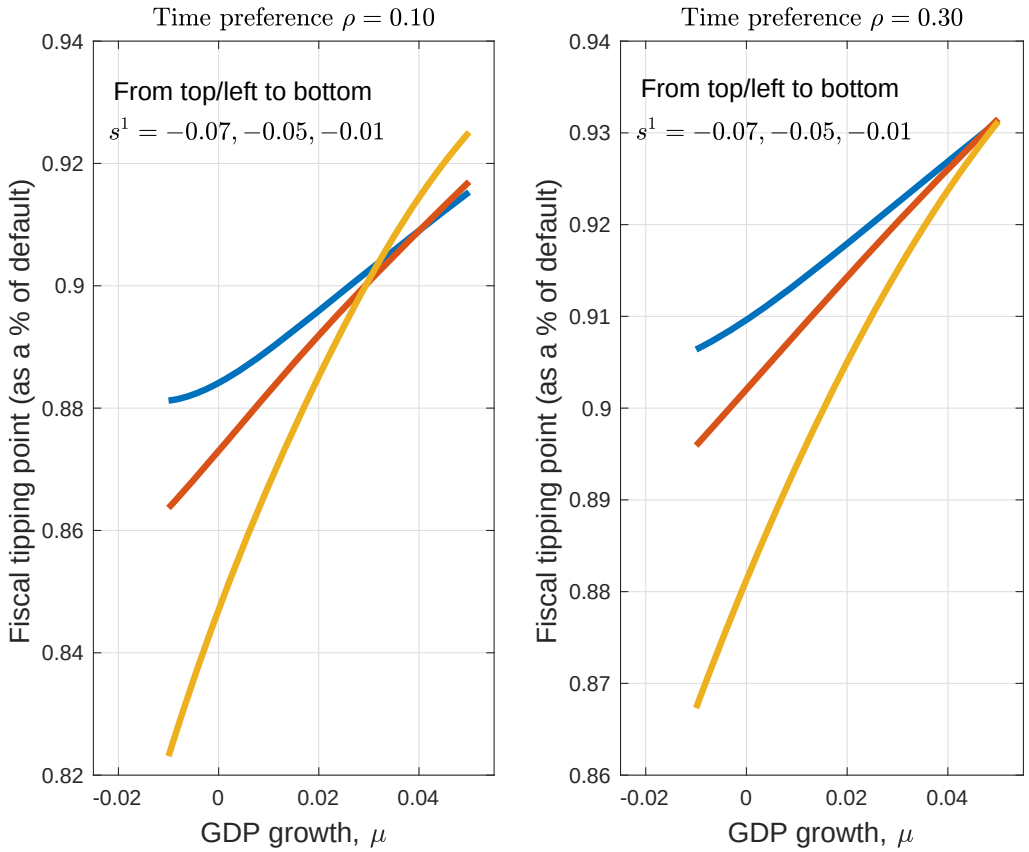
Macroeconomic volatility



Cost of debt - state independent in this presentation

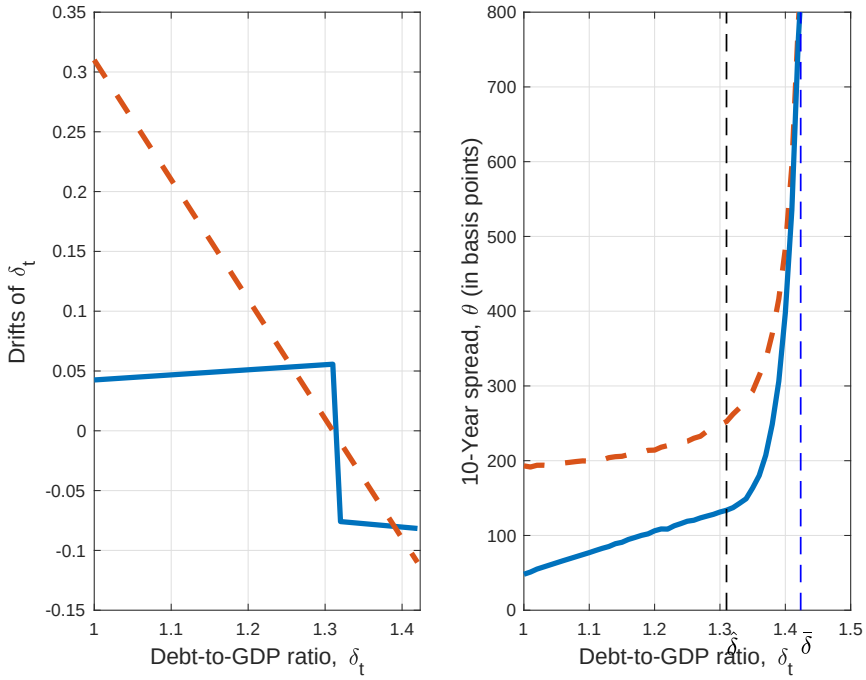


Fiscal expansions



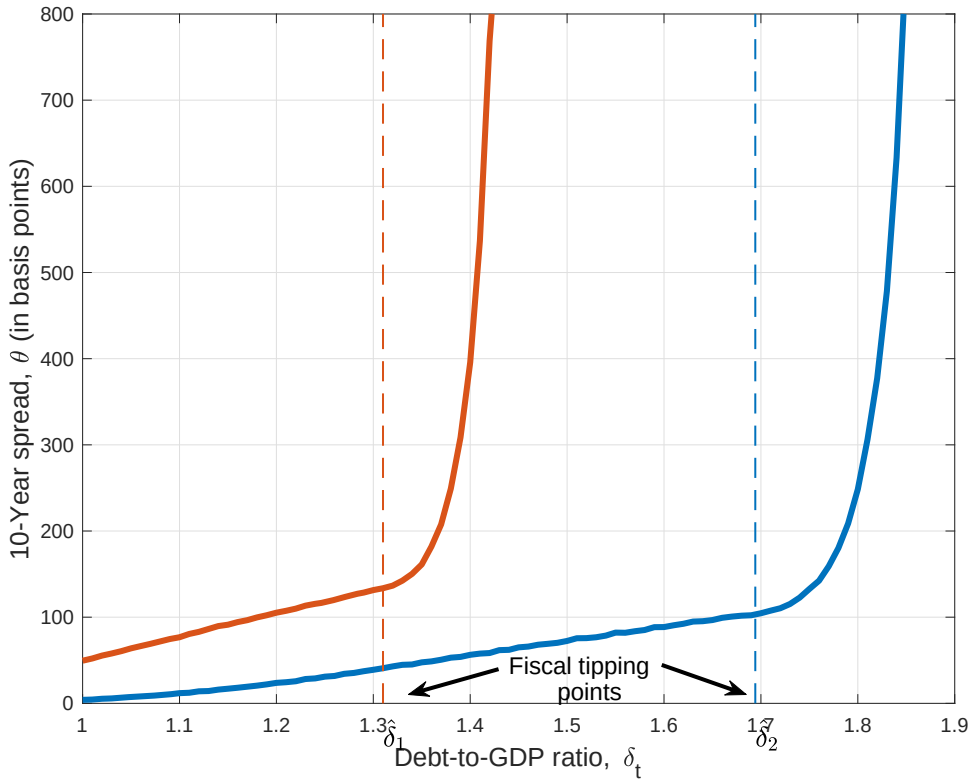
3. Spreads

Debt intolerance around fiscal tipping points

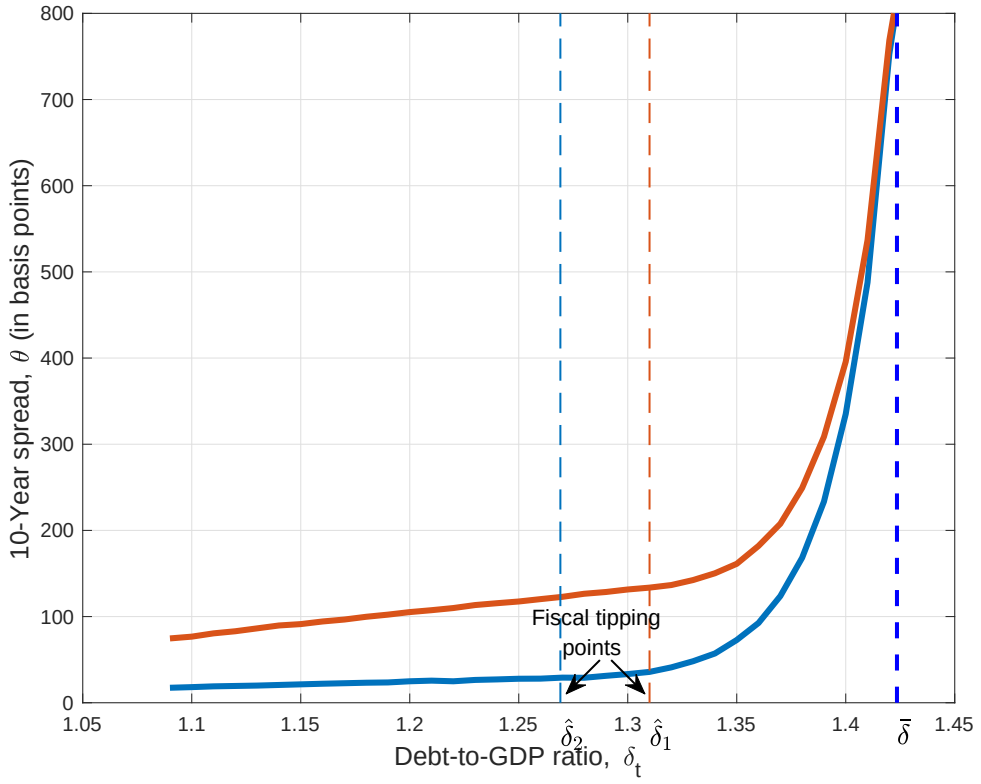


- (Non standard notion of debt intolerance.) Austerity arrives "too late," i.e., it is the very same government arguing for default probs to be unacceptably high

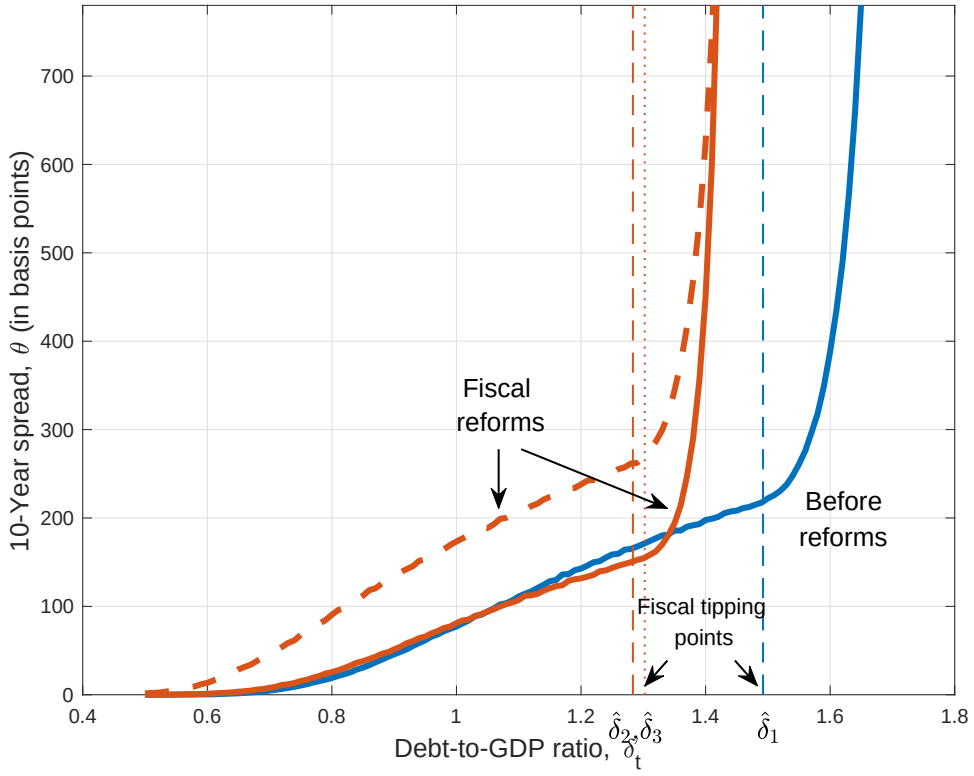
Spreads decrease with liquidity support (e.g., QE)



Spreads decrease with macroeconomic volatility



The effects of unanticipated fiscal reforms



Conclusion

- Alesina, Favero and Giavazzi (2019) have shifted Krugman v. Reinhart & Rogoff debate to
  - how to cure debt-sickness?
  - collect evidence and argue that austerity programs are much less painful and, sometimes, even conducive to growth, provided these programs rely on cutting expenses rather than increasing taxes

- I ask a related question. Too much debt might lead to default, and austerity plans might be unavoidable at some point
  - $When$? My answer is that such austerity plans might arrive too late to avert a crisis
  - Am not mechanically claiming primary deficits are necessarily wrong