Debt As A Safe Asset: Mining the Bubble

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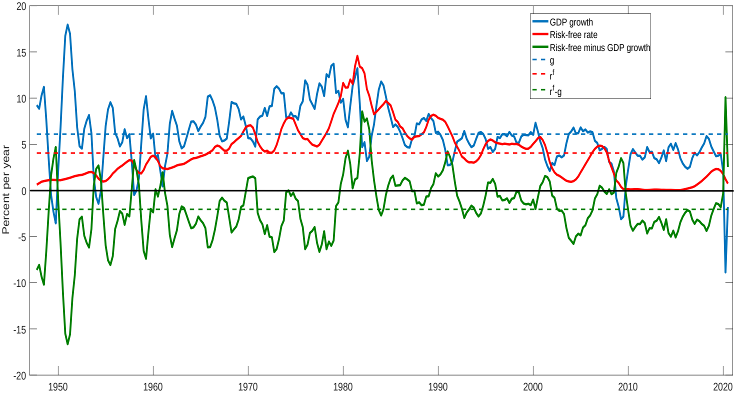
$r^f < g$



- Nominal short rate below nominal GDP growth rate

$r^f < g$

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- Has led Blanchard (2019) and Furman and Summers (2020) to conclude that government can spend trillions more on Covid-19 bailouts, municipal government bailouts, Medicare For All, Green New Deal, etc.
- While insuring taxpayers through traditional counter-cyclical spending and pro-cyclical tax revenue policies.
- And **keeping government debt risk-free**.

Iterating on the Government Budget Constraint

- Nominal budget constraint without money, but with long-term debt
$$Q_{t-1}(1) + G_t = T_t + \sum_{h=0}^{H} Q_t^{h+1} P_t^h$$
- Iterate forward for T periods

$$\mathcal{B}_t = \sum_{h=0}^{H} Q_{t-1}^{h+1} P_t^h = \mathbb{E}_t \left[\sum_{j=0}^{\infty} M_{t,t+j}(T_{t+j} - G_{t+j}) \right] + \mathbb{E}_t[M_{t,t+T}\mathcal{B}_{t+T}].$$

- where M is a nominal SDF that prices government debt: $P_t^h = \mathbb{E}_t[M_{t,t+1} P_{t+1}^{h-1}]$.
- Only imposes no arbitrage, not complete markets

Bubble

- Restrict attention to one-period debt (eliminates maturity structure as fiscal policy instrument)
- Add money as additional source of government debt
- Divide by the CPI level to arrive at the FTPL equation

$$\frac{\mathcal{B}_t + \mathcal{M}_t}{\mathcal{P}_t} = \mathbb{E}_t \left[\sum_{j=0}^{\infty} M^r_{t,t+j} \frac{T_{t+j} - G_{t+j}}{\mathcal{P}_{t+j}} \right] + \mathbb{E}_t \left[\sum_{j=0}^{\infty} M^r_{t,t+j} \Delta i_{t+j} \frac{\mathcal{M}_{t+j}}{\mathcal{P}_{t+j}} \right] + \mathbb{E}_t \left[M^r_{t,t+T} \frac{\mathcal{B}_{t+T}}{\mathcal{P}_T} \right]$$

- Surprise devaluations of existing govt debt or money not very likely/powerful
- Seigniorage revenue from money not that large either: narrow money stock is small; reserves have $\Delta i \approx 0$.
- Leaves the **bubble term**: government can run Ponzi scheme by growing the stock of debt; fully anticipated by private sector

$$\lim_{T\to\infty} \mathbb{E}_t \left[M_{t,t+T} \mathcal{B}_{t+T} \right] > 0$$

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Source of the Bubble

- OLG models (Samuelson 1958)
- Perpetual youth models (Blanchard 1985)
- Idiosyncratic risk (Bewley 1980, Ayagari 1991), **this paper**
  - Faced with uninsurable idiosyncratic risk $\tilde{\sigma}$, agents increase precautionary savings, lowering r^f
  - $r^f < g$ iff govt. debt growth $\mu^B > i$
  - Existence of monetary equilibrium where government bonds have positive value $\Leftrightarrow \tilde{\sigma} \geq \sqrt{\rho + \mu^B - i}$
  - Unique equilibrium if government can commit to increase taxes when bond value falls below a positive threshold
  - Size of bubble and price level pinned down by debt valuation equation and goods market clearing
  - Government bonds help HHs smooth consumption

TVC Violations Hard with Realistic Amount of Aggregate Risk

- Asset pricing literature emphasizes importance of permanent shocks to productivity/consumption to generate realistic risk premia on stocks
  - E.g., Alvarez and Jermann, Borovicka, Hansen, and Scheinkman, Boyarchenko, Backus, and Chernov, etc.
  - Most of equity risk premium compensates for this risk
- With sufficient permanent output risk, it becomes **much harder** to sustain bubbles, even when the debt is risk-free and $r^f < g$
- Show you a simple model that strips away the incomplete risk sharing among agents, taken from Jiang, Lustig, Van Nieuwerburgh, Xiaolan (2020).

Simple Model

- Simple endowment economy à la Lucas and Breeden
- SDF is of the CRRA type $m_{t+1} = \log(M_{t+1})$:

$$m_{t+1} = -r^f - 0.5\gamma^2 - \gamma\varepsilon_{t+1}$$

- GDP has permanent shocks

$$y_{t+1} = g + y_t + \sigma\varepsilon_{t+1}$$

- The government issues only one-period real **risk-free** debt
- The government commits to a constant debt-output ratio: $b = \frac{\mathcal{B}_t}{Y_t}$
- Debt grows in this model, at the same rate as GDP: $\mu^B = g$

The Bubble Condition Revisited

- Government debt valuation:

$$\mathcal{B}_t = \mathbb{E}_t \left[\sum_{j=0}^{T} M_{t,t+j} Y_{t+j} s_{t+j} \right] + \mathbb{E}_t \left[M_{t,t+T} Y_{t+T} \frac{\mathcal{B}_{t+T}}{Y_{t+T}} \right].$$

- Correct TVC is

$$\lim_{T\to\infty} \mathbb{E}_t \left[M_{t,t+T} \mathcal{B}_{t+T} \right] = \lim_{T\to\infty} \exp \left\{ -(r^f - g - \frac{1}{2}\sigma^2 + \gamma\sigma)T \right\} bY_t.$$

- TVC is satisfied if and only if:

$$r^f > g + \frac{1}{2}\sigma^2 - \gamma\sigma$$

- $\gamma\sigma$ is the (unlevered) equity risk premium
- The "Blanchard condition" $r^f < g$ is **neither necessary nor sufficient for TVC** to be violated

The Bubble Condition Revisited

- TVC is satisfied if and only if:

$$r^f > g + \frac{1}{2}\sigma^2 - \gamma\sigma$$

- The correct **TVC** condition is **likely to be satisfied** since permanent output shocks must have a **large price of risk to explain the equity risk premium**
  - $r^f = 2\%, g = 3.1\%, \sigma = 5\%$; Note $r^f < g$
  - $\gamma = 1$ is maximum Sharpe ratio in this economy
  - $2\% > 3.1\% + .5(5\%)^2 - 1 \times 5\% = -1.78\%$
  - TVC holds iff max SR $\gamma > 0.25$

- The debt value $\mathcal{B}_T$ inherits the permanent output risk in Y_T

- $r^f - g$ is not the correct discount rate for the debt term in the presence of permanent shocks, *even when debt is risk-free*

The Bubble Condition Revisited

- Argument extends beyond constant debt/output ratio
- TVC is the same if debt/output ratio is **stationary**
  - Follows AR(p) with roots of characteristic equation outside the unit circle
  - U.S. data: Debt/output best described by AR(2) process

The Bubble Condition Revisited

- Argument extends beyond constant debt/output ratio
- If debt/output is **non-stationary** and counter-cyclical ($\lambda > 0$):

$$\log d_t = \phi_0 + \log d_{t-1} - \lambda \varepsilon_t - \frac{1}{2}\lambda^2$$

- Then TVC is satisfied if and only if:

$$r^f > g + \frac{1}{2}\sigma^2 - \gamma\sigma + \lambda(\gamma - \sigma)$$

- This puts an upper bound on how counter-cyclical debt issuance policy can be without violating TVC
  - $r^f = 2\%, g = 3.1\%, \sigma = 5\%$
  - $\gamma = 1$ is maximum Sharpe ratio in this economy
  - $\lambda = 1.94\sigma = .097$
  - $2\% < 3.1\% + .5(5\%)^2 - 1 \times 5\% + 9.7\%(1 - 5\%) = 7.44\%$
  - Satisfying TVC requires less aggressive debt policy $0 < \lambda < 0.8\sigma$
- Government creates itself an arbitrage opportunity when debt/output is non-stationary: when agents are sufficiently risk averse, insurance provided by counter-cyclical debt issuance

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- This puts an upper bound on how counter-cyclical debt issuance policy can be without violating TVC
- Government creates itself an arbitrage opportunity when debt/output is non-stationary: when agents are sufficiently risk averse, insurance provided by counter-cyclical debt issuance policy is so valuable that price of a claim to $\mathcal{B}_{t+T}$ fails to converge to zero

Summary: Why TVC Violations?

- Above argument should apply here. Why then are they still violations from TVC? Two possibilities.
  1. With risk aversion of 1, TVC is violated, but only because of unrealistically low maximum Sharpe ratio. Model does not match equity risk premium.
  2. Model does not match the stationary nature of debt/GDP in data, well described by AR(2).
- Paper unclear on properties of govt. debt issuance policy
  - Is $\mu_t^B - i_t$ function of x_t?
  - Does it result in debt that is cointegrated with GDP?
  - Counter-cyclicality of the debt issuance?
  - Only if debt/GDP is martingale with sufficient counter-cyclicality, violations of TVC possible.

Incomplete Risk Sharing of Idiosyncratic Risk

- Precautionary savings effect lowers real risk-free rate, making TVC more likely to fail
- But it must fight the equity risk premium effect in a realistic asset pricing model, which makes TVC more likely to hold
- Equity risk premium will be **higher** still since it now reflects **counter-cyclical idiosyncratic income risk** (Krueger-Lustig 10)
- Additional risk premium makes the TVC more likely to be hold
- Ambiguous whether the precautionary savings effect is large enough to offset the additional risk premium effect, and hence whether the incomplete risk sharing channel makes the TVC more or less likely to be violated
- Is incomplete risk sharing a quantitatively plausible mechanism to resolve a government bond valuation puzzle of 3x GDP?
- Incomplete markets intuition **applies to every country**, but many countries have no debt valuation puzzle (e.g., UK).

What Gives? Convenience Yields

- Convenience yield $\lambda_t \Leftrightarrow$ Treasury bonds paying lower yields than implied from SDF:

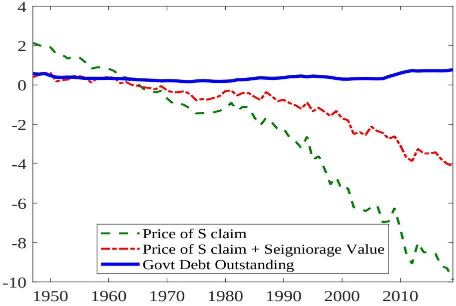
$$E_t[M_{t+1}P^K_{t+1}] \quad = \quad P^{K+1}_t e^{-\lambda_t}.$$

- Debt now also backed by convenience yield services that Treasuries offers investors, separate from bubble term:

$$\mathcal{B}_t = E_t \left[\sum_{j=0}^{\infty} M_{t,t+j} \left(T_{t+j} - G_{t+j} + (1 - e^{-\lambda_{t+j}}) \mathcal{B}_{t+j} \right) \right]$$

- Using Krishnamurty and Vissing-Jorgensen's measure for λ_t, Jiang et al. (2019) find that convenience services resolves about half of the government debt valuation puzzle

Convenience Yields



- Leaves open possibility that convenience yields are larger and more counter-cyclical than conventionally thought
  - Other USD-denominated assets also earn conv. yield
  - Krishnamurthy, Jiang, and Lustig (2019) find conv. yields for foreigners between 2 and 3%; Koijen and Yogo (2020) find 2.15% for U.S. long-term bonds

Conclusions

- Very important question: can the U.S. *safely* borrow trillions more?
- Like theoretical connection between bubble term and the convenience services arising from incomplete risk sharing
- Does the model generate high enough maximum Sharpe ratio?
- Does it produce debt/GDP ratio that looks like the data?
- Is U.S. govt. bond unique in its ability to help agents smooth consumption? What if agents could also trade the aggregate stock market in the model?
- Convenience yields could have other origins. How much can incomplete risk sharing explain as source of conv. yields?