Public Debt and the Slope of the Term Structure

By

Thien T. Nguyen

Nancy R. Xu

Boston College
Carroll School of Management

February 15, 2020, RAPS/RCFS Conference

Objective

- Further the understanding between supply shocks (quantities) and yield spreads (asset prices)

Motivation

- In recent years since the GFC, governments around the world responded by implementing fiscal stabilization measures → rising public debt
- Such policy instruments – can be thought of as supply shocks – might be distortionary and/or have impacts on the asset market in general. However, it is largely unexplored in the literature (except for a few, Koijen & Yogo, 2019a, 2019b)
- This paper focuses on the interest rate and its term structure in particular.

Main findings - Empirical evidence

- Quarterly public debt to lagged quarterly GDP, “DGDP”
- Tables 2-8 (w/ controls: output gap, inflation, corporate debt, foreign demand)

  Finding (1): DGDP has a positive contemporaneous relation with yield spreads from 3- to 10-year horizons.

  Finding (2): An increase in DGDP significantly heightens yield spreads across the term structure.
- Tables 9-11 (w/ controls)

  Finding (3): DGDP negatively predicts the nominal consumption growth (upward term structure)

  Finding (4): DGDP negatively predicts the real consumption growth

  Finding (5): DGDP negatively predicts the inflation (upward term structure)

Main findings - DSGE

- **Goal:** to quantitatively examine the links between public debt, inflation, bond yields, and macroeconomy (growth, investment, labor)
- **Settings:** fiscal policy-side (Croce, Nguyen & Schmid, 2012) + macro-side (Kung, 2015)
- **Agents:**
  - $\Rightarrow$ Households: Epstein-Zin preferences defined over consumption; consume and save (equity and bond); endowed with 1 unit of labor; competitive nominal wage
  - $\Rightarrow$ Firms: final-good and intermediary-good firms; invest and produce; pay wage to HH; pay tax to government
  - $\Rightarrow$ Government: fiscal authority (expenditure = raise public debt + raise tax from corporates); monetary authority (Taylor rule)
- **Structural shocks:** TFP shock, government expenditure shocks, pure fiscal policy shocks, pure monetary policy shocks

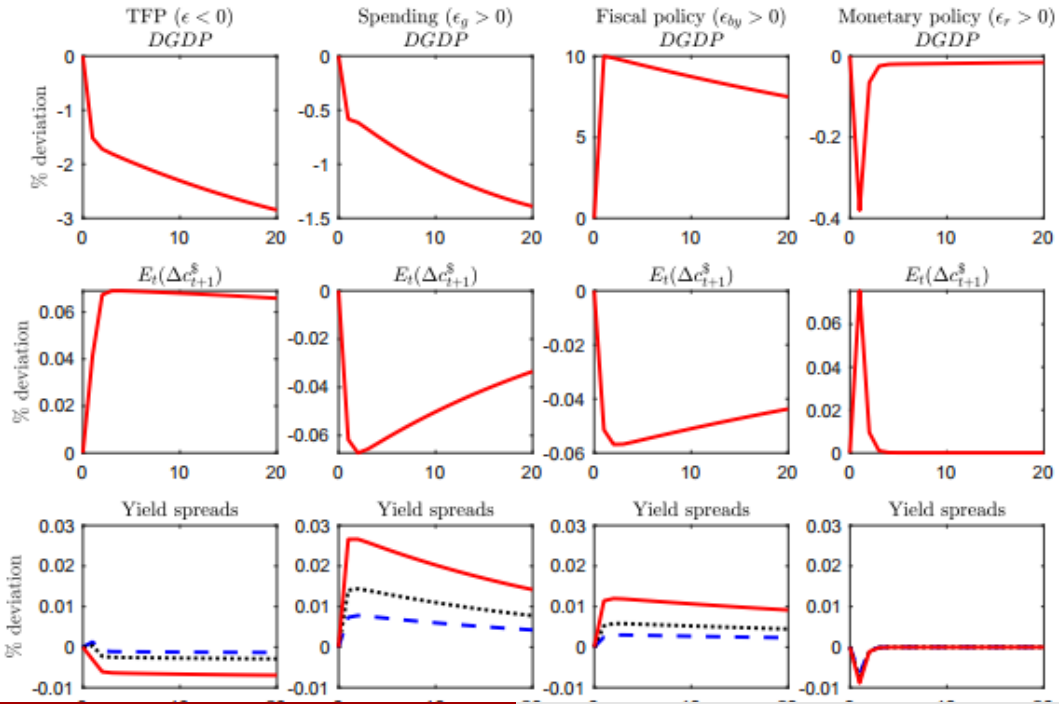
Main findings - DSGE

- DGDP positively predicts bond yield spreads, mainly through:

  ⇒ – Productivity shock: government increases tax to discourage investment and push resources toward consumption, and the increase in taxation leads to lower debt; HH expect growth to mean revert eventually in the future, hence pushing up the price of long-term bond, yield drops)

  ⇒ + Fiscal policy shock: higher DGDP immediately; large drop in expected inflation; yield spread increase

Figure 2.
Impulse responses of $DGDP$ and yield spreads to structural shocks



Comment #1: What I Like About the Paper

1. The structure of the paper is solid:
   - establish empirical evidence
   - propose a generalized model to specify potential channels and quantitatively discuss the relevance
   - relate back to the empirical evidence
2. Economic question is important and relevant:
   - particularly, what is the relationship between quantities and asset prices?
   - government bond market is still understudied
3. The extensive model sensitivity check (in the calibration) is appreciated

Comments:

#2 Empirical evidence

#3 Model

#4 Future directions

#5 Exposition

Comment #2: Empirical evidence (1)

- Collinear explanatory variables:

$\Rightarrow$ $i_t^{(n)} - i_t^{(1)} \sim DGDP_t + \{outputgap, inflation, foreignparticipation, ...\}$

Table 2

DGDP and bond yields (I)

	$i_t^{(3)} - i_t^{(1)}$	$i_t^{(5)} - i_t^{(1)}$	$i_t^{(7)} - i_t^{(1)}$	$i_t^{(10)} - i_t^{(1)}$
		Panel A		
$DGDP_t$	0.222**	0.354***	0.431***	0.433***
	(0.100)	(0.098)	(0.097)	(0.100)
Constant	0.203	−0.067	−0.220	−0.168
	(0.320)	(0.296)	(0.279)	(0.305)
Observations	227	227	227	186
Adjusted R^2	0.045	0.122	0.183	0.203

Table 4

DGDP and bond yields: The impact of global demand

	$i_t^{(3)} - i_t^{(1)}$	$i_t^{(5)} - i_t^{(1)}$	$i_t^{(7)} - i_t^{(1)}$	$i_t^{(10)} - i_t^{(1)}$
		Panel A		
$DGDP_t$	1.419***	1.384***	1.342***	1.241***
	(0.420)	(0.414)	(0.402)	(0.366)
$DGDP_t^F$	−1.358***	−1.177***	−1.050***	−0.892**
	(0.408)	(0.413)	(0.407)	(0.377)
Constant	−1.268*	−1.310**	−1.298**	−1.217**
	(0.688)	(0.645)	(0.609)	(0.542)
Observations	192	192	192	186
Adjusted R^2	0.146	0.183	0.220	0.259

- Suggestion: (1) Helpful to add 1 correlation table of these variables in the regression horserace; some level of correlation should be expected; (2) an US- or global-fiscal-cycle-cleansed $DGDP^F$ will be more helpful

Comment #2: Empirical evidence (2)

- Spurious concern of I(1) bias [Granger and Newbold] in predictive regressions:
  - $\Rightarrow$ $\frac{1}{J}\sum_{j=1}^{J} y_{t+j} \sim DGDP_t + \{outputgap, inflation\}$
  - $\Rightarrow$ The main predictor DGDP seems to be a I(1) variable

Figure 1.
The ratio of debt to GDP and yield spreads

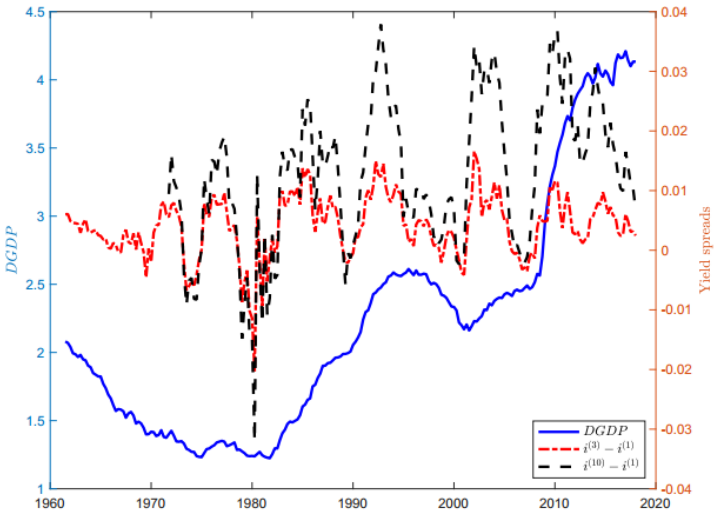


Table 13
Model summary statistics

	Data	SE
$\mathbb{E}(\Delta c)$	2.08	0.20
$\sigma(\Delta c)$	1.62	0.14
$ACF1(\Delta c)$	0.08	0.14
$\mathbb{E}(\pi)$	3.44	0.27
$\sigma(\pi)$	3.86	0.16
$ACF1(\pi)$	0.40	0.07
$\text{corr}(\pi, \Delta c)$	−0.11	0.06
$\sigma(\Delta s)$	3.02	0.25
$\mathbb{E}(\tau)$	35.12	0.72
$\sigma(\tau)$	8.68	0.36
$\mathbb{E}(DGDP)$	2.37	0.35
$\sigma(DGDP)$	0.86	0.04
$ACF1(DGDP)$	0.99	0.01

- Suggestion: (1) check stationarity of DGDP in the data using unit root or stationarity tests (they sometimes cannot agree with each other)
  (2) HH1980 with J lags might not be enough; serial correlation in the residual will be underestimated; suggest to use Hodrick1992 instead or NeweyWest with (way) more lags
  (3) The predictive coefficient (correlation) increases monotonically as J increases (see e.g. Table 9) → this result may also suffer from I(1) bias
  (4) Create a stationary version (e.g. cleansed by 3 year of moving averages)

Comment #3: Model

- I view the main results that the paper is trying to match moments between public debt (government fiscal shock) and asset prices: (1) sign, (2) term structure
- Strong positive DGDP-term spread relation; but weak upward slope evidence of the term structure (even a weak result for empirical evidence)

Table 15
Model: *DGDP* and bond yields (I)

	$i_t^{(3)} - i_t^{(1)}$	$i_t^{(5)} - i_t^{(1)}$	$i_t^{(7)} - i_t^{(1)}$	$i_t^{(10)} - i_t^{(1)}$
		Data		
$DGDP_t$	0.222**	0.354***	0.431***	0.433***
	(0.100)	(0.098)	(0.097)	(0.100)
Adjusted R^2	0.045	0.122	0.183	0.203
		Model		
$DGDP_t$	0.253	0.290	0.324	0.370
Adjusted R^2	0.064	0.084	0.105	0.137

- Suggestion: (1) The impulse responses of 1 unit of the four main structural shocks in the system are very useful (i.e., Figure 2). However, what's more empirically relevant and intriguing (i.e., provide direct policy implications) is their relative importance. I propose some sort of "Jackknife exercise" (i.e., deleting one shock channel, and see how the model then performs in terms of matching the main regression coefficients)
(2) The empirical and theoretical analysis of "predicting consumption growth" is a bit distracting. One can imagine (potentially) splitting up the paper into two, one focusing on the term structure, the other one on economic growth/macroeconomy
(3) Different impacts of independent MP (short-lived) and FP (persistent) processes on yield spreads. In real time, both policies are likely synchronized (e.g., financial crisis).

Comment #4: Future directions

- International evidence is interesting but does not fit in the current exposition:

Table 8
International panel regressions

	$i_{jt}^{(3)} - i_{jt}^{(1)}$	$i_{jt}^{(5)} - i_{jt}^{(1)}$	$i_{jt}^{(7)} - i_{jt}^{(1)}$	$i_{jt}^{(10)} - i_{jt}^{(1)}$
		Panel A		
$DGDP_{jt}$	0.131***	0.144***	0.145***	0.153***
	(0.039)	(0.041)	(0.042)	(0.042)
Constant	0.687	0.693	0.676	0.577
	(0.528)	(0.551)	(0.547)	(0.525)
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Overall R^2	0.502	0.507	0.515	0.537

  - ⇒ DGDP of country *j* in quarter *t* contain debt held by global investors (foreign agents); vice versa. Studying this international DGDP-yield spread relation can be more complicated than a simple international panel regression model captures → However, very interesting extension!
  - ⇒ DSGE does not have an international component

- Other channels public debt influences the financial market Signaling? Risk aversion? Contagious across all debt assets?

Comment #5: Exposition

- Highly recommend to shorten the paper (75 pages, 29 tables)
- Suggestion:
  (1) remove the international parts
  (2) focus on the relation between public debt and yield spread (establish the empirical evidence → model setup → implications on the multiple channels → link back to the empirical evidence by doing some jackknife exercises, i.e., actual relative importance of these channels)
  (3) Overall, the sensitivity section is very impressive; perhaps shorten it by delegating (more) tables to the online appendix

Conclusion

- I highly recommend it: the story is convincing and the structural, quantitative effort is definitely appreciated
- To make it more convincing:
  1. Sharpen the empirical section
     (suggestion: reconsider potential collinearity and I(1) bias concerns)
  2. Build a closer and more transparent link back to empirical evidence
     (suggestion: jackknife exercise)
  3. Shorten the paper
     (suggestion: remove or relegate several “branches”)

Thank You!

nancy.xu@bc.edu