Linking policy to outcomes: a simple framework for debt maturity management

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Christopher Cameron
US Treasury*

Mattia Landoni
SMU Cox School of Business

Winthrop T. Smith
Wells Fargo†

* The analysis and conclusions set forth in this paper are those of the author(s), and do not necessarily reflect those of or indicate concurrence by other members of the Treasury staff, Treasury's senior officials, the Treasury Department, or the United States government.
† The views expressed in this paper are the authors' and not those of Wells Fargo.

Outline

- Motivation
  - Debt management and maturity choice
  - How to describe policy?
- A simple model of portfolio maturity dynamics
  - Simplifying assumptions
  - Notation
  - Long-run dynamics
- Applications
  - Optimal issuance
  - Making sense of “news”
- Conclusion

Total outstanding public debt is $56 trillion*

- Increasing debt/GDP → debt management more consequential

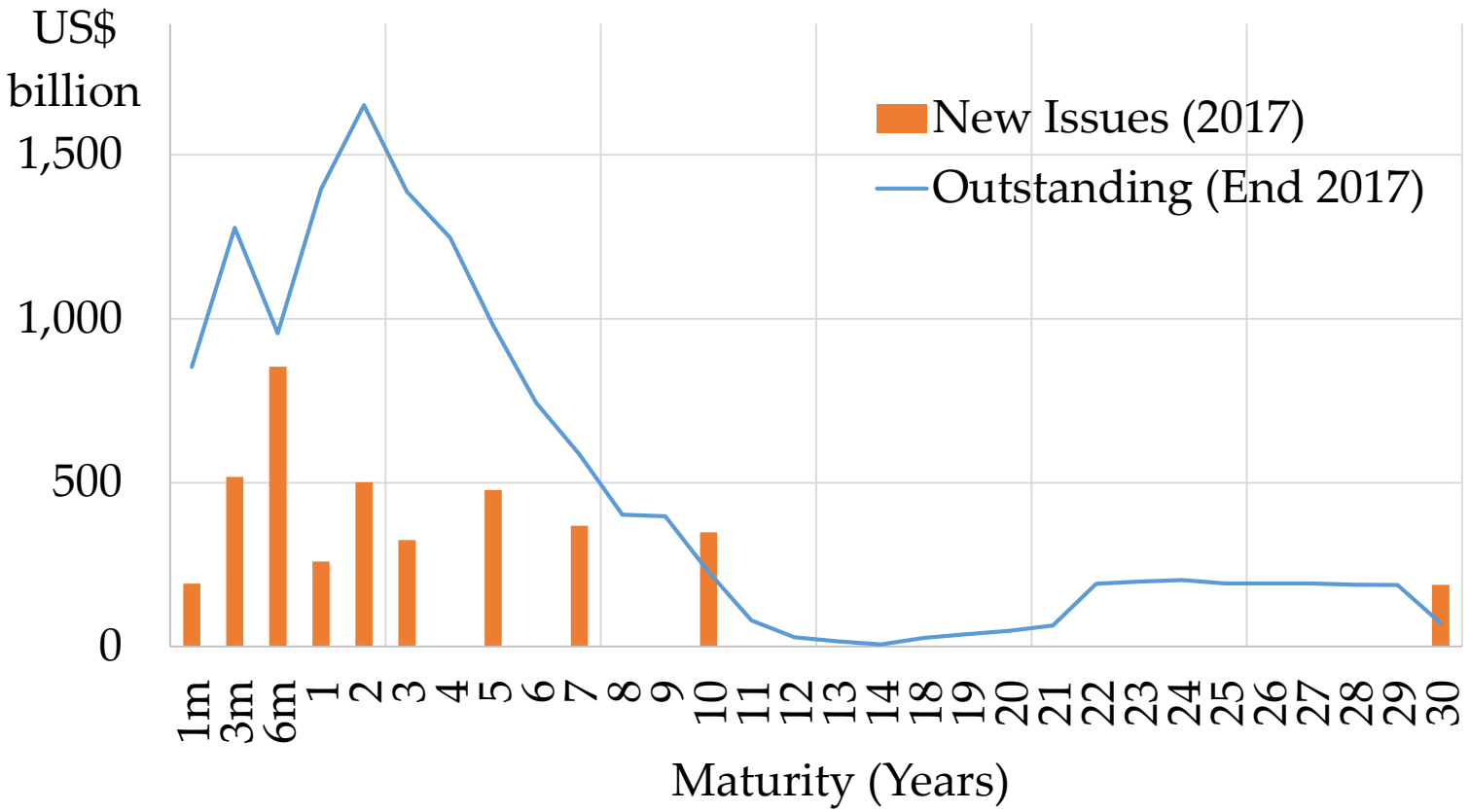
- Government debt management: many difficult choices
  - Indexing
  - Liquidity
  - Refunding options
  - …
  - **This paper: maturity**

* Economist global debt clock. Our estimate on IMF/WB/Eurostat data: $59t. Fitch says $66t.

How to tell what an issuer is doing?

- Is the US Treasury currently lengthening or shortening the maturity?

	Amt ($t)*	WAM (yrs)
New Issues	4.0	4.19
Outstanding	13.4	6.20



* Obligations with less than 1-year maturity are scaled down, e.g. $12b of 1-month bills counted as $1b.

How to discuss debt management?

- Strategy #1: use one scalar measure (WAM of outstanding bonds) for everything.
  - Cost
  - Risk
  - Supply

- Strategy #2: complex black-box simulations
  - Helpful, but…
  - Why do I get the results I get?

- **We need a language to link policy (the maturity mix of new issues) with outcomes (the outstanding maturity distribution).**

This paper

- Proposes a simple framework to represent the evolution of the outstanding distribution
  1. Forward-looking: focus on the maturity mix of new issues
  2. Simple: pencil-and-paper formulas
  3. Complete: a policy variable for every goal

- Uses framework to provide some simple advice on debt management

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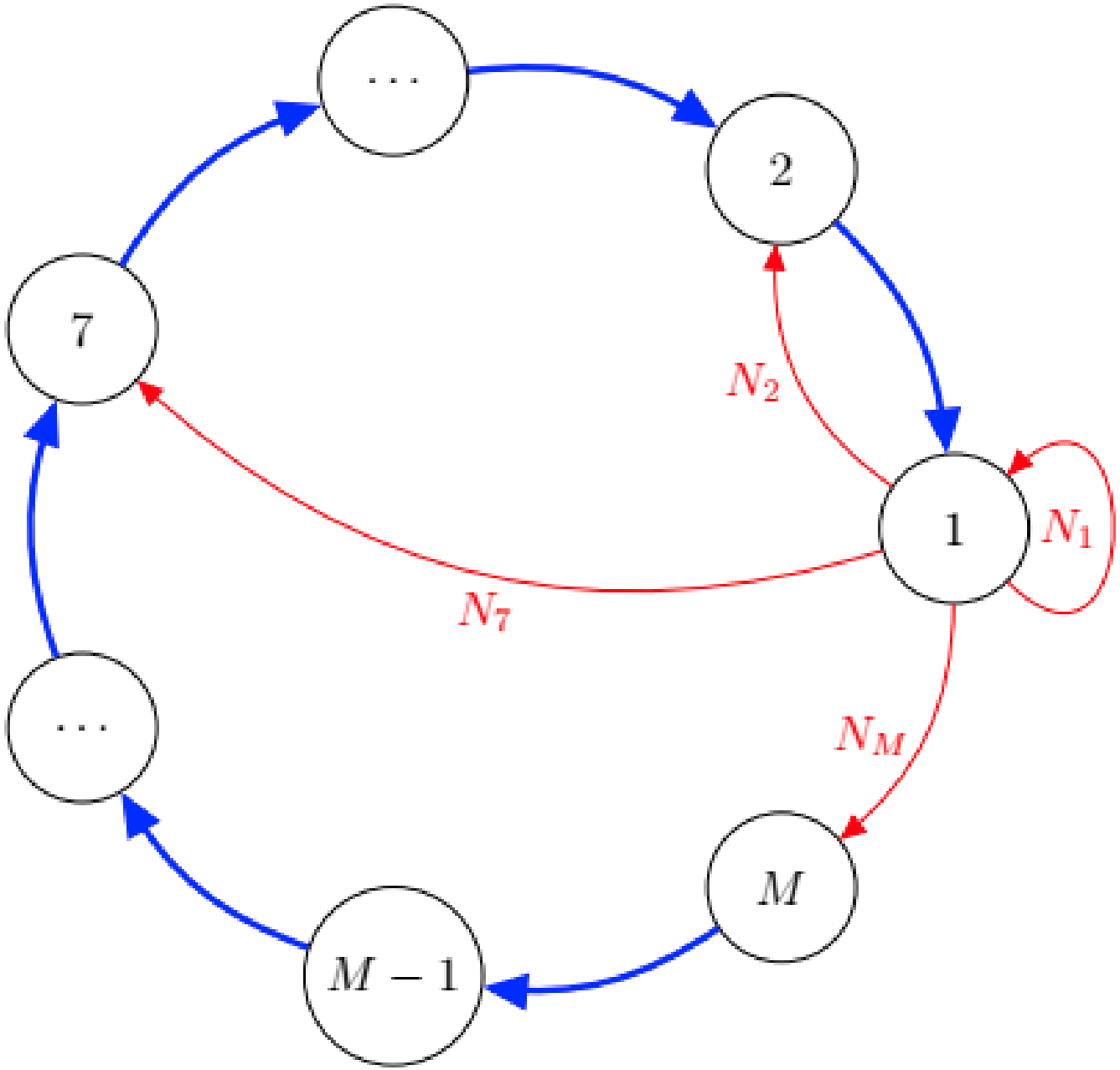
Simplifying assumptions

1. We study refinancing risk in a deterministic framework
   - Volatility of refinancing conditions (mostly exogenous) x
   - Frequency of refinancing (policy choice) ✓
2. We assume policies are sustained indefinitely
   - Policies do change before ever reaching steady state
   - But they are very persistent
3. We focus on issuance alone
   - For some countries, repurchases can be important
   - But issuance is always more important

Dynamics

- Bond aging and replacement process can be represented as a flow diagram
- Blue: bonds get shorter with time
- Red: 1-year bonds mature, new bonds get issued



A simple example

- Consider the following maturity distributions (assume for simplicity longest maturity $M = 3$):

$$Outstanding_t = \begin{bmatrix} 0.625 \\ 0.250 \\ 0.125 \end{bmatrix}; \quad New\ issues\ (N) = \begin{bmatrix} 0.600 \\ 0.250 \\ 0.150 \end{bmatrix}$$

  - WAM: outstanding 1.500; new 1.550

- What happens if the issuer continues with this policy indefinitely?

Long-run dynamics: Continued example

- Outstanding distribution converges to the "stable distribution"

	Outstanding distribution in k years, k = …					
Maturity	1	2	3	…	6	7
1 Yr	0.625	0.625	0.656			
2 Yr	0.250	0.281	0.250			
3 Yr	0.125	0.094	0.094			
WAM	1.500	1.469	1.438			

Stable WAM lower than both initial WAM, new-issue WAM

The stable distribution in closed form

$$x \equiv \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_{M-1} \\ x_M \end{pmatrix} = \frac{1}{\mu_N} \begin{pmatrix} \sum_{m=1}^{M} N_m = 1 \\ \sum_{m=2}^{M} N_m = 1 - N_1 \\ \vdots \\ N_{M-1} + N_M \\ N_M \end{pmatrix}$$

where $\mu_N = \sum_m m N_m$ is the WAM of new issues.

- This formula assumes zero debt growth
- For formula with debt growing at rate r, see paper.

Stable indicators

- **Risk**: stable per-period refinancing need

$$x_1 = \frac{1}{\mu_N}$$

WAM of new issues!

- **Cost**: stable debt service cost (average coupon)

$$Y_x = \frac{\sum_m mN_m C(m)}{\sum_m mN_m}$$

Exogenous coupon curve

Stable indicators (continued)

- **LT bond supply**: stable WAM

$$\mu_x = \frac{1}{2}\left(\frac{\sigma_N^2}{\mu_N} + \mu_N + 1\right)$$

Not only WAM; dispersion matters too

Debt management goals in our framework

Standard debt-management tradeoff:

- Minimize cost $[Y_x]$
- Subject to acceptable level of refinancing risk $[1/\mu_N]$

Other possible goals:

- Regulate long-term bond supply (as in QE) $[\mu_x]$
- Issue 30y bonds to provide markets with benchmark curve $[N_{30}]$
- Converge quickly to stable distribution [See paper]
- …

Easier to reconcile apparently competing goals when they are represented by different metrics.

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Optimal issuance

A very simple exercise:

Given a stable per-period refinancing need $1/\mu_N$, choose N to minimize cost Y_x

- Note that μ_N is given; we are optimizing the *shape* of the new-issue maturity distribution, keeping its *WAM* constant.

How to minimize cost?

For almost any reasonable upward-sloping coupon curve, **issue 100% bonds of just one maturity**.

- (Realistic takeaway: concentrate issuance at intermediate maturities)

Intuition: Long-term bonds remain outstanding longer, and thus are more expensive than they seem. E.g.:

- Policy A: issue all 15-year bonds costing **5.00%**.
- Policy B: issue half 1-month bills (yield=1.00%) and half 30-year bonds (yield 5.10%). Result: 360 out of 361 bonds in the stable distribution will be 30-year bonds. Stable debt service cost: **5.09%**.

Stable indicators, revised

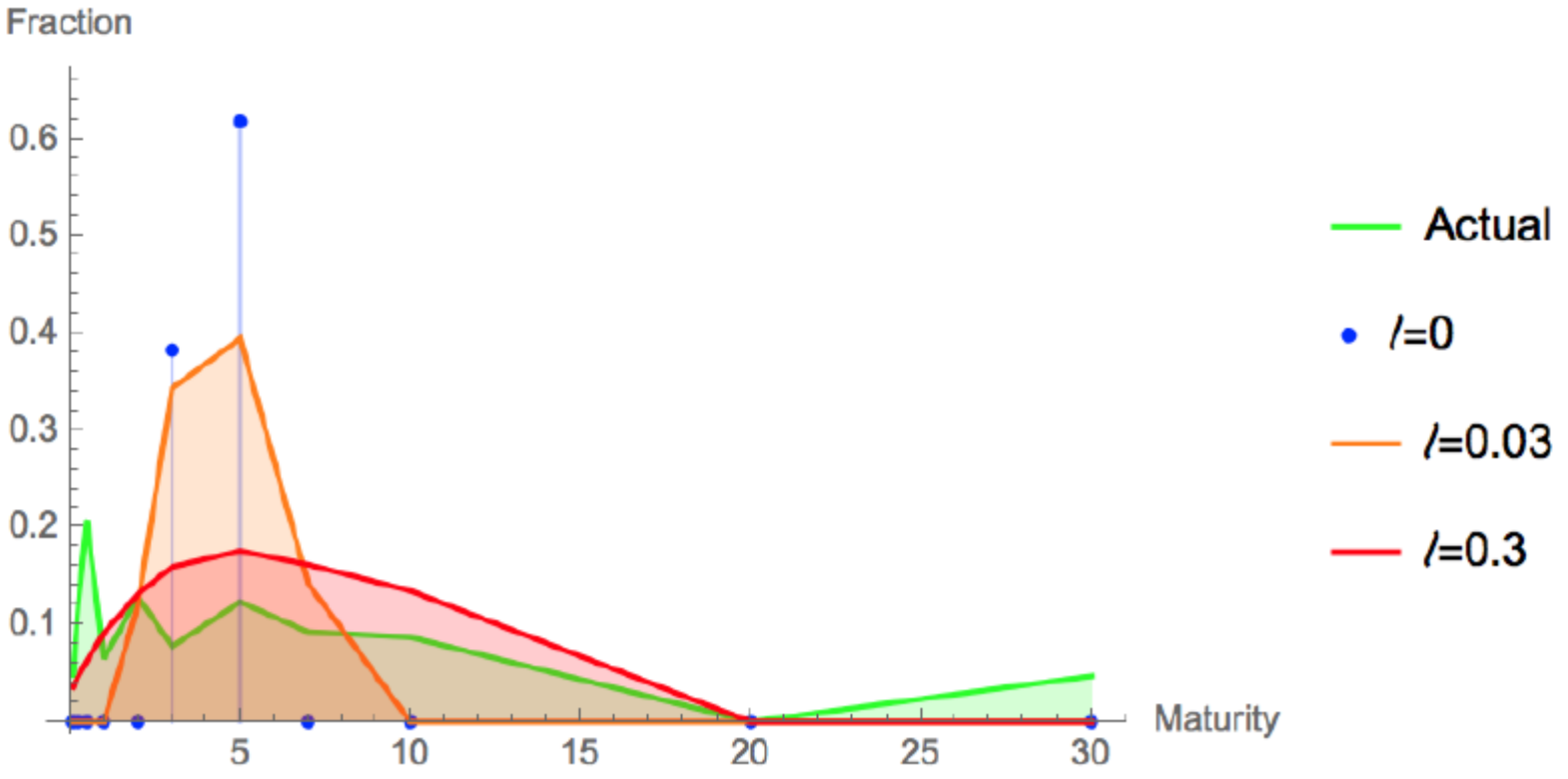
- Stable debt service cost with a penalty for concentrated issuance:

Proportional to per-period total issuance

Quadratic liquidity friction

$$Y_x = \underbrace{\frac{\sum_m mN_m C(m)}{\sum_m mN_m}}_{\text{Stable coupon payment}} + \underbrace{x_1 \cdot \frac{1}{2}\sum_m \ell N_m^2}_{\text{Stable liquidity cost}}$$

Numerical optimization with liquidity friction



- Actual issuance skewed towards bills, LT bonds
- Realistic scenario: $\ell = 0.03$
- Could save taxpayer money without increasing refinancing risk

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Example: making sense of recent media reports

Search

Bloomberg

Markets

Treasury's Surprise Debt-Maturity Move Eases Sting of Fed Unwind

By Rich Miller and Liz McCormick
November 8, 2017, 11:00 PM CST

- Treasury will no longer seek to extend maturity of its debt
- Move aimed at preventing 'yield shock' to U.S. economy

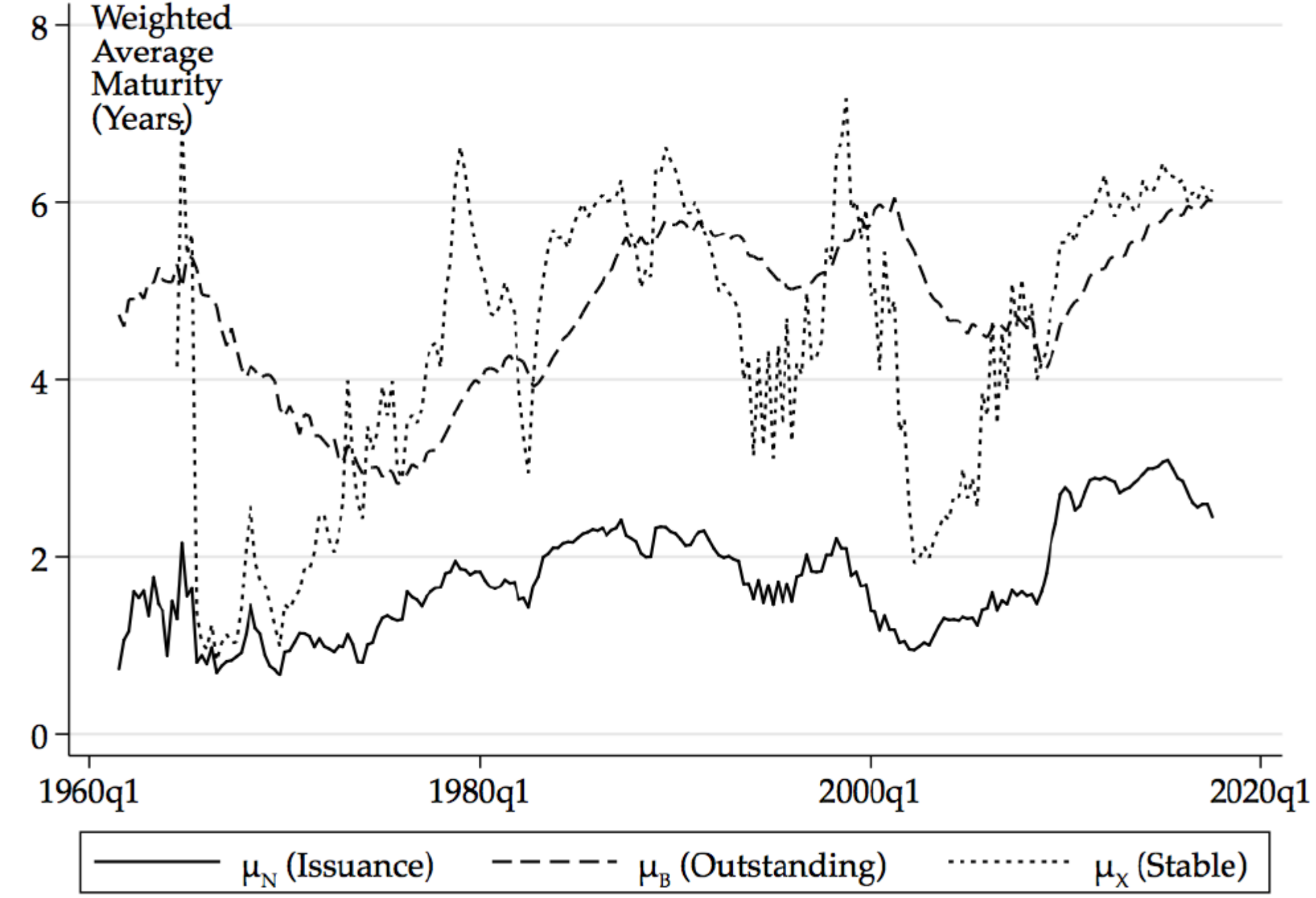
Example: making sense of recent media reports

fastFT US + Add to myFT

Treasury halts attempts to extend maturity of US debt in refunding plan

Joe Rennison in New York JANUARY 31, 2018

The US Treasury broke with recent tradition on Wednesday, announcing a debt refunding package that halts attempts to extend the maturity of the federal government's debt.



- Outstanding distribution was already close to stable upon announcement
- "No further lengthening" = "Continuation of current issuance policy"
- Not "break with tradition" or "surprise"

Conclusion

We introduce new simple math to link issuance policy to maturity structure of outstanding debt

- New, easy to use indicators for policy outcomes
  - A policy's stable metrics indicate where outstanding distribution is bound to head if policy is enacted or continued
- New insights
  - Concentrated issuance at intermediate maturities is efficient
  - Dispersed new-issue mix increases supply of LT bonds without reducing refinancing risk
  - Prime-number maturities (2-, 3-, 5-, 7- year bonds) facilitate convergence to stable refinancing need [See paper]

The End