Treasury Presentation to TBAC

Office of Debt Management

Fiscal Year 2017 Q4 Report

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Section I:
Executive Summary

Highlights of Treasury's November 2017 Quarterly Refunding Presentation to the Treasury Borrowing Advisory Committee (TBAC)

Receipts and Outlays

- During fiscal year 2017, total receipts were up by 1 percent year-over-year driven mainly by individual income and payroll taxes which increased by $110 billion. YoY corporate taxes have declined $7 billion; one contributing factor could be the tax extension relief offered to companies affected by Hurricanes Harvey and Irma.
- During fiscal year 2017, total outlays were up by $128 billion (3 percent) year-over-year driven mainly by these 5 categories: Health and Human Services outlays were $14 billion higher due to increases in Medicare and Medicaid. Social Security Administration outlays were up $24 billion due to increases in program enrollment. Treasury outlays have increased $20 billion mainly due to higher inflation accretions. Education and Housing and Urban Development outlays were up $29 billion and $35 billion, respectively, due to large subsidy re-estimate differences.

Sources of Financing

- Based on the Quarterly Borrowing Estimate, Treasury's Office of Fiscal Projections currently projects a net marketable borrowing need of $275 billion for Q1 FY 2018, with an end-of-December cash balance of $205 billion. For Q2 FY 2018, the net marketable borrowing need is projected to be $512 billion, with an end-of-March cash balance of $300 billion.

Projected Net Marketable Borrowing

- Treasury continues to analyze and model various scenarios to address potential funding needs based on deficit forecasts and expectations for SOMA Treasury redemptions. Recent Primary Dealer estimates show a wide distribution for net marketable borrowing, reflecting uncertainty in fiscal outlook.
- Assumes SOMA capped redemptions end date in the first quarter of CY 2022. The assumption is based on the September *FEDS Notes* "Projected Evolution of the SOMA Portfolio and the 10-year Treasury Term Premium Effect."

Demand for Treasury Securities

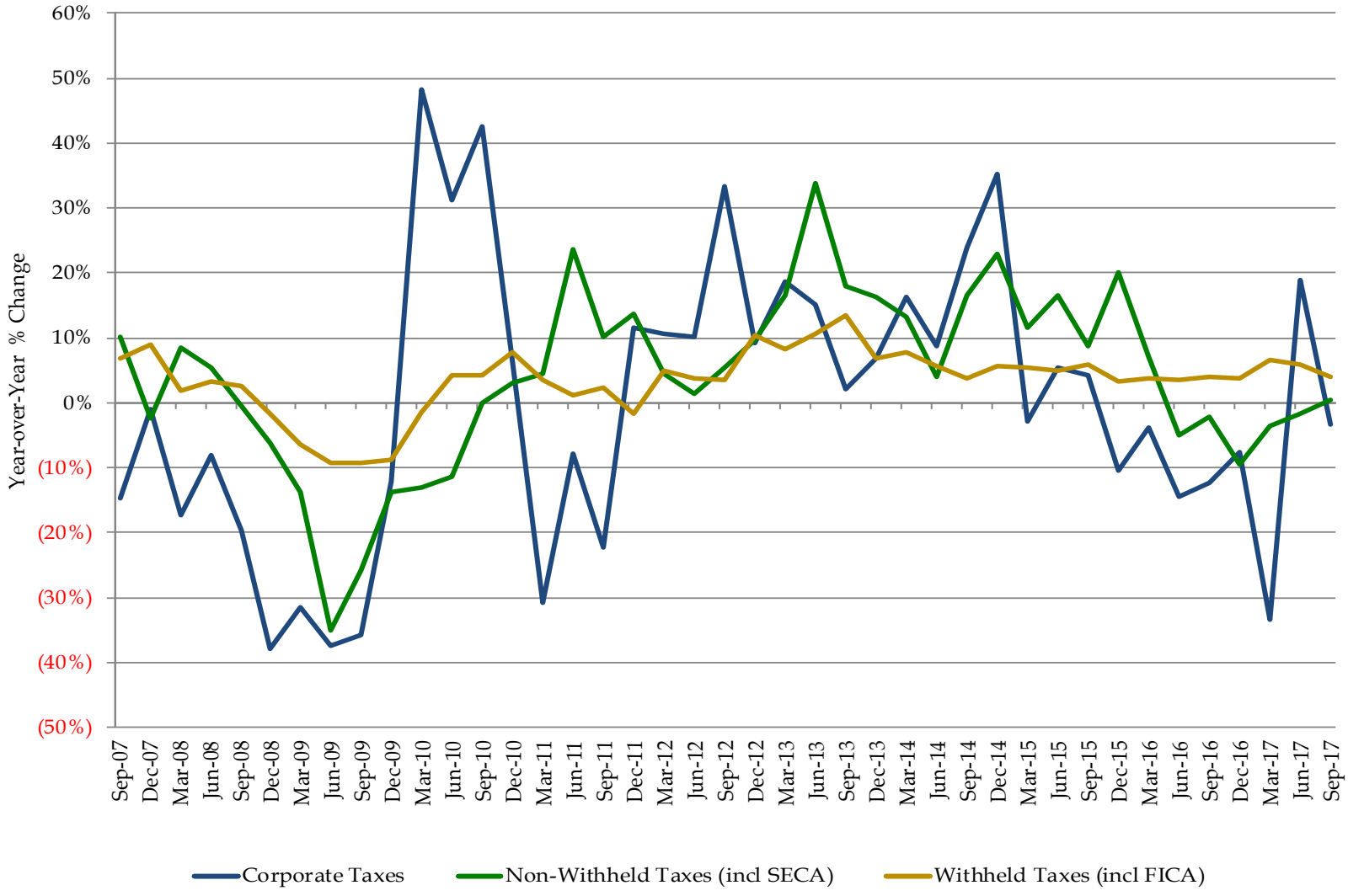
- Bid-to-Cover ratios for bills remain above the crisis-era levels. Demand for the short and intermediate coupons remains strong while Bid-to-Cover ratios for longer term coupons, FRNs and TIPS remain flat.

Award allocation

- September total foreign awards were below average. One contributing factor was the deferred settlement date for month-end coupon auctions (2s, 5s and 7s) due to September 30, 2017 falling on a weekend. If these auction awards were included in September total, the foreign awards would be approximately $8 billion higher.

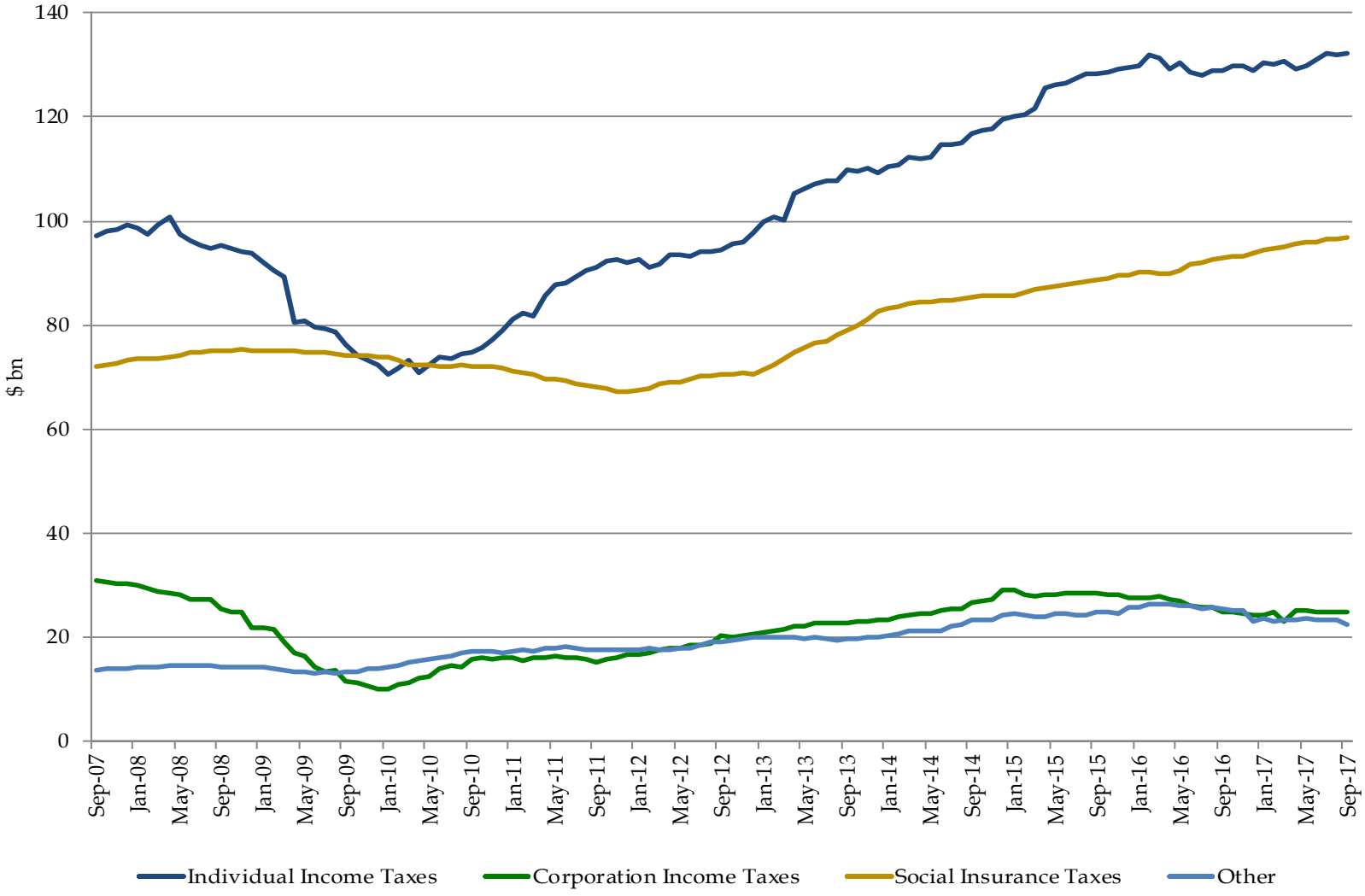
Section II: Fiscal

Quarterly Tax Receipts



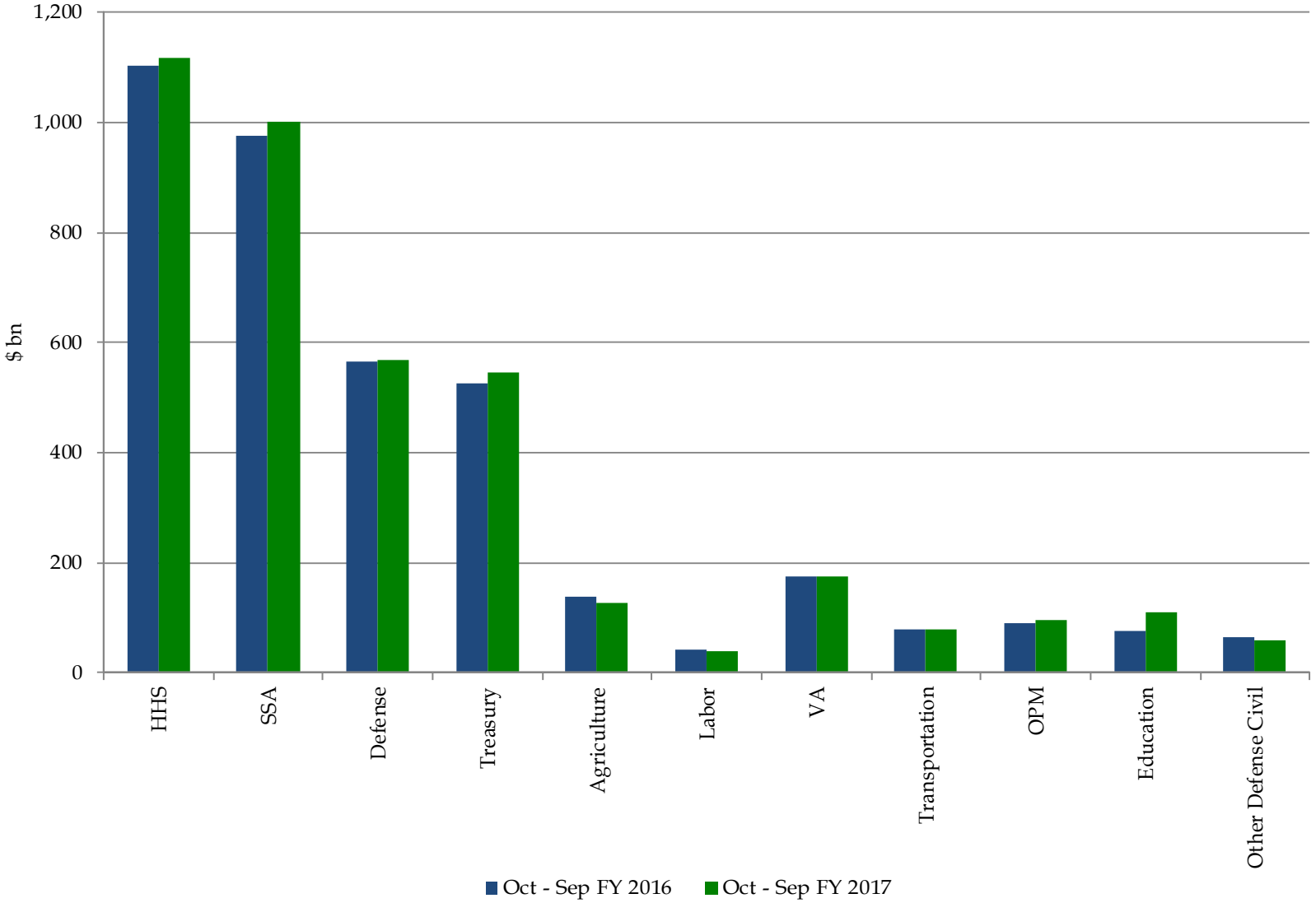
Source: United States Department of the Treasury

Monthly Receipt Levels
(12-Month Moving Average)



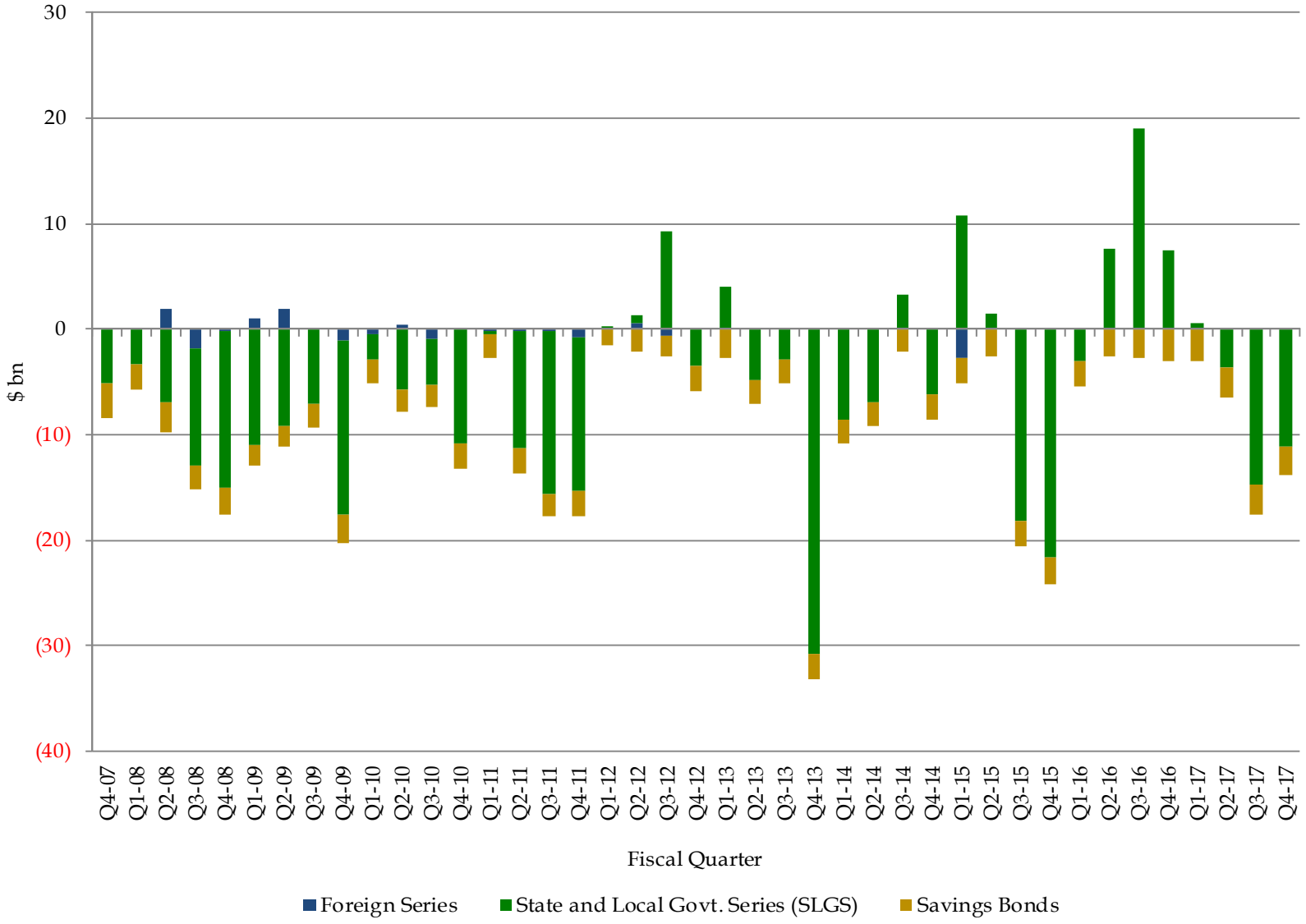
Individual Income Taxes include withheld and non-withheld. Social Insurance Taxes include FICA, SECA, RRTA, UTF deposits, FUTA and RUIA. Other includes excise taxes, estate and gift taxes, customs duties and miscellaneous receipts.
Source: United States Department of the Treasury

Eleven Largest Outlays



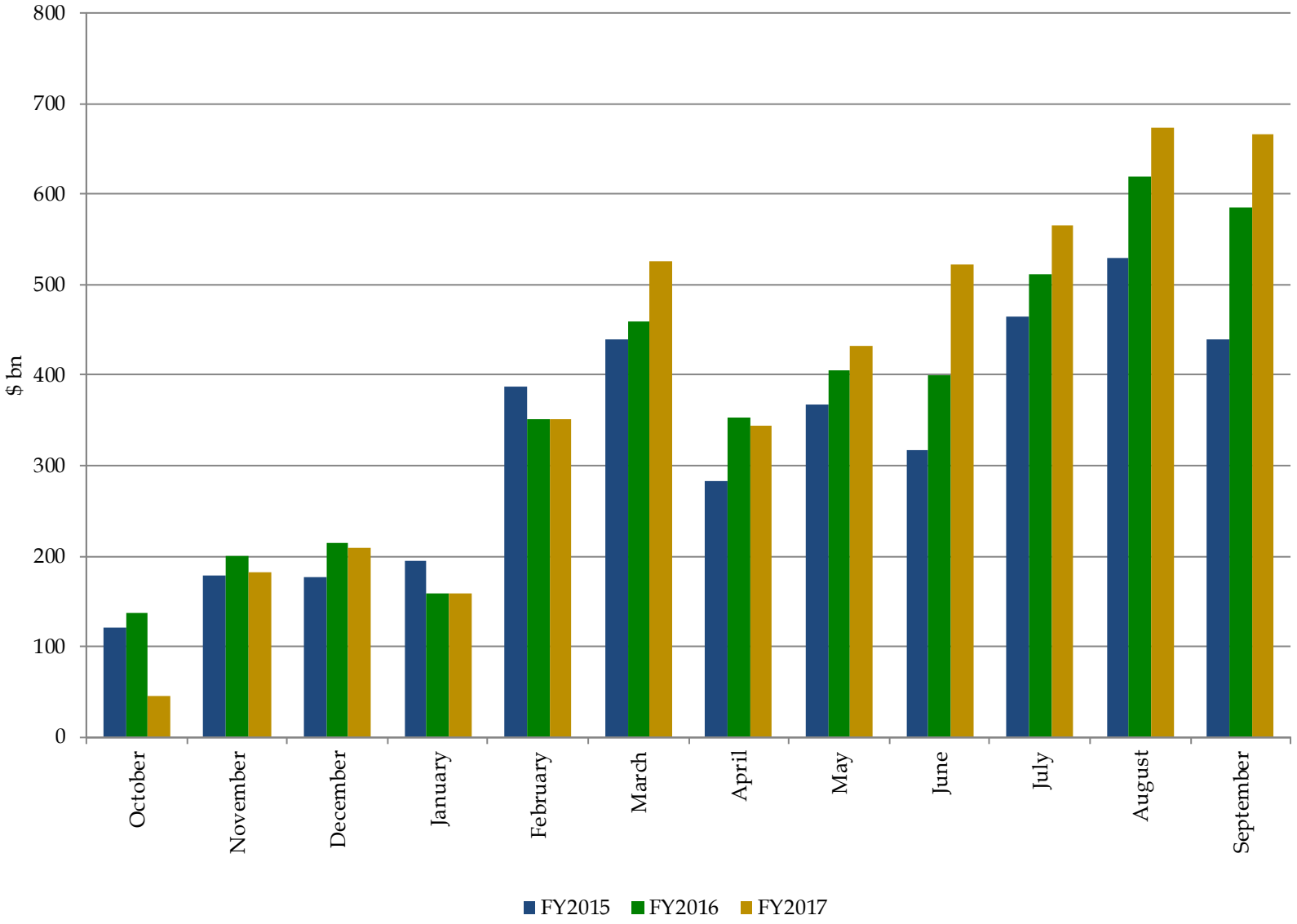
Source: United States Department of the Treasury

Treasury Net Nonmarketable Borrowing



Source: United States Department of the Treasury

Cumulative Budget Deficits by Fiscal Year



Source: United States Department of the Treasury

FY 2018-2020 Deficits and Net Marketable Borrowing Estimates — In $ billions

	Primary Dealers[1]	CBO[2]	CBO[3]	OMB[4]
FY 2018 Deficit Estimate	677	563	593	440
FY 2019 Deficit Estimate	786	689	689	526
FY 2020 Deficit Estimate	853	775	664	488
FY 2018 Deficit Range	560-850			
FY 2019 Deficit Range	650-975			
FY 2020 Deficit Range	680-1100			
FY 2018 Net Marketable Borrowing Estimate	869	881*	912*	529
FY 2019 Net Marketable Borrowing Estimate	906	745	748	604
FY 2020 Net Marketable Borrowing Estimate	946	826	719	552
FY 2018 Net Marketable Borrowing Range	635-1100			
FY 2019 Net Marketable Borrowing Range	661-1100			
FY 2020 Net Marketable Borrowing Range	720-1150			
Estimates as of:	Oct-17	Jul-17	Jun-17	May-17

1Based on primary dealer feedback on October 23, 2017. Estimates above are averages.

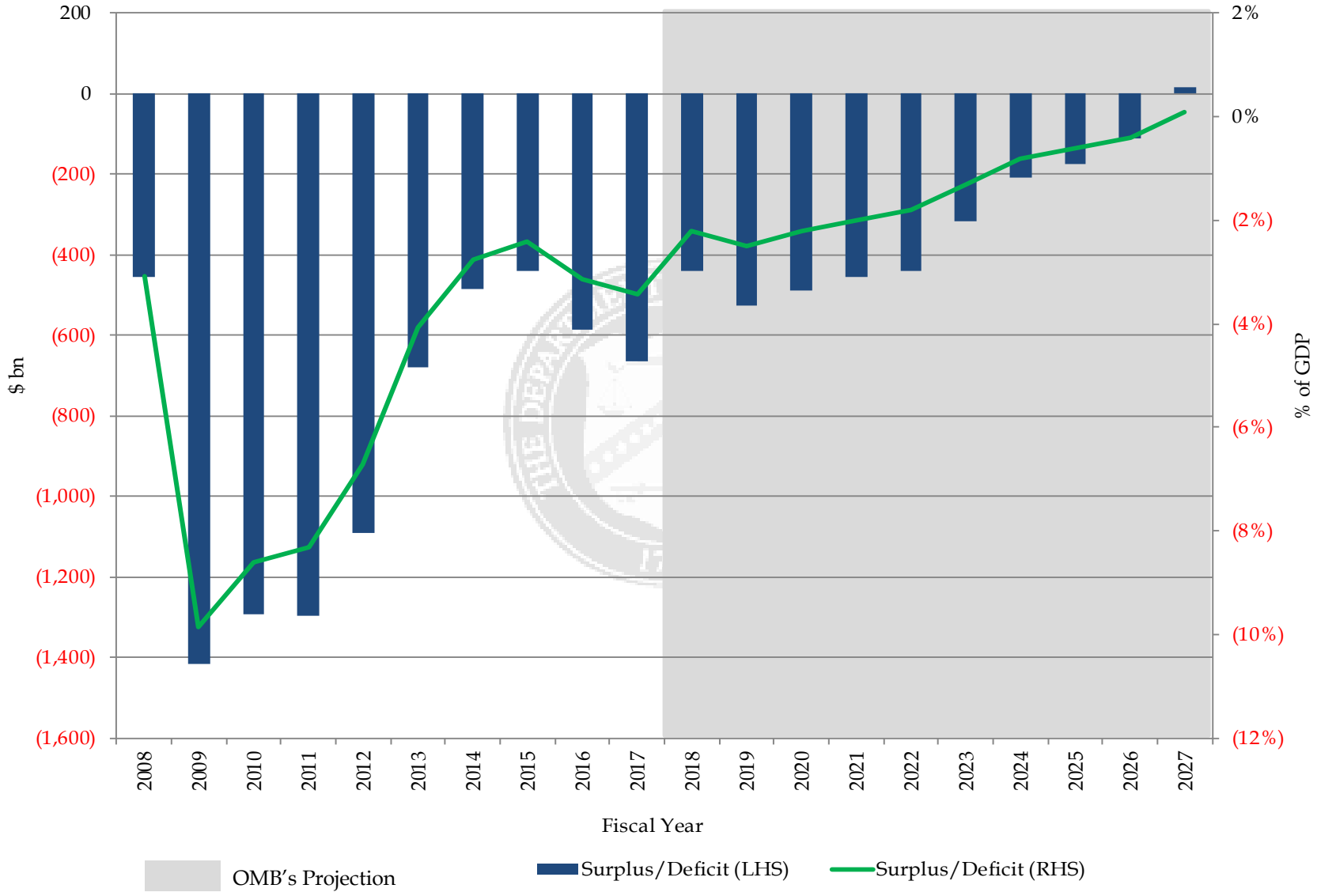
2Summary Table 1 of CBO's "An Update to the Budget and Economic Outlook: 2017 to 2027"

3Table 1 and 2 of CBO's "An Analysis of the President's 2018 Budget"

4Table S-10 of OMB's "Budget of the United States Government, Fiscal Year 2018"

*For FY 2018, the restoration of extraordinary measures used during debt limit impasse artificially adds this amount to "Other means of financing" which shows a larger net borrowing assumption.

Budget Surplus/Deficit



Projections are from Table S-10 of "Budget of The U.S. Government Fiscal Year 2018."

Section III: Financing

Assumptions for Financing Section (pages 15 to 20)

- Portfolio and SOMA holdings as of 09/30/2017.
- Assumes SOMA capped redemptions end date in the first quarter of CY 2022. The assumption is based on September FEDS Notes of "Projected Evolution of the SOMA Portfolio and the 10-year Treasury Term Premium Effect."
- Assumes announced issuance sizes and patterns constant for nominal coupons, TIPS, and FRNs as of 09/30/2017, while using an average of ~$1.8 trillion of bills outstanding.
- The principal on the TIPS securities was accreted to each projection date based on market ZCIS levels as of 09/30/2017.
- No attempt was made to match future financing needs.

Sources of Financing in Fiscal Year 2017 Q4

July - September 2017	
Net Bill Issuance	84
Net Coupon Issuance	105
Subtotal: Net Marketable Borrowing	189
Ending Cash Balance	159
Beginning Cash Balance	181
Subtotal: Change in Cash Balance	(22)
Net Implied Funding for FY 2017 Q4*	211

Security	July - September 2017 Bill Issuance			Fiscal Year-to-Date Bill Issuance		
	Gross	Maturing	Net	Gross	Maturing	Net
4-Week	475	500	(25)	2,318	2,343	(25)
13-Week	513	507	6	1,975	1,964	11
26-Week	435	372	63	1,663	1,564	99
52-Week	60	60	0	260	230	30
CMBs	105	65	40	268	228	40
Bill Subtotal	1,588	1,504	84	6,484	6,329	155

Security	July - September 2017 Coupon Issuance			Fiscal Year-to-Date Coupon Issuance		
	Gross	Maturing	Net	Gross	Maturing	Net
2-Year FRN	43	41	2	173	164	9
2-Year	55	26	29	315	240	75
3-Year	80	81	(1)	313	348	(35)
5-Year	73	96	(23)	413	444	(32)
7-Year	60	60	0	340	351	(11)
10-Year	70	28	42	276	99	177
30-Year	44	11	33	172	45	126
5-Year TIPS	14	0	14	44	48	(3)
10-Year TIPS	25	17	9	76	37	39
30-Year TIPS	0	0	0	19	0	19
Coupon Subtotal	464	359	105	2,140	1,777	364

Total	2,052	1,863	189	8,624	8,105	519

*An end-of-September 2017 cash balance of $159 billion versus a beginning-of-July 2017 cash balance of $181 billion. By keeping the cash balance constant, Treasury arrives at the net implied funding number.
Gross issuance values include SOMA add-ons.

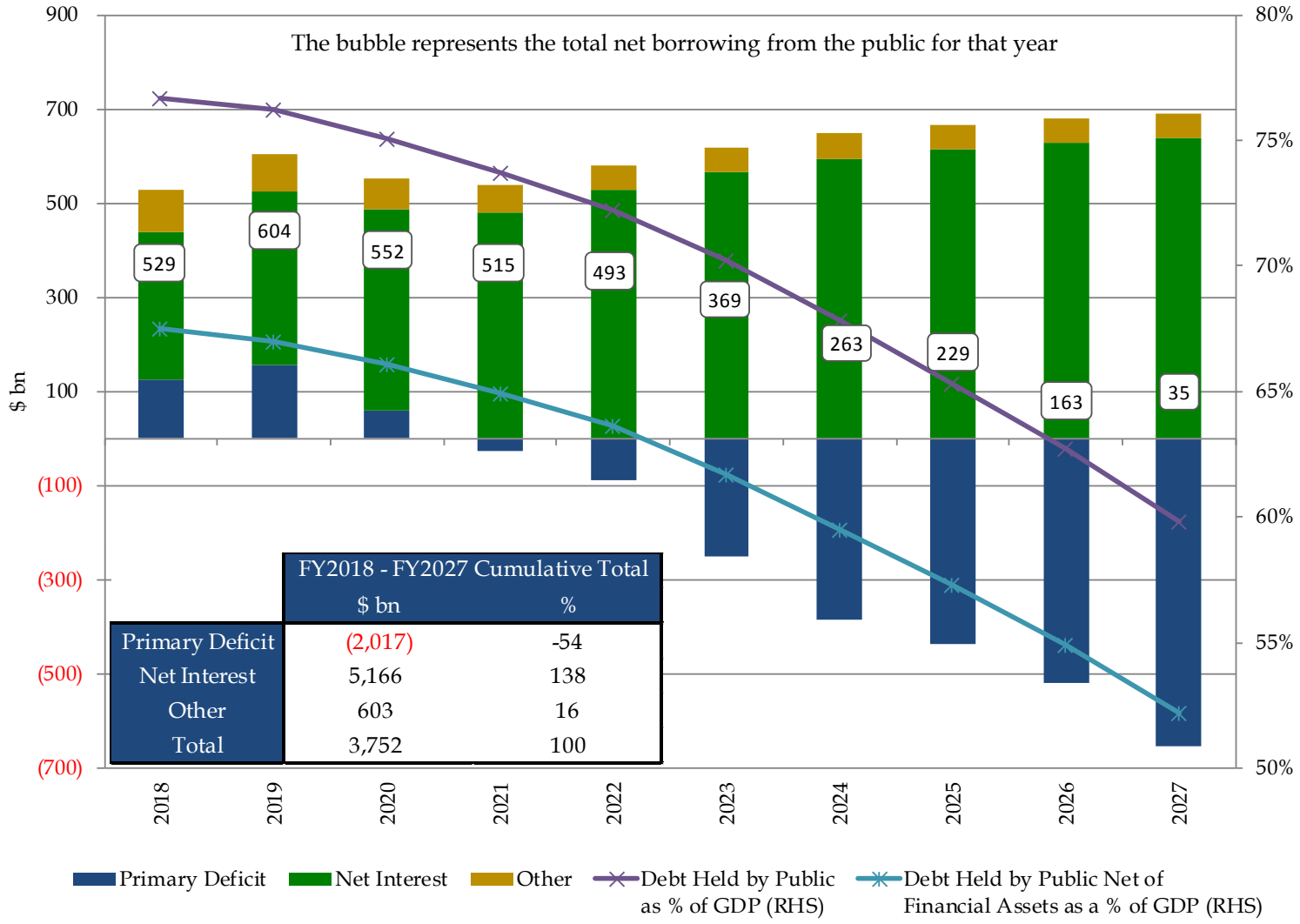
Sources of Financing in Fiscal Year 2018 Q1

October - December 2017	
Assuming Constant Coupon Issuance Sizes*	
Treasury Announced Net Marketable Borrowing**	275
Net Coupon Issuance	128
Implied Change in Bills	147

Security	October - December 2017 Coupon Issuance			Fiscal Year-to-Date Coupon Issuance		
	Gross	Maturing	Net	Gross	Maturing	Net
2-Year FRN	41	41	0	41	41	0
2-Year	78	26	52	78	26	52
3-Year	72	78	(6)	72	78	(6)
5-Year	102	147	(45)	102	147	(45)
7-Year	84	72	12	84	72	12
10-Year	63	17	46	63	17	46
30-Year	39	0	39	39	0	39
5-Year TIPS	14	0	14	14	0	14
10-Year TIPS	11	0	11	11	0	11
30-Year TIPS	5	0	5	5	0	5
Coupon Subtotal	509	381	128	509	381	128

*Keeping announced issuance sizes and patterns constant for nominal coupons, TIPS, and FRNs as of 09/30/2017.
**Assumes an end-of-December 2017 cash balance of $205 billion versus a beginning-of-October 2017 cash balance of $159 billion.
Financing Estimates released by the Treasury can be found here: http://www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Pages/Latest.aspx

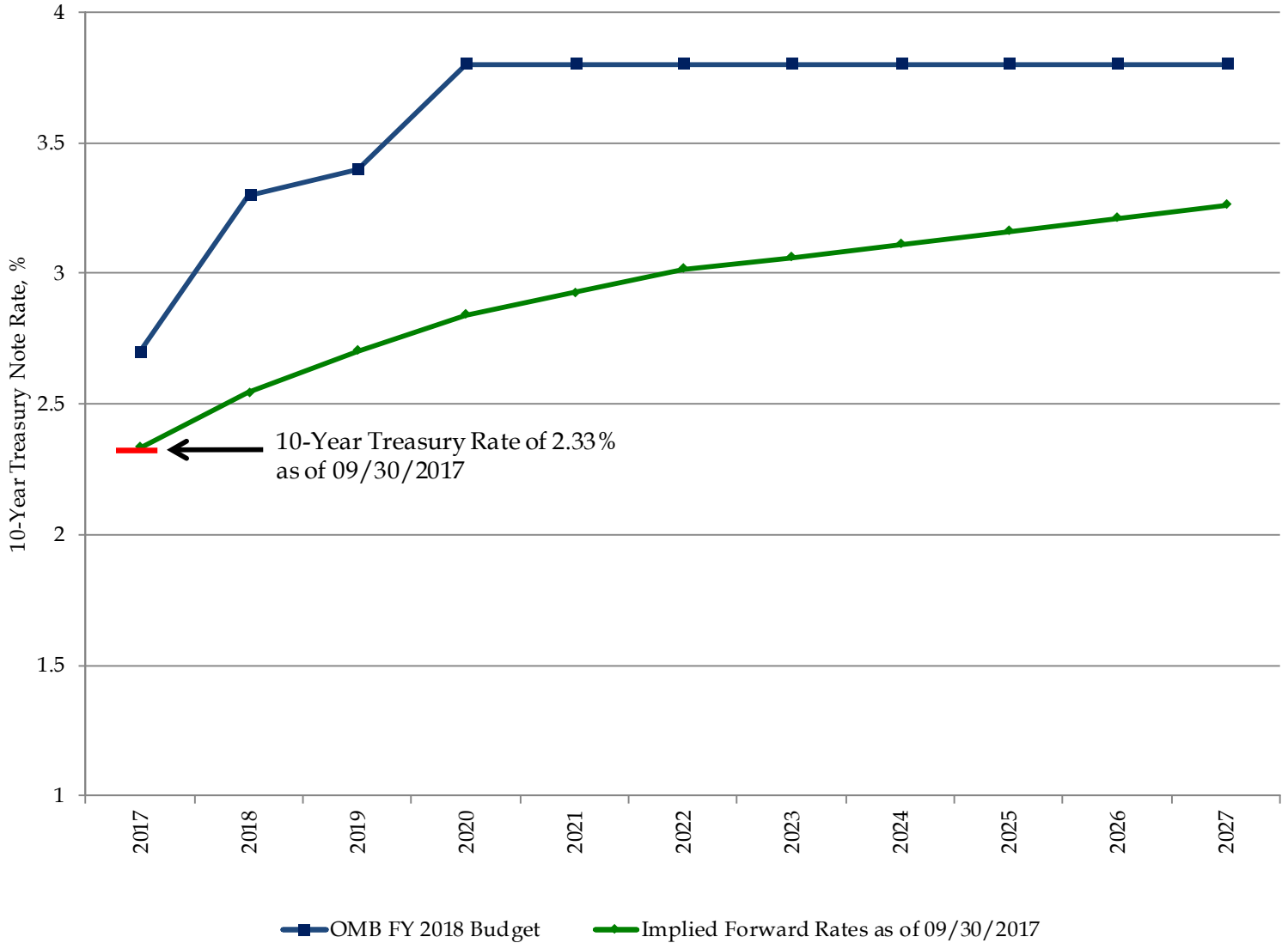
OMB's Projection of Borrowing from the Public



	FY2018 - FY2027 Cumulative Total	
	$ bn	%
Primary Deficit	(2,017)	-54
Net Interest	5,166	138
Other	603	16
Total	3,752	100

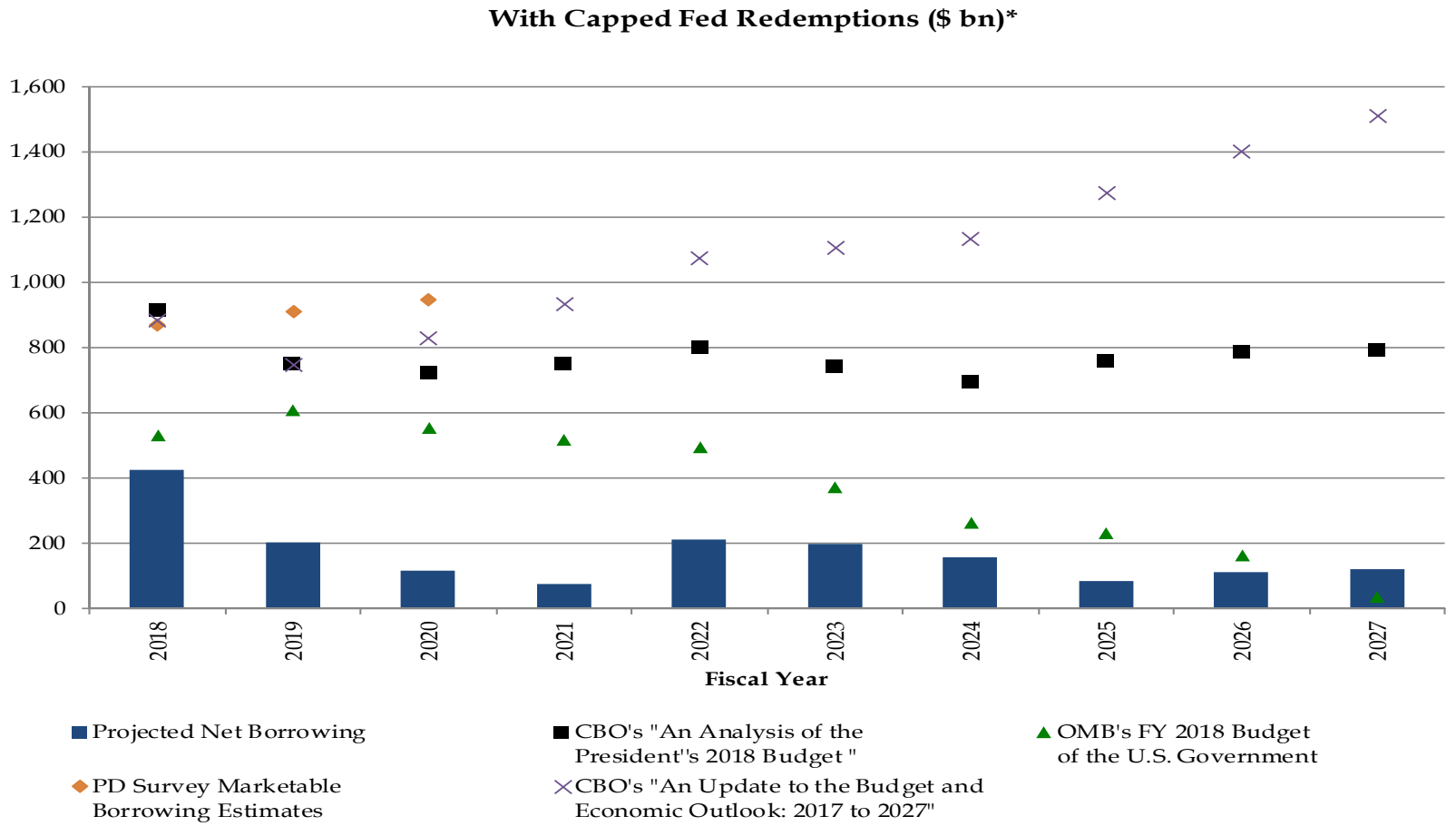
OMB's projections of net borrowing from the public are from Table S-10 of "Budget of the U.S. Government Fiscal Year 2018."
"Other" represents borrowing from the public to provide direct and guaranteed loans.

Interest Rate Assumptions: 10-Year Treasury Note



OMB's economic assumption of the 10-Year Treasury Note rates are from Table S-9 of OMB's "Budget of the United States Government, Fiscal Year 2018." The forward rates are the implied 10-Year Treasury Note rates on September 30 of that year.

Impact of SOMA Actions on Projected Net Borrowing Assuming Future Issuance Remains Constant



Treasury's primary dealer survey estimates can be found on page 11. OMB's projections of net borrowing from the public are from Table S-10 of "Budget of the U.S. Government Fiscal Year 2018." CBO's estimates of the borrowing from the public are from Summary Table 1 of "The Budget and Economic Outlook: 2017 to 2027." CBO's analysis of the President's budget for net public borrowing estimates are from Table 2 of CBO's "An Analysis of the President's 2018 budget." See table at the end of this section for details.

*Reflects capped SOMA Treasury redemptions up until the first quarter of CY 2022.

**For both of FY 2018 CBO projections, the restoration of extraordinary measures used during debt limit impasse artificially adds this amount to "Other means of financing" which shows a larger net borrowing assumption.

Historical Net Marketable Borrowing and Projected Net Borrowing Assuming Future Issuance Remains Constant, $ billions

Fiscal Year	Bills	2/3/5	7/10/30	TIPS	FRN	Historical/Projected Net Borrowing Capacity	OMB's FY 2018 Budget of the U.S. Government	CBO's "An Analysis of the President"s 2018 Budget "	Primary Dealer Survey
2013	(86)	86	720	111	0	830			
2014	(119)	(92)	669	88	123	669			
2015	(53)	(282)	641	88	164	558			
2016	289	(82)	477	64	47	795			
2017	155	9	292	55	9	519			
2018	0	92	276	55	0	423	529	912*	869
2019	0	61	101	46	(6)	201	604	748	906
2020	0	(31)	138	15	(7)	116	552	719	946
2021	0	(53)	134	(4)	(3)	73	515	747	
2022	0	15	205	(11)	2	211	493	797	
2023	0	27	172	(9)	6	196	369	737	
2024	0	12	152	(10)	1	155	263	694	
2025	0	(21)	157	(52)	(1)	83	229	758	
2026	0	(22)	177	(43)	(2)	110	163	782	
2027	0	3	151	(33)	(2)	119	35	787	

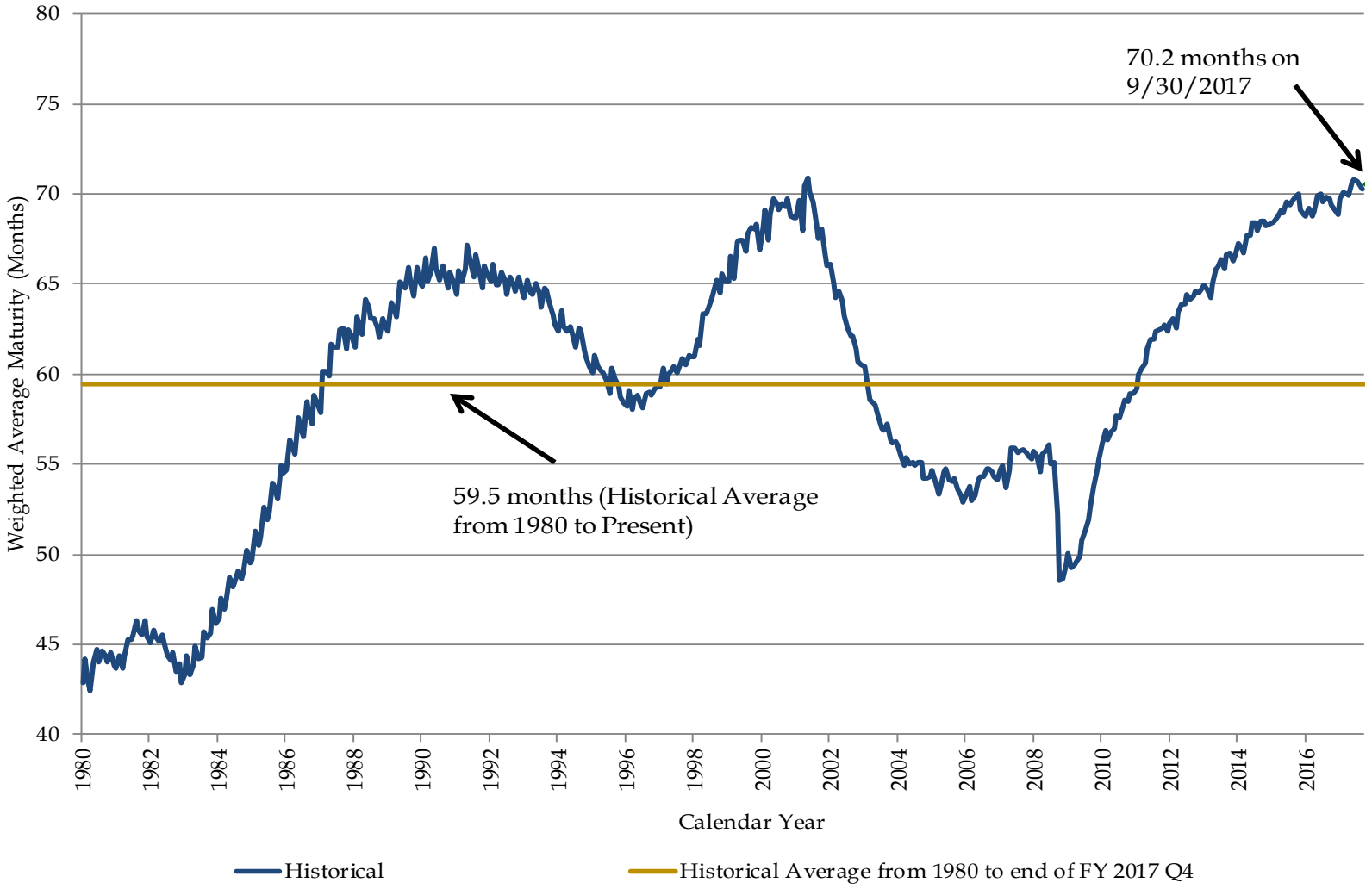
Net Borrowing capacity reflects capped SOMA redemptions up until the first quarter of CY 2022.
Treasury's primary dealer survey estimates can be found on page 11. OMB's projections of net borrowing from the public are from Table S-10 of "Budget of the U.S. Government Fiscal Year 2018." CBO's estimates of the borrowing from the public are from Table 1 of "The Budget and Economic Outlook: 2017 to 2027." CBO's analysis of the President's budget for net public borrowing estimates are from Table 2 of CBO's "An Analysis of the President's 2018 budget."
*For FY 2018, the restoration of extraordinary measures used during debt limit impasse artificially adds this amount to "Other means of financing" which shows a larger net borrowing assumption.

Section IV:
Portfolio Metrics

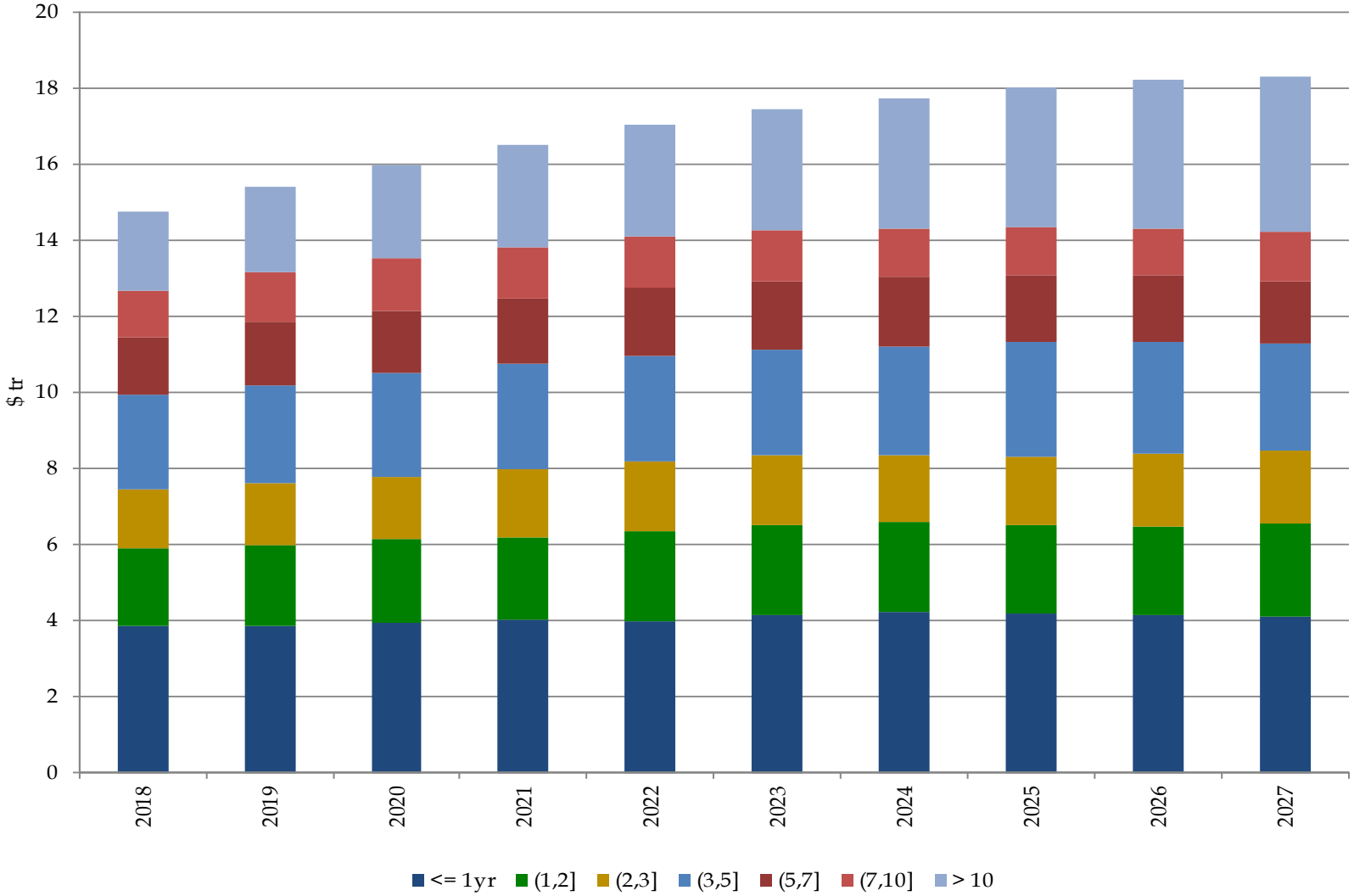
Assumptions for Portfolio Metrics Section (pages 23 to 27) and Appendix

- Portfolio and SOMA holdings as of 09/30/2017.
- Assumes SOMA capped redemptions end date in the first quarter of CY 2022. The assumption is based on the September *FEDS Notes* "Projected Evolution of the SOMA Portfolio and the 10-year Treasury Term Premium Effect."
- Assumes announced issuance sizes and patterns constant for nominal coupons, TIPS, and FRNs as of 09/30/2017, while using an average of ~$1.8 trillion of bills outstanding.
- To match OMB's projected borrowing from the public for the next 10 years, nominal coupon securities (2-, 3-, 5-, 7-, 10-, and 30-year) were adjusted by the same percentage.
- The principal on the TIPS securities was accreted to each projection date based on market ZCIS levels as of 09/30/2017.
- OMB's estimates of borrowing from the public are Table S-10 of the "Budget of the U.S. Government Fiscal Year 2018."

Historical Weighted Average Maturity of Marketable Debt Outstanding



Projected Maturity Profile from end of Fiscal Year



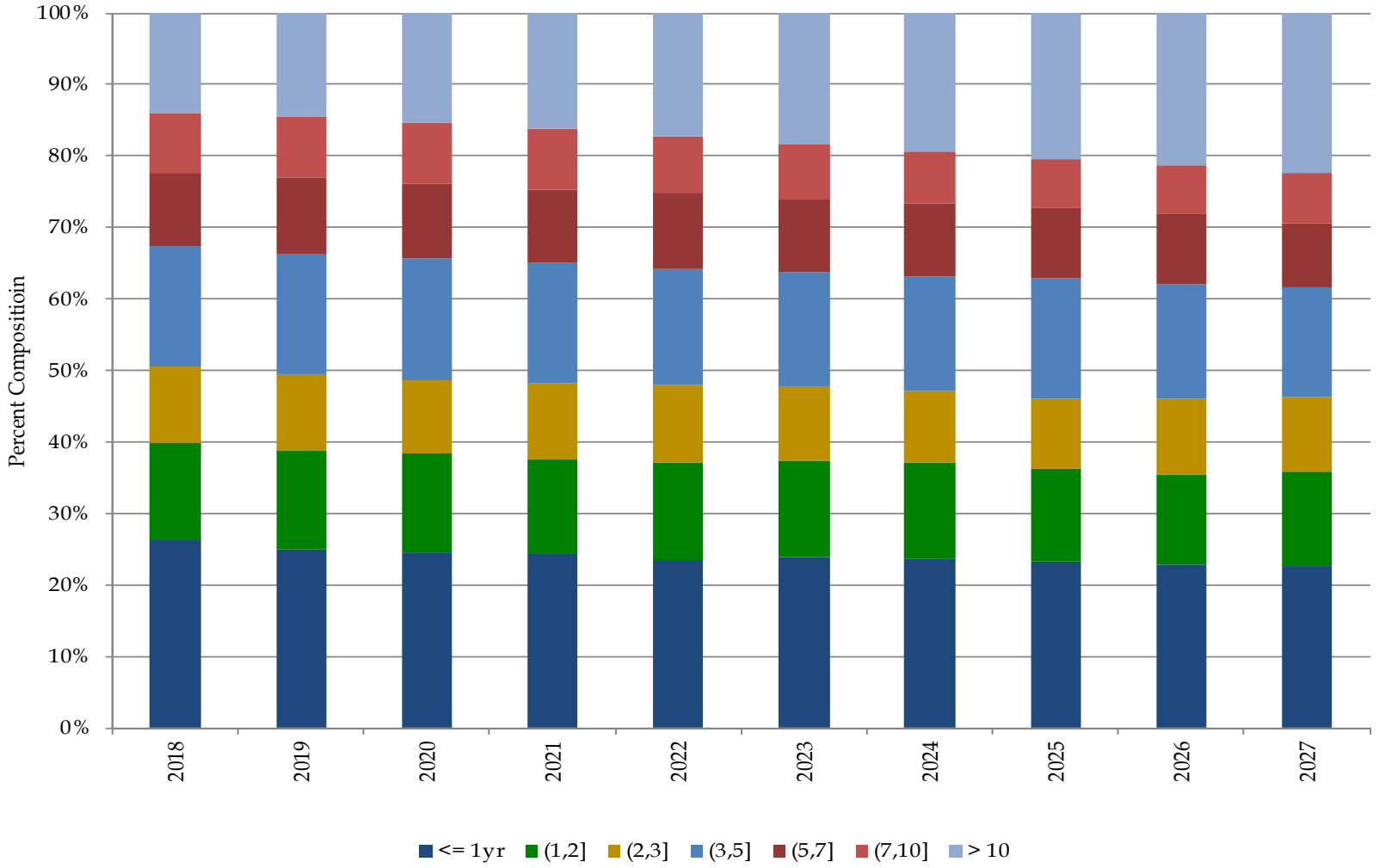
This scenario does not represent any particular course of action that Treasury is expected to follow. See table on following page for details.

Recent and Projected Maturity Profile, $ billions

End of Fiscal Year	<= 1yr	(1,2]	(2,3]	(3,5]	(5,7]	(7,10]	> 10	Total	(0,5]
2010	2,563	1,141	895	1,273	907	856	853	8,488	5,872
2011	2,620	1,334	980	1,541	1,070	1,053	1,017	9,616	6,476
2012	2,951	1,373	1,104	1,811	1,214	1,108	1,181	10,742	7,239
2013	2,939	1,523	1,242	1,965	1,454	1,136	1,331	11,590	7,669
2014	2,935	1,739	1,319	2,207	1,440	1,113	1,528	12,281	8,199
2015	3,097	1,775	1,335	2,382	1,478	1,121	1,654	12,841	8,589
2016	3,423	1,828	1,538	2,406	1,501	1,151	1,800	13,648	9,195
2017	3,631	2,027	1,504	2,433	1,466	1,180	1,946	14,188	9,596
2018	3,862	2,017	1,560	2,484	1,538	1,210	2,072	14,743	9,923
2019	3,853	2,119	1,644	2,581	1,639	1,313	2,229	15,378	10,197
2020	3,924	2,207	1,641	2,727	1,656	1,351	2,455	15,960	10,498
2021	4,012	2,182	1,782	2,776	1,692	1,380	2,682	16,506	10,752
2022	3,987	2,345	1,826	2,791	1,787	1,352	2,945	17,032	10,949
2023	4,150	2,367	1,812	2,777	1,810	1,318	3,202	17,436	11,107
2024	4,205	2,371	1,771	2,864	1,817	1,277	3,430	17,734	11,210
2025	4,177	2,344	1,788	3,007	1,771	1,234	3,679	18,001	11,316
2026	4,150	2,310	1,912	2,931	1,771	1,233	3,894	18,201	11,303
2027	4,117	2,415	1,915	2,833	1,622	1,292	4,080	18,274	11,280

This scenario does not represent any particular course of action that Treasury is expected to follow. Portfolio composition by original issuance type and term can be found in the appendix (Page 44).

Projected Maturity Profile from end of Fiscal Year



This scenario does not represent any particular course of action that Treasury is expected to follow. See table on following page for details.

Recent and Projected Maturity Profile, percent

End of Fiscal Year	<= 1yr	(1,2]	(2,3]	(3,5]	(5,7]	(7,10]	> 10	(0,3]	(0,5]
2010	30.2	13.4	10.5	15.0	10.7	10.1	10.0	54.2	69.2
2011	27.2	13.9	10.2	16.0	11.1	10.9	10.6	51.3	67.3
2012	27.5	12.8	10.3	16.9	11.3	10.3	11.0	50.5	67.4
2013	25.4	13.1	10.7	17.0	12.5	9.8	11.5	49.2	66.2
2014	23.9	14.2	10.7	18.0	11.7	9.1	12.4	48.8	66.8
2015	24.1	13.8	10.4	18.5	11.5	8.7	12.9	48.3	66.9
2016	25.1	13.4	11.3	17.6	11.0	8.4	13.2	49.7	67.4
2017	25.6	14.3	10.6	17.1	10.3	8.3	13.7	50.5	67.6
2018	26.2	13.7	10.6	16.8	10.4	8.2	14.1	50.5	67.3
2019	25.1	13.8	10.7	16.8	10.7	8.5	14.5	49.5	66.3
2020	24.6	13.8	10.3	17.1	10.4	8.5	15.4	48.7	65.8
2021	24.3	13.2	10.8	16.8	10.3	8.4	16.2	48.3	65.1
2022	23.4	13.8	10.7	16.4	10.5	7.9	17.3	47.9	64.3
2023	23.8	13.6	10.4	15.9	10.4	7.6	18.4	47.8	63.7
2024	23.7	13.4	10.0	16.1	10.2	7.2	19.3	47.1	63.2
2025	23.2	13.0	9.9	16.7	9.8	6.9	20.4	46.2	62.9
2026	22.8	12.7	10.5	16.1	9.7	6.8	21.4	46.0	62.1
2027	22.5	13.2	10.5	15.5	8.9	7.1	22.3	46.2	61.7

This scenario does not represent any particular course of action that Treasury is expected to follow. Portfolio composition by original issuance type and term can be found in the appendix (Page 44).

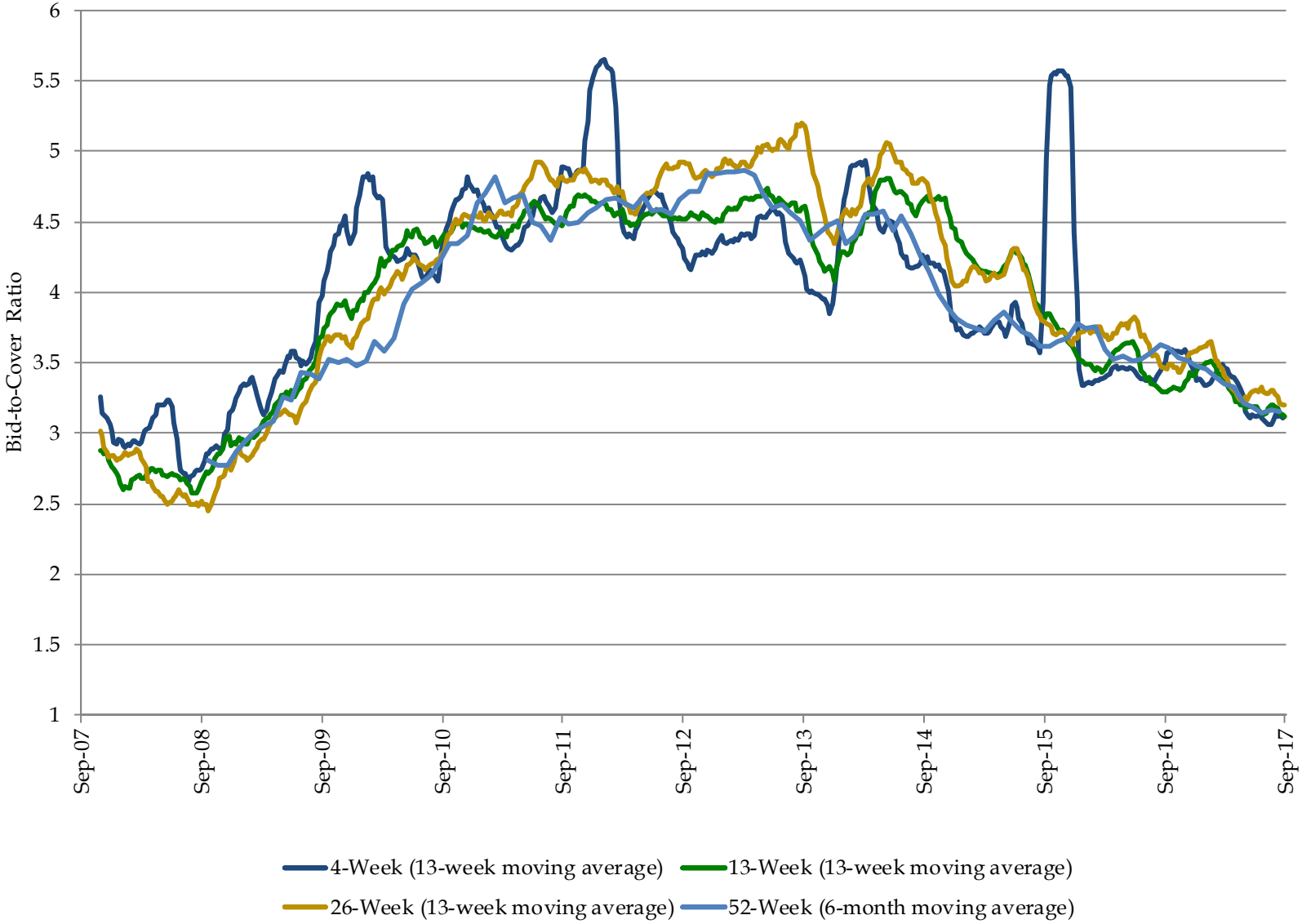
Section V: Demand

Summary Statistics for Fiscal Year 2017 Q4 Auctions

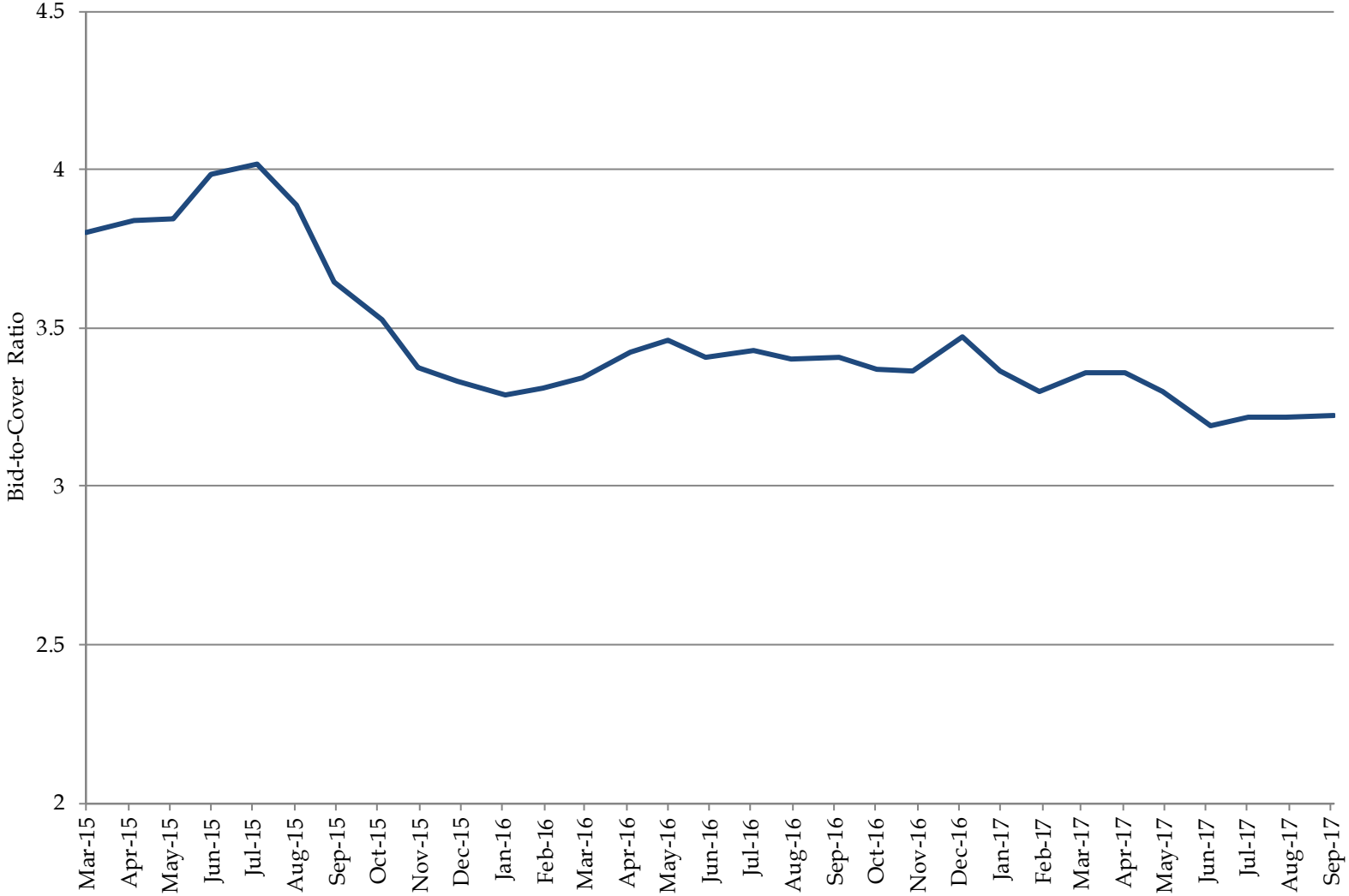
Security Type	Term	Stop Out Rate (%)*	Bid-to-Cover Ratio*	Competitive Awards ($bn)	% Primary Dealer*	% Direct*	% Indirect*	Non-Competitive Awards ($bn)	SOMA Add Ons ($bn)	10-Year Equivalent ($bn)**
Bill	4-Week	0.978	3.1	469.2	61.7	10.3	28.0	5.7	0.0	4.1
Bill	13-Week	1.047	3.1	502.1	52.6	7.3	40.1	7.0	0.0	14.5
Bill	26-Week	1.132	3.2	421.4	46.8	4.2	49.0	5.9	0.0	24.6
Bill	52-Week	1.220	3.2	59.2	55.6	7.0	37.5	0.7	0.0	6.7
Bill	CMB	1.029	3.6	105.0	66.6	5.5	27.8	0.0	0.0	1.7
Coupon	2-Year	1.401	2.9	77.3	34.4	16.2	49.5	0.4	6.7	18.9
Coupon	3-Year	1.509	2.9	71.5	35.6	10.1	54.3	0.2	7.8	26.7
Coupon	5-Year	1.846	2.6	101.8	21.6	8.9	69.5	0.2	8.8	60.0
Coupon	7-Year	2.066	2.6	84.0	15.2	15.7	69.1	0.0	7.2	67.4
Coupon	10-Year	2.252	2.3	63.0	34.5	6.2	59.3	0.0	7.4	71.3
Coupon	30-Year	2.846	2.3	39.0	31.1	6.1	62.8	0.0	4.8	100.8
TIPS	5-Year	0.117	2.4	14.0	22.8	11.6	65.5	0.0	0.4	7.5
TIPS	10-Year	0.471	2.1	24.0	33.9	5.4	60.7	0.0	1.3	28.1
FRN	2-Year	0.058	3.3	41.0	46.7	0.9	52.5	0.0	1.5	0.0
Total Bills		1.054	3.2	1,556.8	54.8	7.2	37.9	19.3	0.0	51.7
Total Coupons		1.902	2.6	436.5	27.6	11.1	61.3	0.9	42.6	345.2
Total TIPS		0.341	2.2	37.9	29.8	7.7	62.5	0.1	1.8	35.5
Total FRN		0.058	3.3	41.0	46.7	0.9	52.5	0.0	1.5	0.0

*Weighted averages of Competitive Awards.
**Approximated using prices at settlement and includes both Competitive and Non-Competitive Awards. For TIPS 10-year equivalent, a constant auction BEI is used as the inflation assumption.

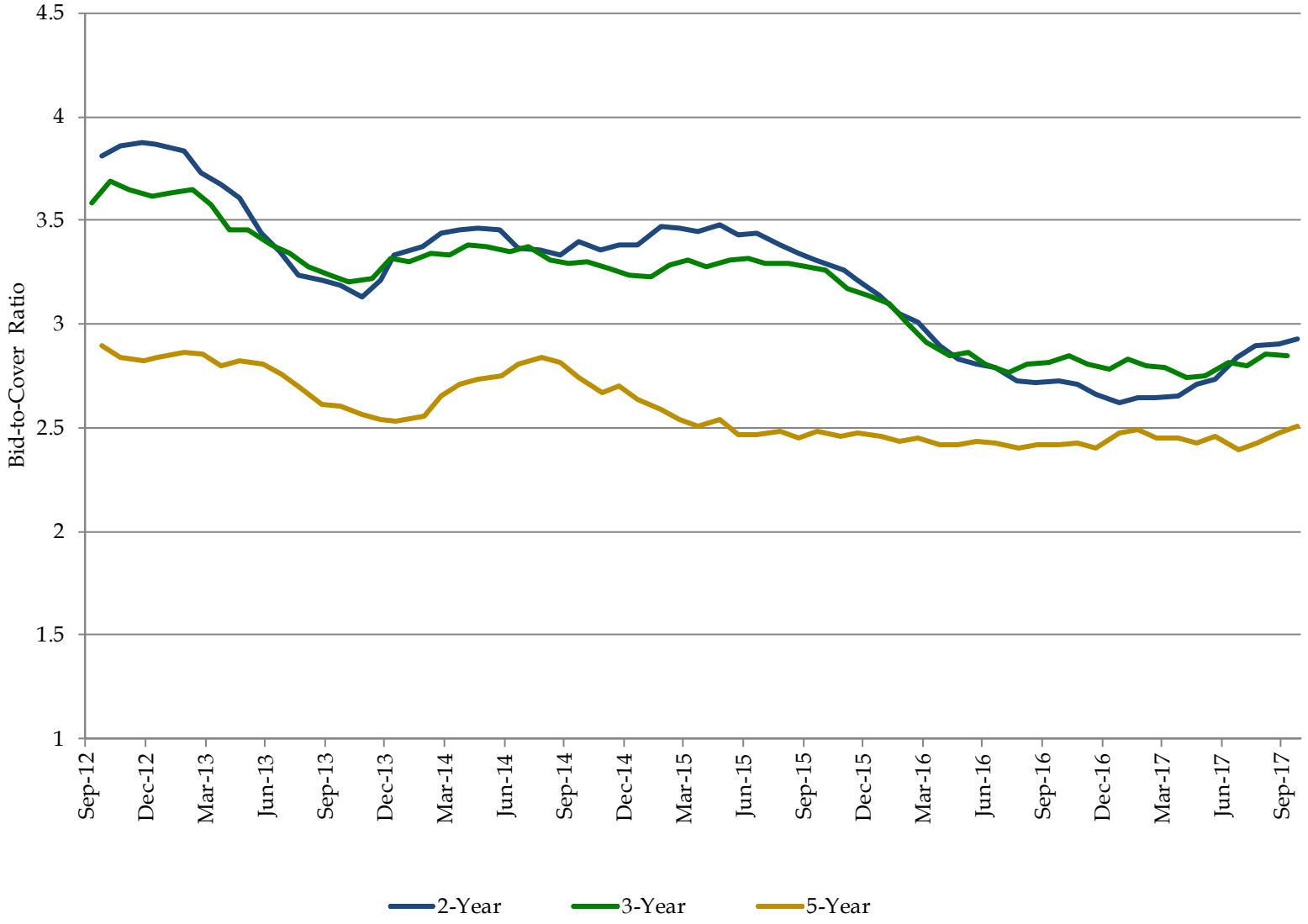
Bid-to-Cover Ratios for Treasury Bills



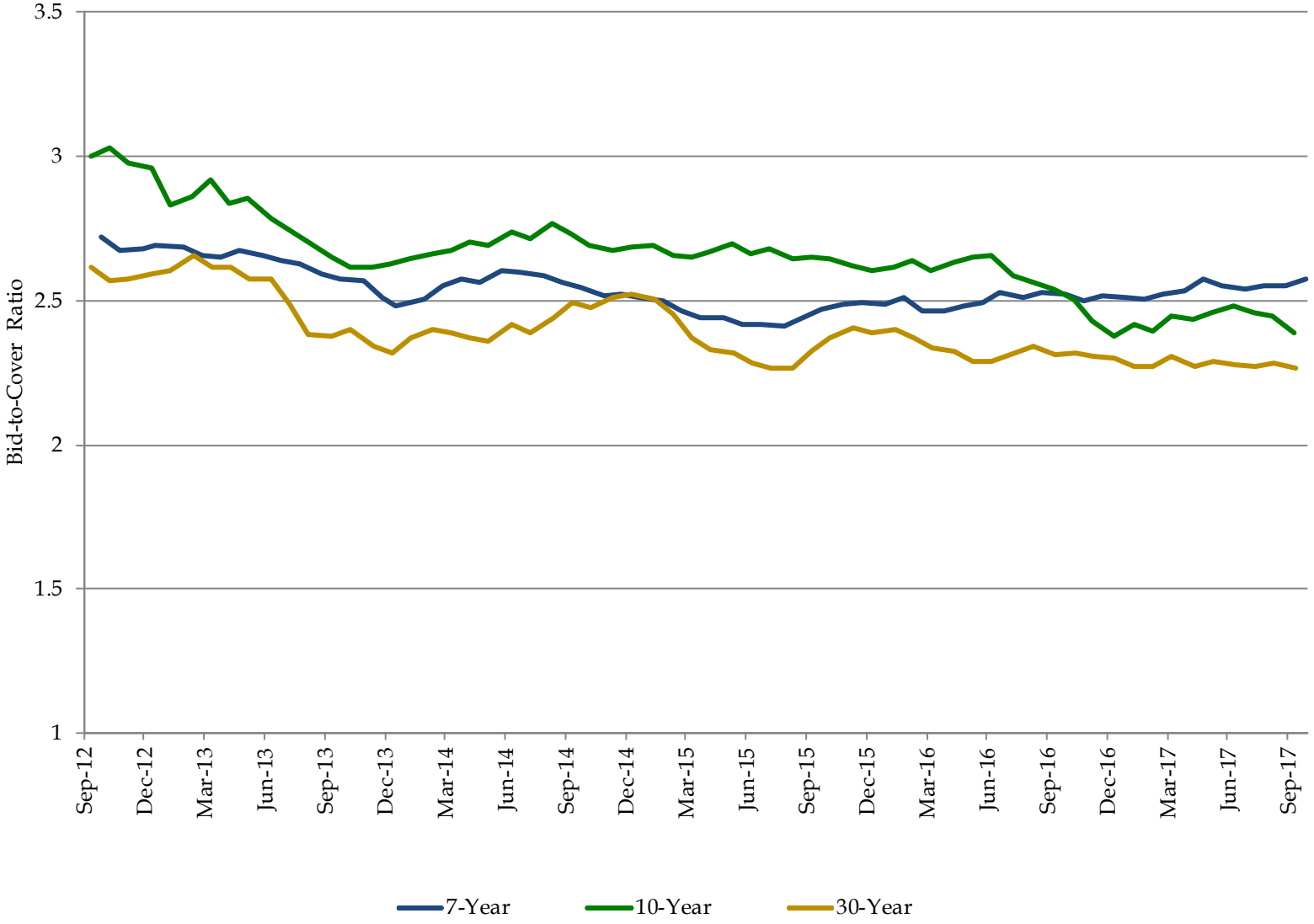
Bid-to-Cover Ratios for FRNs
(6-Month Moving Average)



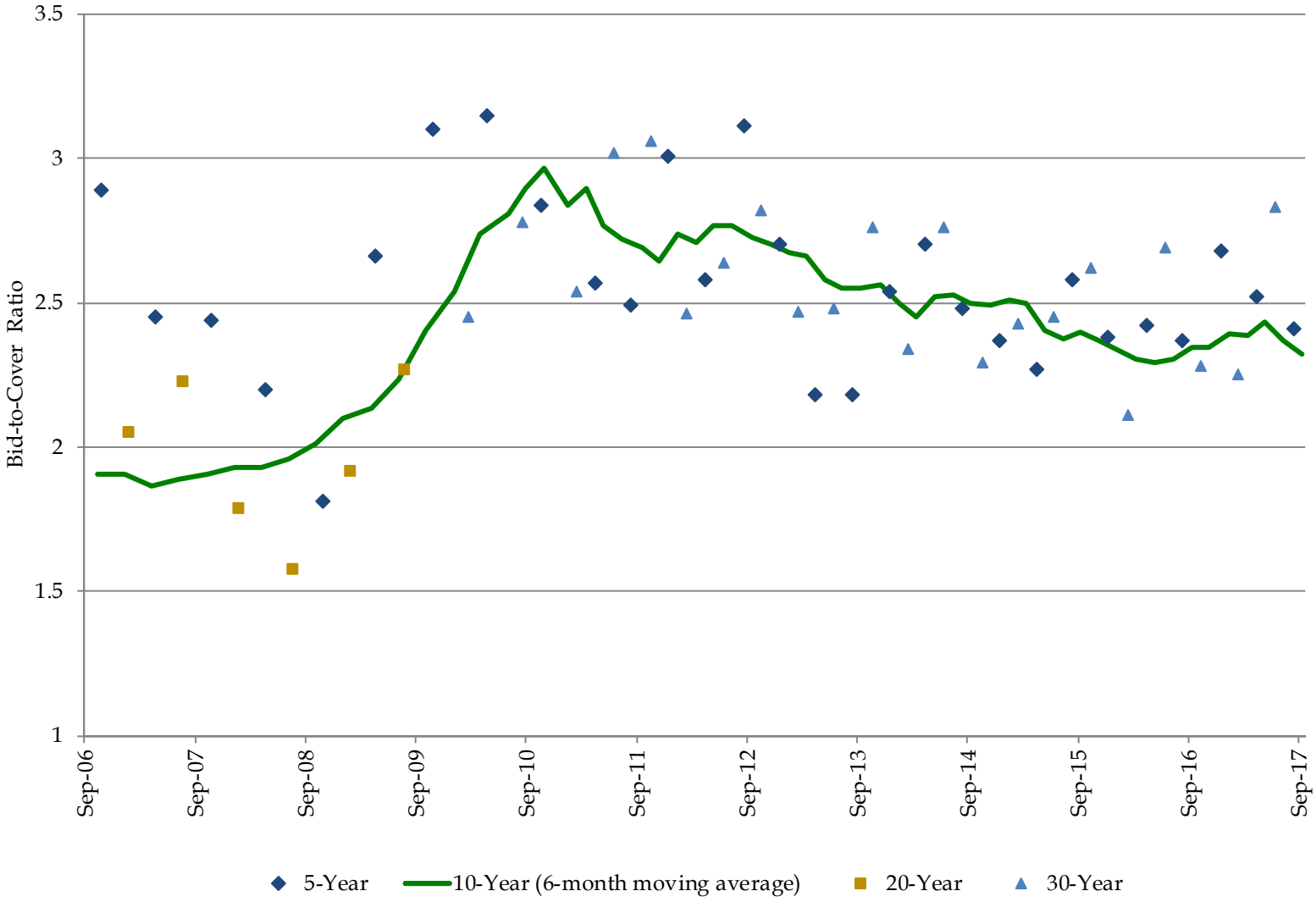
Bid-to-Cover Ratios for 2-, 3-, and 5-Year Nominal Securities (6-Month Moving Average)



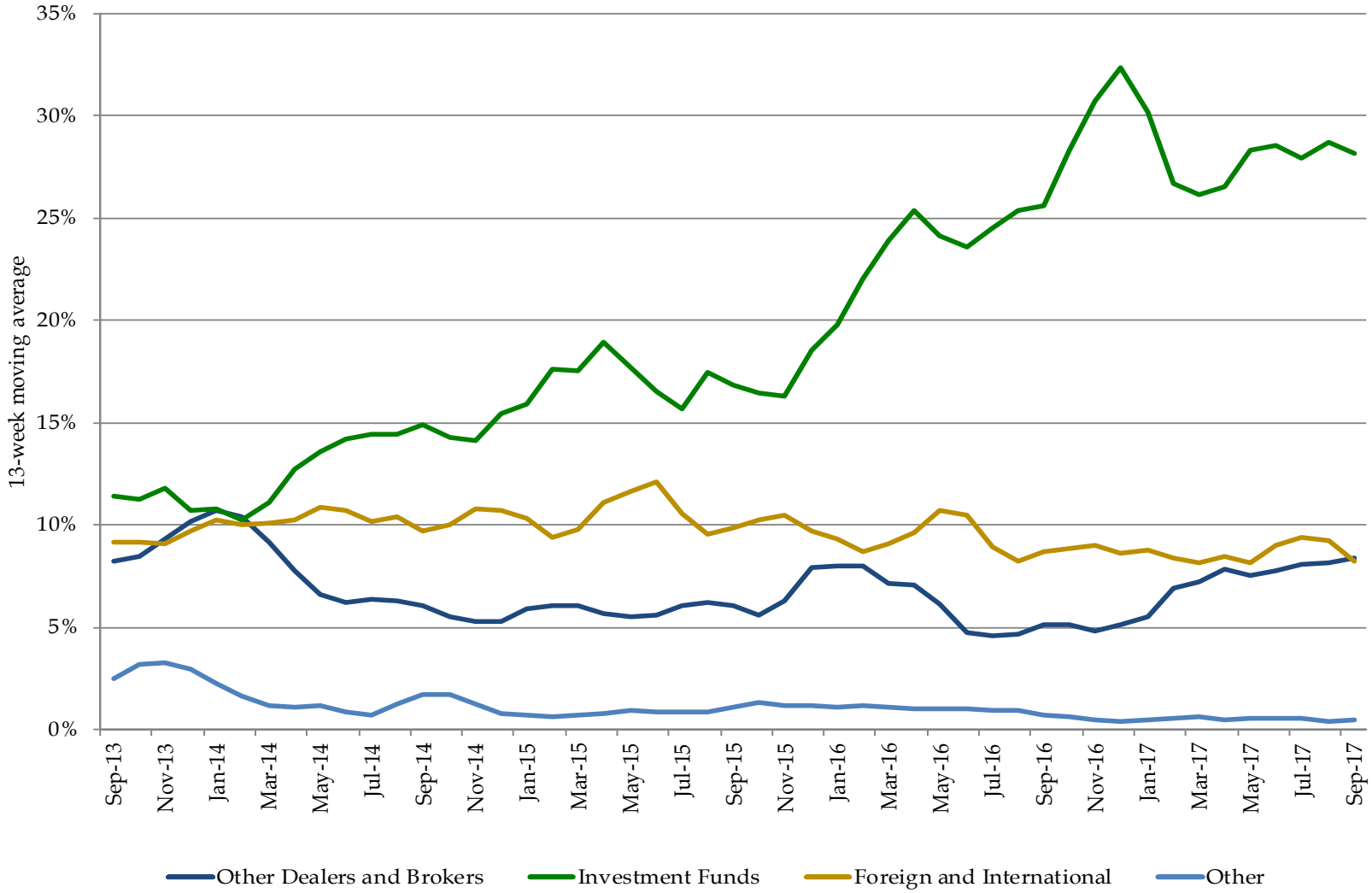
Bid-to-Cover Ratios for 7-, 10-, and 30-Year Nominal Securities (6-Month Moving Average)



Bid-to-Cover Ratios for TIPS

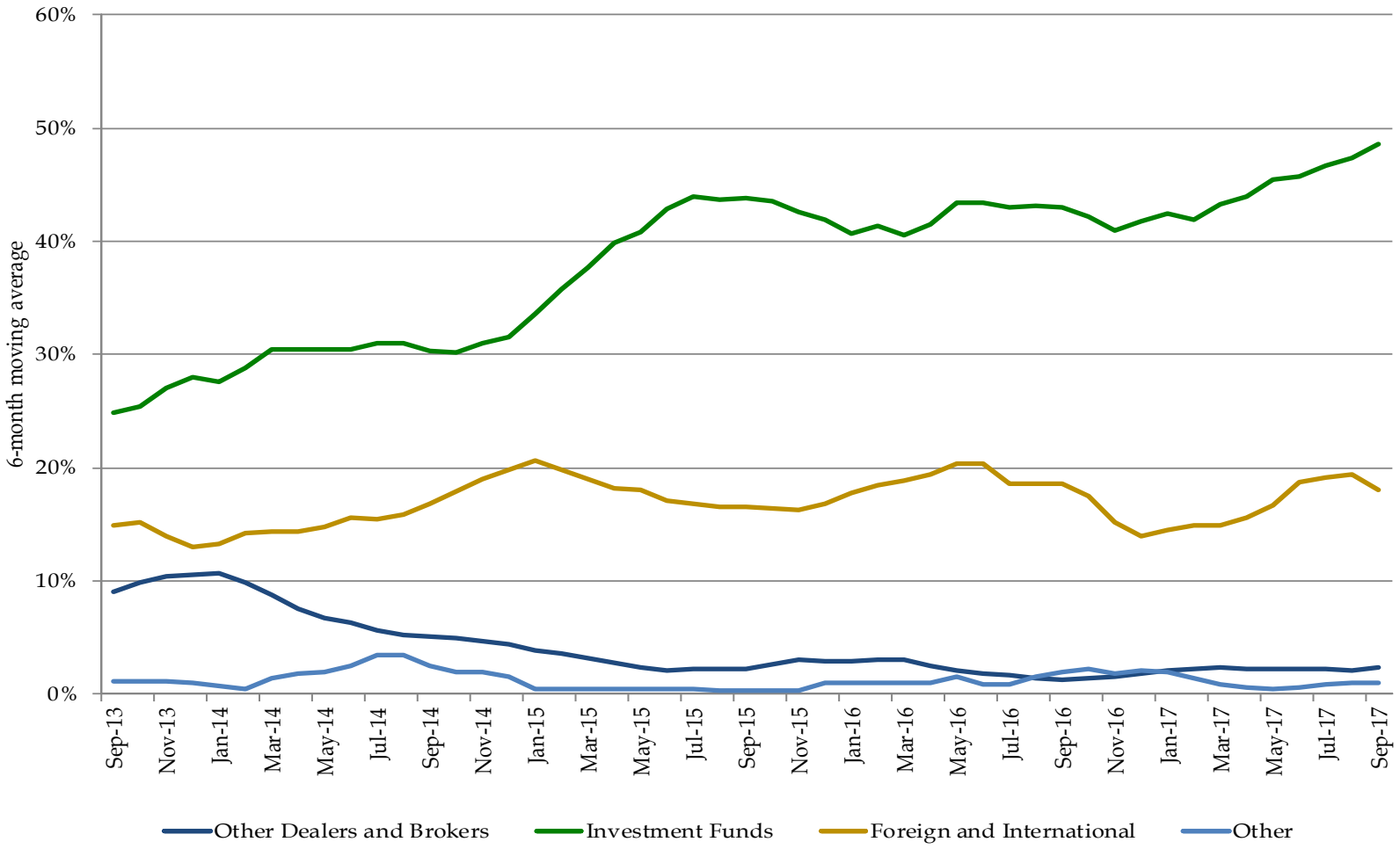


Percent Awarded in Bill Auctions by Investor Class (13-Week Moving Average)



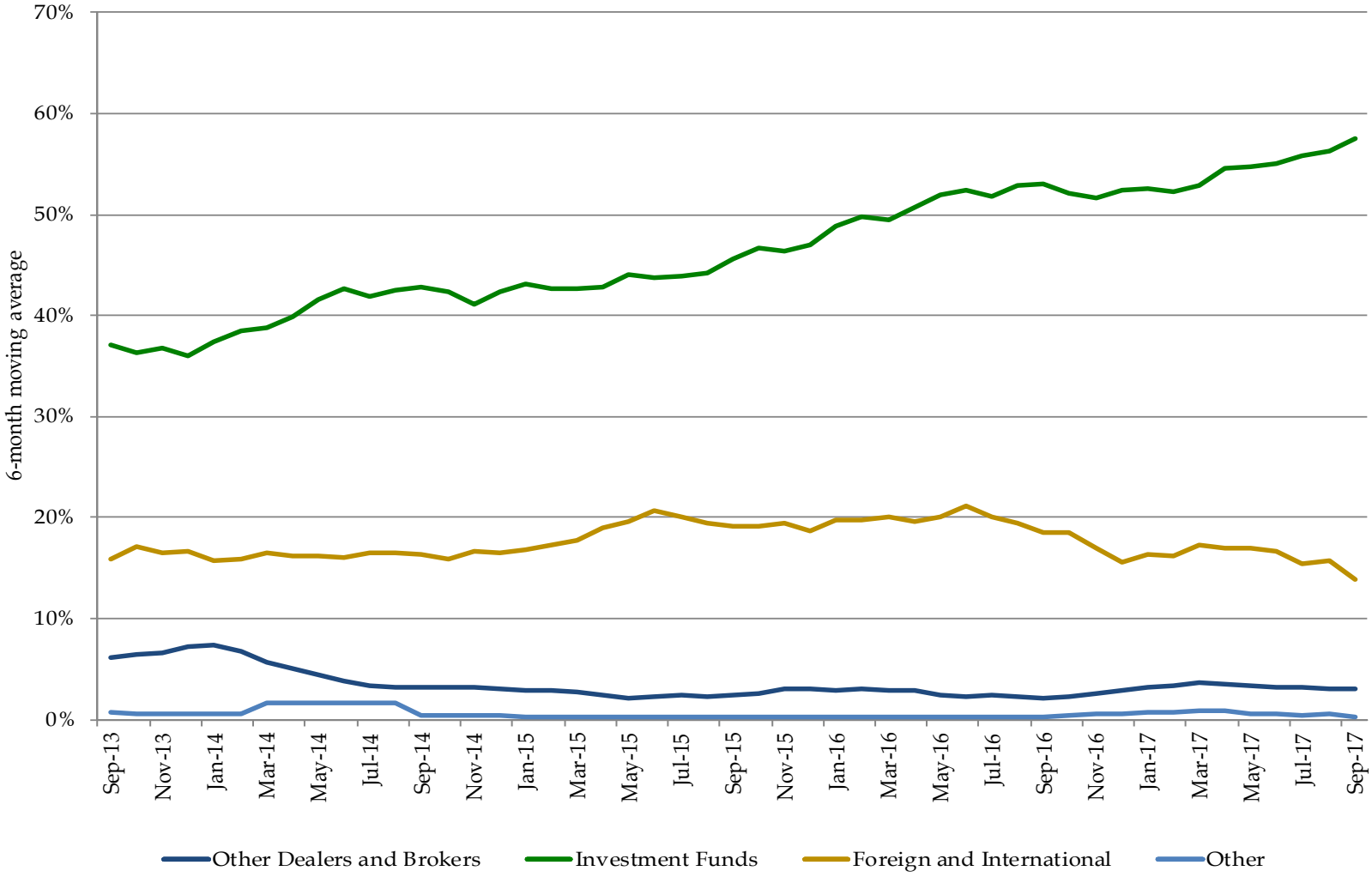
Excludes SOMA add-ons. The "Other" category includes categories that are each less than 5%, which include Depository Institutions, Individuals, Pension and Insurance.

Percent Awarded in 2-, 3-, and 5-Year Nominal Security Auctions by Investor Class (6-Month Moving Average)



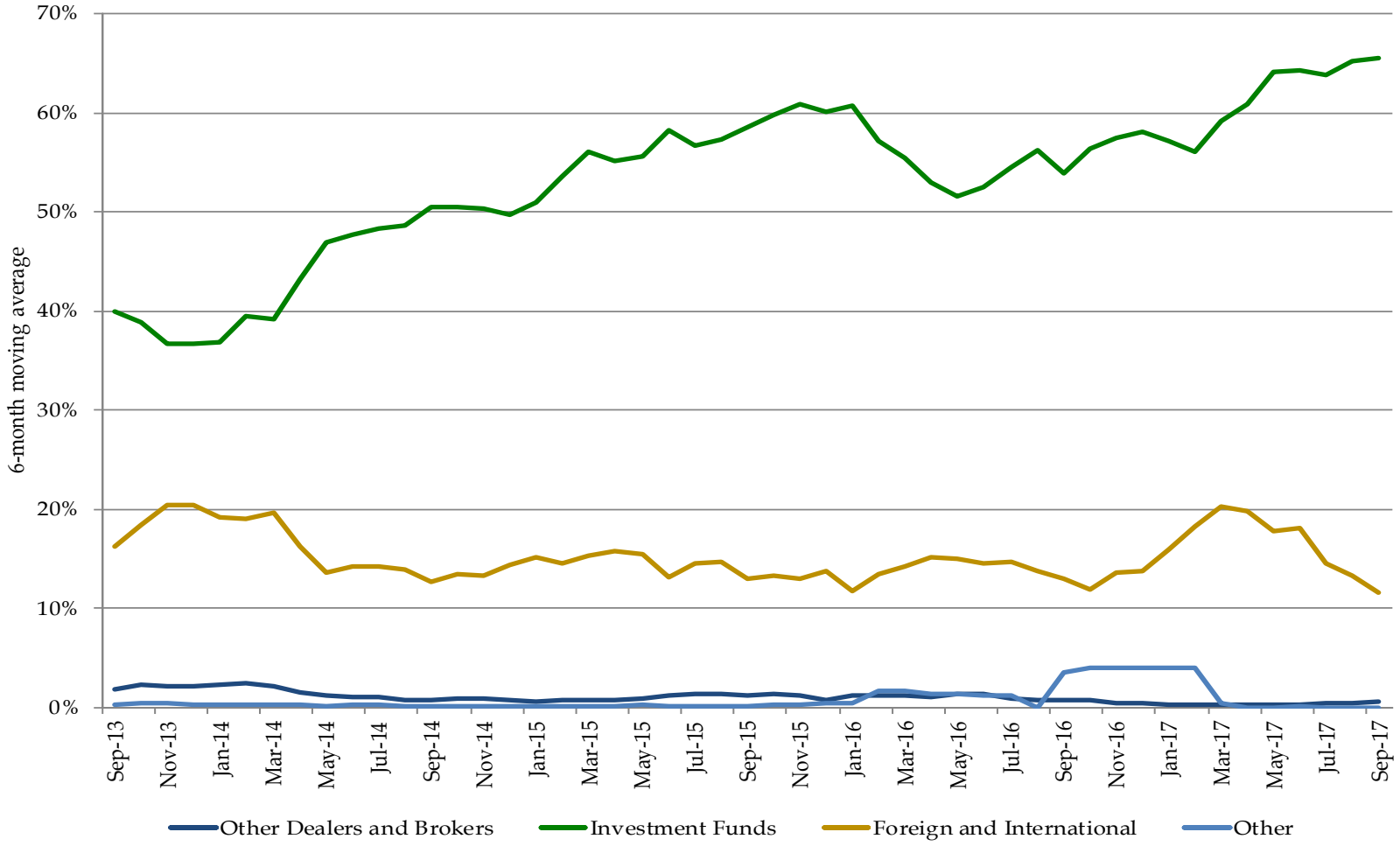
Excludes SOMA add-ons. The "Other" category includes categories that are each less than 5%, which include Depository Institutions, Individuals, Pension and Insurance.

Percent Awarded in 7-, 10-, 30-Year Nominal Security Auctions by Investor Class (6-Month Moving Average)



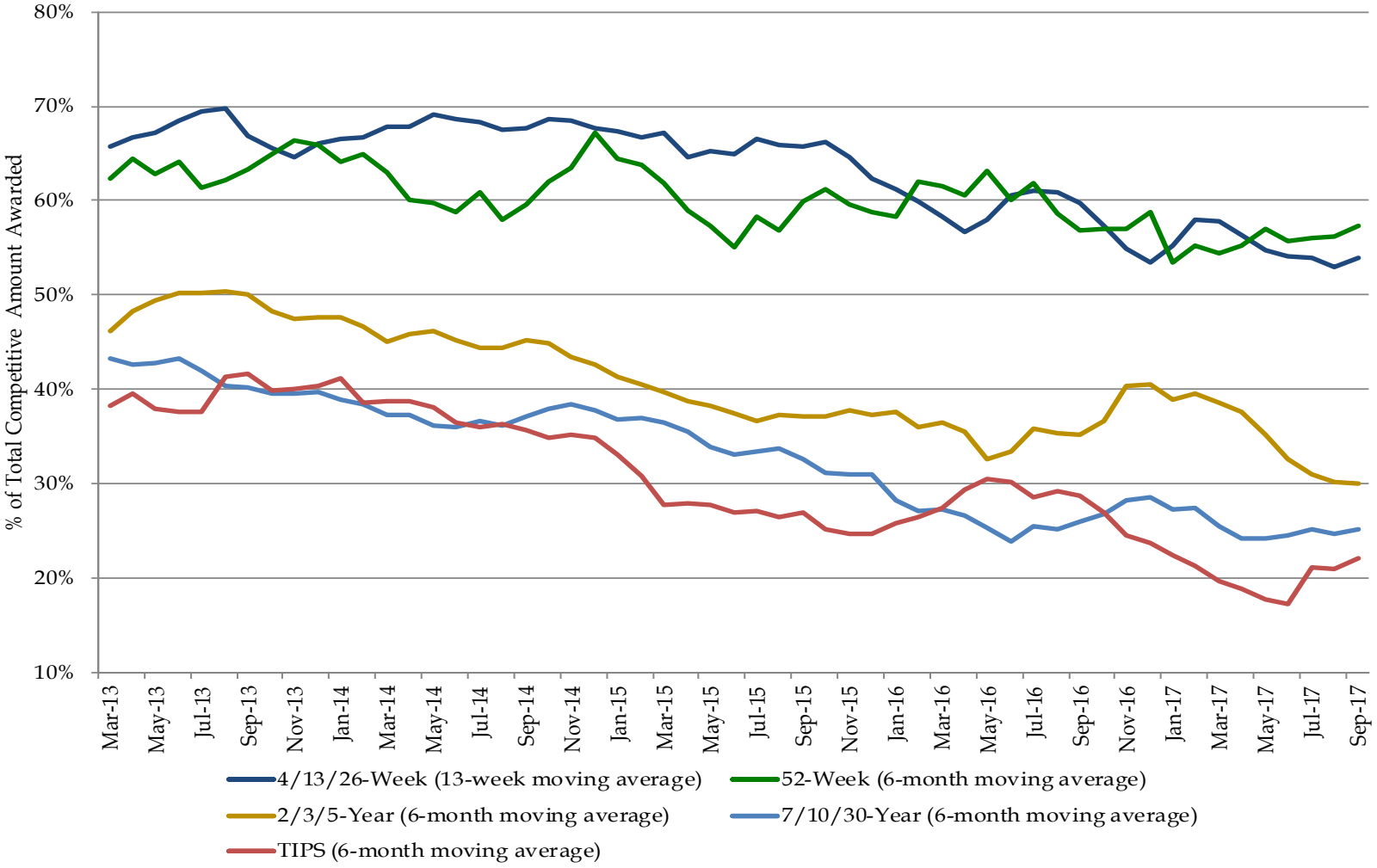
Excludes SOMA add-ons. The "Other" category includes categories that are each less than 5%, which include Depository Institutions, Individuals, Pension and Insurance.

Percent Awarded in TIPS Auctions by Investor Class (6-Month Moving Average)



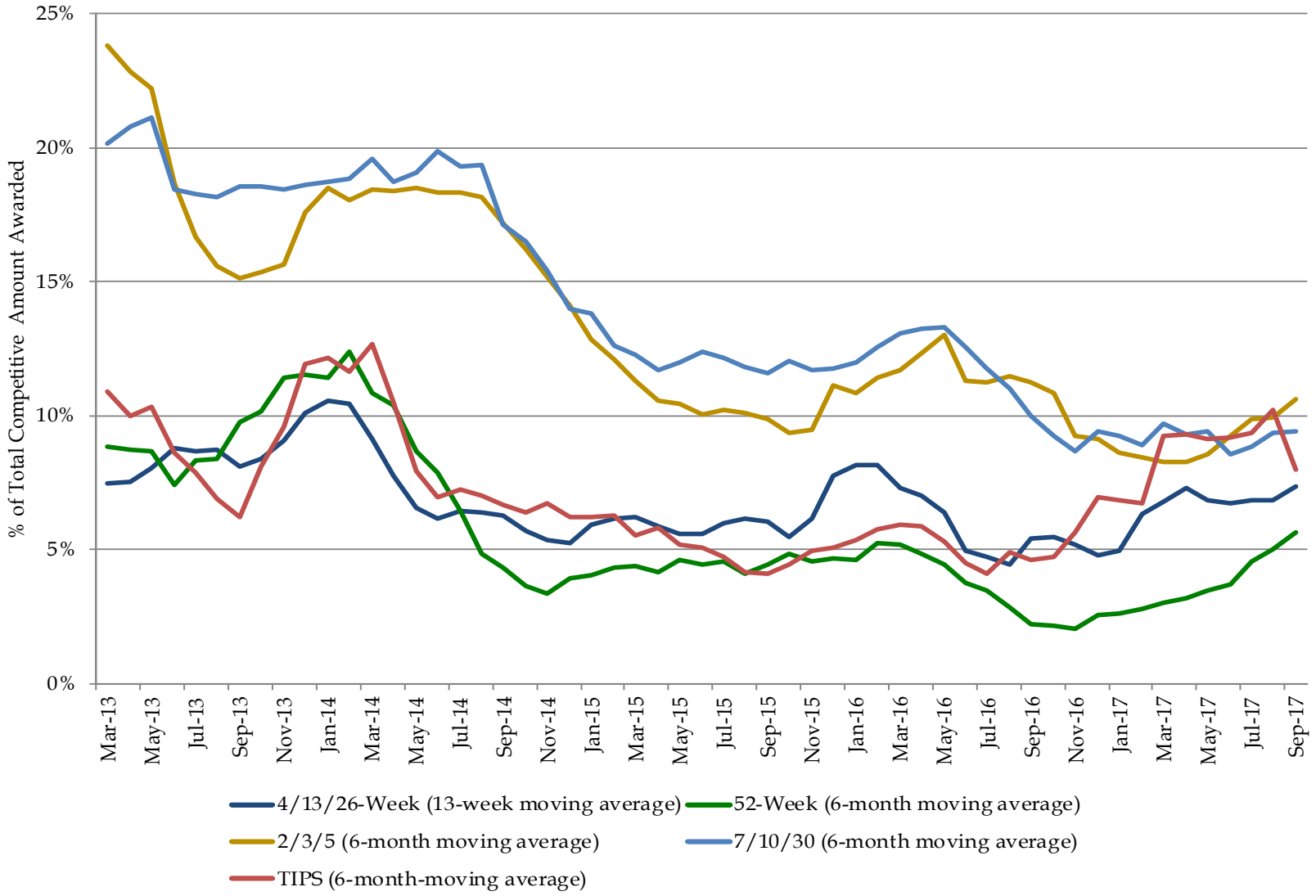
Excludes SOMA add-ons. The "Other" category includes categories that are each less than 5%, which include Depository Institutions, Individuals, Pension and Insurance.

Primary Dealer Awards at Auction



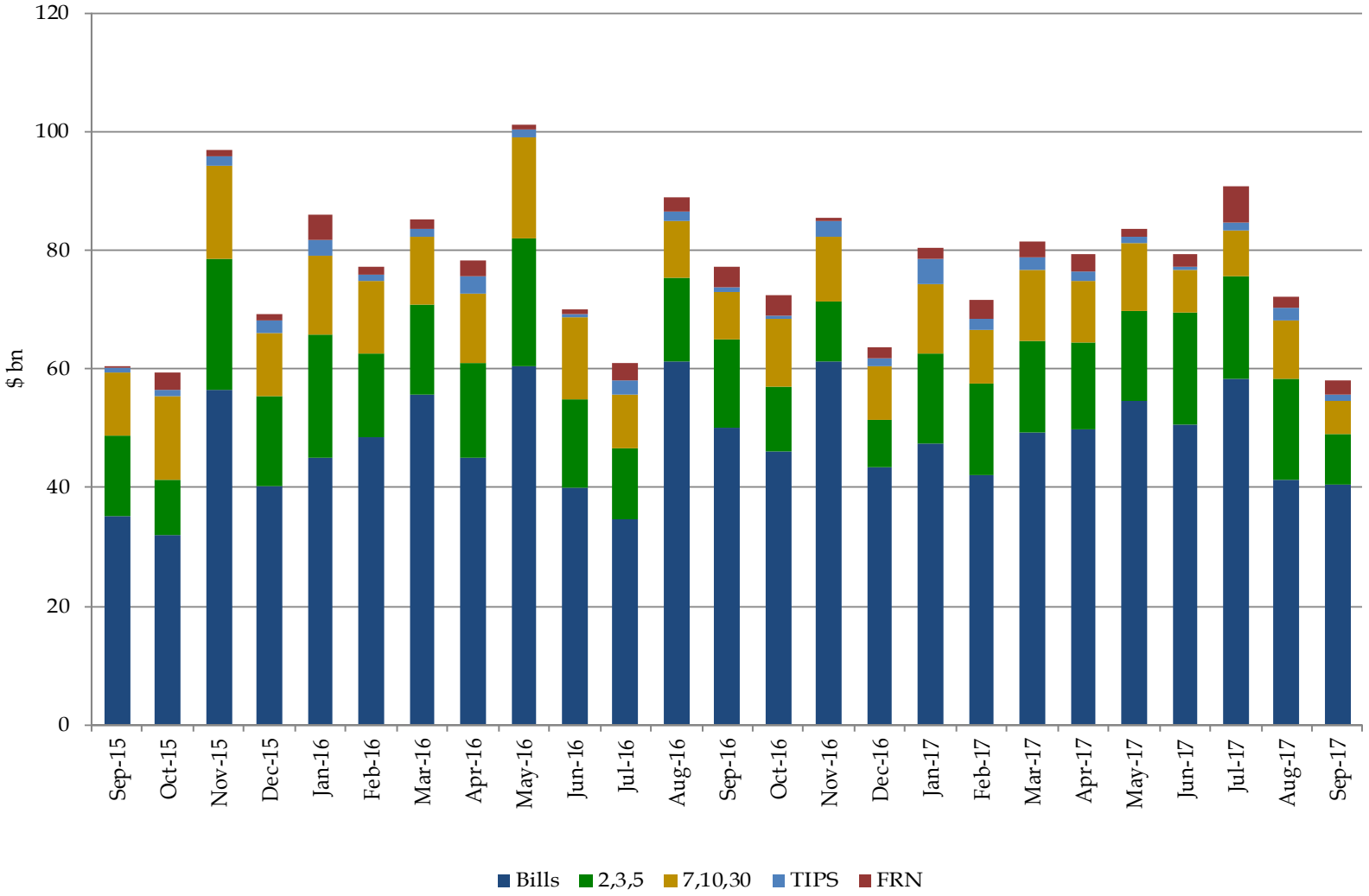
Excludes SOMA add-ons.

Direct Bidder Awards at Auction



Excludes SOMA add-ons.

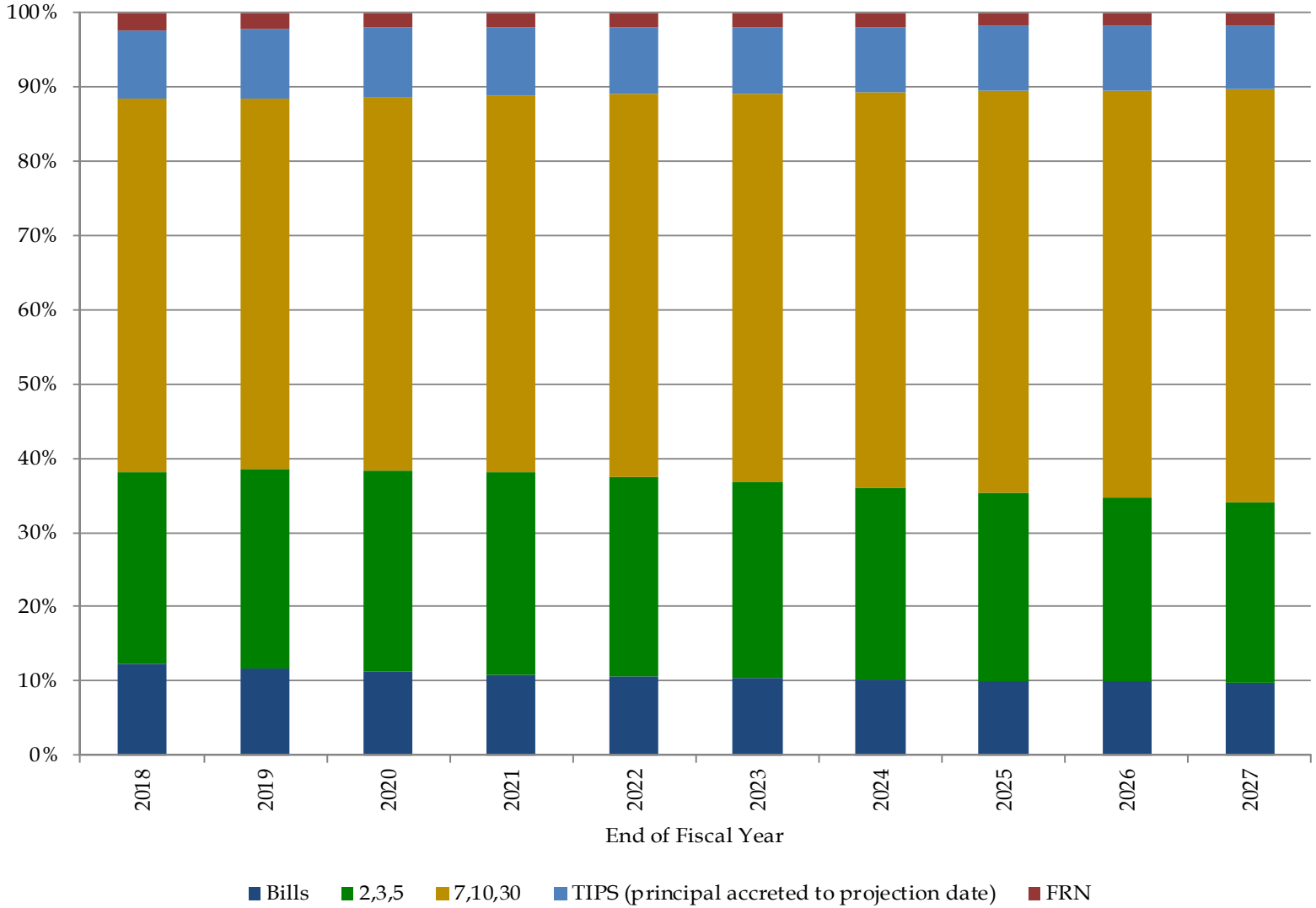
Total Foreign Awards of Treasuries at Auction, $ billions



Foreign includes both private sector and official institutions.

Appendix

Projected Portfolio Composition by Issuance Type



This scenario does not represent any particular course of action that Treasury is expected to follow. See table on following page for details.

Recent and Projected Portfolio Composition by Issuance Type, Percent

End of Fiscal Year	Bills	2-, 3-, 5-Year Nominal Coupons	7-, 10-, 30-Year Nominal Coupons	Total Nominal Coupons	TIPS (principal accreted to projection date)	FRN
2010	21.1	40.1	31.8	71.9	7.0	0.0
2011	15.4	41.4	35.9	77.3	7.3	0.0
2012	15.0	38.4	39.0	77.4	7.5	0.0
2013	13.2	35.8	43.0	78.7	8.1	0.0
2014	11.5	33.0	46.0	79.0	8.5	1.0
2015	10.6	29.4	49.0	78.3	8.8	2.2
2016	12.1	27.0	49.6	76.6	8.9	2.4
2017	12.7	25.9	50.0	75.8	9.1	2.4
2018	12.2	25.9	50.3	76.2	9.3	2.3
2019	11.7	26.7	50.0	76.7	9.4	2.2
2020	11.3	27.0	50.3	77.3	9.3	2.1
2021	10.9	27.1	50.8	77.9	9.2	2.0
2022	10.6	26.9	51.6	78.5	9.0	1.9
2023	10.3	26.5	52.3	78.8	8.9	1.9
2024	10.2	25.9	53.1	79.0	8.9	1.9
2025	10.0	25.3	54.1	79.4	8.7	1.9
2026	9.9	24.7	54.9	79.7	8.6	1.8
2027	9.9	24.1	55.6	79.7	8.6	1.8

This scenario does not represent any particular course of action that Treasury is expected to follow.

Bills										
Issue	Settle Date	Stop Out Rate (%)*	Bid-to-Cover Ratio*	Competitive Awards ($bn)	% Primary Dealer*	% Direct*	% Indirect*	Non-Competitive Awards ($bn)	SOMA Add Ons ($bn)	10-Year Equivalent ($bn)*
4-Week	7/6/2017	0.950	3.02	39.6	65.0	9.1	25.9	0.4	0.0	0.3
4-Week	7/13/2017	0.950	3.15	39.6	58.4	14.2	27.3	0.4	0.0	0.3
4-Week	7/20/2017	0.955	3.06	44.5	54.3	12.2	33.5	0.5	0.0	0.4
4-Week	7/27/2017	0.980	2.95	44.6	67.7	12.0	20.3	0.4	0.0	0.4
4-Week	8/3/2017	0.990	2.90	44.6	66.1	8.4	25.5	0.4	0.0	0.4
4-Week	8/10/2017	0.985	3.06	44.6	53.1	11.0	35.9	0.4	0.0	0.4
4-Week	8/17/2017	0.940	3.02	34.4	61.8	6.2	31.9	0.5	0.0	0.3
4-Week	8/24/2017	0.940	3.06	29.6	74.5	5.3	20.2	0.4	0.0	0.3
4-Week	8/31/2017	0.960	3.43	24.6	70.3	5.9	23.8	0.4	0.0	0.2
4-Week	9/7/2017	1.300	3.04	19.6	58.5	16.9	24.6	0.4	0.0	0.2
4-Week	9/14/2017	0.970	3.49	34.5	52.4	10.3	37.3	0.5	0.0	0.3
4-Week	9/21/2017	0.960	3.18	34.5	61.3	12.9	25.8	0.5	0.0	0.3
4-Week	9/28/2017	0.970	3.18	34.5	62.8	9.2	28.0	0.5	0.0	0.3
13-Week	7/6/2017	1.045	3.21	38.5	42.7	4.2	53.1	0.5	0.0	1.1
13-Week	7/13/2017	1.040	2.87	38.5	59.6	9.0	31.4	0.5	0.0	1.1
13-Week	7/20/2017	1.050	2.94	38.5	63.4	10.4	26.2	0.5	0.0	1.1
13-Week	7/27/2017	1.180	2.87	37.4	55.9	5.6	38.4	0.6	0.0	1.1
13-Week	8/3/2017	1.070	3.18	38.4	44.9	11.9	43.2	0.5	0.0	1.1
13-Week	8/10/2017	1.040	3.62	37.6	31.3	6.1	62.6	0.5	0.0	1.1
13-Week	8/17/2017	1.015	3.52	38.3	39.2	4.8	56.0	0.6	0.0	1.1
13-Week	8/24/2017	1.000	3.11	38.4	51.5	6.4	42.0	0.5	0.0	1.1
13-Week	8/31/2017	1.020	3.03	38.3	60.7	5.7	33.6	0.5	0.0	1.1
13-Week	9/7/2017	1.020	3.18	38.5	59.0	6.1	34.9	0.5	0.0	1.1
13-Week	9/14/2017	1.035	3.03	38.2	46.0	7.6	46.3	0.5	0.0	1.1
13-Week	9/21/2017	1.045	3.05	41.1	55.6	8.9	35.6	0.6	0.0	1.2
13-Week	9/28/2017	1.050	2.89	40.4	72.2	8.1	19.7	0.6	0.0	1.2
26-Week	7/6/2017	1.130	3.21	32.2	52.6	3.1	44.3	0.5	0.0	1.9
26-Week	7/13/2017	1.125	3.20	32.2	45.3	8.3	46.4	0.5	0.0	1.9
26-Week	7/20/2017	1.105	3.54	32.0	32.4	2.5	65.1	0.6	0.0	1.9
26-Week	7/27/2017	1.130	2.91	31.5	56.6	2.7	40.7	0.5	0.0	1.9
26-Week	8/3/2017	1.130	3.08	32.3	48.6	3.4	48.0	0.4	0.0	1.9
26-Week	8/10/2017	1.140	3.05	32.0	58.2	6.7	35.1	0.5	0.0	1.9
26-Week	8/17/2017	1.115	3.47	31.8	38.6	5.3	56.1	0.5	0.0	1.9
26-Week	8/24/2017	1.115	3.02	31.8	48.3	4.1	47.6	0.4	0.0	1.8
26-Week	8/31/2017	1.115	3.41	31.6	39.3	3.1	57.7	0.4	0.0	1.9
26-Week	9/7/2017	1.115	3.08	31.9	60.2	4.7	35.1	0.4	0.0	1.9
26-Week	9/14/2017	1.140	3.12	32.2	44.3	2.9	52.7	0.4	0.0	1.9
26-Week	9/21/2017	1.180	3.21	35.0	44.8	3.8	51.3	0.5	0.0	2.0
26-Week	9/28/2017	1.170	3.34	34.8	39.5	4.1	56.4	0.4	0.0	2.0
52-Week	7/20/2017	1.190	3.17	19.7	49.0	8.0	43.0	0.3	0.0	2.3
52-Week	8/17/2017	1.230	3.25	19.7	61.5	6.0	32.4	0.2	0.0	2.2
52-Week	9/14/2017	1.240	3.16	19.8	56.2	6.9	37.0	0.2	0.0	2.2
CMB	8/1/2017	1.010	3.94	20.0	74.1	12.0	13.9	0.0	0.0	0.1
CMB	9/1/2017	1.060	3.04	40.0	69.2	6.4	24.3	0.0	0.0	1.5
CMB	9/7/2017	1.010	3.54	25.0	50.8	2.2	47.0	0.0	0.0	0.1
CMB	9/8/2017	1.010	4.28	20.0	73.8	1.5	24.7	0.0	0.0	0.0

*Weighted averages of competitive awards.
**Approximated using prices at settlement and includes both competitive and non-competitive awards.

Nominal Coupons										
Issue	Settle Date	Stop Out Rate (%)*	Bid-to-Cover Ratio*	Competitive Awards ($bn)	% Primary Dealer*	% Direct*	% Indirect*	Non-Competitive Awards ($bn)	SOMA Add Ons ($bn)	10-Year Equivalent ($bn)*
2-Year	7/31/2017	1.395	3.06	25.7	24.6	16.9	58.5	0.2	2.6	6.5
2-Year	8/31/2017	1.345	2.86	25.8	41.6	12.6	45.8	0.1	0.8	5.9
2-Year	10/2/2017	1.462	2.88	25.8	36.8	19.0	44.2	0.1	3.2	6.5
3-Year	7/17/2017	1.573	2.87	23.8	37.6	9.9	52.6	0.1	0.5	8.2
3-Year	8/15/2017	1.520	3.13	23.8	25.8	10.2	64.1	0.0	7.2	10.6
3-Year	9/15/2017	1.433	2.70	23.9	43.4	10.4	46.2	0.0	0.0	7.9
5-Year	7/31/2017	1.884	2.58	34.0	24.1	6.2	69.8	0.0	3.5	20.5
5-Year	8/31/2017	1.742	2.58	33.9	17.5	13.5	69.1	0.1	1.1	18.9
5-Year	10/2/2017	1.911	2.52	33.9	23.3	7.1	69.6	0.1	4.2	20.6
7-Year	7/31/2017	2.126	2.54	28.0	20.6	11.6	67.7	0.0	2.8	23.0
7-Year	8/31/2017	1.941	2.46	28.0	14.6	16.6	68.8	0.0	0.9	21.2
7-Year	10/2/2017	2.130	2.70	28.0	10.4	19.0	70.6	0.0	3.5	23.2
10-Year	7/17/2017	2.325	2.45	20.0	29.5	5.7	64.8	0.0	0.5	20.4
10-Year	8/15/2017	2.250	2.23	23.0	35.3	6.8	57.9	0.0	6.9	30.9
10-Year	9/15/2017	2.180	2.28	20.0	38.7	6.0	55.3	0.0	0.0	20.0
30-Year	7/17/2017	2.936	2.31	12.0	31.9	6.4	61.7	0.0	0.3	27.7
30-Year	8/15/2017	2.818	2.32	15.0	27.8	5.4	66.8	0.0	4.5	45.8
30-Year	9/15/2017	2.790	2.21	12.0	34.4	6.8	58.8	0.0	0.0	27.4
2-Year FRN	7/31/2017	0.060	3.32	15.0	38.7	2.0	59.2	0.0	1.5	0.0
2-Year FRN	8/25/2017	0.060	3.09	13.0	49.6	0.4	50.1	0.0	0.0	0.0
2-Year FRN	9/29/2017	0.055	3.46	13.0	52.9	0.0	47.1	0.0	0.0	0.0

TIPS										
Issue	Settle Date	Stop Out Rate (%)*	Bid-to-Cover Ratio*	Competitive Awards ($bn)	% Primary Dealer*	% Direct*	% Indirect*	Non-Competitive Awards ($bn)	SOMA Add Ons ($bn)	10-Year Equivalent ($bn)*
5-Year TIPS	8/31/2017	0.117	2.41	14.0	22.8	11.6	65.5	0.0	0.4	7.5
10-Year TIPS	7/31/2017	0.489	1.98	13.0	39.5	8.0	52.5	0.0	1.3	16.1
10-Year TIPS	9/29/2017	0.450	2.32	11.0	27.3	2.3	70.4	0.0	0.0	12.0

*Weighted averages of competitive awards.
**Approximated using prices at settlement and includes both competitive and non-competitive awards. For TIPS' 10-Year equivalent, a constant auction BEI is used as the inflation assumption.

Office of Debt Management

Floating Rate Note Cost Comparison

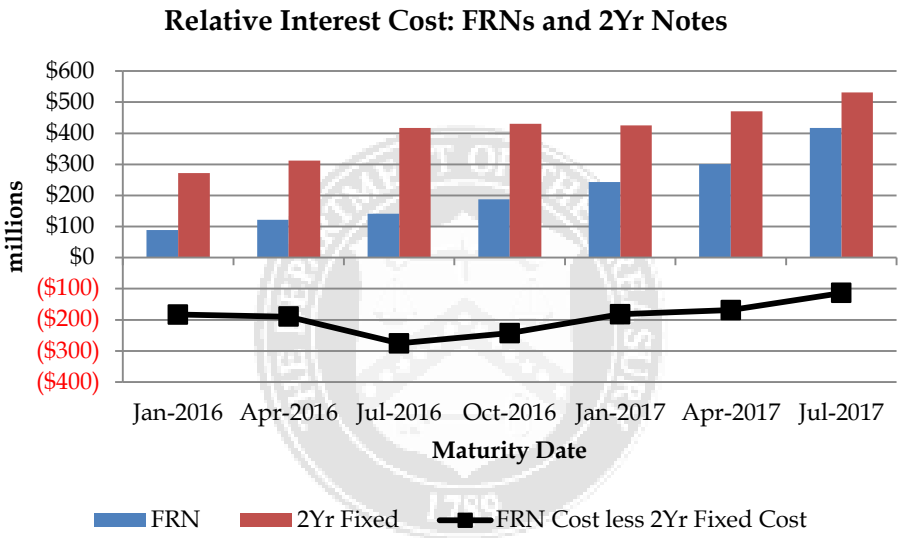
October 2017

Executive Summary

- Treasury floating rate notes (FRNs) were introduced in January 2014.
  - Quarterly issuance of $41 billion (excl. SOMA auction add-ons) has resulted in cumulative issuance of $615 billion, $328 billion of which is currently outstanding
- Since 2014, FRNs have been less costly to issue than 2-year fixed-rate notes, comparable in cost to 1-year bills, but more expensive than 3-month and 6-month bills.
  - Seven FRN issues have matured, representing a total notional (ex-SOMA) of $287 billion.
  - Matured FRN interest costs have totaled $1.5 billion for an average annual yield of ~25 bps.
  - Using FRN equivalent notional and issuance weeks:
    - 2-year fixed-rate notes would have cost $2.9 billion, or an average annual yield of ~50 bps
    - 3-month bills would have cost $0.8 billion, or an average annual yield of ~15 bps.
- A few important caveats:
  - FRN auctions are $13-15 billion in size, compared to an average of $27 billion in 2-year fixed-rate notes and $30 billion in 3-month bills.
  - This study focuses only on FRNs that have matured, with original issue dates between January 2014 and July 2015.

Cost Comparison

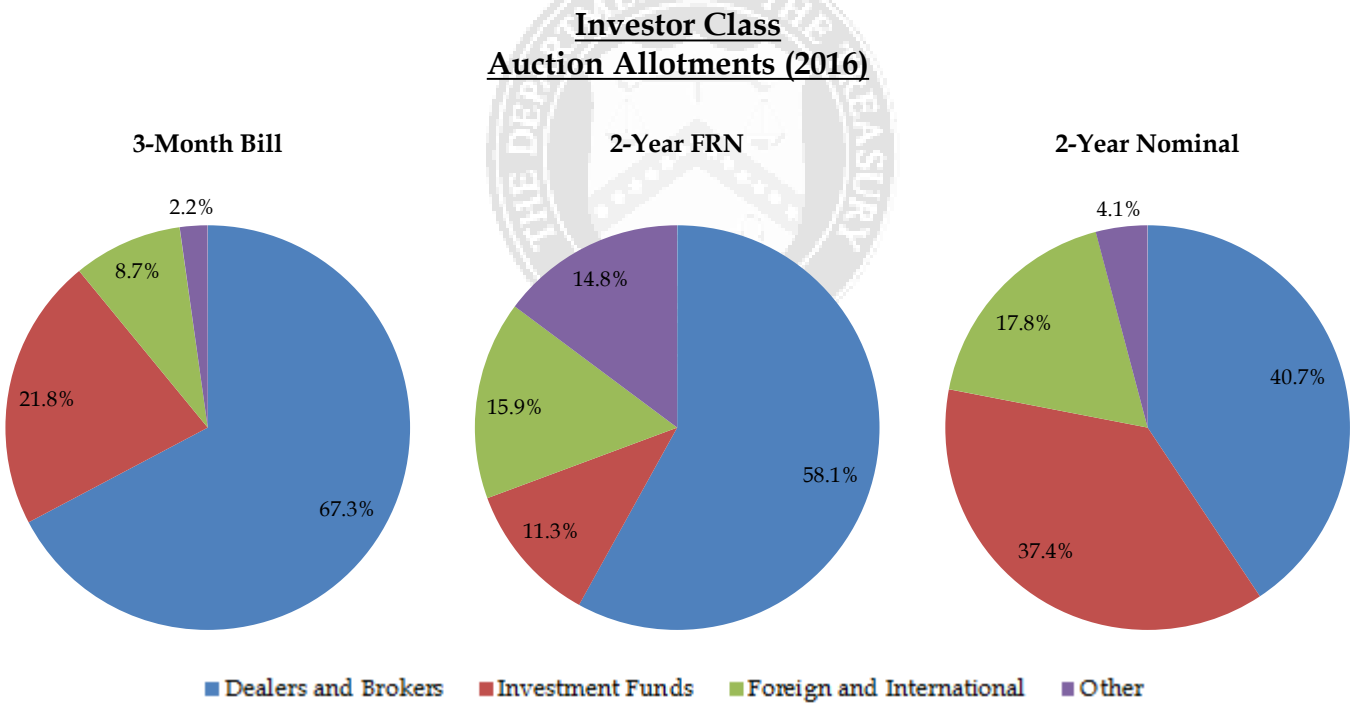
- To date, realized costs of the FRN program compare favorably to the 2-year fixed, resulting in savings of approximately $1.3 billion:



- However, because this analysis incorporates only realized costs (i.e., matured securities), it does not include FRNs issued between 4Q 2015 and 1Q 2017 when spreads to the index widened noticeably.
  - Using market-implied forwards (as of Sept 29), one can estimate the unrealized costs of FRNs currently outstanding:
    - In this instance, the aggregate realized and unrealized costs of FRNs would still result in a net savings of approximately $0.2 billion versus the 2-year fixed.

Investor Auction Activity

- FRNs are most comparable to both the 2-year fixed-rate note and the 3-month bill:
  - New FRN issues are $15 billion the first month of each quarter, with two monthly $13 billion re-openings.
  - The interest rate is reset daily based on the most recently auctioned 3-month bill plus a spread, known as the discount margin, that is set at the initial FRN auction.
  - Interest is paid every 3 months, compared to every 6 months for the 2-year fixed-rate note.



Conclusions

- To finance potential SOMA redemptions, consideration should be given to the potential for increasing FRN issuance - possibly in 1H 2018.
- FRNs have been effective in reducing interest costs at the 2-year tenor, saving approximately $1.3 billion in interest payments for matured issues. To date, realized interest costs for the FRN are comparable to the 1-year bill.
- FRNs have successfully broadened Treasury's investor base.
- Conversations with some market participants have indicated that there is scope to increase FRN issuance.
  - The most recent Primary Dealer Auction Size Survey indicates a maximum recommended auction size of $19 billion.
  - Discount margins (i.e., spread to the 3-month) are near all-time lows with the September auction stop-out at 6 bps. Market participants have indicated that the FRN is particularly attractive in a rising rate environment.

Office of Debt Management

TIPS Program Review

October 2017

Executive Summary

- Introduced in 1997, TIPS represent over $1.2 trillion or approximately 9 percent of the marketable debt portfolio. TIPS are the largest inflation-linked debt program in the world.

- TIPS benefit Treasury given that investors typically demand a higher yield on nominal debt to compensate for risks associated with future inflation expectations.
  - Thus, issuing inflation-indexed debt eliminates that risk and Treasury avoids having to pay an inflation risk premium at auction.
  - Benefit financial markets by providing a new debt security and deepening the Treasury investor base.

- Occasional changes to the TIPS program.
  - Originally sold 5- and 10-year tenors; 30-year maturity added in 1998, but discontinued in 2001.
  - 20-year maturity introduced in 2004, but discontinued in 2009 in favor of reintroduced 30-year maturity.
  - Monthly issuance began in 2011.

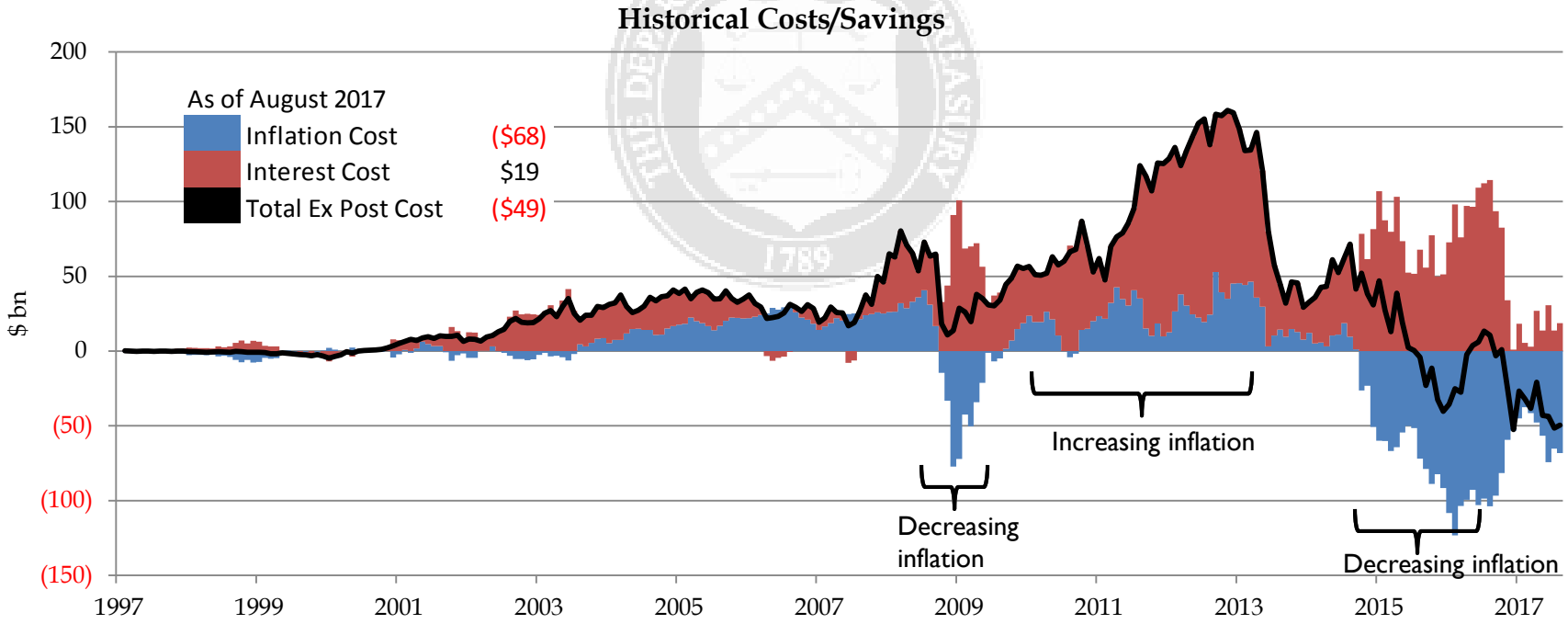
- Since inception, TIPS have been less costly compared to equivalent nominal coupons.
  - Approximately $49 billion in lower costs compared to nominal issuance.

- Although TIPS auctions typically attract stronger levels of participation from investment funds than their nominal coupon counterparts, TIPS appear to have had limited success in significantly diversifying Treasury's investor base.

- Despite a prolonged period of low expectations for future inflation, investors continue to support the program, but have suggested potential changes over the years.

Cost Comparison

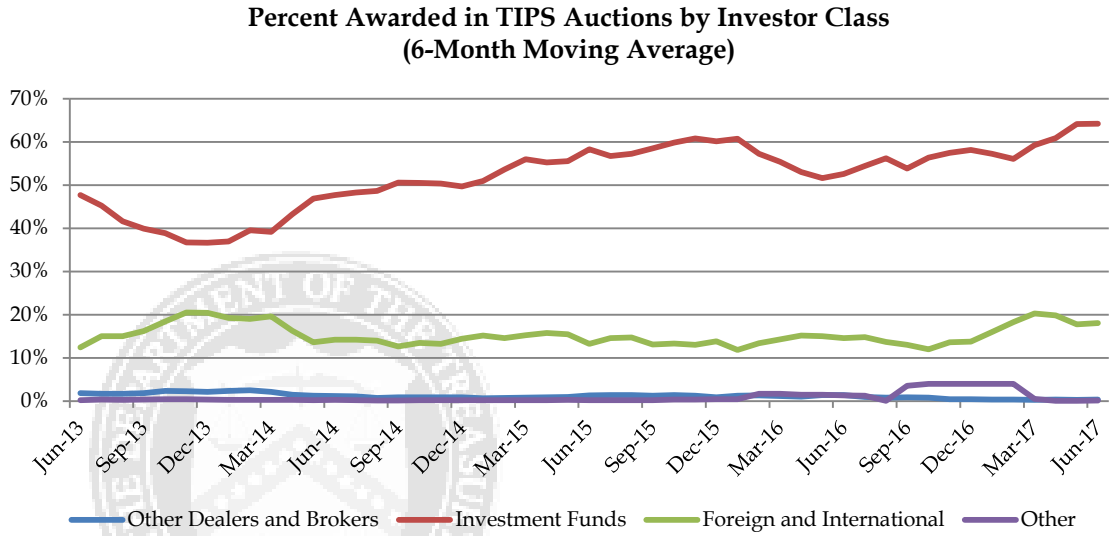
- TIPS have saved approximately $49 billion compared to issuing an equivalent nominal security. The auction implied break-even inflation rate generally has been higher than the realized.
- During periods when the inflation rate decreases (2008 to 2009 and 2014 to 2016), there is an inflation savings on the outstanding portfolio.
- Given that Treasury does not time the market and continues to issue during times of low inflation, those issuances would incur inflation costs when the inflation rate increases (such as 2010 to 2013).
- This does not ensure savings in the future, but does illustrate the value of diversifying the inflation risk to Treasury by issuing both fixed and floating inflation coupons.



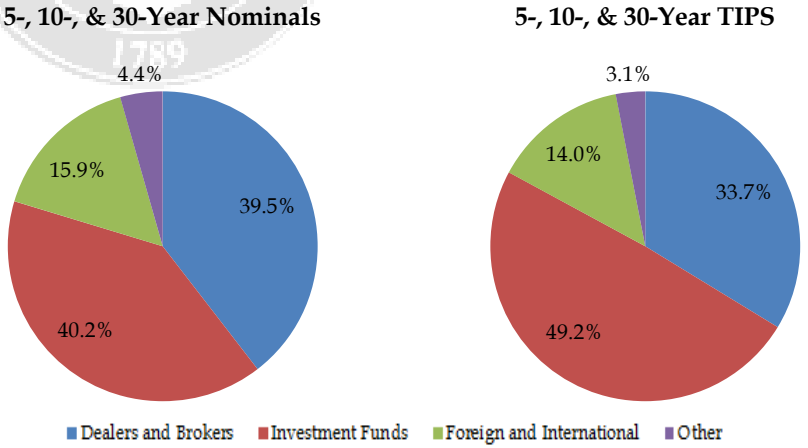
Chung, D., C. Kim, and A. Zhang. "An Ex Post Performance Analysis of the TIPS Program." *The Journal of Fixed Income* (Spring 2013), pp. 31-47.
Dudley, W., J. Roush, and M. Ezer. "The Case for TIPS: An Examination of the Costs and Benefits." *FRBNY Economic Policy Review* (July 2009), pp. 1-17.

Investor Auction Activity

- In recent years, TIPS auctions have experienced increasing levels of participation from investment funds, more so than in nominal coupon auctions, primarily at the expense of comparatively lower primary dealer award allocations.



- Investor class auction allotments since 2012:



Foreign Holdings

- TIPS have increased from 4.4% of total Treasury investments held overseas in 2011, to 9.1% in 2016.
  - Although TIPS currently represent a similar proportion of Treasury portfolios held both domestically and internationally, foreign holdings have been increasing at a much faster pace --- particularly within foreign official accounts:

TIPS - as % of Treasury Holdings

Year	Global	Foreign	Foreign Official	Foreign Private
2016	8.8%	9.1%	8.9%	9.4%
2015	8.7%	8.3%	8.3%	8.1%
2014	8.4%	7.2%	7.3%	6.9%
2013	8.0%	6.1%	5.9%	6.7%
2012	7.6%	5.4%	5.1%	6.3%
2011	7.1%	4.4%	3.9%	5.9%

Source: Treasury International Capital (Annual Reports)

  - In addition, when evaluating Treasury holdings by region, it is worthy to note that the proportion represented by TIPS has been consistently higher in both the Caribbean and in Canada --- that having been said, aggregate TIPS holdings in those two regions totaled only $70 billion as of June 30, 2016:

TIPS - as % of Treasury Holdings

Year	Global	Africa	Asia	Caribbean	Europe	Latin America	Canada
2016	8.8%	1.1%	9.2%	15.8%	8.3%	5.3%	11.0%
2015	8.7%	0.4%	8.9%	16.9%	6.0%	4.5%	12.4%
2014	8.4%	3.4%	7.9%	12.5%	5.4%	4.2%	10.9%
2013	8.0%	4.4%	6.5%	8.8%	5.1%	4.4%	10.1%
2012	7.6%	1.0%	5.4%	9.9%	4.8%	4.3%	10.5%
2011	7.1%	0.1%	4.0%	7.1%	4.2%	4.8%	9.3%

Source: Treasury International Capital (Annual Reports)

Auction Sizing and Timing

- TIPS issuance tripled from 2003 to 2005 and 2009 to 2012, but was decreased in 2016 along with nominal coupons given the improved deficit and intent to increase bills outstanding.
- Issuance sizes are near minimums in the dealer survey, potentially indicating the ability to increase auction sizes.
- At current issuance sizes, net issuance is about $60 billion this year, crossing over to net pay downs of $5 billion starting in 2021 and increasing in net pay downs to $60 billion in 2025. During this period, TIPS as a percent of total portfolio hovers around 9%.
- Comparing the same tenors between TIPS and nominal coupons, there is about 2 months of weighted average maturity (WAM) extension provided by the principal accretion for the TIPS securities. The contribution to the total portfolio is only 0.2 months.

Tenor	Auction Calendar (New/Reopen)	Annual New Issuanance	Current Auction Size (New/Reopen) ($ bn)	Current Annual Issuance ($ bn)	Primary Dealer Auction Size Survey ($ bn)			
					Min	Max	Min Annual	Max Annual
5-Year	Apr/Aug/Dec	1	16/14/14	44	12	20	36	60
10-Year	Jan/Mar/May - Jul/Sep/Nov	2	13/11/11	70	10	17	60	102
30-Year	Feb/Jun/Oct	1	7/5/5	17	6	11	18	33

Sizing Treasury Bill Issuance

TBAC Charge

Treasury would like the Committee to comment on sizing considerations related to the issuance of Treasury bills over the short-, medium-, and long-term. What factors should Treasury consider when optimizing the size of bills outstanding over the coming years? Specifically, comment on expected drivers of demand, the investor base, auction sizing, and market pricing relative to other short-term money market instruments.

Sizing Treasury Bill Issuance

Objectives

- In order to evaluate the appropriate amount of Treasury bill issuance, we examine two important considerations:
  1) Investor demand for bills.
  2) The impact of alternative bill issuance scenarios on the overall outstanding stock of marketable Treasury securities – specifically, focusing on the bill share and the weighted average maturity (WAM) of Treasury debt.
- We do not address the impact of financial stability considerations on Treasury debt management. As noted in a TBAC presentation last year, there is some academic evidence suggesting that an increased supply of short term, liquid assets by the public sector reduces the attractiveness of private short term liabilities and thus potentially helps to enhance the stability of the financial system. This is an important issue but it would require a reevaluation of the Treasury's long held "lowest cost over time" policy and thus is beyond the scope of our charge. Moreover, the academic work cited suggests that the Fed might be better suited to address these stability considerations than Treasury.*

**See "The Demand for Short-Term, Safe Assets and Financial Stability" by Carlson, Duygan-Bump, Natalucci, Nelson, Ochoa, Stein, and den Heuvela and "The Federal Reserve's Balance Sheet as a Financial-Stability Tool" by Greenwood, Hanson and Stein.*

Agenda

I. Treasury Bill Demand
   A. Current Investor Demand
   B. Factors That Could Influence Future Demand
II. Treasury Bill Market Dynamics
III. Treasury Bill Supply

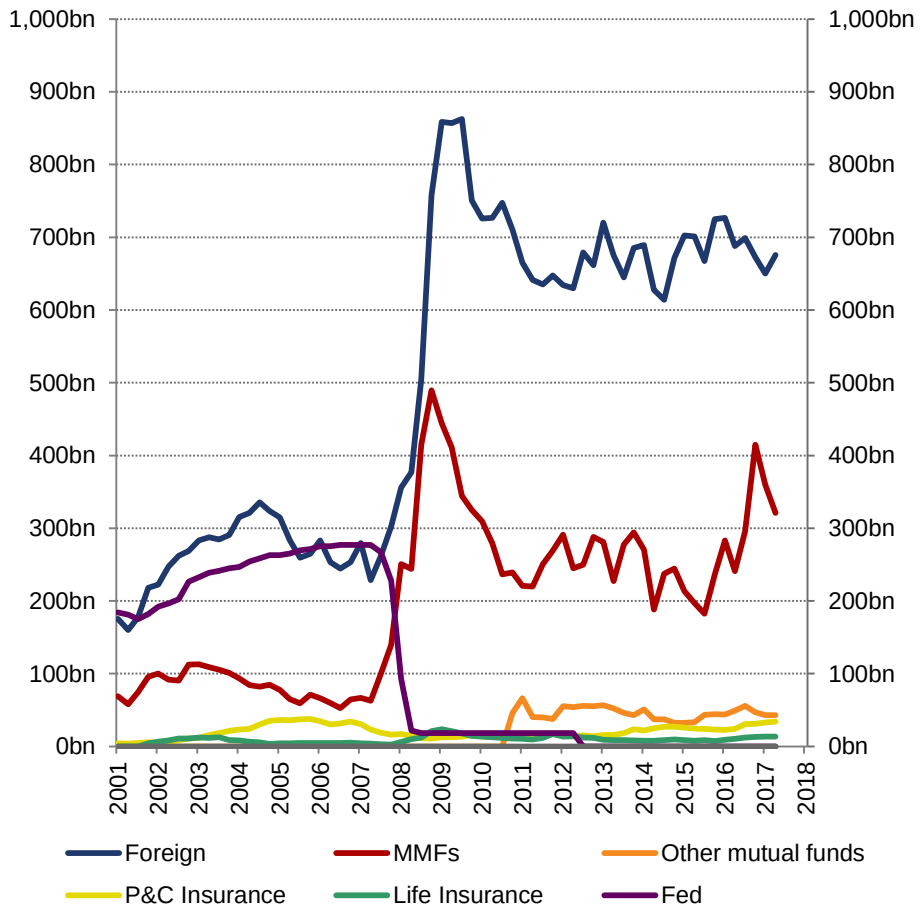
I. Treasury Bill Demand

A. Current Investor Demand

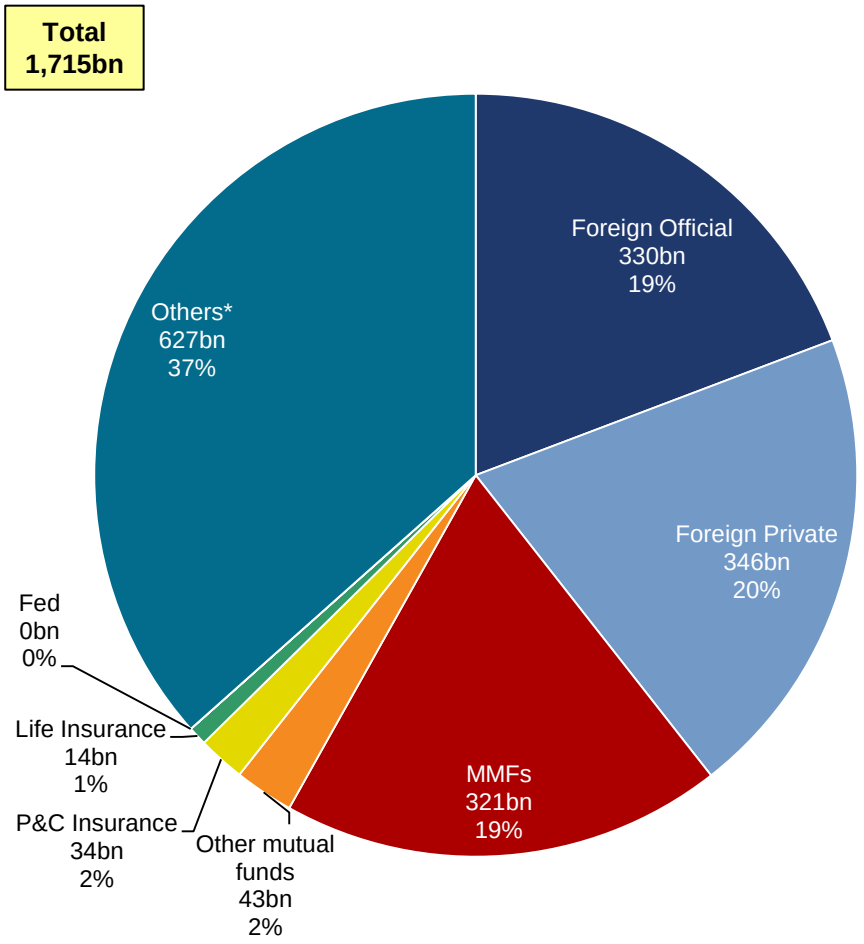
Major Treasury Bill Holders by Investor Type

Foreign investors and U.S. Money Market Funds hold the majority of bills

Historical Bill Holdings by Investor Type



Treasury Bill Holdings – Q2 2017

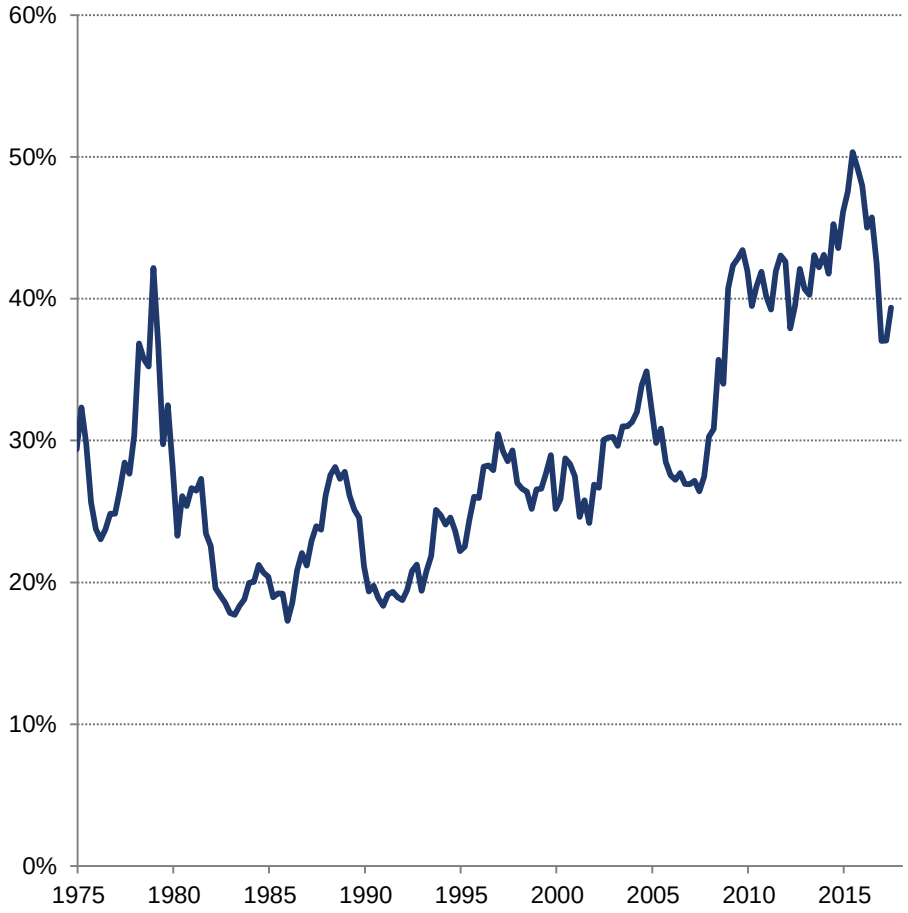


**Other holders include all investor types not included in the granular flow of fund breakdown, notably: banks, broker/dealers, hedge funds, clearinghouses, and retail investors.*
Source: Fed Flow of Funds (via Haver). As of 25-Oct-17.

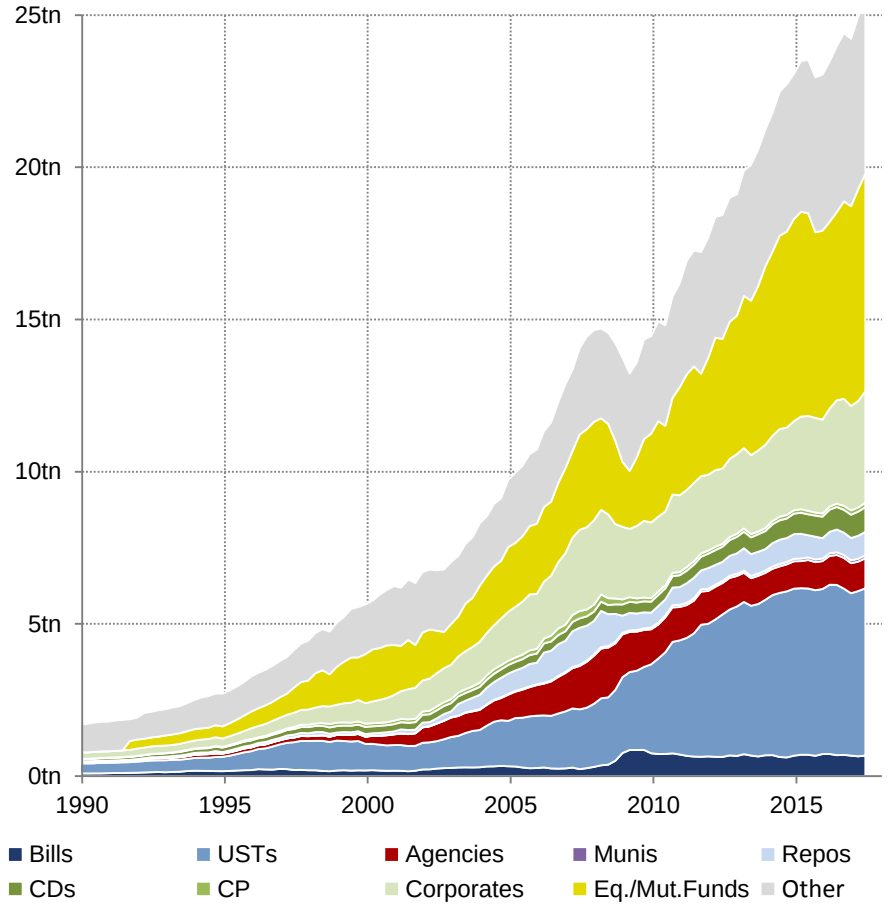
Foreign Bill Holdings

Despite being bills' largest investor, bills are only a tiny portion of foreign USD investments

Foreign Bill Holdings as a % of Total Outstanding



Foreign USD Financial Assets

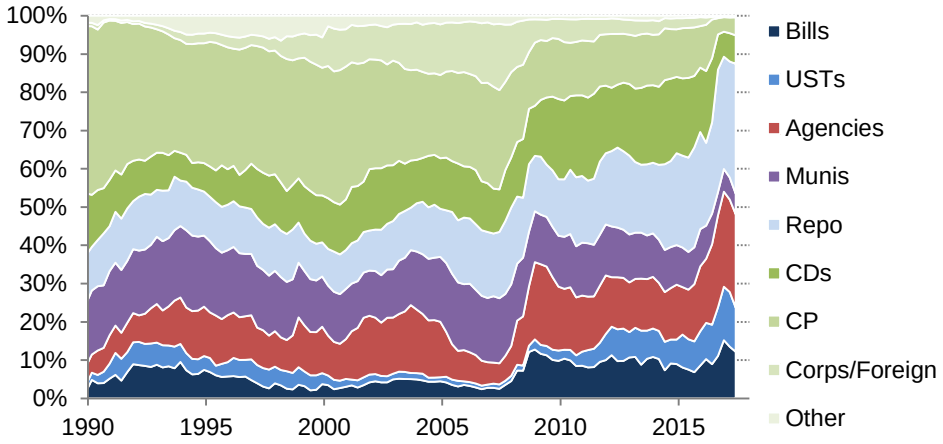


Source: Fed Flow of Funds (via Haver). As of 25-Oct-17.

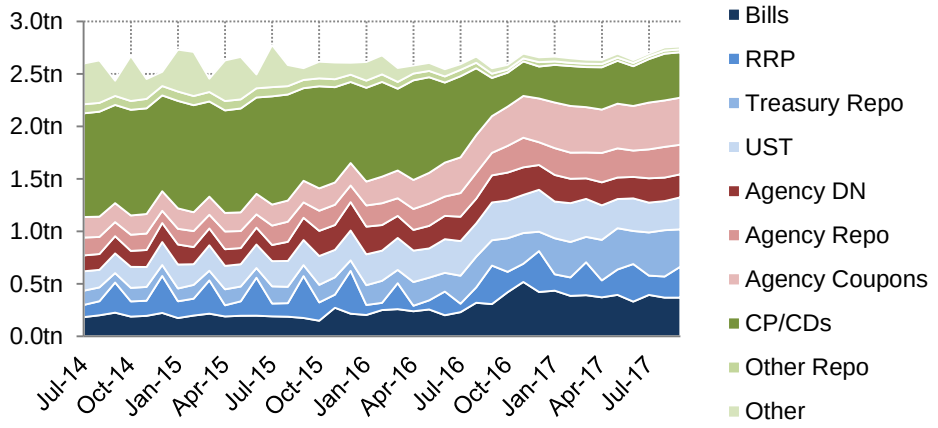
Money Market Fund Bill Holdings

Recent allocations away from credit products have not resulted in increased bill buying

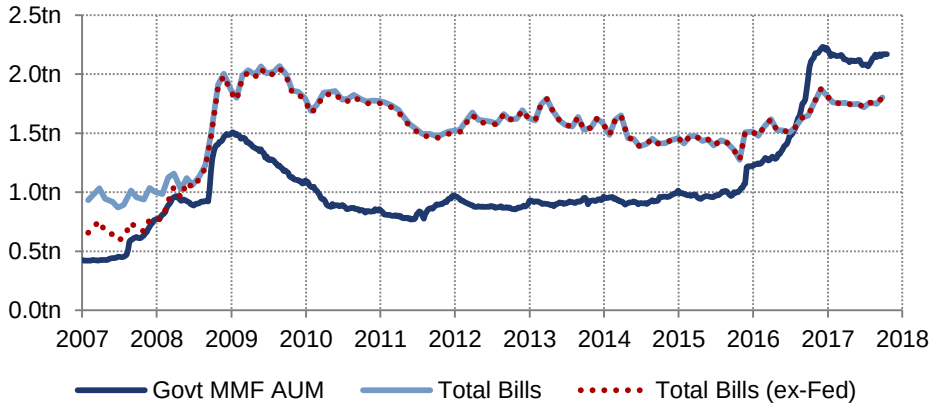
2a7 Money Fund Relative Holdings



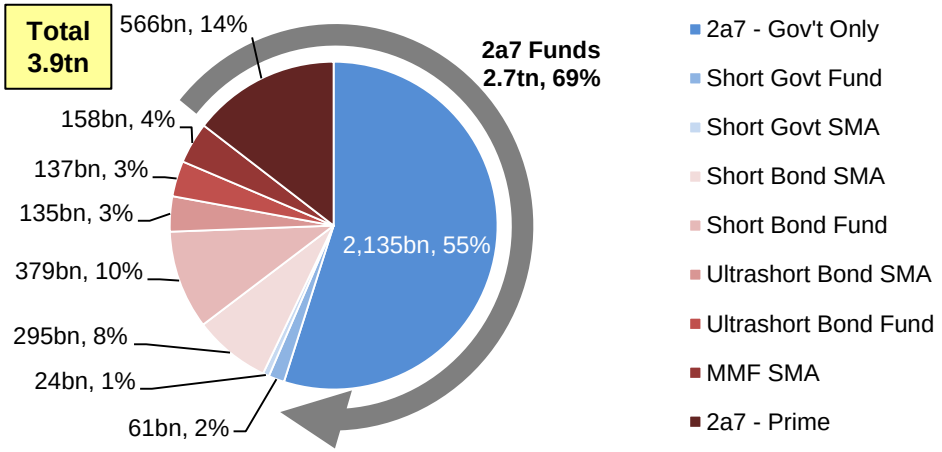
2a7 Money Fund Holdings by Product Type



2a7 Govt Money Fund AUM vs. Bills Outstanding



2a7 Funds vs. "MMF-Like" Mutual Funds/SMAs*



**Mutual fund classifications via Morningstar: Short = 1-3yr; Ultrashort = <1yr. SMAs report to Morningstar on a voluntary basis and thus underestimate the total AUM of SMAs with a MMF-like mandate.*
Source: Morgan Stanley Research, Fed Flow of Funds (via Haver), Crane, ICI, Bloomberg, MSPD (via Haver), Morningstar. As of 24-Oct-17.

I. Treasury Bill Demand

B. Factors That Could Influence Future Demand

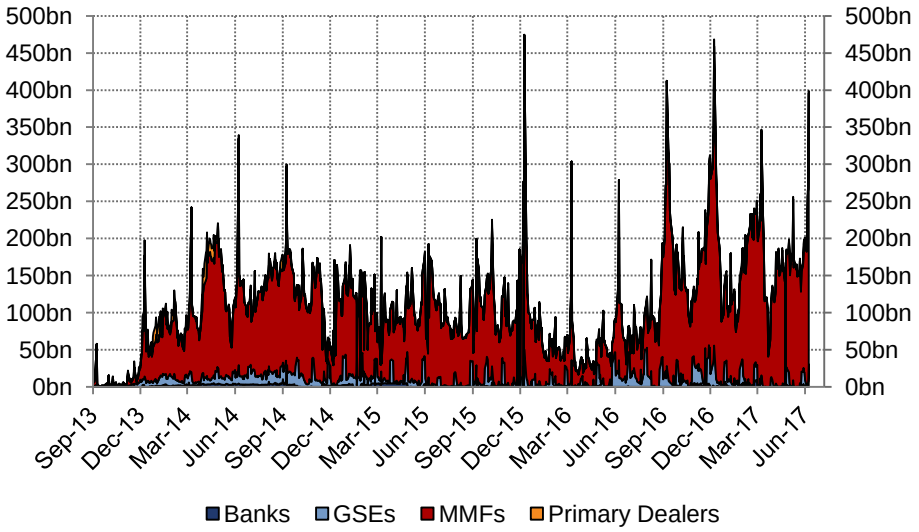
Reverse Repo Facility (RRP)

RRP provides a shock-absorber for excess cash over month/quarter-ends

- The RRP facility is an important monetary policy tool for the Federal Reserve to manage their federal funds rate target range, theoretically "flooring" front-end rates by borrowing cash overnight against treasury collateral in the SOMA portfolio.
- In reality, bills persistently trade through RRP for a variety of reasons:
  - RRP has a cap of 30bn per participant per day, and only certain U.S. banks, GSEs, and money-market funds have access.
  - Treasury bills can be posted as collateral, and they can be sold at any time, resulting in greater re-investment flexibility.
- RRP usage spikes around month-ends when there is scarcity in dealers offering repo; bills usually richen in these episodes.
- **Any changes to the RRP facility (expansion, dissolution, etc.) would directly impact bill demand.**

RRP Rate vs. 1m T-Bills

Reverse Repo Utilization by Counterparty Type



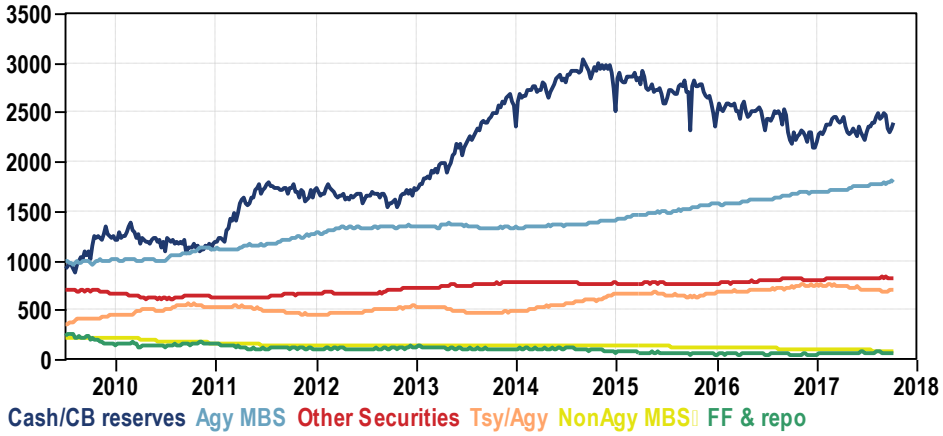
Source: GS Securities Division, NY Fed. As of 24-Oct-17.

Commercial Banks in the U.S.

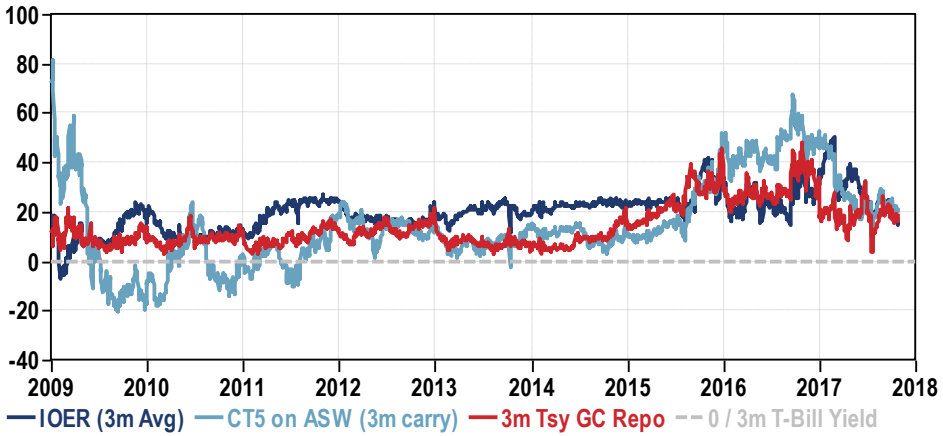
Demand for HQLA has been met with excess reserves, agency MBS & USTs – not bills

- To comply with post-crisis bank liquidity requirements (LCR), U.S. banks have increased their holdings of high-quality liquid assets (HQLA), primarily by increasing reserves at central banks and holding additional agency MBS and UST securities.
- **Banks are unlikely to hold bills as HQLA given they trade rich to low-duration alternatives, such as IOER, and banks have a natural demand for duration for ALM & NIM purposes.**
- Balance sheet capital requirements (SLR, GAAP leverage) have caused dealers to shrink their repo balance sheets, increasing demand for alternatives such as bills and RRP.
- **Changes to leverage requirements could result in a drop in bill demand as availability of dealer repo increases.**

Post-Crisis Bank Holdings ($bn)



HQLA Alternatives Spread to 3m T-Bills



Dealer Repo Books Have Shrunk by ~$1tn Since 2012

Source: Fed H.8, GS Securities Division, SIFMA. As of 25-Oct-17.

Bilateral Derivative Initial Margin

Global margin rules mandate counterparties to post IM for all bilateral derivatives

- In order to adhere to global margin rules, counterparties will be required to begin posting initial margin on their bilateral derivative positions, with a phase-in period from September 2016 through 2020.*
  - Currently, only large derivatives dealers are in-scope for mandatory IM posting on inter-dealer bilateral trades, and it is expected that most non-dealer counterparties will not come into scope until 2020.
- ISDA's recent margin survey estimates dealers currently have ~47bn in aggregate, delivered regulatory IM; this figure is expected to grow significantly when all counterparties come into scope.
- **It is unlikely that incremental collateral needs for IM purposes will result in a greater demand for bills.**
  - Some counterparties already hold excess, unencumbered high-quality collateral that can be pledged as IM.
  - Eligible collateral is negotiated on a bilateral basis, so incremental collateral demands could be met with less-liquid collateral such as corporate bonds or mortgage-backed securities.
  - IM reducing strategies such as clearing or reducing bilateral risk exposures are expected to continue to rise in prominence.

ISDA Margin Survey (Sep'17) – Estimated Total Margin

Estimated Regulatory Initial Margin Received	46.6
Estimated Regulatory Initial Margin Delivered	47.2
Estimated Discretionary Initial Margin Received	60.5
Estimated Discretionary Initial Margin Delivered	16.3
Estimated Variation Margin Received	870.4
Estimated Variation Margin Delivered	685.0
Total Collateral Received	**977.5**
Total Collateral Delivered	**748.6**

In US$ billions

ISDA Margin Survey (Sep'17) – Margin by Collateral Type

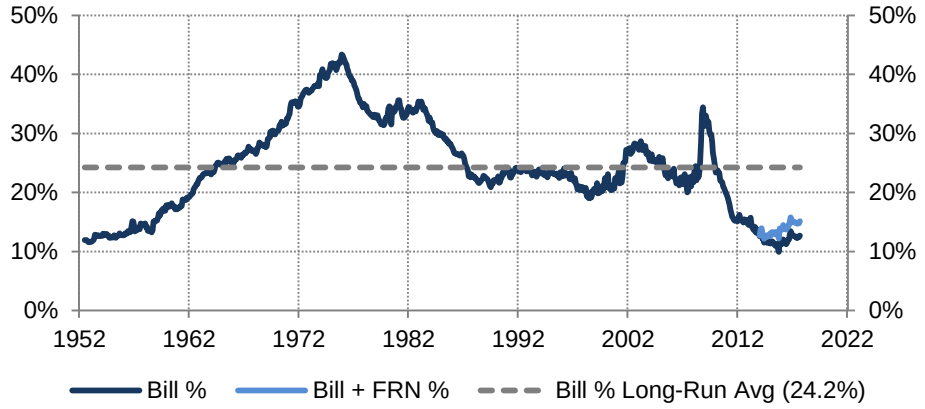
**See the BIS Summary of Changes for more information: http://www.bis.org/bcbs/publ/d317.pdf.*
Source: ISDA Margin Survey 2017 (Link: http://assets.isda.org/media/85260f13-45/71e04f49-pdf/).

II. Treasury Bill Market Dynamics

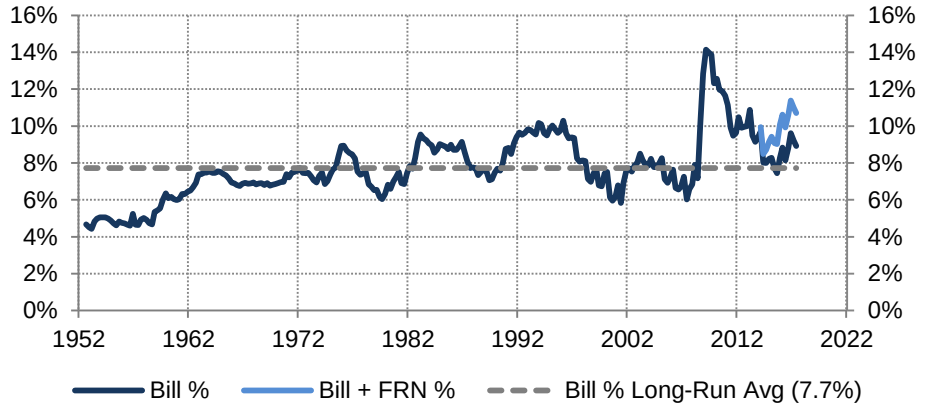
Treasury Bills Outstanding

Bill share of marketable debt is near historical lows, but bill share of GDP is elevated

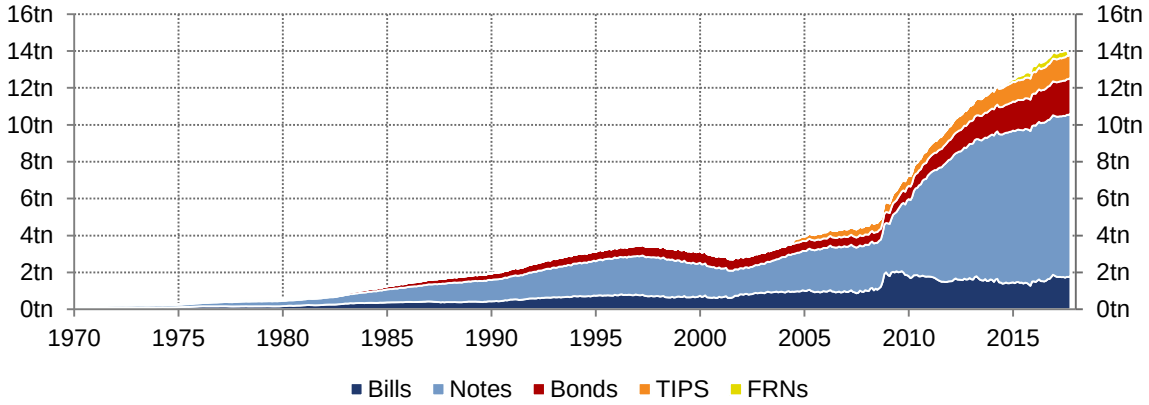
Bills as a % of Marketable Debt



Bills as a % of GDP



Marketable Debt Outstanding by Instrument Type

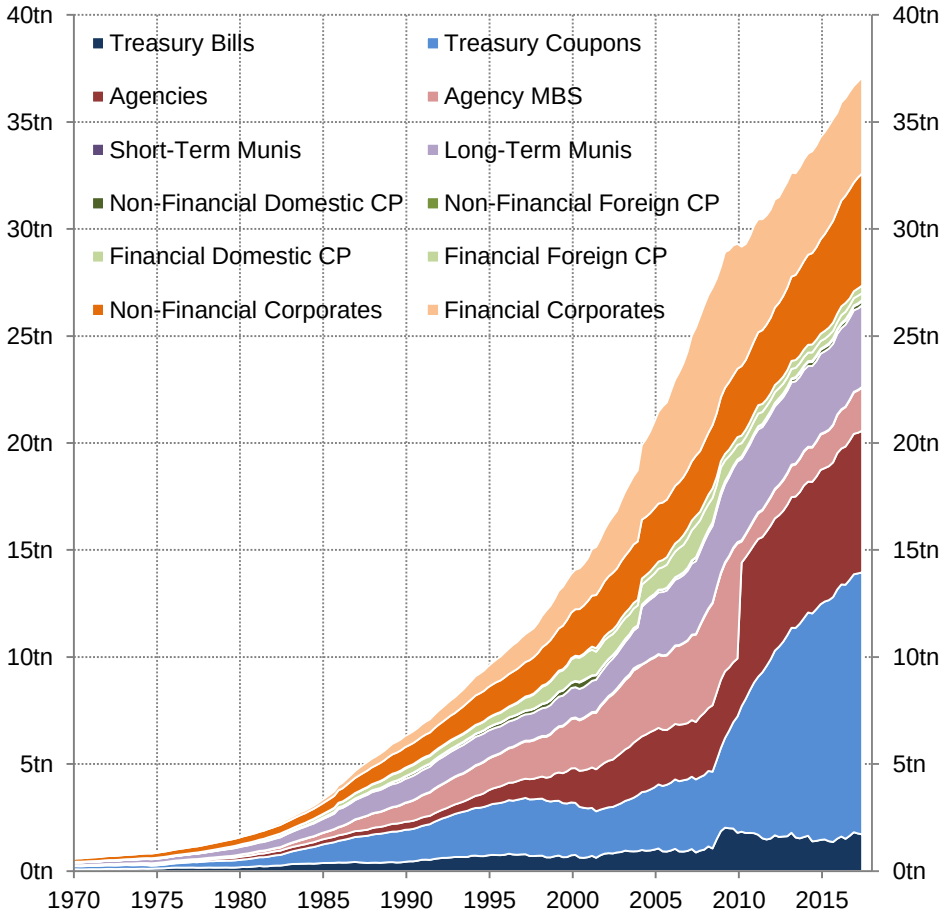


Source: MSPD, Bureau of Economic Analysis. Retrieved via Haver Analytics as of 23-Oct-17.

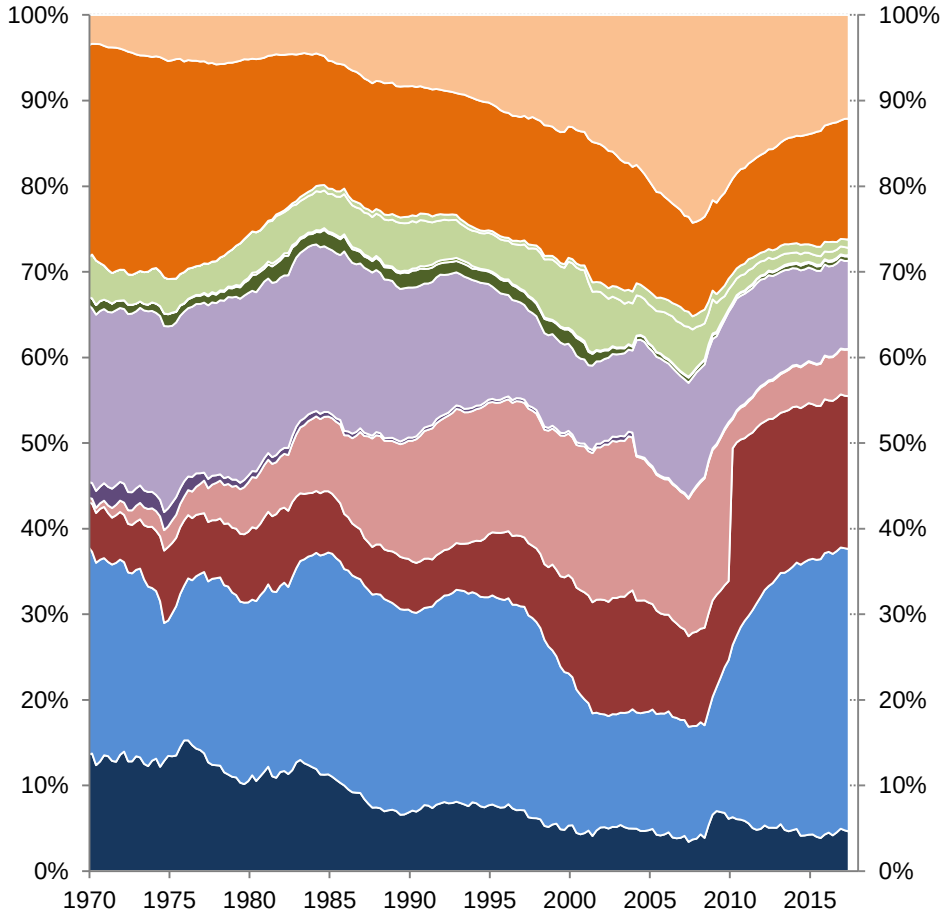
Bill Supply in Context: Total Fixed Income Supply

Bills have been roughly unchanged, while other asset classes have substantially grown

Outstanding Fixed Income Debt Securities



Relative Fixed Income Supply

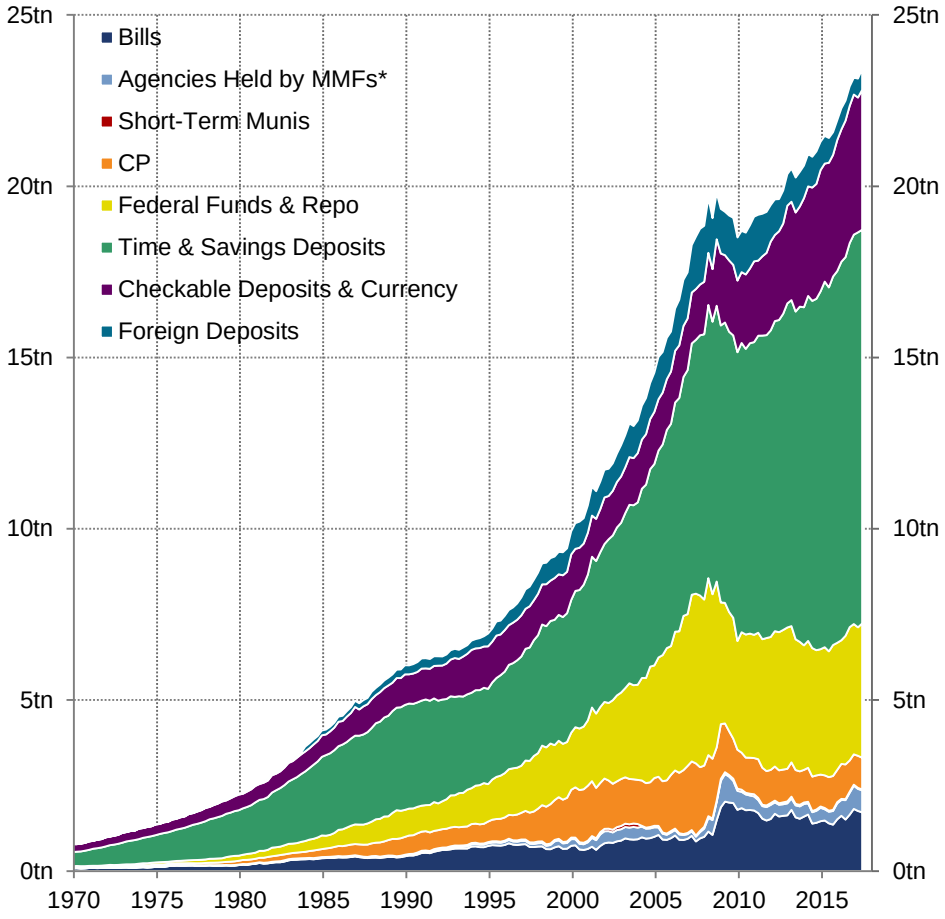


Source: Fed Flow of Funds. Retrieved via Haver Analytics as of 24-Oct-17.

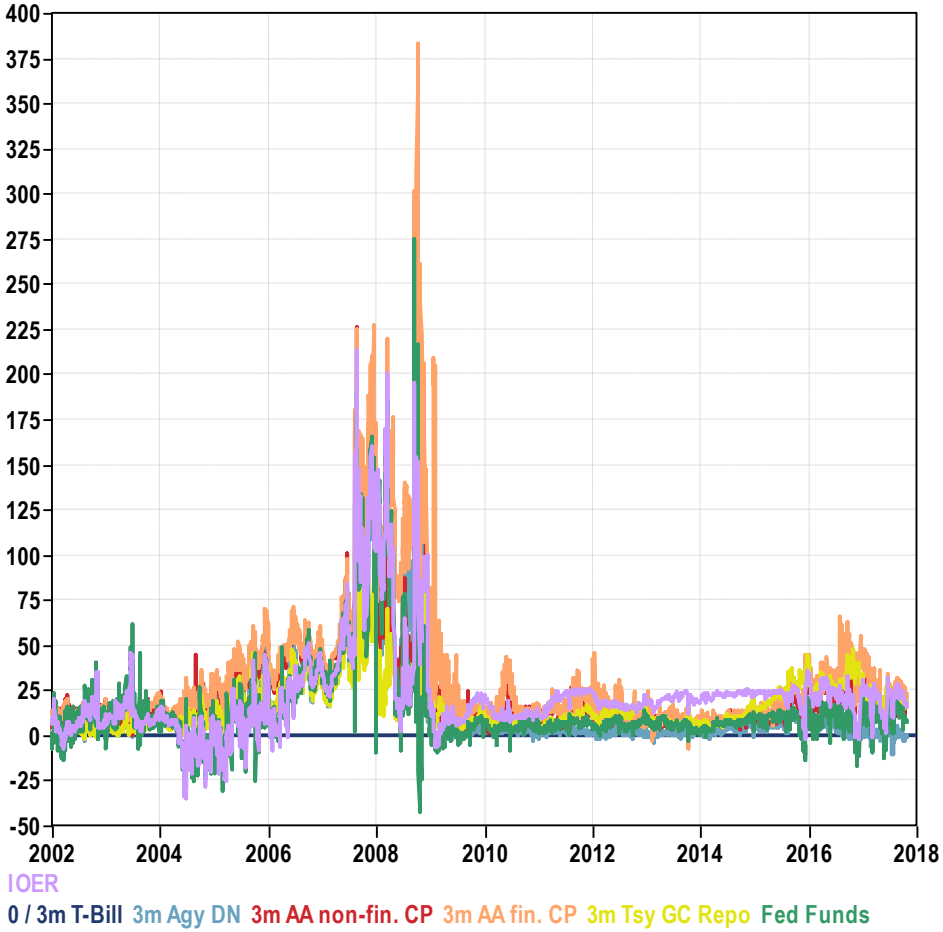
Bill Supply in Context: Front-End Money Markets

Treasury bill "substitutes" outstanding have outpaced growth of bills outstanding

Size of Front-End Money Market



Front-End Rates as a Spread to 3m T-Bills

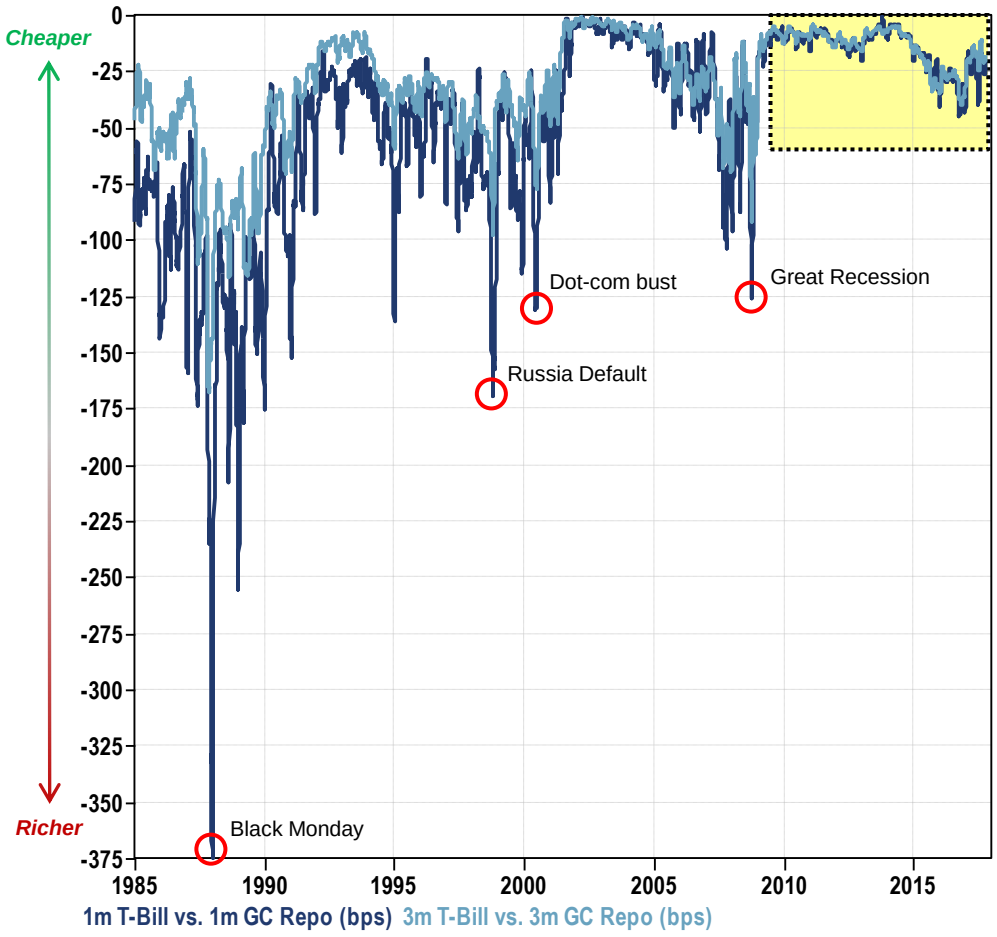


**Rough proxy for Agency DNs/short-dated Agency coupons.*
Source: GS Securities Division, Bloomberg, Fed Flow of Funds. Retrieved via Haver Analytics as of 24-Oct-17.

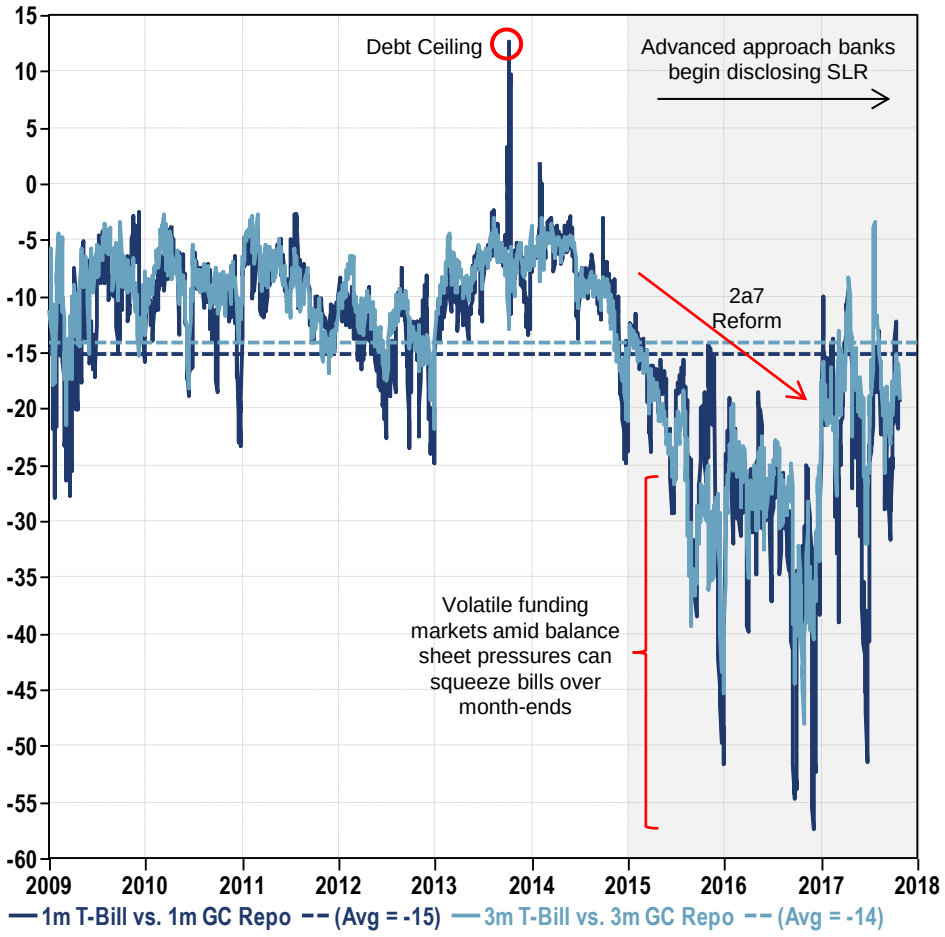
Treasury Bills Relative Value

Bills trade rich to GC repo (SOFR proxy), especially in a flight-to-quality

1985-Present: Trailing 1m Average



Post-Crisis: 2009 to Present



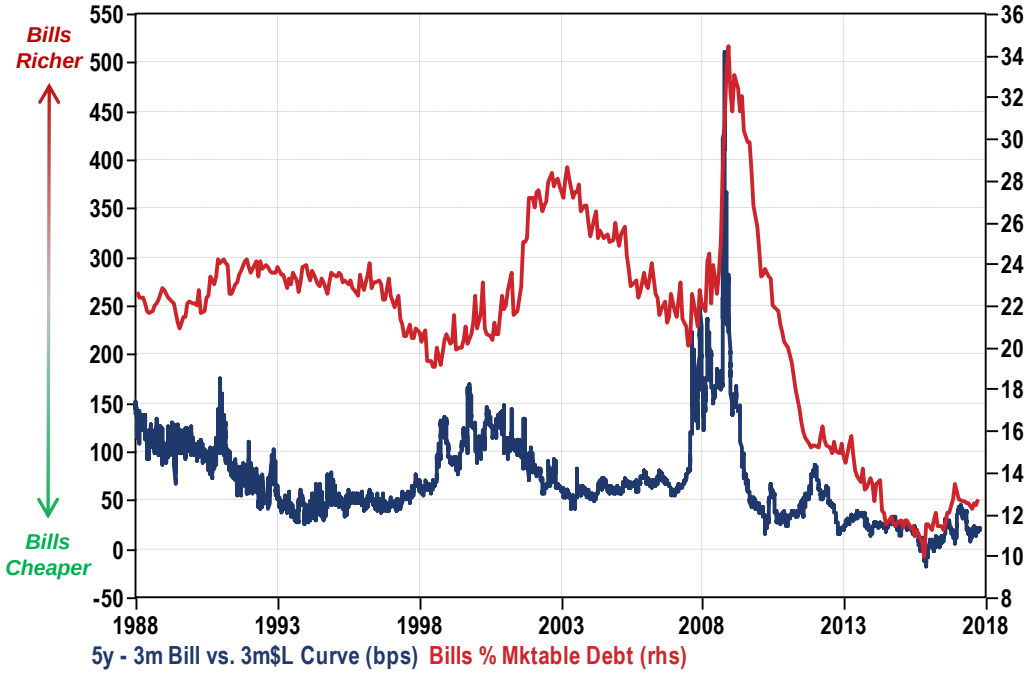
Source: GS Securities Division. As of 23-Oct-17.

Treasury Bills Relative Value

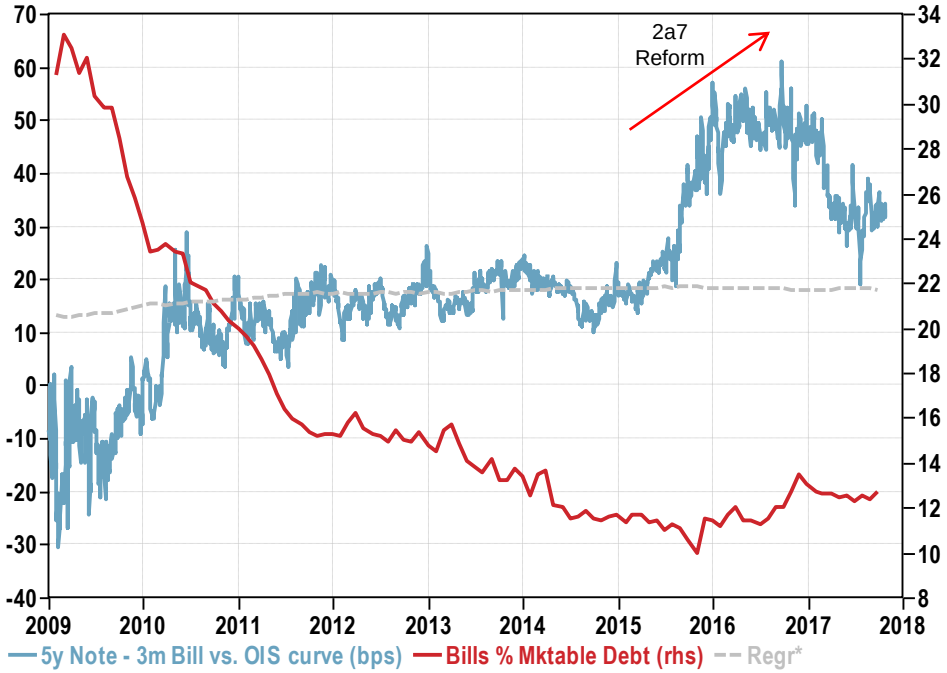
Bills trade rich on the curve post 2a7 reform, even adjusting for lower relative supply

- When bill supply increases relative to coupons, bills cheapen and coupons richen relative to one another as expected.
- Regressing the relative richness of 5y note – 3m bill curve vs. the OIS curve against the marketable debt bill allocation from 2009 to present suggests bills cheapen ~¼ bp vs. 5s for every 1% increase in bill allocation.*
- All else equal, this means normalizing from 13% back to 23% bill allocation would suggest bills would cheapen ~2.5bps vs. 5s.

3m Bill Relative Richness vs. 5y Note – 3m Libor



3m Bill Relative Richness vs. 5y Note – OIS



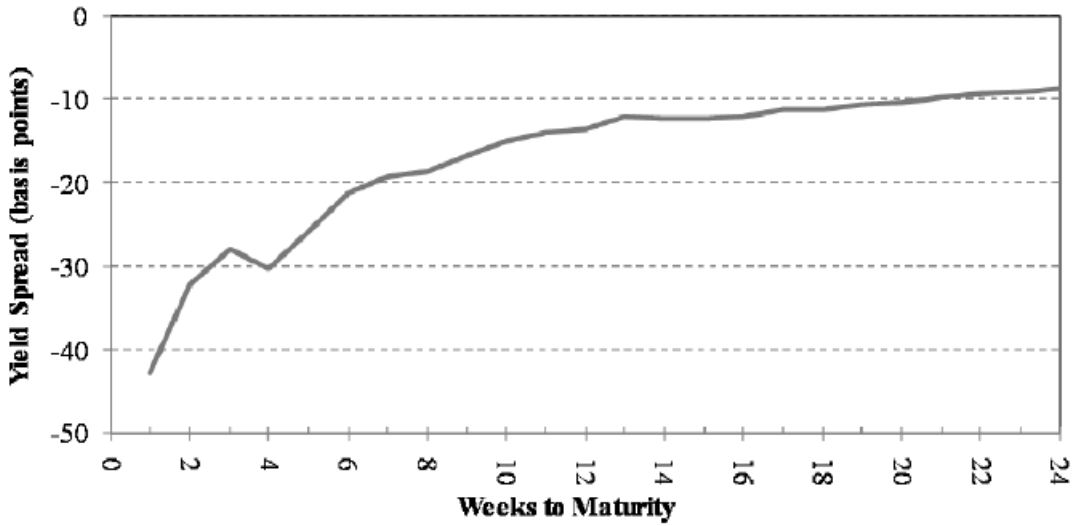
**Linear Regression: [5y vs. OIS – 3m vs. OIS] = 21.33bps – 0.26bps/% × [Bills %]* R^2 *= 56%*
Source: GS Securities Division, MSPD (via Haver). As of 23-Oct-17.

Revisiting the T-Bill Premium

Research presented at the Nov'16 TBAC meeting supports the existence of bill premia

Even pre-MMF reform, academic research suggested that Treasury should consider issuing more bills. A couple of reasons have been offered: (1) financial stability considerations; and, (2) the existence of a T-bill premium. This premium seems to be especially large at the very short-end of the bill curve.

GHS Estimate of T-Bill Premium (1983-2009)



Note: The GHS estimate of the Tbill premium is based on the difference between actual T-bill yields and a curve that is fitted using all outstanding nominal Treasury coupon securities with a maturity greater than 3 months.. The curve is fitted using the model developed by Gurkaynak, Sack and Wright (2007).

Source: Greenwood, Robin, Samuel G. Hansen, and Jeremy C. Stein, 2015, "A Comparative Advantage Approach to Government Debt Maturity," Journal of Finance.

III. Treasury Bill Supply

Sizing Treasury Bill Supply

Assumptions for Alternative Financing Scenarios

1. Baseline and Pessimistic Budget Deficit estimates based on August Treasury Dealer Survey (for 2018-19) and latest CBO Baseline (June 2017 Update). See next slide for more details.
2. SOMA runoff in line with latest NY Fed estimates*:

FY	Amount
2018	$175 bil
2019	$284 bil
2020	$221 bil
2021	$168 bil

SOMA assumed to be normalized at the end of FY 2021, so no further runoff of Treasuries beyond that point.

3. Treasury Cash Balance Target = $300 bil for FY 2018-27.
4. Nonmarketable + Other Means of Finance = $60 bil for FY 2018-27.
5. Financing Gap is the amount of issuance that will be needed if coupon sizes are held steady at current level and net bill issuance is set to zero (i.e., Financing Gap = Budget Deficit – Net Marketable Coupon Issuance + Change in Cash Balance - (Net Nonmarketable Issuance + Other Means of Finance)).

** See "Projections for the SOMA Portfolio and Net Income", Federal Reserve Bank of New York, July 2017 (median scenario with September 2017 announcement/October 2017 implementation).*

Sizing Treasury Bill Supply

Budget Deficit Assumptions

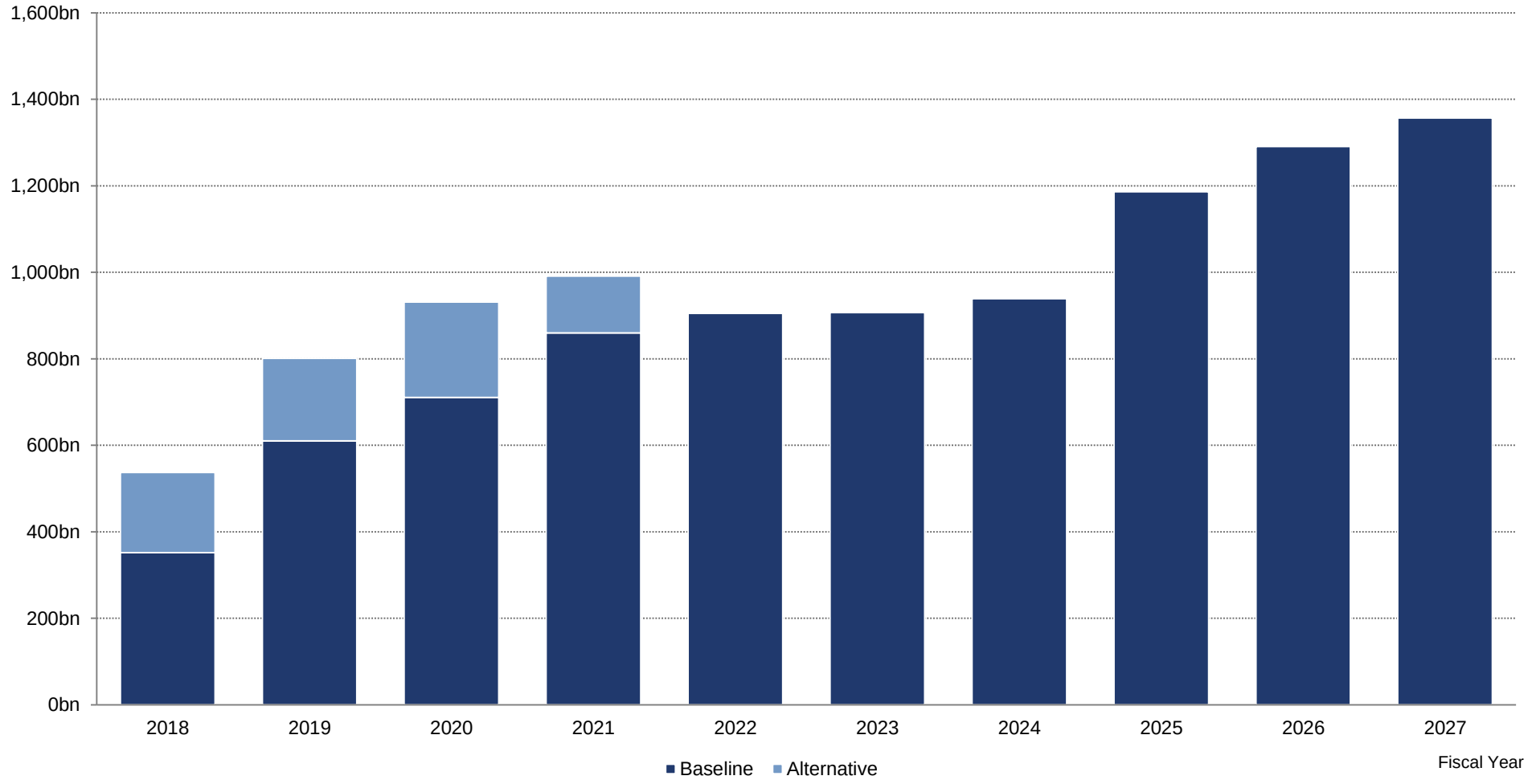
- Baseline scenario is derived from the Primary Dealer mean from the August 2017 survey in FY 2018-19 and the latest (June 2017) CBO Baseline thereafter.
- Alternative scenario is derived from the high estimate in the August 2017 Primary Dealer survey for FY 2018-19, a linear interpolation in 2020-2021 and the latest (June 2017) CBO baseline thereafter.

Budget Deficit Assumptions

Fiscal Year	Baseline	% of GDP	Alternative	% of GDP
2017 (actual)	666bn	3.5	666bn	3.5
2018	690bn	3.5	875bn	4.4
2019	789bn	3.8	980bn	4.7
2020	775bn	3.6	995bn	4.7
2021	879bn	4.0	1,011bn	4.6
2022	1,027bn	4.5	1,027bn	4.5
2023	1,057bn	4.4	1,057bn	4.4
2024	1,083bn	4.3	1,083bn	4.3
2025	1,225bn	4.7	1,225bn	4.7
2026	1,352bn	5.0	1,352bn	5.0
2027	1,463bn	5.2	1,463bn	5.2

Sizing Treasury Bill Supply

Financing Gap Estimates

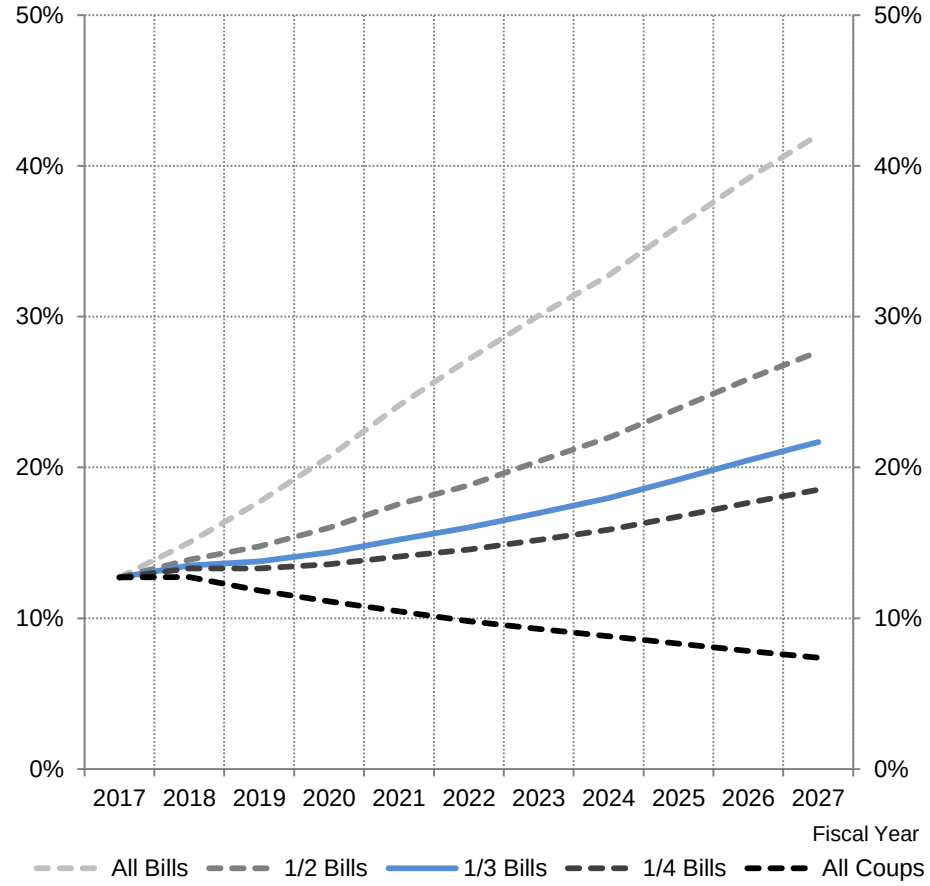


Financing Gap is the amount of issuance that will be needed if coupon sizes are held steady at current level and net bill issuance is set to zero (i.e., Financing Gap = Budget Deficit – Net Marketable Coupon Issuance + Change in Cash Balance - (Net Nonmarketable Issuance + Other Means of Finance)).
FY18 Financing Gap excludes 131bn of bill issuance needed to restore the treasury general account (TGA) cash balance.

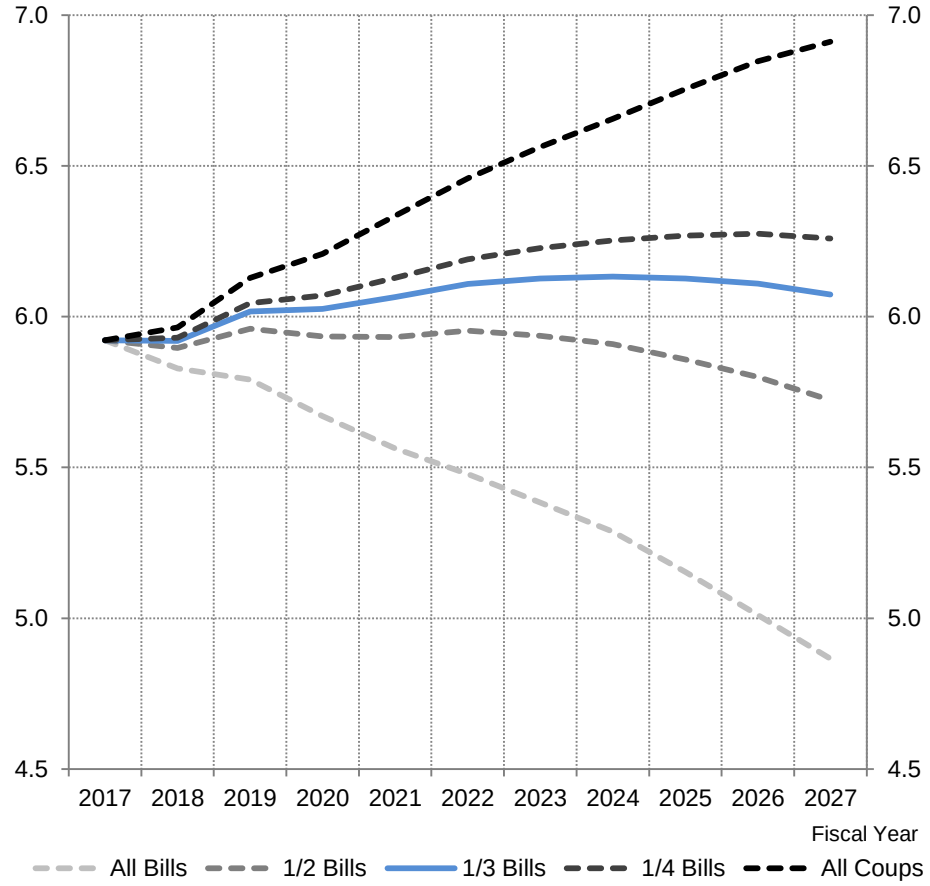
Sizing Treasury Bill Supply

Issuing 1/3 Bills, 2/3 Coupons minimizes WAM impact while normalizing bill supply

Bills as a % of Marketable Debt*



WAM of Debt*

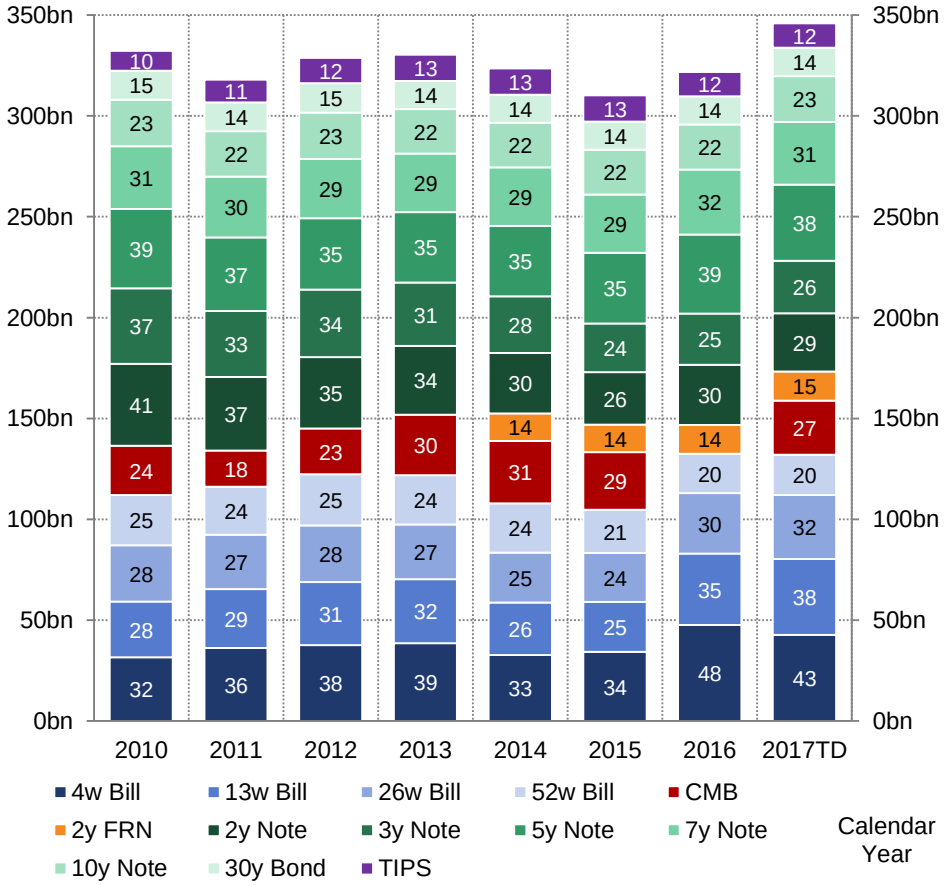


**Calculations performed under the "Baseline" deficit scenario. Financing within the bill and coupon allocations is done pro-rata across the curve.*

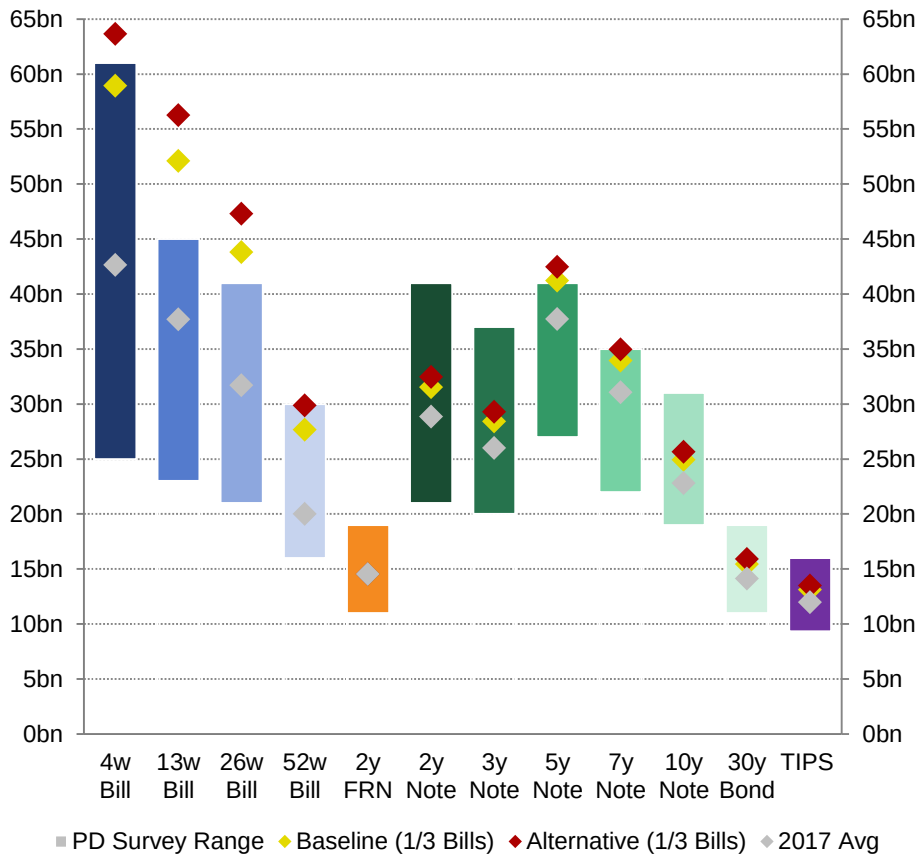
Sizing Treasury Bill Supply

Impact on auction sizes

Average Auction Size: 2010-Present*



Estimated Auction Sizes: 2020**



**Average is shown per auction, including re-openings. 4w/13w/26w bills are auctioned weekly; 52w bills are 4-weekly; CMBs are ad-hoc; and all others are monthly.*
***The top of the PD range shows dealer estimated "maximum auction size that could be issued without causing significant yield deviations from fair value" in 2017. In the baseline/alternative scenarios, the financing gap is assumed to be filled 1/3 in bills and 2/3 in coupons+TIPS, pro-rata across the curve according to 2017YTD average auction size. FRNs are kept unchanged and CMB are excluded.*
Source: Treasury Direct, Primary Dealer Survey Q2'17. As of 23-Oct-17.

Conclusions

1. The bill share of marketable Treasury debt outstanding is quite low at present relative to the historical norm. Similarly, the volume of bills outstanding is small relative to Money Market Mutual Fund (MMMF) assets.
2. However, the volume of Treasury bills outstanding as a percentage of GDP is above the long run average.
3. Many Treasury bill alternatives are available, although none are perfect substitute. For example, CP and DNs have credit risk, repo is balance sheet intensive for dealers, Fed RRP is capped and only available to a subset of market participants. Moreover, the FOMC may eliminate the RRP – or place further restrictions on it – at some point.
4. Treasury bills trade rich relative to coupons at present. There appears to be a significant correlation between the degree of richness and the amount of available supply.
5. Under various budget deficit scenarios, the financing gap confronting the Treasury appears likely to be quite sizeable in coming years. This implies a need to begin to increase auction amounts.
6. While the bill sector can absorb a significant volume of new supply over the near term, allocating more than 1/3 of the financing gap expected in coming years to bills would lead to a shortening of WAM, necessitate bill auction sizes that approach the primary dealer maximum estimates, and result in nearly a doubling of the bill share of marketable Treasuries over the coming decade.

DEBT ISSUANCE OPTIMIZATION MODELS

October 31, 2017

Charge question

October 31, 2017

The primary objective of Treasury's debt management strategy is to finance the government's borrowing needs at the lowest risk-adjusted cost over time. To accomplish this, Treasury strives to issue debt in a regular and predictable pattern, but that approach leaves open a wide range of potential outcomes for the maturity structure of the debt. The interest expense associated with any issuance strategy will depend on a variety of factors that are not under the control of the debt manager, including the behavior of interest rates, the business cycle, and the federal government's fiscal policy.

Pursuant to the TBAC charge and discussion at the January 2017 meeting, please provide an update on efforts the Committee is making with regard to the development of issuance models. Please comment on any revisions to or extensions of the modeling work that was presented in January. Provide an analysis of results from these models and how aspects of these models can complement or be incorporated with ODM's existing issuance model framework. Comment on the degree to which the updated modeling efforts can help to inform potential increases to nominal coupon auction issuance.

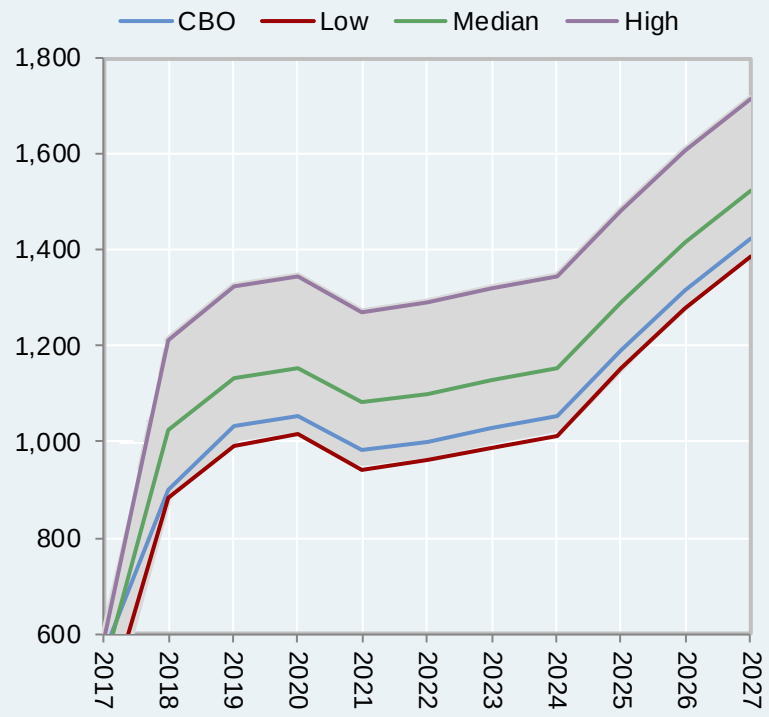
Treasury funding requirements over the next several years

- Treasury financing needs projected to grow significantly over the next several years reflecting both rising fiscal deficits and Fed redemptions
- As highlighted in both the May 2017 and August 2017 TBAC presentations, the financing need is likely too large to address solely through increased bill issuance; that is particularly the case if fiscal stimulus is large and the financing need approaches the high end of expectations shown in the charts below
- Ongoing work around debt optimization is designed to provide insights to help Treasury choose an optimal maturity structure of issuance to meet the increased funding need

Fiscal deficit ($B)

Year	CBO Baseline	Primary Dealer Survey		
		Low	Median	High
2017	693	559	664	720
2018	563	550	690	875
2019	689	650	789	980
2020	775	736	875	1,066
2021	879	840	979	1,170
2022	1,027	988	1,127	1,318
2023	1,057	1,018	1,157	1,348
2024	1,083	1,044	1,183	1,374
2025	1,225	1,186	1,325	1,516
2026	1,352	1,313	1,452	1,643
2027	1,463	1,424	1,563	1,754

Projected net Borrowing needs including SOMA runoff[1] ($B)



1. Net borrowing needs includes projected fiscal deficit + student loans and other funding needs + cash balance changes + SOMA runoff; Dealer survey projections after 2020 are extrapolated using 2019 dealer estimates vs. 2019 CBO baseline

Use of debt optimization models for assessing risk / cost tradeoffs

The January 2017 TBAC presentation summarized the key components of a debt optimization model being developed within TBAC; since then, the model has developed further and includes the following key components:

- A stylized macroeconomic model that can be used to generate stochastic simulations of the unemployment rate, inflation, short term interest rates, and the primary deficit
- A model that relates term premium to the macroeconomic variables and other factors
- Debt stock dynamics that track outstanding debt in terms of maturities and costs
- An optimization module that identifies low cost strategies given alternative risk and issuance constraints
- Recent work includes the following improvements to the January 2017 model
  - Consideration of a broader set of issuance strategies through the introduction of issuance kernels
  - Further analysis on risk/return tradeoffs faced from alternative issuance strategies including consideration of alternative risk measures
  - Use of the model to assess the appropriateness of extending WAM at various points in time
  - Development of an optimal issuance response function that allows for issuance to vary with the macroeconomic environment
  - Assessment of how the optimal issuance mix should change with various constraints including volatility constraints, and financial stability-related constraints on the supply of Treasury bills

Model results with single-point issuance strategies

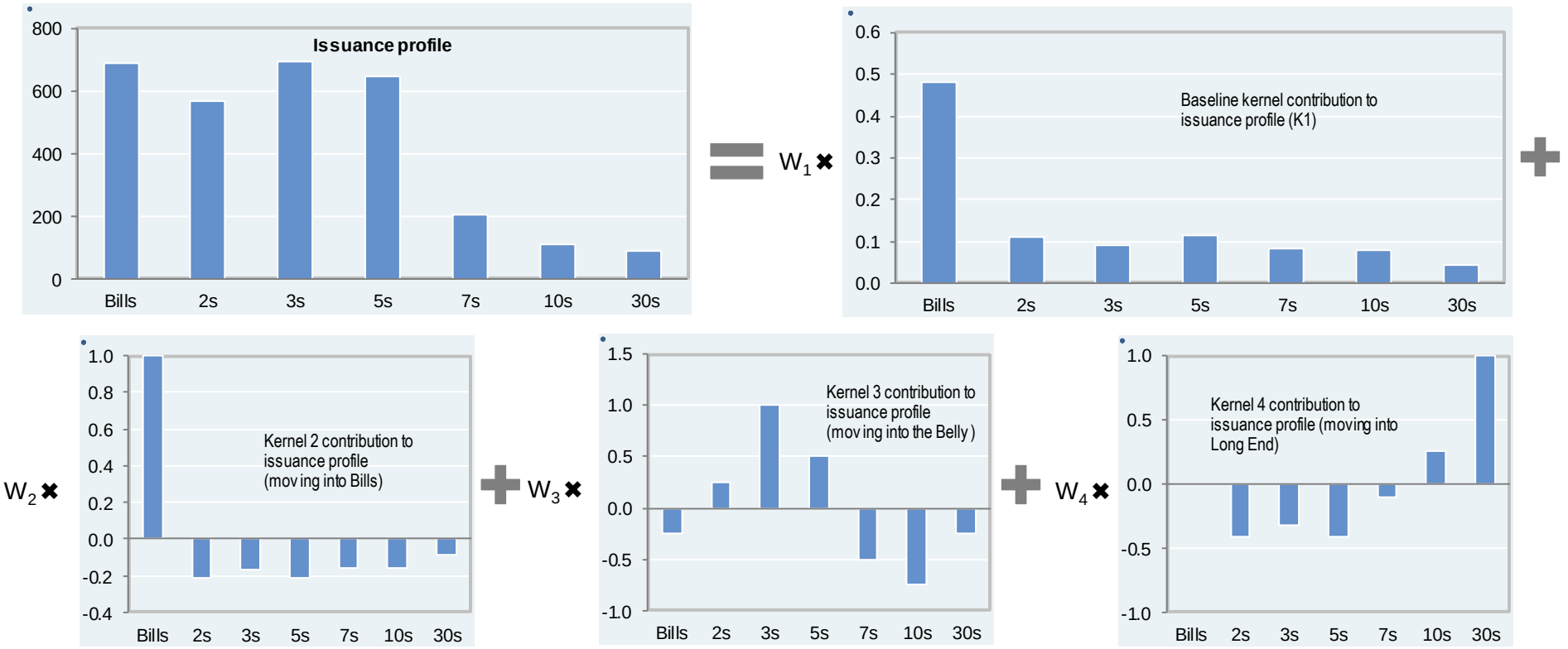
- The model can be used to assess the trade-off between expected funding cost and the variation in funding cost
- The analysis here focuses on strategies that concentrate all issuance into a single maturity point, ignoring issuance capacity or any feedback to market prices
- The purpose of this exercise is to illustrate how the model works; more realistic issuance strategies are considered next
- As previously shown, the model finds a reduction in the variability of funding cost by moving from bills into the belly of the curve, without a substantial increase in expected funding cost. In contrast, extending to long maturities raises funding cost without an additional reduction in the variation in funding costs

Expected cost / variation trade-off

Using kernels to incorporate more realistic issuance patterns

- In order to explore a broader set of issuance strategies, it is useful to simplify the full set of tenors into a smaller set of stylized strategies that we refer to as issuance kernels; this is both for computational reasons as well as for gaining intuition on which issuance strategies are most appropriate
- To see this, we characterize any given issuance profile as being the sum of different decisions – a "baseline" issuance pattern, which can be scaled up or down depending on total gross issuance, plus other zero sum reallocations across different curve strategies
- In the example outlined below, the actual dollar issuance profile (top left chart) may be written as the weighted sum of the top right profile (the baseline profile scaled up to match total issuance), a weighted amount of Kernel 2 (which produces a shift out of the front end and into the back end), and a weighted amount of Kernel 3 (which shifts gross issuance out of the wings and into the belly)[1]

An illustration of a particular issuance profile and its decomposition into stylized issuance kernels ($B)

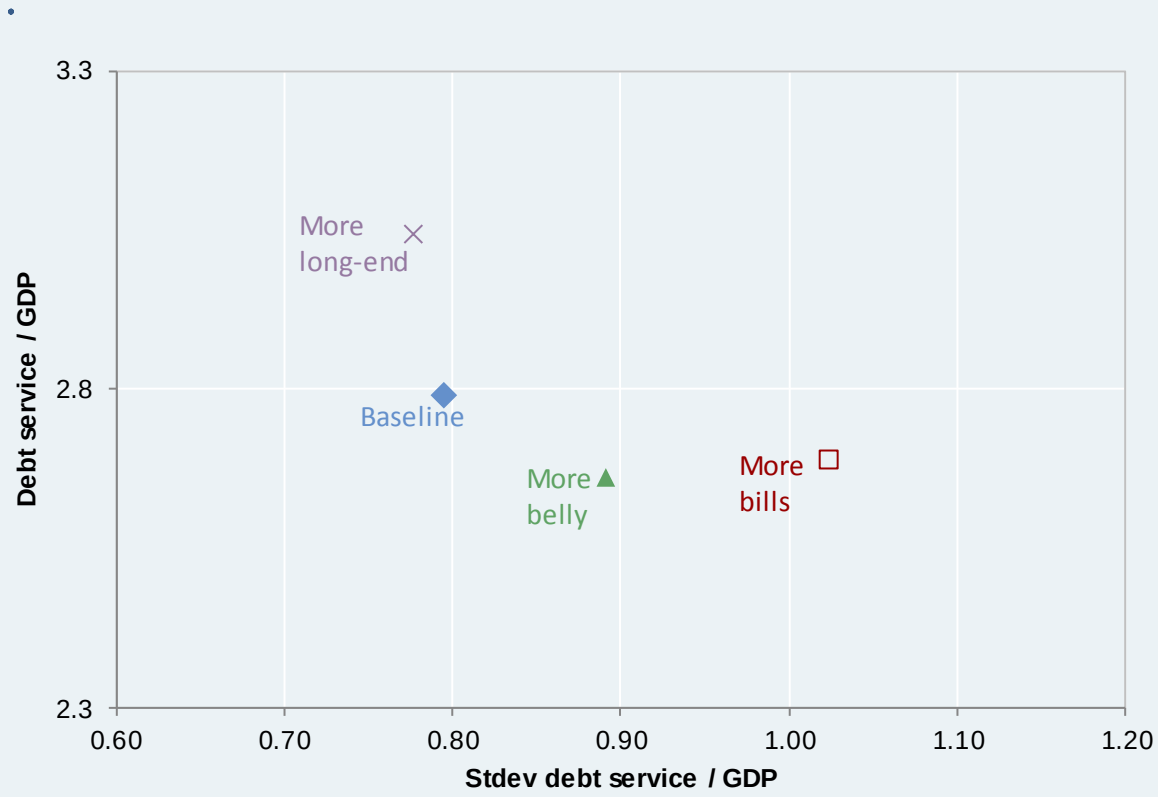


1. In particular, Issuance profile shown in upper left chart can be calculated as 3,000 K1 + (-674.2) K2 + 307.4 K3 + (-24.4) K4

Model results with more realistic issuance strategies (1 of 2)

- The baseline outcome represents maintaining the current issuance pattern (it keeps bill share of debt unchanged and keeps current proportions of issuance across coupons)
- Shifting issuance into bills (the “more bills” scenario achieved through kernel 2) increases the variation of the debt while reducing expected cost relative to the baseline
- Shifting issuance towards the belly (the “more belly” scenario achieved through kernel 3) reduces debt cost variation relative to the “more bills” outcome without increasing the expected cost
- Shifting issuance to the long end (the “more long-end” scenario achieved through kernel 4) raises the expected cost meaningfully while reducing risk only slightly relative to the baseline

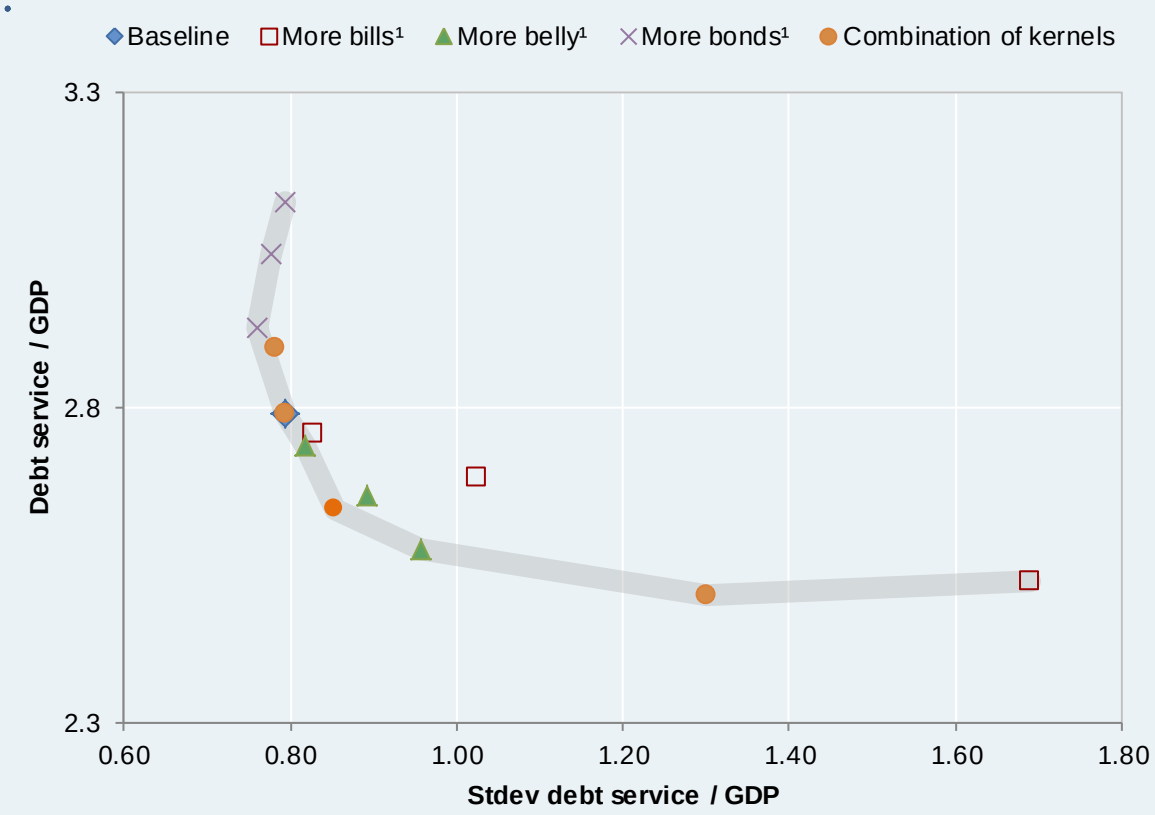
Expected cost / variation trade-off



Model results with more realistic issuance strategies (2 of 2)

- The loadings on these alternative strategies can be varied to trace out a more complete set of possible outcomes
- Below we again consider moving into bills, the belly, and the long end, but we now vary the degree to which the issuance loads up on these additional kernels and also consider strategies that combine these shifts
- This exercise creates a number of possible outcomes, and the outer limit of those outcomes presents a frontier for the potential trade-off that debt managers can achieve

Expected cost / variation trade-off

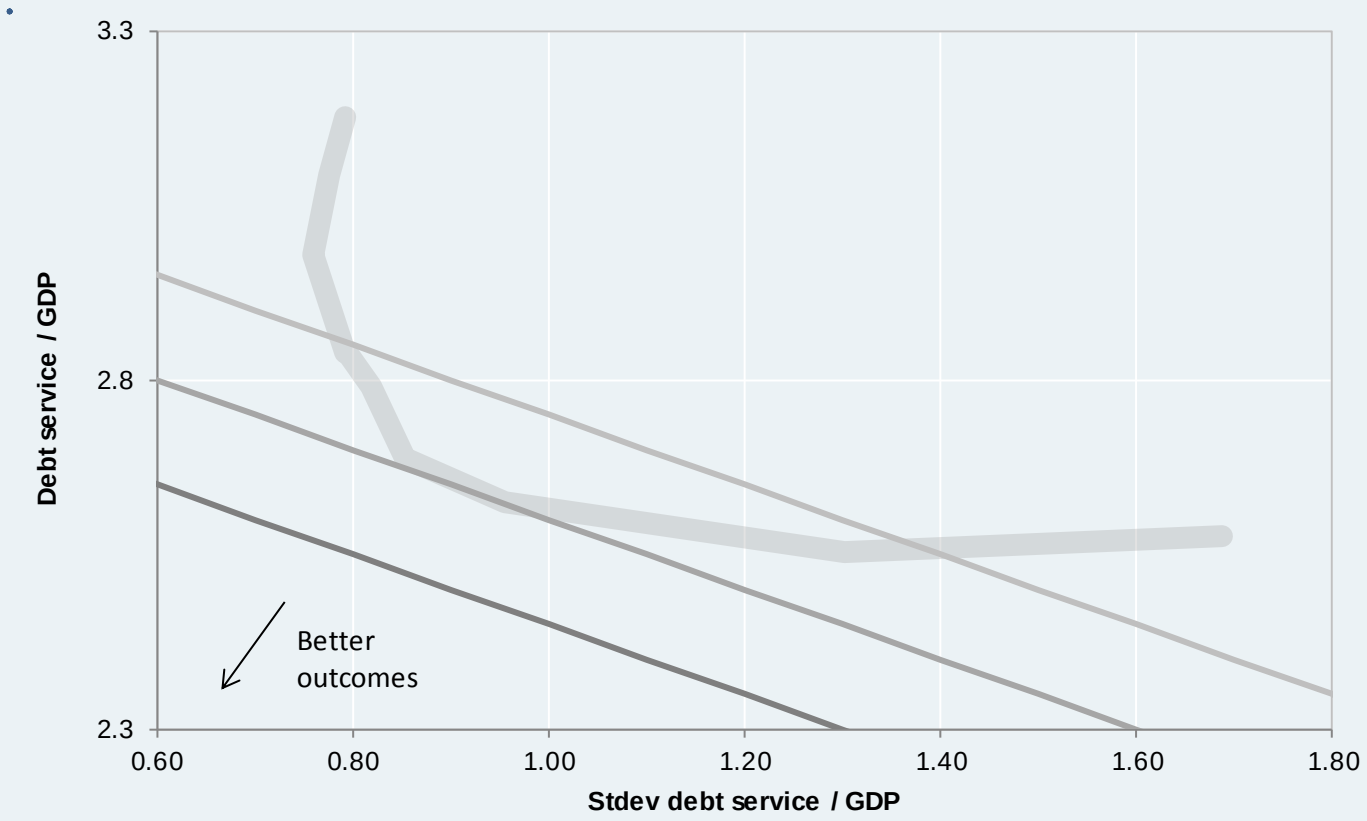


1. Varying intensity to demonstrate different possible outcomes

Optimal strategy with assumed Treasury preferences

- Treasury would presumably prefer to reach outcomes that are as far down and left as possible on the trade-off chart
- The lines on the chart capture this preference, with lower lines representing better outcomes
- Risk-neutral cost minimization would be represented by horizontal lines, while a desire to also reduce risk would provide some slope to the lines
- Achieving the lowest line represents the “risk-adjusted cost minimization” from the charge

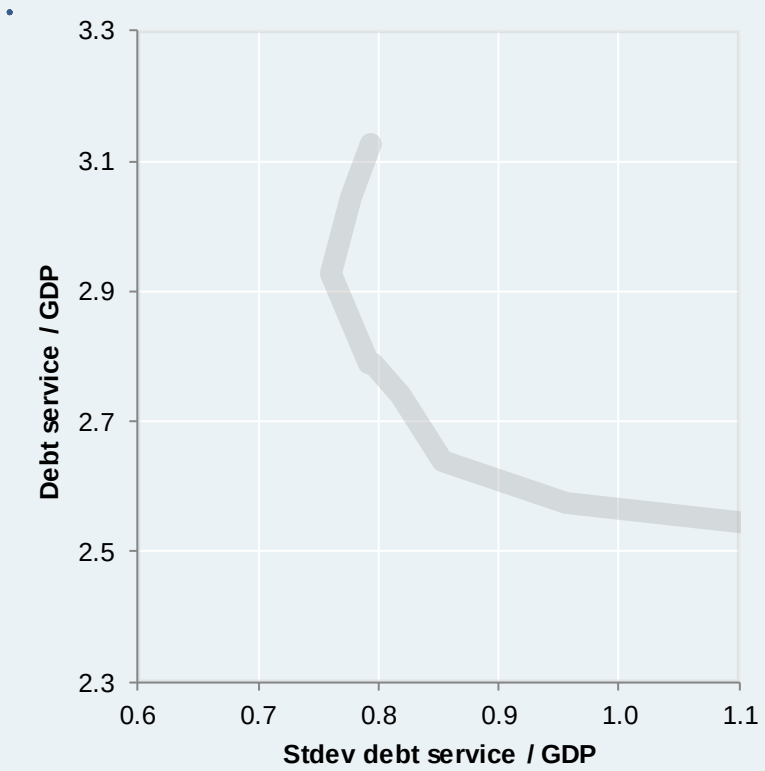
Expected cost / variation trade-off

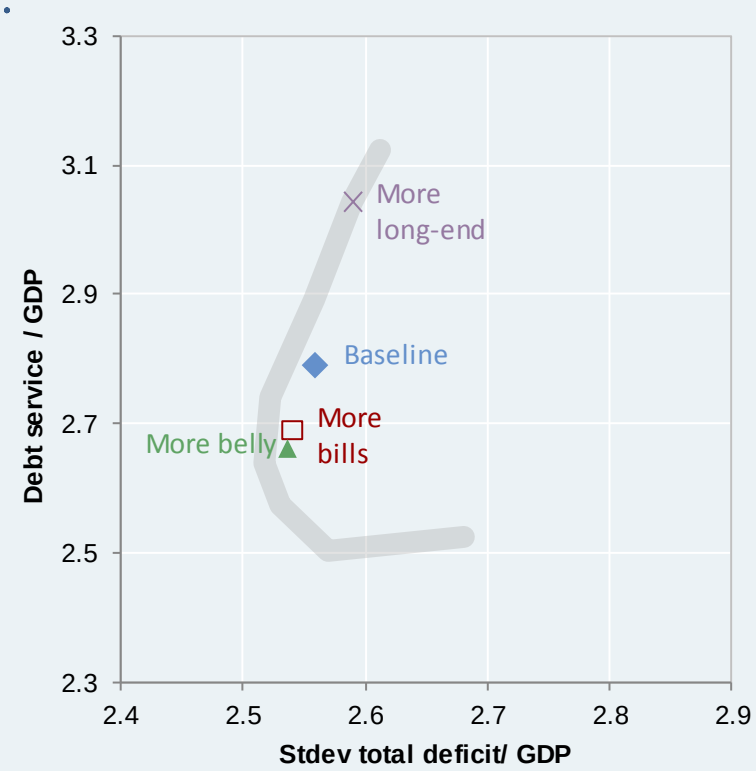


Model results with alternative measure of risk

- Funding risk is often discussed in terms of variation in funding costs (as used in earlier results); however, the more appropriate measure to use in many economic models is the variation in the fiscal deficit
- We can conduct the same exercise of considering a range of issuance strategies to trace out a frontier of potential outcomes under this metric for funding risk
- The negative correlation between shorter-term rates and the primary deficit makes issuing at front and intermediate maturities appear even more attractive, bringing the lower end of the frontier to the left in the chart (this finding is consistent with previously published work on debt optimization[1])
- The performance of increasing bill issuance and increasing belly issuance become more similar in this case

Expected cost / variation trade-off



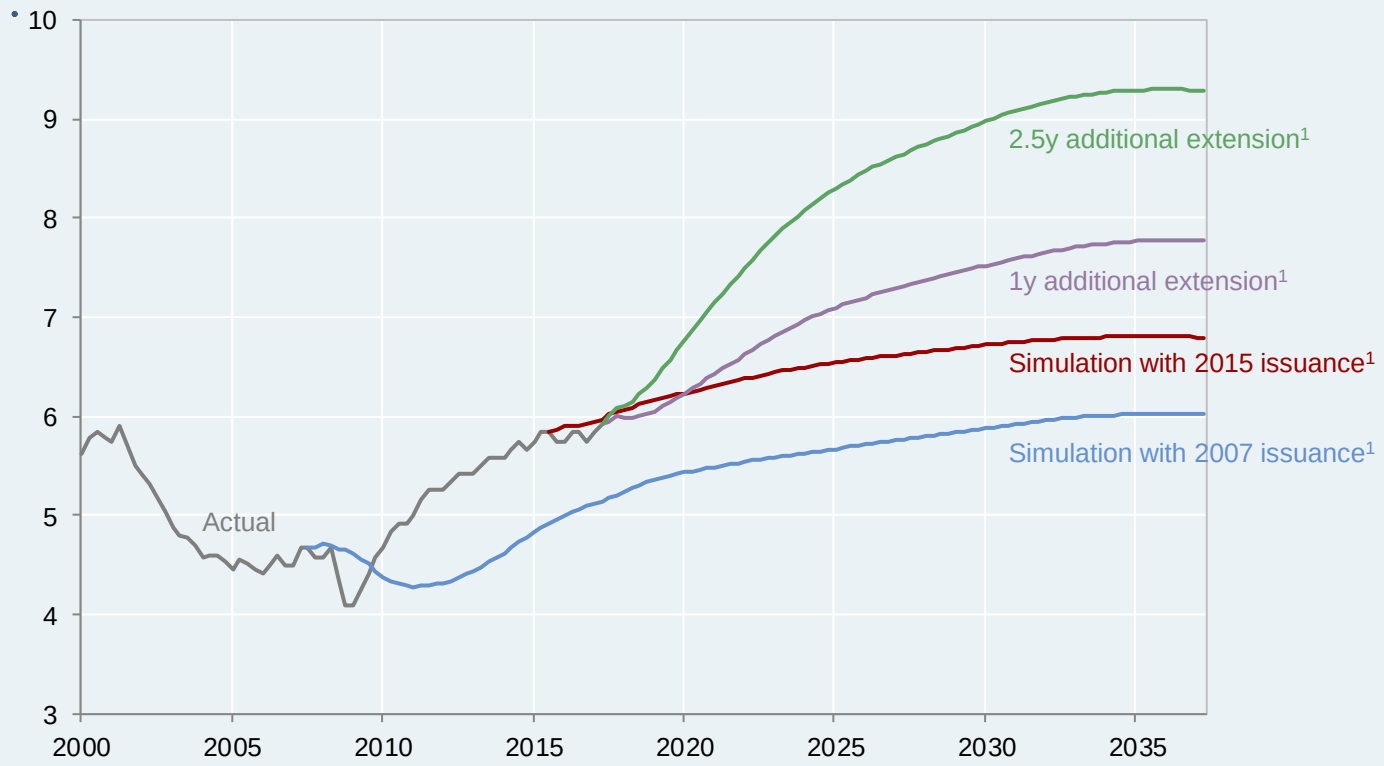


1. See for example Bolder and Deeley, "The Canadian Debt-Strategy Model: An Overview of the Principal Elements", 2011

WAM extension since 2007

- The model can be used to assess the WAM extension that resulted from issuance changes between 2007 and 2015
  - Those issuance changes boosted the projected WAM by nearly a year
- We consider additional debt management changes that would raise long-end issuance enough to boost the projected WAM further

WAM profiles under alternative issuance scenarios

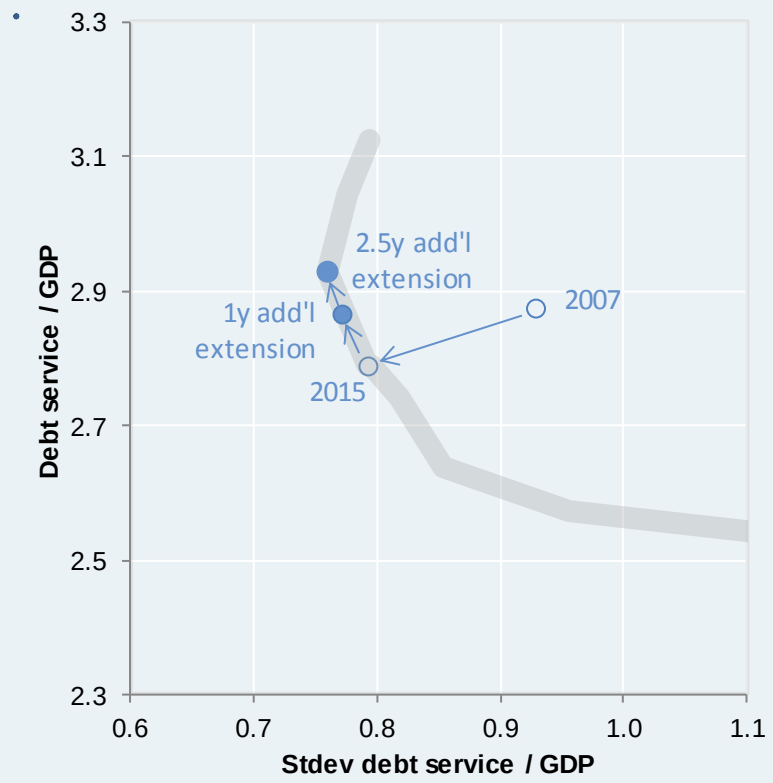


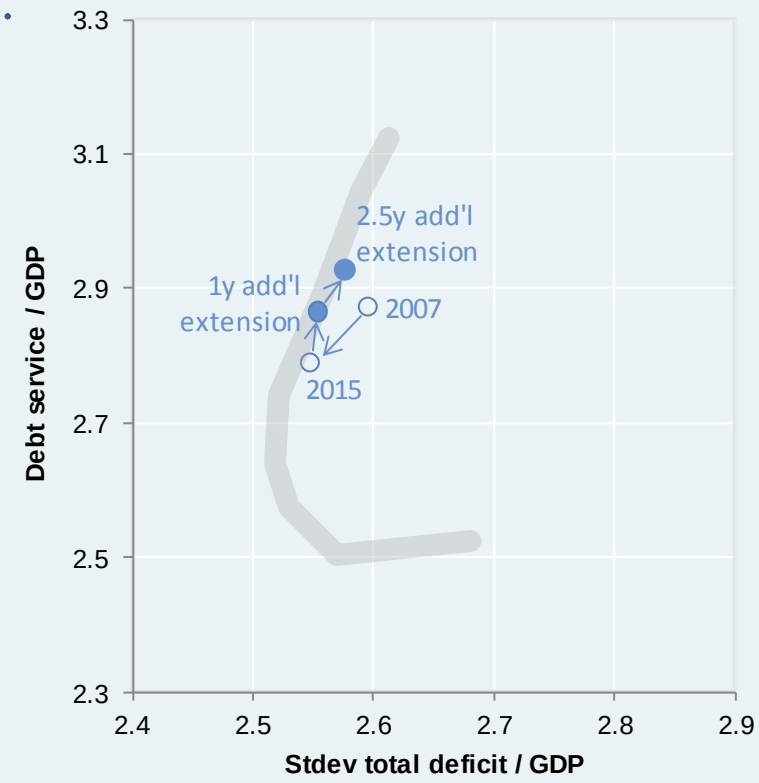
1. Historical simulations from date X assume the issuance pattern as of date X is unchanged over the projection horizon, and jump off from historical debt distribution as of date X. From date X to the present, realized values for macro variables and rates are used. From the present to the end of the projection horizon, model-simulated values are used

WAM extension in the context of the model

- The previous increase in WAM appears to have been relatively efficient in this model, reducing funding risk without raising expected cost
- An additional extension of WAM provides a less favorable trade-off, as it raises funding costs without reducing risk meaningfully (and even raising risk when measured by the standard deviation of the budget)

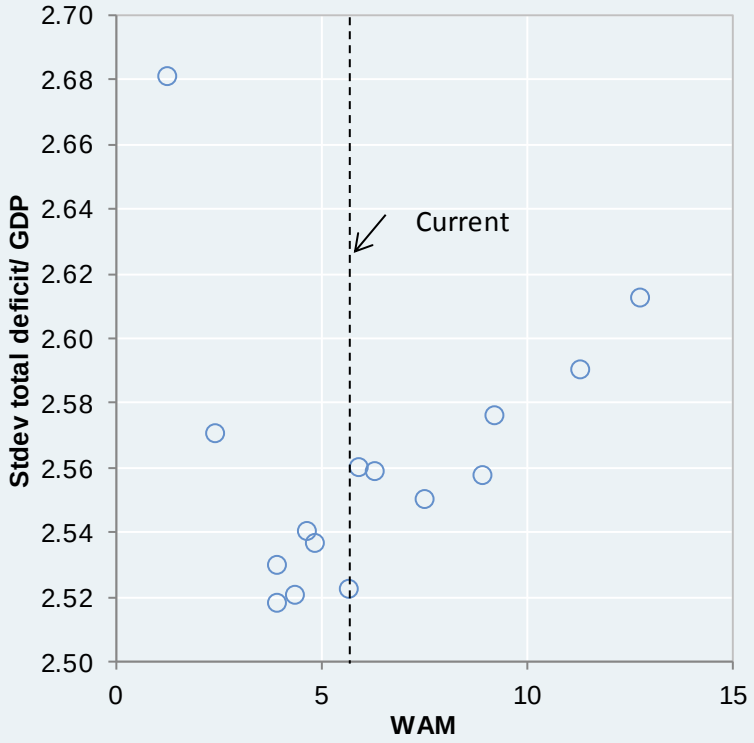
Expected cost / variation trade-off





WAM and alternative measures of funding risk

- WAM has some shortcomings as a proxy for risk. In our simulations, extending WAM is a good proxy for risk reduction only when starting at a short average maturity. After a point, extending the WAM increases risk
- We consider several other summary measures of the debt distribution, including (1) weighted median maturity (WMM), (2) "truncated" WAM, which treats all debt >10y equally in terms of WAM impact, (3) the share of debt maturing in >1y, (4) the share of debt maturing in 2-5y, and (5) a measure of "concentration," or the degree to which the debt outstanding differs from a uniform distribution
- An ideal measure that accurately captures the amount of risk reduction would have a correlation of -1. Among the measures considered, the share of debt maturing in 2-5y has the most negative correlation with our preferred measure of risk, suggesting that it may be a useful measure to consider in addition to WAM



Correlation w/ stdev funding cost[1]		Correlation w/ stdev total deficit[1]	
>1y share	-0.98	2y-5y share	-0.89
TWAM	-0.77	>1y share	-0.44
WAM	-0.70	TWAM	0.02
2y-5y share	-0.55	WAM	0.11
WMM	-0.51	WMM	0.29
Concentration	0.95	Concentration	0.34

1. Points correspond to the strategies explored in Slide 7

Extending the model with a dynamic debt management reaction function

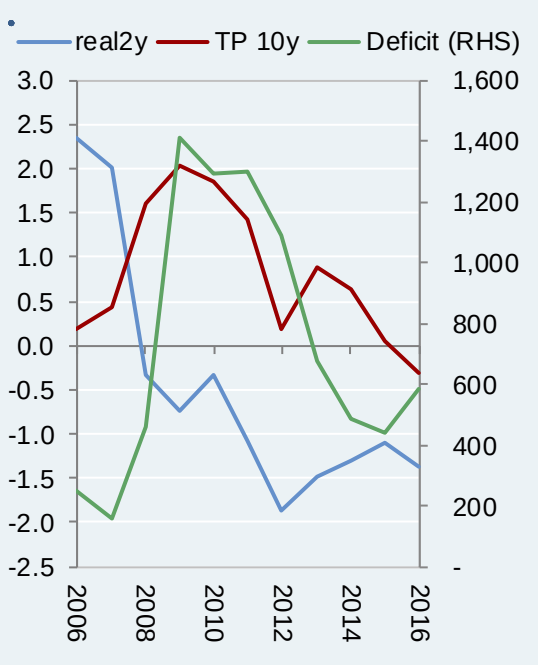
- All of the issuance strategies considered above are static issuance strategies that assume a constant mix of issuance across tenors through time
- We can improve on this approach by allowing the optimal issuance to vary with the macroeconomic environment
- The subsequent slides show preliminary results for an optimal issuance strategy that responds dynamically to budget deficits, term premium and short term real rates
  - Solving for an optimal issuance reaction function rather than fixed issuance weights helps provide useful intuition on how sovereign debt issuers should modify their issuance patterns given changes in the macroeconomic environment
  - The model optimizes by choosing the coefficients of a linear issuance response function in order to minimize the risk-adjusted expected costs of issuance subject to various constraints (see Appendix for detailed description of the model)
  - Use of kernels and the linear response function reduces the dimensionality of the problem and allows for a large set of dynamic issuance strategies to be considered in the optimization

Debt management reaction function has issuance responding significantly to changes in the macroeconomic environment

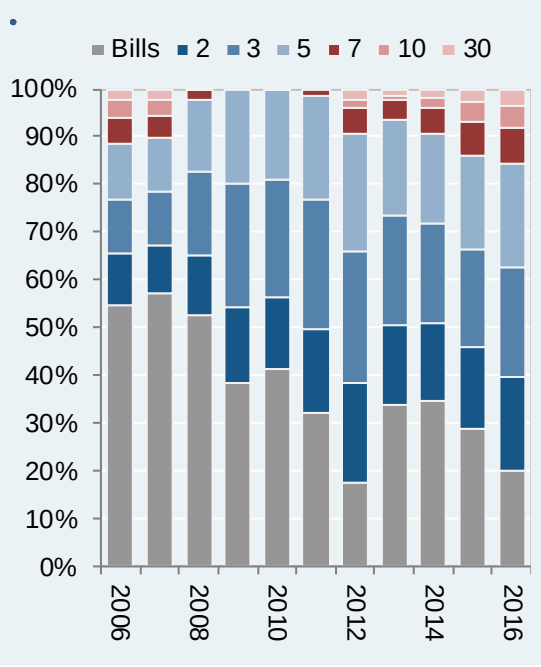
- In general, optimal issuance can respond significantly to macroeconomic variables (MEVs), including deficits, rates, and term premium
  - Rising deficits generally favor a rotation out of bills into the belly of the curve
  - High term premium favors a higher proportion of issuance in bills versus all coupons
  - High real 2-year rates favors a rotation from the belly into bills
- Declining term premium and low 2-year real yields has caused the optimal mix to trend towards intermediates over time

Sensitivity of optimal issuance to MEVs; % pts per 1 sigma move in MEV

Macroeconomic variables



Optimal issuance mix[1]

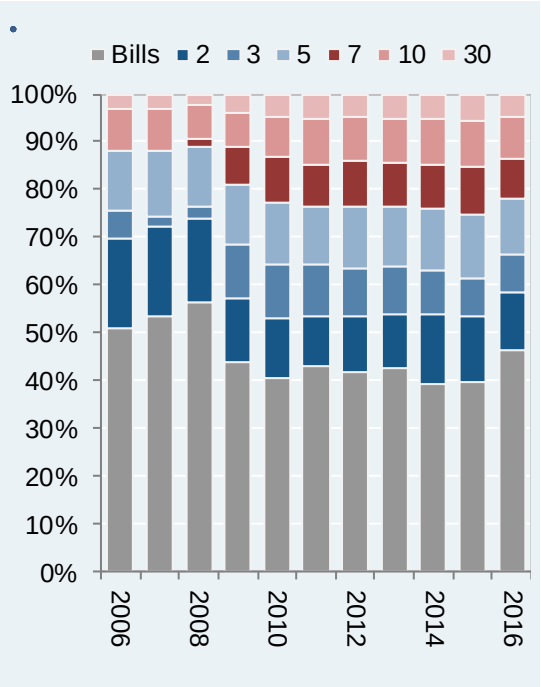


1. Bill issuance across varying tenors are all scaled to 1-year (52-week) tenor, i.e. 100B of 26-week Bills scales to 50B of 1-year equivalent Bills

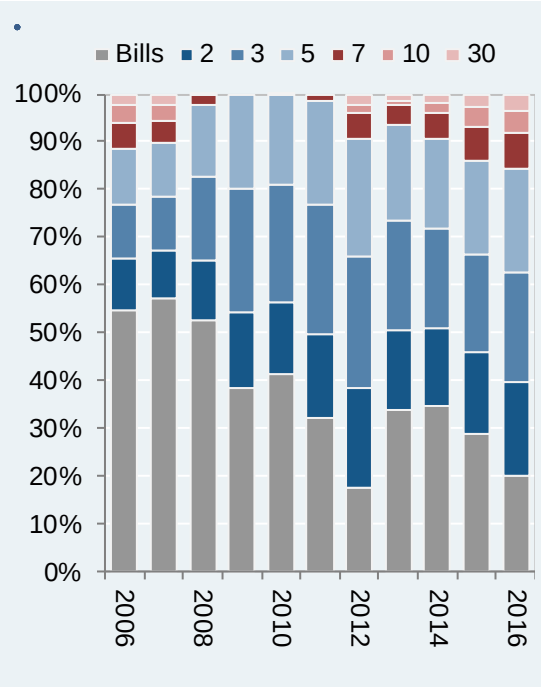
Issuance under the dynamic reaction function compared to historical issuance

- Actual issuance patterns have been more stable over time than what is signaled by the optimization model; in part this reflects the importance of regular and predictable issuance for Treasury
  - Variability in optimal issuance over time most pronounced in bills and intermediates; by contrast, the recommended allocation to the long end is more stable over the sample
- Reaction function has consistently favored a lower allocation to bills and higher allocation to intermediates than actual issuance
- Today's optimal mix recommends close to the largest allocation to intermediates of the last decade
  - Model currently favors over 60% of issuance in 2s/3s/5s and less than 25% in bills
  - Primarily reflects low real rates, and rising budget deficits

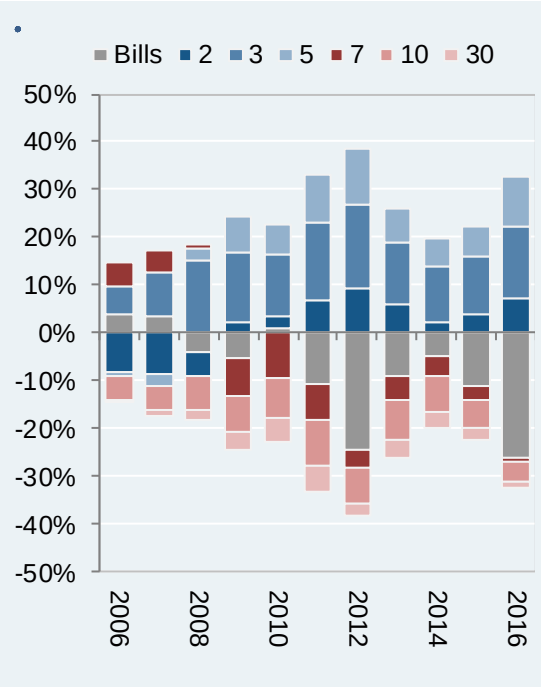
Actual historical issuance mix[1]



Optimal issuance mix[1]



Δ optimal – actual historical mix

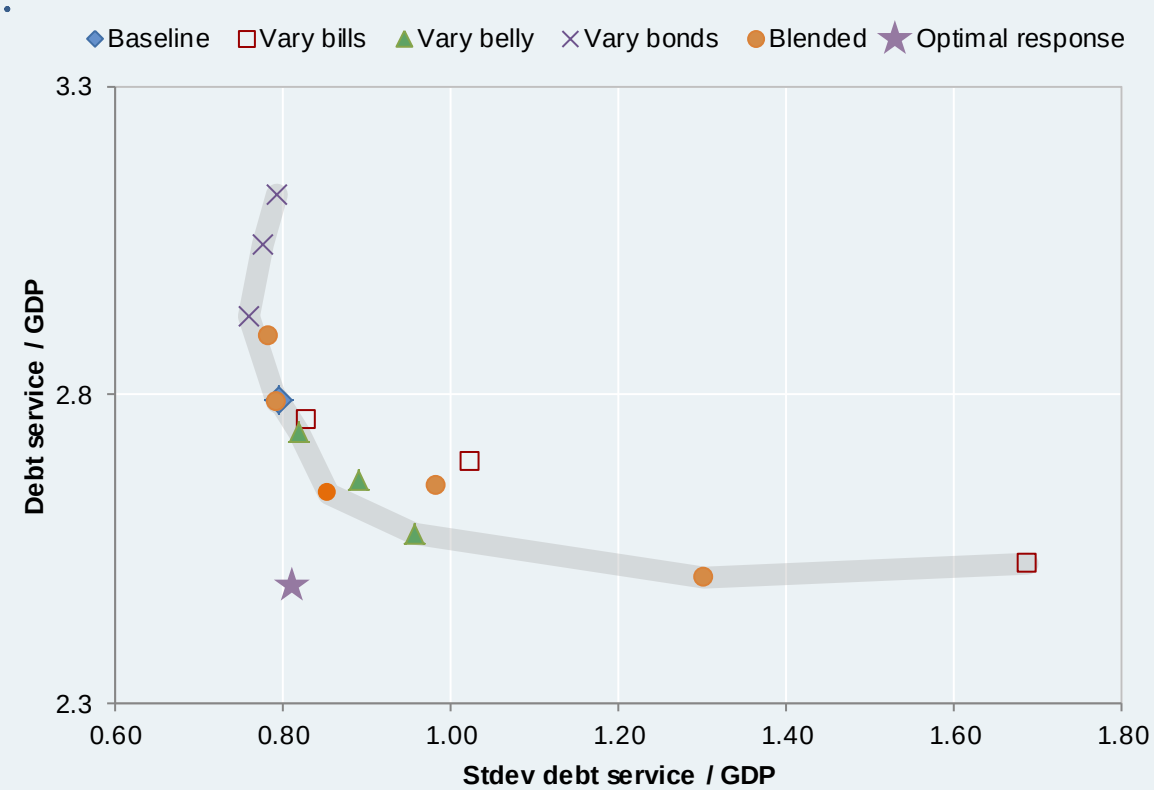


1. Bill issuance across varying tenors are all scaled to 1-year (52-week) tenor, i.e. 100B of 26-week Bills scales to 50B of 1-year equivalent Bills

Risk/return improvements from dynamic debt management reaction function

- Compared to a static issuance strategy, the debt management reaction function allows debt managers to pursue strategies with lower expected cost for a given volatility level
- In the chart below, the star provides the expected cost and volatility generated from the debt management reaction function; this lies below the efficient frontier, indicating a better outcome for debt managers compared to the static issuance strategies
- One caveat is that the model is not taking into account the importance of regular and predictable issuance for maintaining low issuance costs

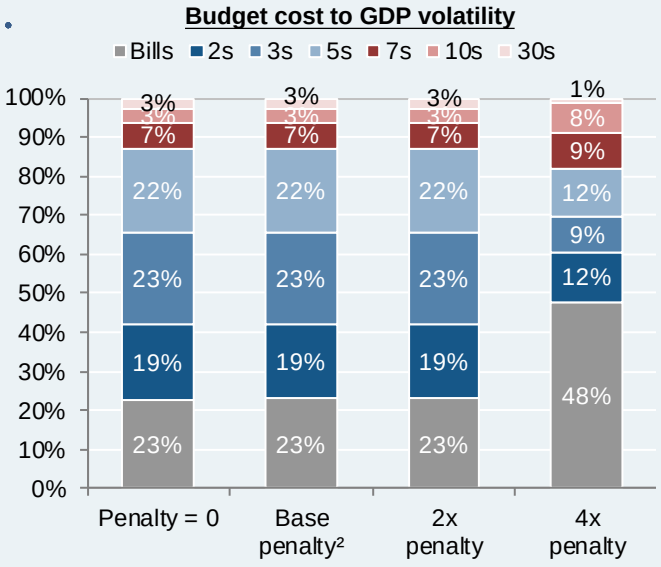
Expected cost/variance tradeoff

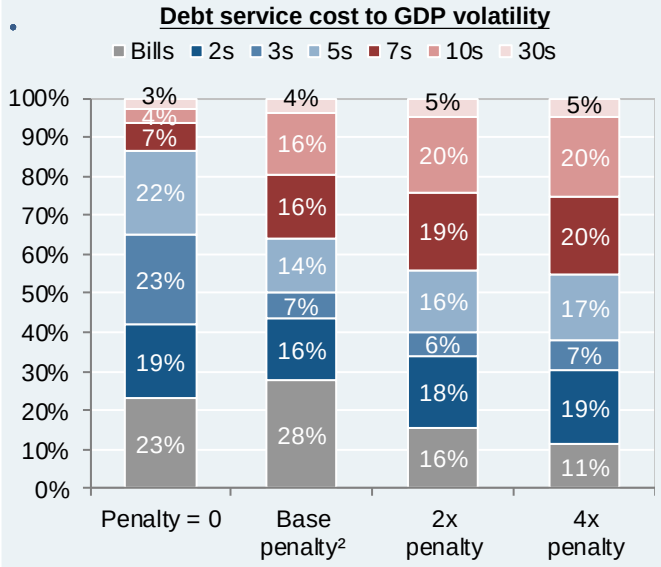


Risk/cost tradeoffs in dynamic optimization

- The chart below examines how optimal issuance changes with varying degrees of risk aversion on the part of the debt manager; risk is quantified using 2 different measures; the first (LHS chart) relates to the volatility of budget deficits relative to GDP while the second (RHS chart) relates to the volatility of debt servicing costs relative to GDP. In both cases we add a penalty cost to the objective function that increases with the measure of risk
- In the current macroeconomic environment, the optimal mix is relatively insensitive to the degree of risk aversion under both risk measures with the mix changing only for very large values of the penalty cost
- At high enough risk levels, the optimal mix shifts more heavily out of intermediates into bills when the penalty relates to budget volatility; as discussed above, this reflects the negative correlation in the model between rates and levels of primary deficits
- When the penalty cost relates to debt servicing cost volatility, the optimal mix shifts out of bills into the long end; for moderate to high levels of risk aversion, the reaction function recommends a significant allocation to the long end

Current issuance mix as we change penalty cost on budget or debt service volatility[1]





Objective function cost ($B)	524	1,020	1,516	2,507
Debt service cost ($B)	524	524	524	528
Penalty cost ($B)	-	496	992	1,979
Debt service cost / GDP (bps)	250	250	250	251

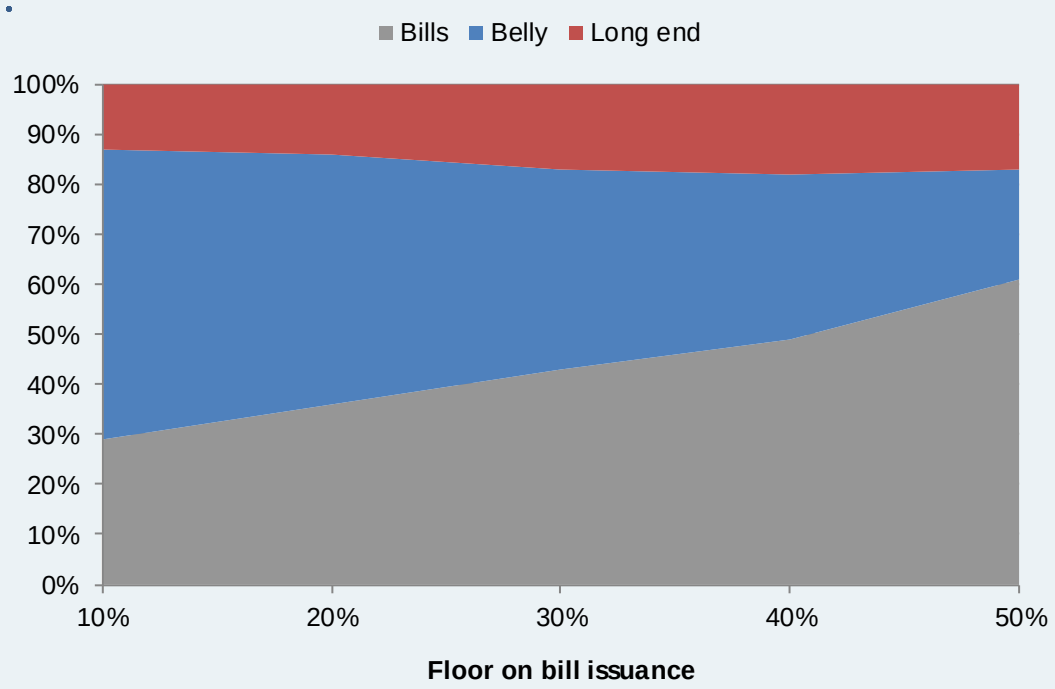
524	982	1,430	2,323
524	532	536	538
-	450	894	1,785
250	253	255	256

1. Penalty cost applied to volatility measure; Left hand side = volatility of budget cost /GDP; Right hand side = volatility of debt service cost /GDP
2. Base penalty set so that penalty cost = average debt servicing cost in 0 penalty case ($524B); 2x penalty cost = 2x base penalty cost

Optimal coupon mix under different scenarios for bill supply

- A useful application of debt optimization models is to assess how issuance should change when other constraints are added to the debt manager's objective function.
- For example, to meet investor demand for liquidity, it may be desirable for Treasury to increase the stock of outstanding bills even if it raises the variation in finding costs. The chart below summarizes how the optimal issuance changes when bill issuance is constrained to be above various thresholds.
- As the desired level of bill issuance increases, optimization generally favors maintaining long end issuance with cuts in intermediate issuance absorbing all of the impact of increased bill supply
- Thus, while much of the earlier discussion supports expanding intermediate issuance, the model is also willing to substitute between the belly and bills as part of a broader mandate of meeting investor demand for bill supply

Optimal issuance mix with various floors on bill issuance



Model limitations

- As with any model, our debt optimization framework relies on a number of key inputs and assumptions in both the macroeconomic model and optimization framework. In some cases, sensitivity to these inputs are high and changing them could change the conclusions from the model. Key sensitivities worth highlighting include:
  - Supply effects: Introducing a feedback loop where term premium and/or rates are responsive to issuance choices would likely bias the results further away from long end issuance
  - Yield curve parameters: Assuming a model structure with greater scope for the overall level of rates to drift higher over time might support more long-end issuance
  - Issuance constraints: Incorporating additional constraints on issuance such as regular and predictable issuance, liquidity-based constraints on bill supply, or other issuance-related constraints could change the results of the optimizer
  - Types of securities: The model considers only bills and nominal coupons and excludes TIPs and FRNs; extending the analysis to include a broader set of issues could change the results
  - Objective function: The current model minimizes risk-adjusted expected costs subject to various constraints but other objective functions could be used that would generate different results

Conclusions

- The modeling work discussed here, while having limitations, provides some meaningful insights into the relevant tradeoffs for Treasury in meeting its increased funding needs

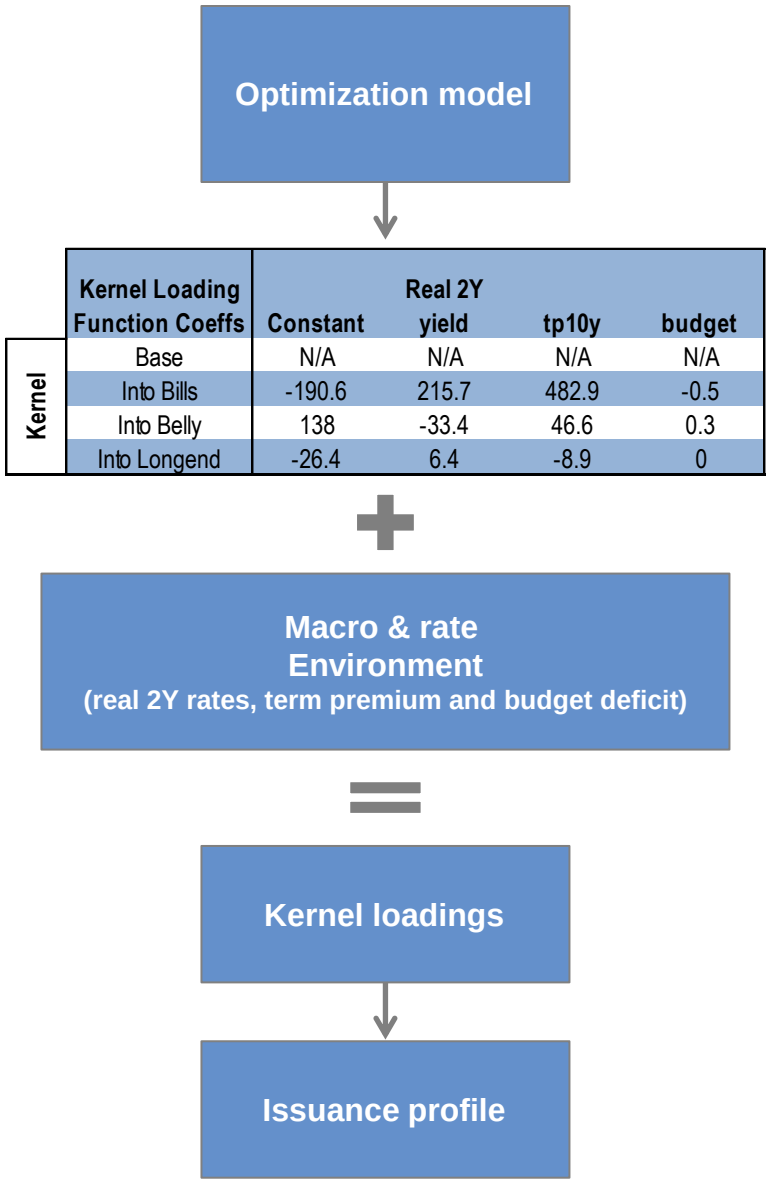
- The projected path of debt supply will likely require issuance to increase across a range of maturities. However, the optimization framework at least offers a few guideposts for those decisions. It suggests:
  - Issuance in the 2-, 3-, and 5-year sector of the curve is attractive for meeting the higher funding needs
    - These tenors provide an effective trade-off between expected cost and risk, whether risk is measured by the variation in funding costs or budget deficits
    - Further extension of WAM from current levels by increasing long end issuance appears inefficient today compared to the past
    - The framework also highlights that the current environment of low real yields, low term premium, and rising budget deficits favors issuance in the belly of the curve
  - Increased long end issuance could be appropriate in certain cases
    - In general the model wants to lean away from long-end issuance
    - Heavier reliance on long end issuance may be attractive when the debt manager views the cost of risk as high and risk is measured by the variation in funding costs
    - Long- end issuance is also favored more when the macroeconomic environment is characterized by low deficits, and significantly negative term premium
    - The possibility that the overall level of rates may drift more over time than captured in the model could also support long- end issuance
    - Finally, a heavier allocation to long end issuance might be appropriate when coupled with increased bill supply to achieve a broader mandate on the part of the debt manager to meet investor demand for liquidity
  - Increased reliance on bill issuance could also be appropriate in certain cases
    - The model generally prefers to move issuance from bills into intermediate maturities
    - Bill issuance is more attractive when the term premium is high and budget deficits are low, which are not conditions that we see in place today
    - However, the model also suggests that debt managers should be more willing to substitute bills for intermediate maturities when risk is measured by the volatility of budget deficits costs (rather than debt servicing costs)

Agenda

An illustration of the response function approach

- Once the kernels are specified, actual gross issuance notional amounts in each tenor are determined by the weights applied to each kernel. We refer to these weights as kernel loadings
- The loading on Kernel 1 (the baseline kernel) is determined by the total amount of gross issuance needed in any given period. As such, this loading is determined by the funding need, rather than by any active decision making
- However, the loadings on all the other kernels represent decisions to shift the issuance profile away from its baseline pattern. In our approach, the loadings on these kernels are modeled as linear functions of certain rate and macro variables. It is these coefficients that are the real target of the optimization model
- In our implementation, kernel loadings (except for the base kernel) are modeled as linear functions of:
  - Real 2Y yield
  - 10Y ACM term premium, and the
  - Primary budget deficit, in dollars
- The table on the right includes the optimal response function produced by the model
  - Low real yields in the front end, and/or high longer end term premium, warrant shifting issuance into Bills
  - High term premium also warrants moving out of the Long End and into the Belly

Schematic illustrating the translation of optimal response function weights into kernel loadings and issuance notionals



A high level description of the dynamic optimization model

Decision variables

- Coefficients that determine the “response function” that relates the loadings on each issuance kernel to the macro/market variables it is allowed to depend on

Objective function

- Minimize risk-adjusted expected value (across paths) of PV of costs of new debt issuance over long term (e.g. 40-year) horizon
- Risk-adjusted expected value=expected debt servicing costs + penalty cost for risk
  - Risk measured as the sum (across paths) of absolute deviations of the cost along each path from a central cost. This is the linear analogue to a limit on the variance of cost across paths

Constraints

- Tenor profile: Optimal response function coefficients, along with knowledge of the macro and market conditions in each time step and in each path, specify the gross issuance amounts in each tenor at each time step (in each path)
- Issuance capacity: Minimum (possibly for sector presence reasons) and maximum issue size in each tenor; maximum change in issuance size in any period for each tenor; upper bound on duration-weighted gross issuance (Currently set to wide bands for “blue-skies” analysis that is intended to relax constraints related to current issuance practice)
- Fiscal equation: Total gross issuance = Primary budget deficit + Maturing amount + 1-period debt service costs, for each period

Comments

- Data regarding the debt stock at inception was sourced from the US Treasury
- Simulated MEV for paths sourced from our Macroeconomic simulation model