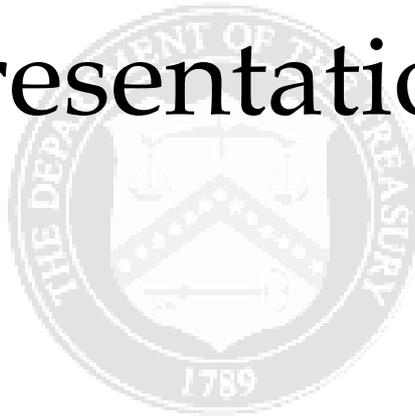


Treasury Presentation to TBAC



Office of Debt Management



Fiscal Year 2018 Q3 Report

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Section I: Executive Summary



Highlights of Treasury's August 2018 Quarterly Refunding Presentation to the Treasury Borrowing Advisory Committee (TBAC)

Receipts and Outlays

- As the end of June, fiscal-year-to-date receipts were up \$33 billion (1%). Adjusted Non-Withheld Income and SECA taxes were up \$78 billion (16%), most of which occurred during April when strong final payments were made for 2017 liabilities. Adjusted Withheld Income and FICA taxes were up \$33 billion (2%), reflecting growth in both employment and wages. These increases were partially offset by lower gross corporate taxes \$51 billion (20%), reflecting the corporate tax rate reduction and the expanded ability to immediately deduct the full value of equipment purchases.
- After calendar adjustments, fiscal-year-to-date outlays were \$123 billion (4%) higher than the comparable period last year. Department of Treasury outlays were \$57 billion (12%) higher due primarily to increased interest on the public debt \$38 billion (10%) and lower overall receipts from the GSEs.

Projected Net Marketable Borrowing (FY2018)

- Based on the Quarterly Borrowing Estimate, Treasury's Office of Fiscal Projections (OFP) currently estimates a net privately-held marketable borrowing need of \$329 billion for Q4 FY 2018, with an end-of-September cash balance of \$350 billion. For Q1 FY 2019, the net privately-held marketable borrowing need is projected to be \$440 billion, with an end-of-December cash balance of \$390 billion. OFP's FY 2018 projection for net privately-held marketable borrowing is \$1,172 billion. Privately-held marketable borrowing excludes rollovers (auction "add-ons") of Treasury securities held in the Federal Reserve's System Open Market Account (SOMA), but includes financing required due to SOMA redemptions.
- Other agencies' forecasts do not include the concept of privately-held marketable borrowing when discussing financing requirements, but rather net marketable borrowing. OFP's net marketable borrowing estimate is \$1,016 billion, OMB's estimate is \$1,127 billion, and CBO's is \$1,011 billion.

Projected Net Marketable Borrowing (FY2019)

- Recent deficit estimates contained in OMB's "Mid-Session-Review, Fiscal Year 2019" (July 2018) in conjunction with SOMA redemptions suggest that Treasury auction sizes will need to rise over the next few years. CBO's updated budget projections are not yet available.

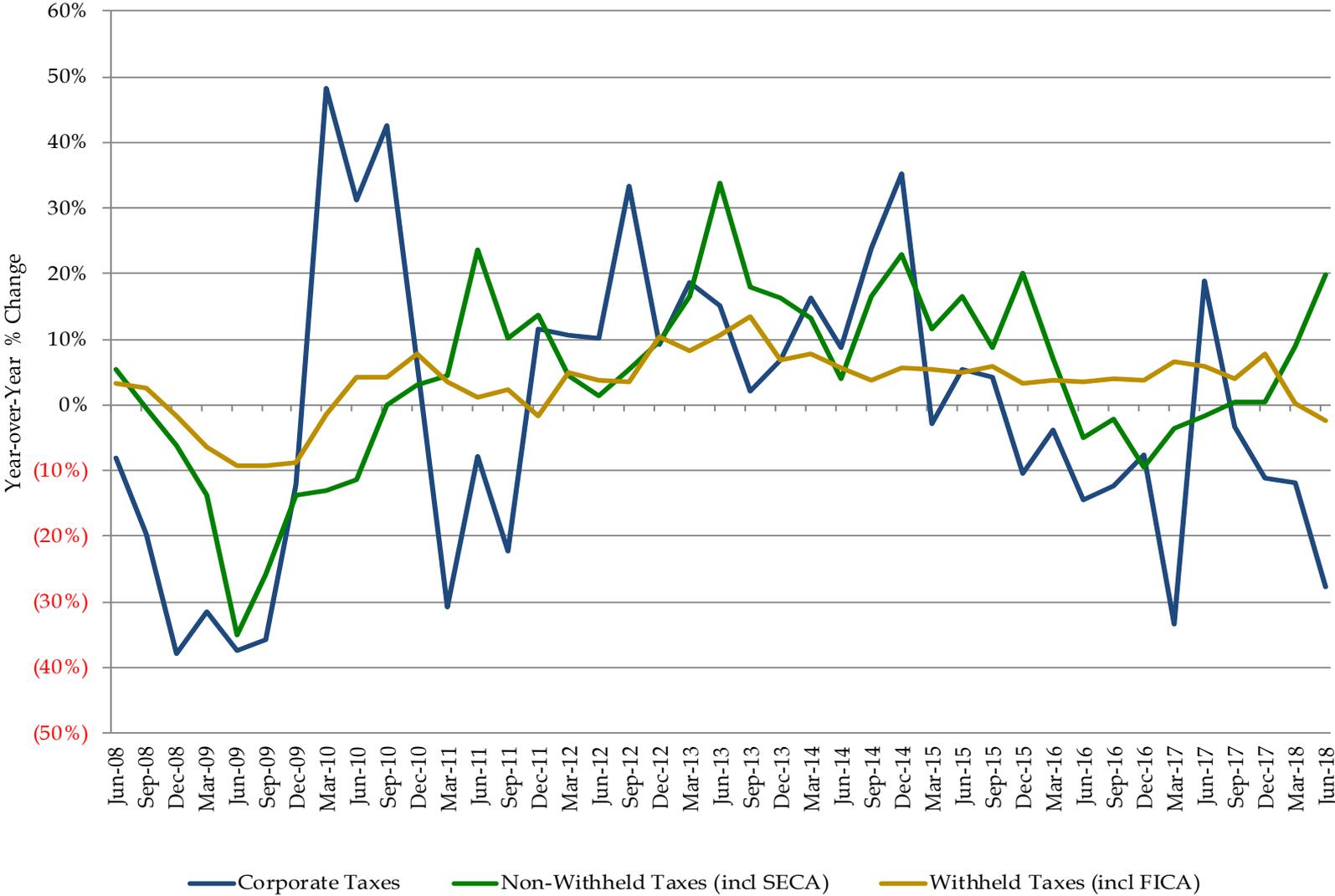
Demand for Treasury Securities

- Bid-to-cover ratios for all products were largely stable over the last quarter.
- Foreign demand remained steady.

Section II: Fiscal

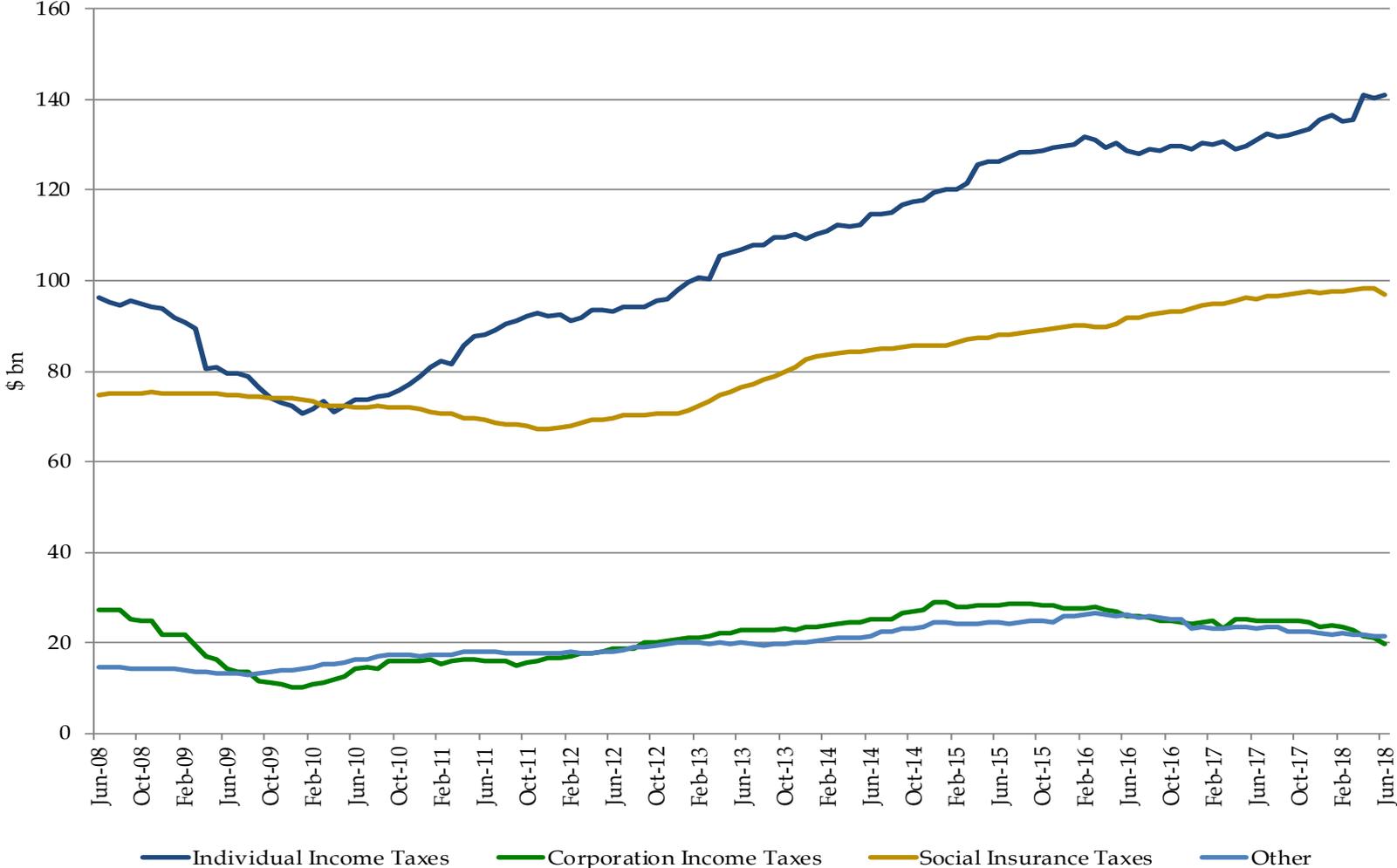


Quarterly Tax Receipts



Source: United States Department of the Treasury

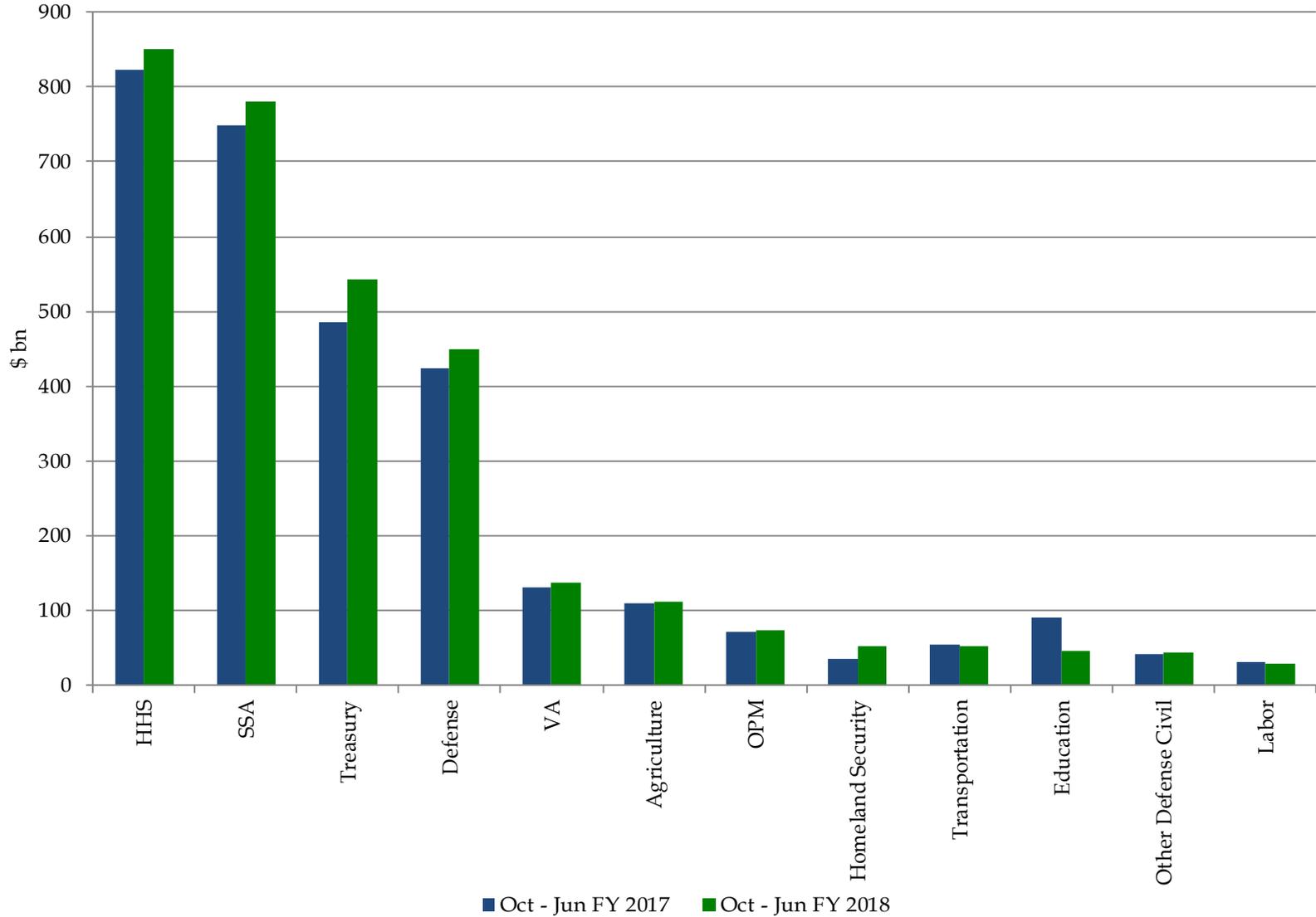
Monthly Receipt Levels (12-Month Moving Average)



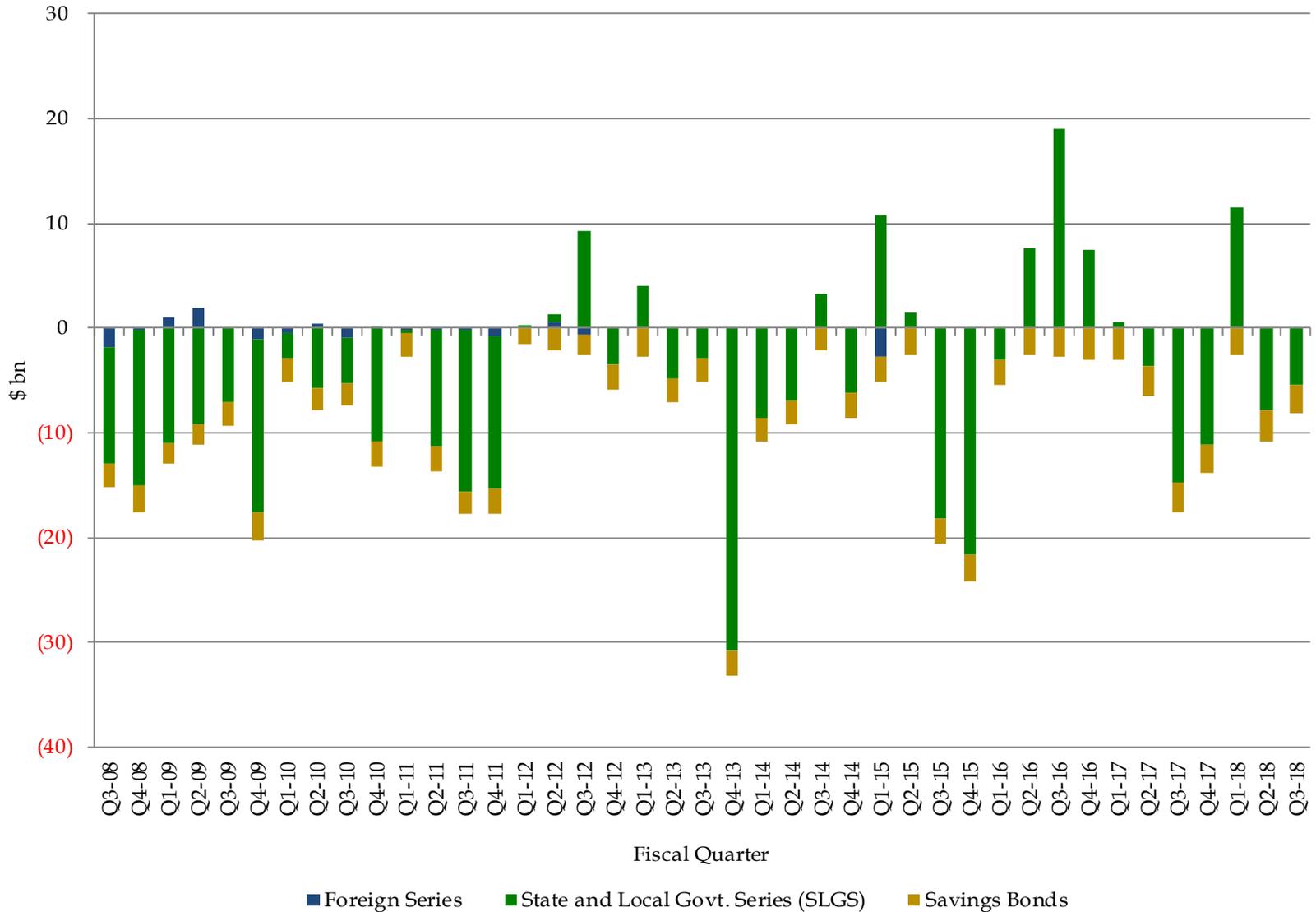
Individual Income Taxes include withheld and non-withheld. Social Insurance Taxes include FICA, SECA, RRTA, UTF deposits, FUTA and RUIA. Other includes excise taxes, estate and gift taxes, customs duties and miscellaneous receipts.

Source: United States Department of the Treasury

Largest Outlays

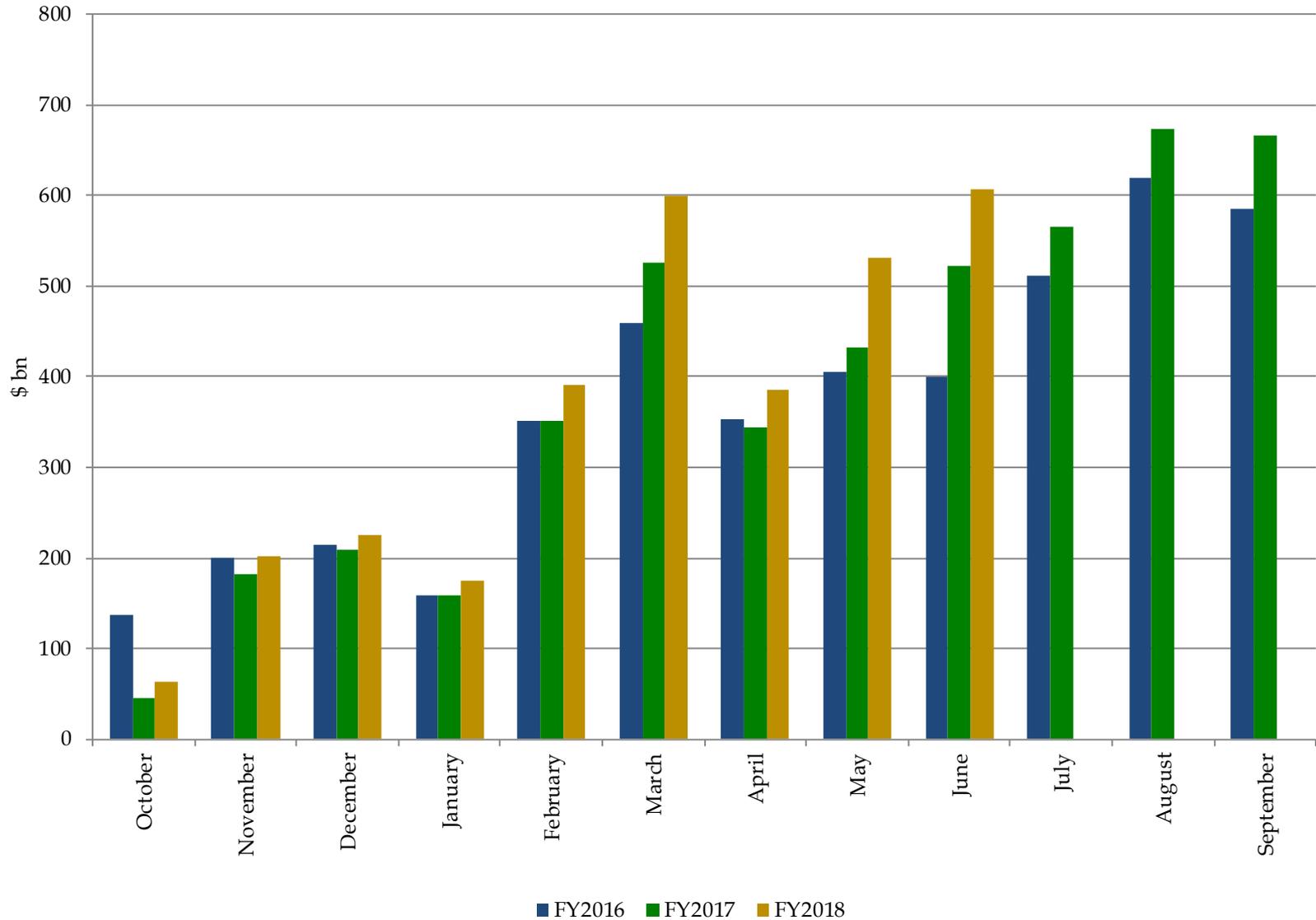


Treasury Net Nonmarketable Borrowing



Source: United States Department of the Treasury

Cumulative Budget Deficits by Fiscal Year



FY 2018-2020 Deficits and Net Marketable Borrowing Estimates in \$ billions

	Primary Dealers ¹	OFP ²	OMB ³	CBO ⁴	OMB ⁵
FY 2018 Deficit Estimate	815		849	792	832
FY 2019 Deficit Estimate	1,010		1,086	955	984
FY 2020 Deficit Estimate	1,100		1,076	866	987
FY 2018 Deficit Range	750-895				
FY 2019 Deficit Range	959-1,150				
FY 2020 Deficit Range	969-1,250				
FY 2018 Privately-Held Net Marketable Borrowing Estimate*	1,098	1,172			
FY 2019 Privately-Held Net Marketable Borrowing Estimate	1,292				
FY 2020 Privately-Held Net Marketable Borrowing Estimate	1,250				
FY 2018 Privately-Held Net Marketable Borrowing Range	899-1,251				
FY 2019 Privately-Held Net Marketable Borrowing Range	868-1,480				
FY 2020 Privately-Held Net Marketable Borrowing Range	903-1,580				
FY 2018 SOMA Redemption Estimate	175	156			
FY 2019 SOMA Redemption Estimate	285				
FY 2020 SOMA Redemption Estimate	225				
FY 2018 Net Marketable Borrowing Estimate	923	1,016	1,127	1,011	1,124
FY 2019 Net Marketable Borrowing Estimate	1,007		1,186	1,049	1,082
FY 2020 Net Marketable Borrowing Estimate	1,025		1,164	924	1,075
Estimates as of:	Jul-18	Jul-18	Jul-18	May-18	Feb-18

¹Based on primary dealer feedback in July 2018. Estimates above are medians.

²Treasury's Office of Fiscal Projections (OFP) borrowing estimates announced on July 30, 2018

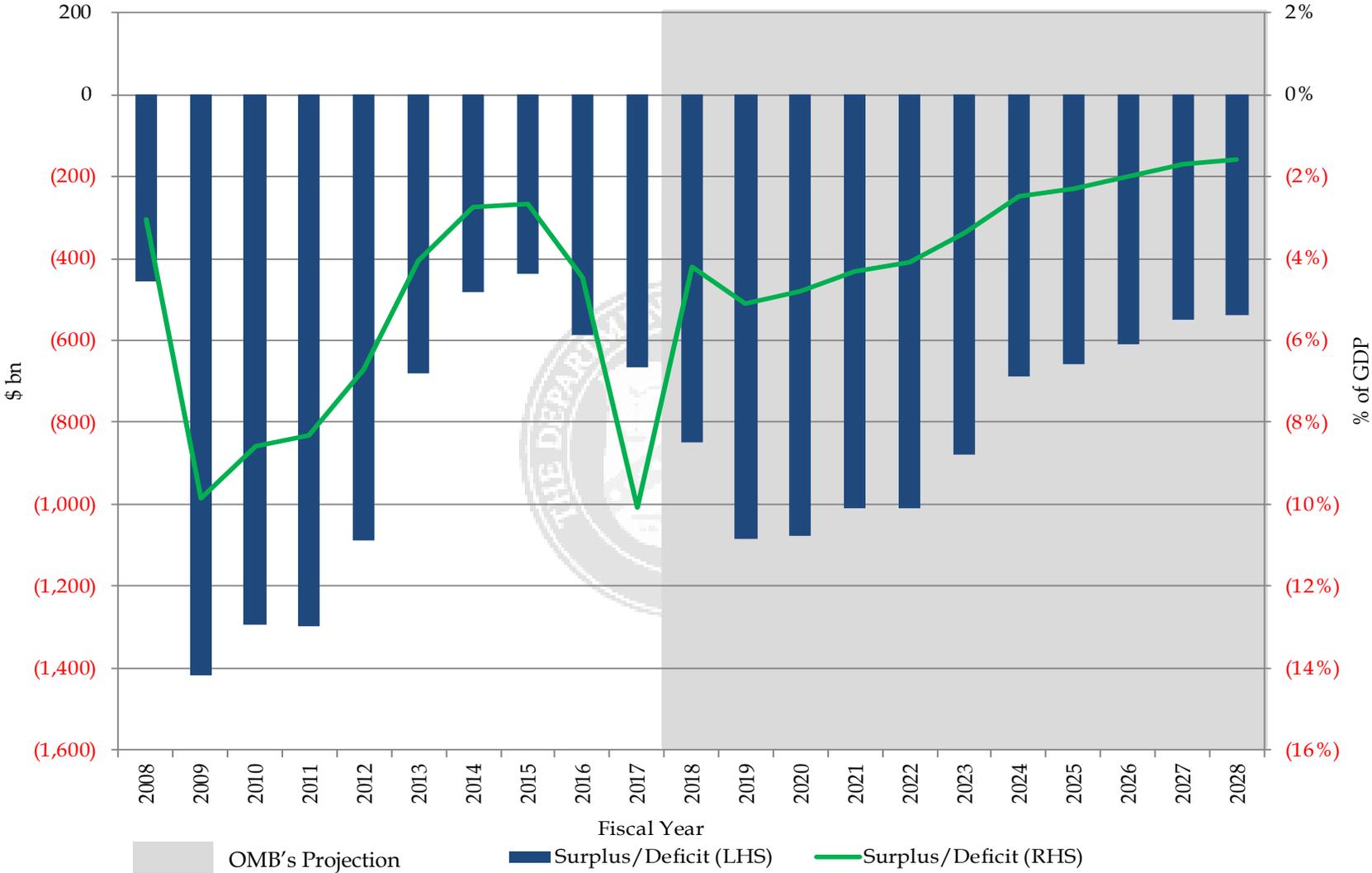
³Table S-11 of OMB's "Mid-Session Review, Fiscal Year 2019," July 2018.

⁴Table 2 of CBO's "An Analysis of the President's 2019 Budget," May 2018.

⁵Table S-10 of OMB's "Budget of the United States Government, Fiscal Year 2019," February 2018.

*Privately-held marketable borrowing excludes rollovers (auction "add-ons") of Treasury securities held in the Federal Reserve's System Open Market Account (SOMA), but includes financing required due to SOMA redemptions.

Budget Surplus/Deficit



Projections are from OMB's Table S-11 of "Mid-Session Review, Fiscal Year 2019," July 2018.

Section III: Financing



Assumptions for Financing Section (pages 15 to 20)

- Portfolio and SOMA holdings as of 6/30/2018.
- Estimates assume an end date for SOMA capped redemptions at the end of CY2020. The assumption is based on the median case from “Statement Regarding the Annual Report on Open Market Operations during 2017,” Federal Reserve Bank of New York, April 2018.
- Estimates assume announced issuance sizes and patterns remain constant for nominal coupons, TIPS, and FRNs given changes made at May 2018 refunding, while using a total of ~\$2.16 trillion of bills outstanding.
- The principal on the TIPS securities was accreted to each projection date based on market ZCIS levels as of 6/30/2018.
- No attempt was made to account for future financing needs.



Sources of Privately-Held Financing in Fiscal Year FY18 Q3*

April - June 2018	
Net Bill Issuance	(131)
Net Coupon Issuance	203
Subtotal: Net Marketable Borrowing	72
Ending Cash Balance	333
Beginning Cash Balance	290
Subtotal: Change in Cash Balance	43
Net Implied Funding for FY18 Q3**	29

Security	April - June 2018 Bill Issuance			Fiscal Year-to-Date Bill Issuance		
	Gross	Maturing	Net	Gross	Maturing	Net
4-Week	550	670	(120)	1,770	1,755	15
13-Week	624	642	(18)	1,821	1,710	111
26-Week	546	477	69	1,587	1,341	246
52-Week	78	60	18	224	200	24
CMBs	0	80	(80)	139	179	(40)
Bill Subtotal	1,798	1,929	(131)	5,541	5,185	356

Security	April - June 2018 Coupon Issuance			Fiscal Year-to-Date Coupon Issuance		
	Gross	Maturing	Net	Gross	Maturing	Net
2-Year FRN	64	41	23	135	123	12
2-Year	95	78	17	253	156	97
3-Year	93	72	21	243	222	21
5-Year	106	90	16	311	345	(34)
7-Year	88	37	51	257	155	102
10-Year	68	12	56	196	52	144
30-Year	44	3	41	124	3	121
5-Year TIPS	16	53	(37)	30	53	(23)
10-Year TIPS	11	0	11	46	16	30
30-Year TIPS	5	0	5	17	0	17
Coupon Subtotal	590	387	203	1,612	1,125	487

Total	2,388	2,316	72	7,153	6,310	843
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*Privately-held marketable borrowing excludes rollovers (auction “add-ons”) of Treasury securities held in the Federal Reserve’s System Open Market Account (SOMA), but includes financing required due to SOMA redemptions.

**An end-of-June 2018 cash balance of \$333 billion versus a beginning-of-April 2018 cash balance of \$290 billion. By keeping the cash balance constant, Treasury arrives at the net implied funding number.

Sources of Privately-Held Financing in Fiscal Year FY18 Q4*

July - September 2018	
Assuming Constant Coupon Issuance Sizes**	
Treasury Announced Net Marketable Borrowing***	329
Net Coupon Issuance	260
Implied Change in Bills	69

Security	July - September 2018 Coupon Issuance			Fiscal Year-to-Date Coupon Issuance		
	Gross	Maturing	Net	Gross	Maturing	Net
2-Year FRN	50	41	9	185	164	21
2-Year	104	78	26	357	234	123
3-Year	99	72	27	342	294	48
5-Year	108	53	55	419	398	21
7-Year	90	69	21	347	224	123
10-Year	69	14	55	265	66	199
30-Year	45	0	45	169	3	166
5-Year TIPS	14	0	14	44	53	(9)
10-Year TIPS	24	16	8	70	32	38
30-Year TIPS	0	0	0	17	0	17
Coupon Subtotal	603	343	260	2,215	1,469	746

*Privately-held marketable borrowing excludes rollovers (auction “add-ons”) of Treasury securities held in the Federal Reserve’s System Open Market Account (SOMA), but includes financing required due to SOMA redemptions.

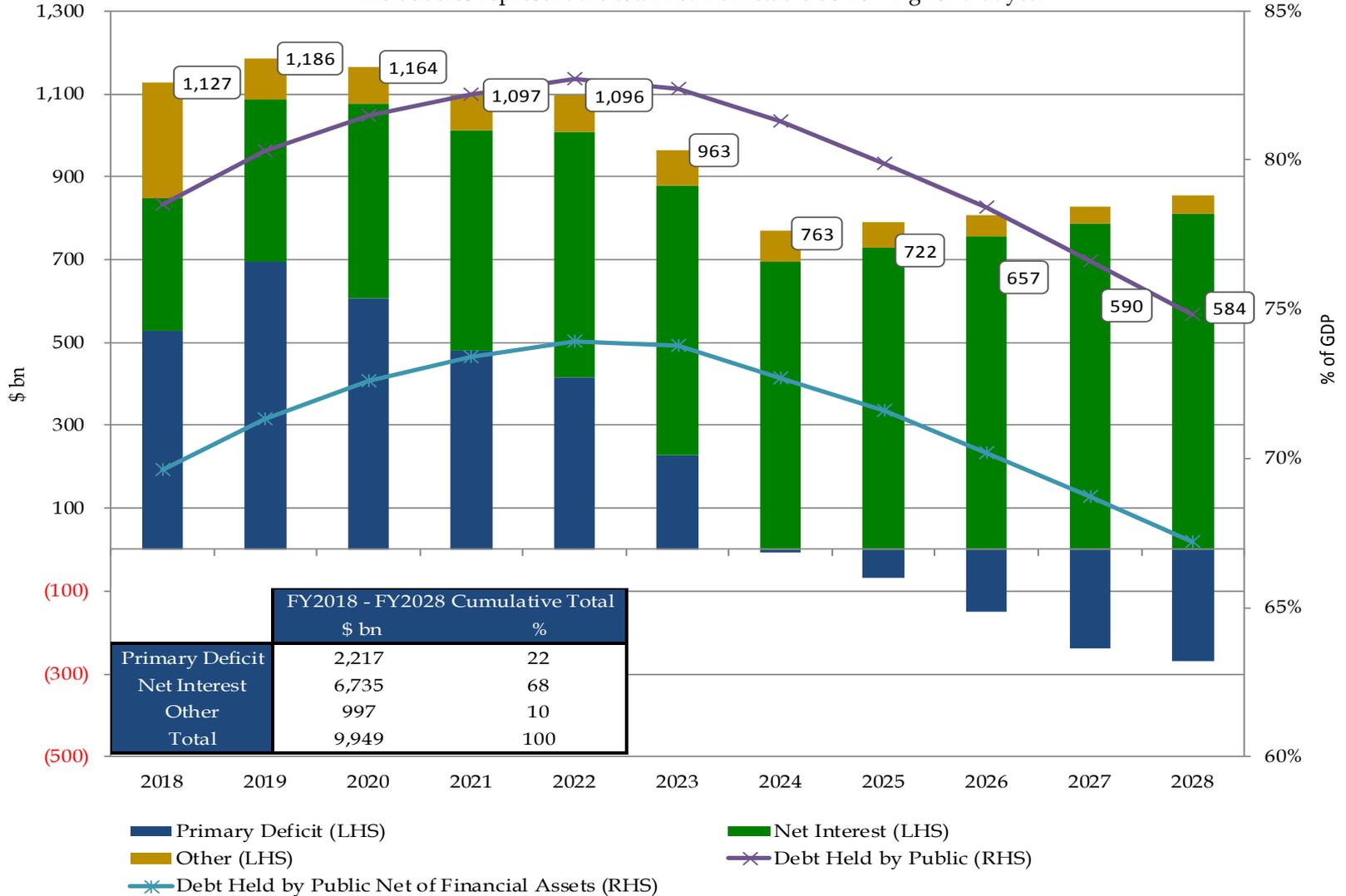
**Keeping announced issuance sizes and patterns constant for nominal coupons, TIPS, and FRNs based on changes made at the May 2018 refunding.

***Assumes an end-of-September 2018 cash balance of \$350 billion versus a beginning-of-July 2018 cash balance of \$333 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>

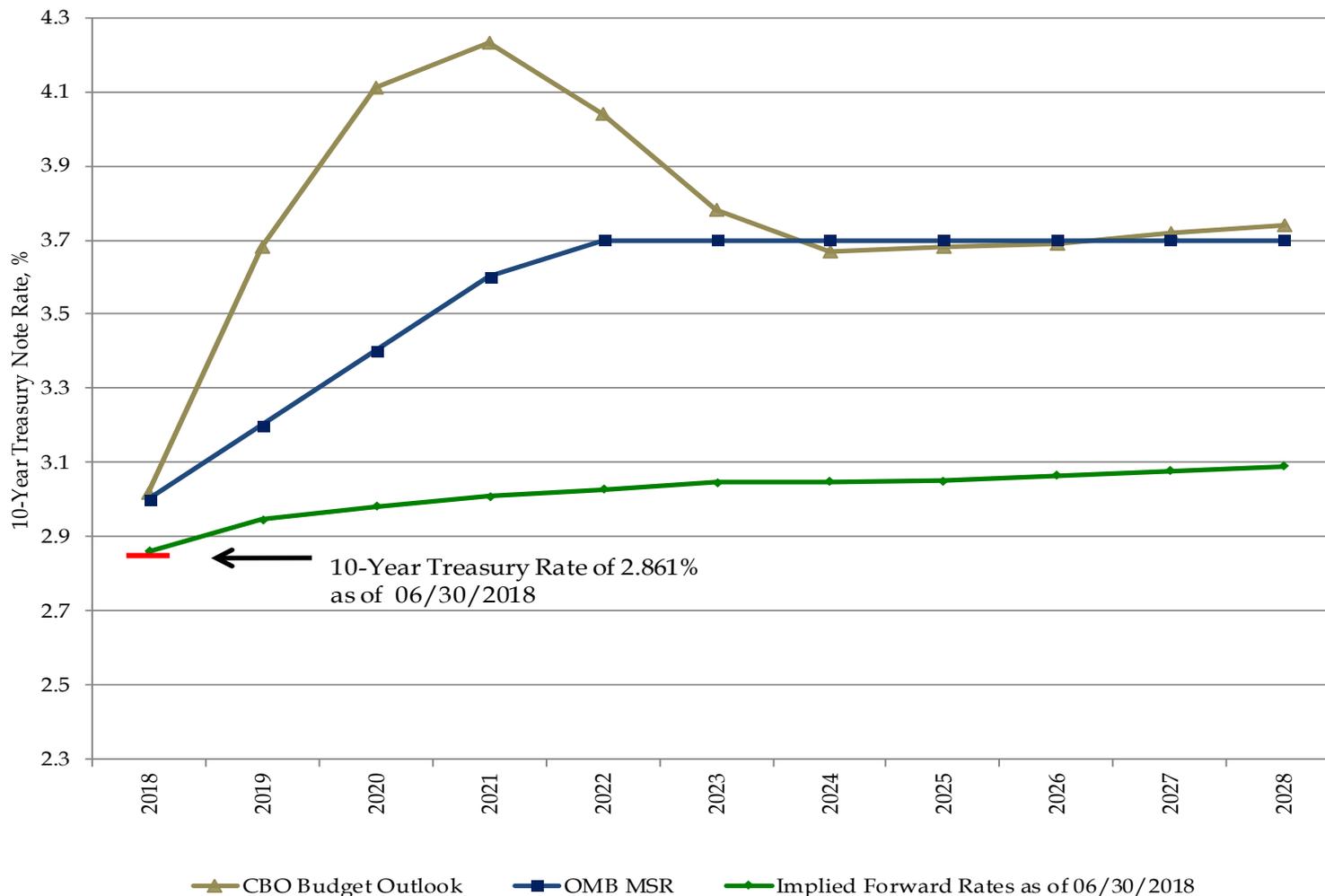
OMB's Projection of Borrowing from the Public

The bubbles represent the total net marketable borrowing for that year



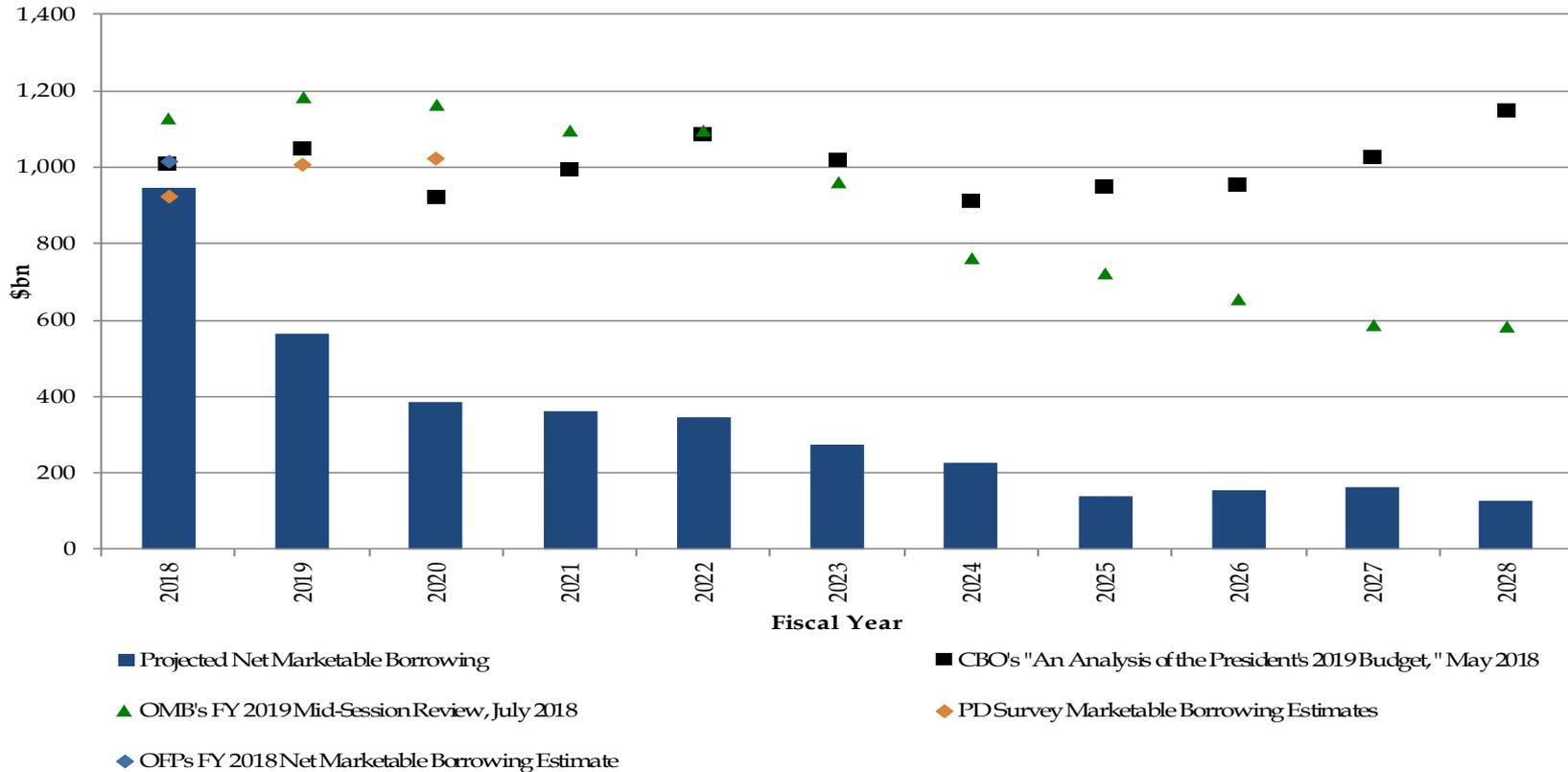
OMB's projections of the change in debt held by the public (borrowing) are from Table S-11 of "Mid-Session Review, Fiscal Year 2019," July 2018. "Other" represents borrowing from the public to provide direct and guaranteed loans.

Interest Rate Assumptions: 10-Year Treasury Note



OMB's economic assumption of the 10-Year Treasury Note rates are from Table 2 of OMB's "Mid-Session Review, Fiscal Year 2019," July 2018. CBO's economic assumption of the 10-Year Treasury Note rates are from Table D-1 of CBO's "The Budget and Economic Outlook: 2018 to 2028," April 2018. The forward rates are the implied 10-Year Treasury Note rates on June 30, 2018.

Projected Net Marketable Borrowing Assuming Future Issuance Remains Constant



Treasury's July 2018 primary dealer survey estimates can be found on page 11. OMB's projections of the change in debt held by the public are from Table S-11 of "Mid-Session Review, Fiscal Year 2019," July 2018. CBO's baseline budget projections of the change in debt held by the public are from Table 2 of "An Analysis of the President's 2019 Budget," May 2018. See table at the end of this section for details.

*Projections reflect capped SOMA Treasury redemptions up until the end of CY 2020.

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 2019 Mid-Session Review	CBO's "An Analysis of the President's 2019 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	356	204	310	51	24	946	1,016*	1,011	923
2019	0	317	169	44	30	561	1,186	1,049	1,007
2020	0	158	206	14	6	384	1,164	924	1,025
2021	0	98	264	(2)	(0)	360	1,097	993	
2022	0	67	289	(13)	3	346	1,096	1,085	
2023	0	114	166	(10)	5	274	963	1,018	
2024	0	(7)	245	(13)	1	227	763	911	
2025	0	(31)	228	(56)	(2)	138	722	951	
2026	0	(29)	233	(47)	(2)	155	657	952	
2027	0	(5)	209	(36)	(3)	164	590	1,027	

Net borrowing capacity reflects capped SOMA redemptions up until the end of CY 2020.

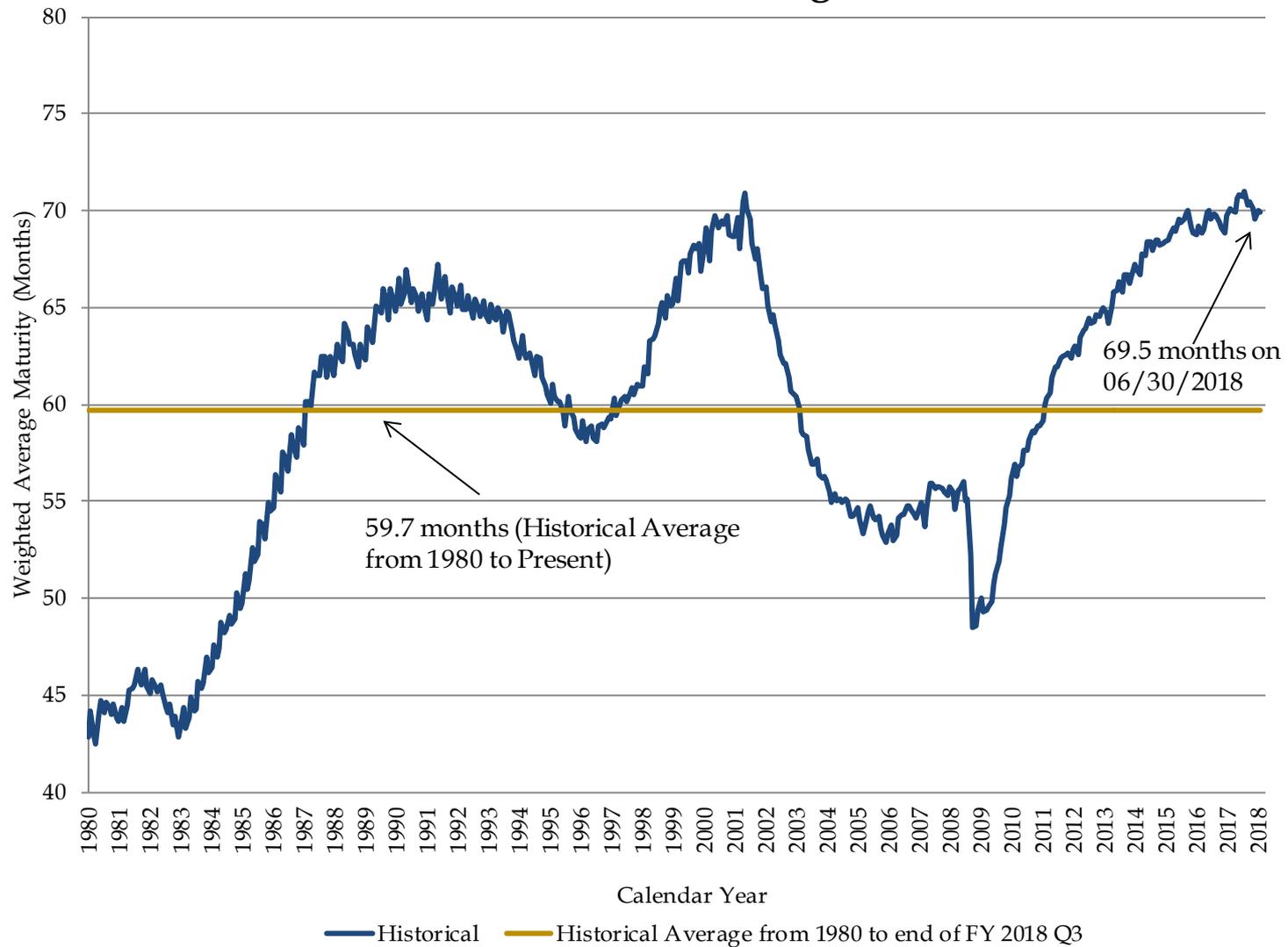
Treasury's July 2018 primary dealer survey estimates can be found on page 11. OMB's projections of the change in debt held by the public are from Table S-11 of "Mid-Session Review, Fiscal Year 2019," July 2018. CBO's baseline budget projections of the change in debt held by the public are from Table 2 of CBO's "An Analysis of the President's Budget," May 2018.

*OFP's FY 2018 Net Marketable Borrowing Estimate.

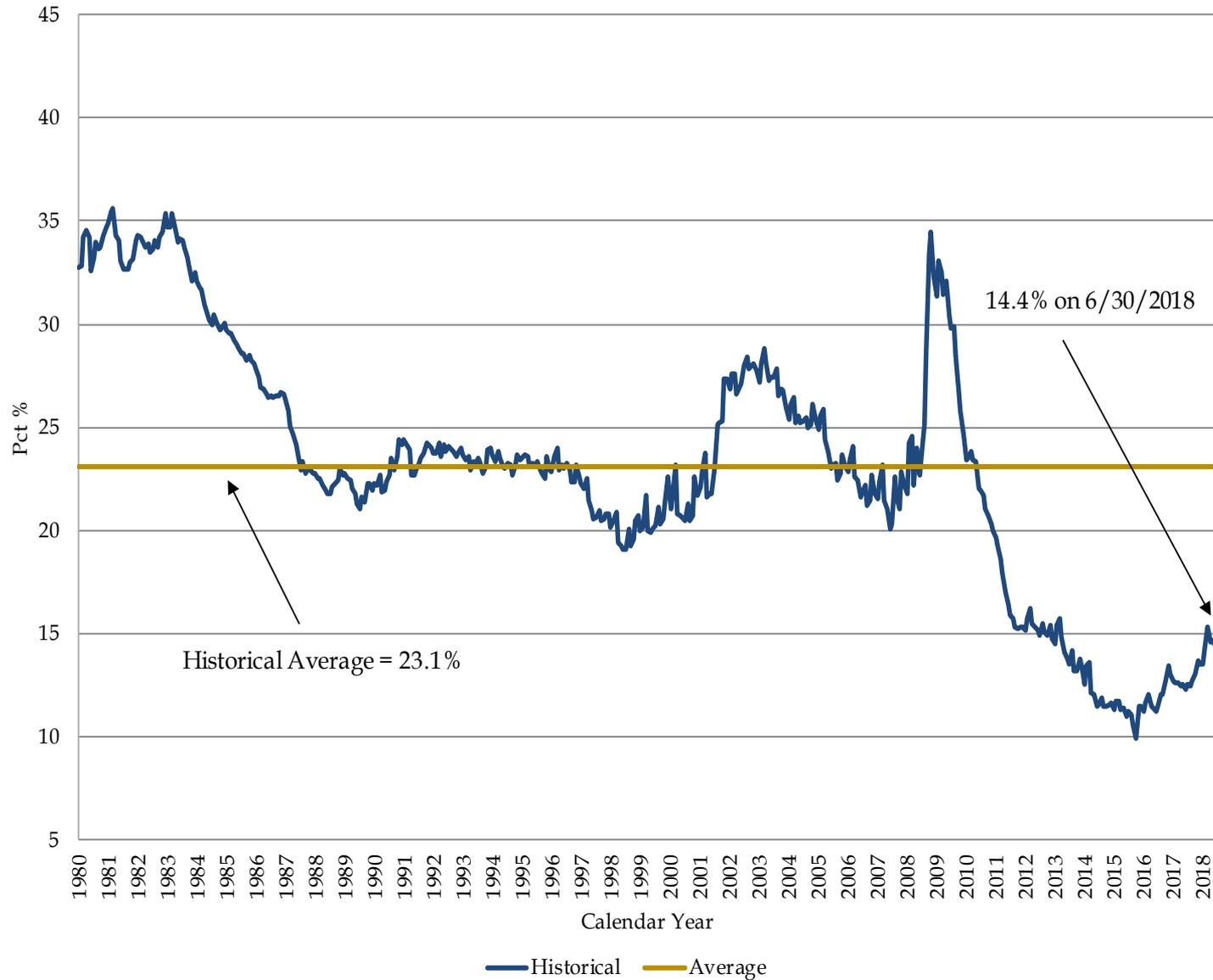
Section IV: Portfolio Metrics



Historical Weighted Average Maturity of Marketable Debt Outstanding



Bills Outstanding as a Percent of Portfolio



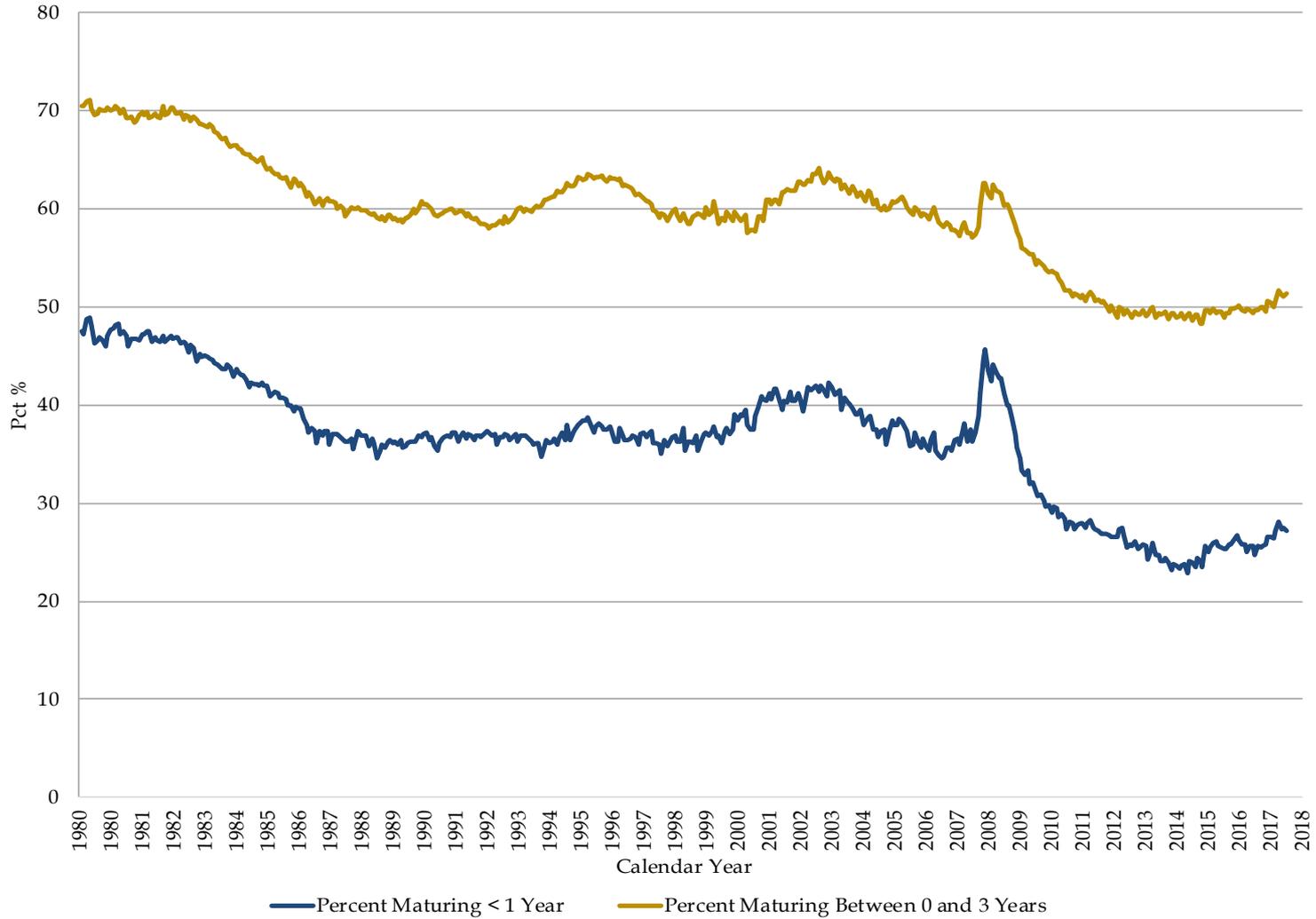
Recent Maturity Profile, \$ billions

Date	<= 1yr	(1,2]	(2,3]	(3,5]	(5,7]	(7,10]	> 10	Total	(0,5]
Sep-10	2,563	1,141	895	1,273	907	856	853	8,488	5,872
Sep-11	2,620	1,334	980	1,541	1,070	1,053	1,017	9,616	6,476
Sep-12	2,951	1,373	1,104	1,811	1,214	1,108	1,181	10,742	7,239
Sep-13	2,939	1,523	1,242	1,965	1,454	1,136	1,331	11,590	7,669
Sep-14	2,935	1,739	1,319	2,207	1,440	1,113	1,528	12,281	8,199
Sep-15	3,097	1,775	1,335	2,382	1,478	1,121	1,654	12,841	8,589
Sep-16	3,423	1,828	1,538	2,406	1,501	1,151	1,800	13,648	9,195
Sep-17	3,631	2,027	1,504	2,433	1,466	1,180	1,946	14,188	9,596
Jun-18	4,074	2,106	1,578	2,457	1,503	1,217	2,038	14,972	10,214

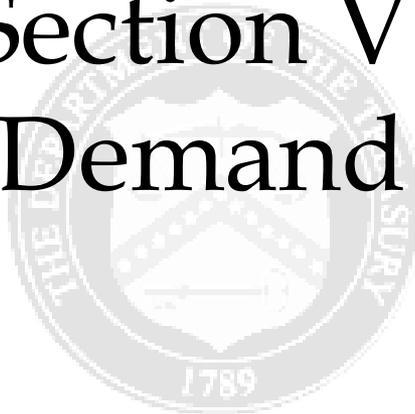
Recent Maturity Profile, percent

Date	<= 1yr	(1,2]	(2,3]	(3,5]	(5,7]	(7,10]	> 10	(0,3]	(0,5]
Sep-10	30.2	13.4	10.5	15.0	10.7	10.1	10.0	54.2	69.2
Sep-11	27.2	13.9	10.2	16.0	11.1	10.9	10.6	51.3	67.3
Sep-12	27.5	12.8	10.3	16.9	11.3	10.3	11.0	50.5	67.4
Sep-13	25.4	13.1	10.7	17.0	12.5	9.8	11.5	49.2	66.2
Sep-14	23.9	14.2	10.7	18.0	11.7	9.1	12.4	48.8	66.8
Sep-15	24.1	13.8	10.4	18.5	11.5	8.7	12.9	48.3	66.9
Sep-16	25.1	13.4	11.3	17.6	11.0	8.4	13.2	49.7	67.4
Sep-17	25.6	14.3	10.6	17.1	10.3	8.3	13.7	50.5	67.6
Jun-18	27.2	14.1	10.5	16.4	10.0	8.1	13.6	51.8	68.2

Treasury Maturity Profile History



Section V: Demand



Summary Statistics for Fiscal Year 2018 Q3 Auctions

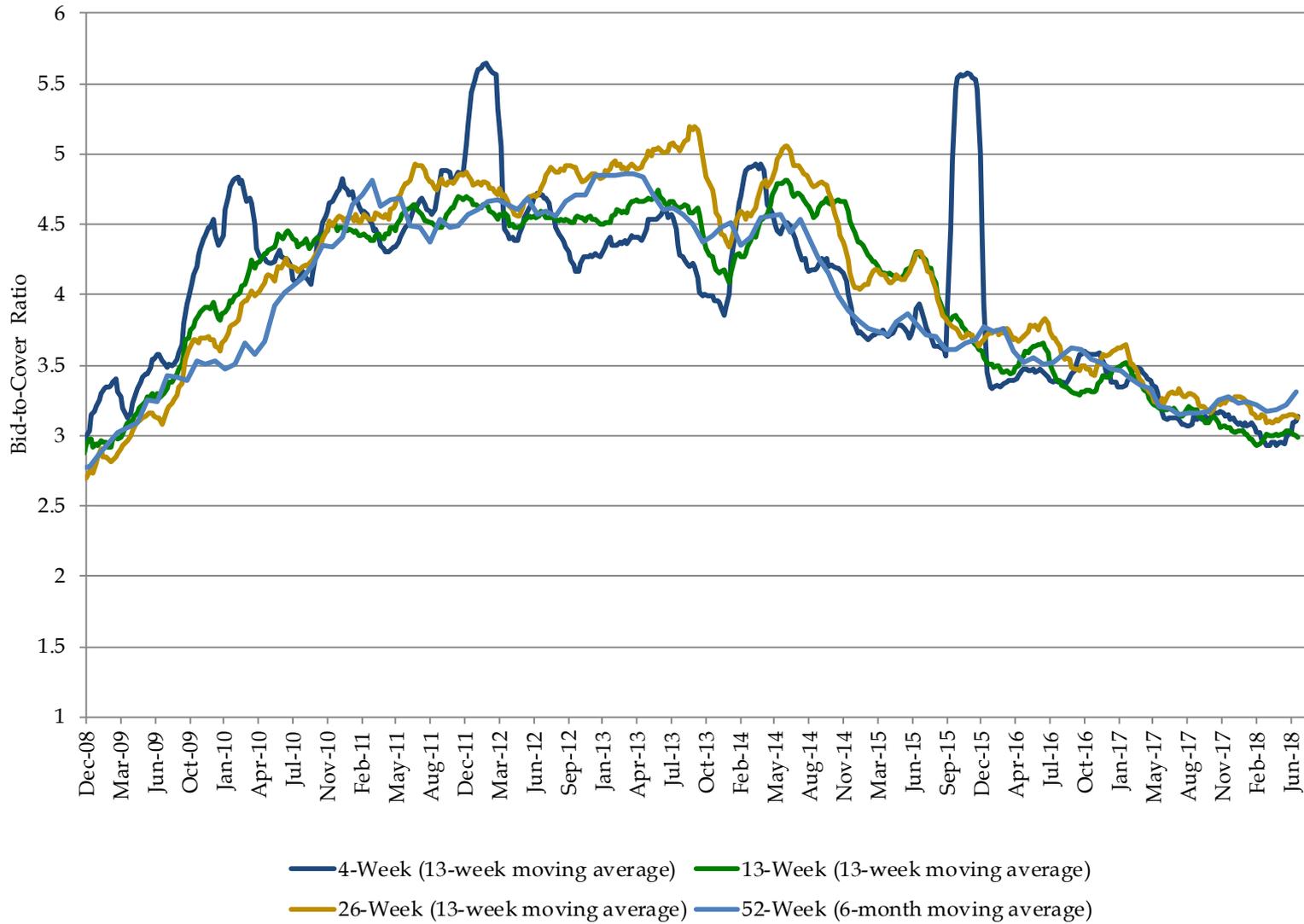
Security Type	Term	Stop Out Rate (%)*	Bid-to-Cover Ratio*	Competitive Awards (\$bn)	% Primary Dealer*	% Direct*	% Indirect*	Non-Competitive Awards (\$bn)	SOMA "Add-Ons" (\$bn)	10-Year Equivalent (\$bn)**
Bill	4-Week	1.702	3.1	539.4	53.0	9.9	37.1	10.6	0.0	4.9
Bill	13-Week	1.847	3.0	606.6	55.0	6.6	38.4	17.4	0.0	18.0
Bill	26-Week	2.012	3.1	529.2	46.5	4.3	49.2	16.8	0.0	31.5
Bill	52-Week	2.250	3.5	76.1	47.1	8.0	44.9	1.9	0.0	9.0
Coupon	2-Year	2.542	2.7	97.4	43.6	15.4	41.0	1.6	14.1	25.7
Coupon	3-Year	2.595	2.8	92.5	40.8	11.0	48.2	0.5	7.5	33.9
Coupon	5-Year	2.806	2.5	106.8	29.2	11.3	59.5	0.2	15.2	66.5
Coupon	7-Year	2.896	2.6	88.9	22.4	13.6	63.9	0.1	12.6	75.1
Coupon	10-Year	2.923	2.5	67.9	31.4	10.9	57.7	0.1	6.1	74.7
Coupon	30-Year	3.095	2.4	44.0	27.1	10.8	62.1	0.0	4.1	109.8
TIPS	5-Year	0.631	2.6	15.9	23.2	14.3	62.4	0.1	2.0	10.4
TIPS	10-Year	0.934	2.4	11.0	29.0	6.7	64.3	0.0	1.9	14.0
TIPS	30-Year	0.934	2.6	5.0	14.6	4.6	80.8	0.0	0.0	15.0
FRN	2-Year	0.034	3.2	48.9	49.2	9.3	41.5	0.1	2.2	0.0

Total Bills	1.870	3.1	1,751.4	51.5	7.0	41.5	46.6	0.0	63.4
Total Coupons	2.773	2.6	497.6	33.1	12.4	54.6	2.4	59.6	385.7
Total TIPS	0.783	2.5	31.9	23.9	10.2	65.9	0.1	4.0	39.4
Total FRN	0.034	3.2	48.9	49.2	9.3	41.5	0.1	2.2	0.0

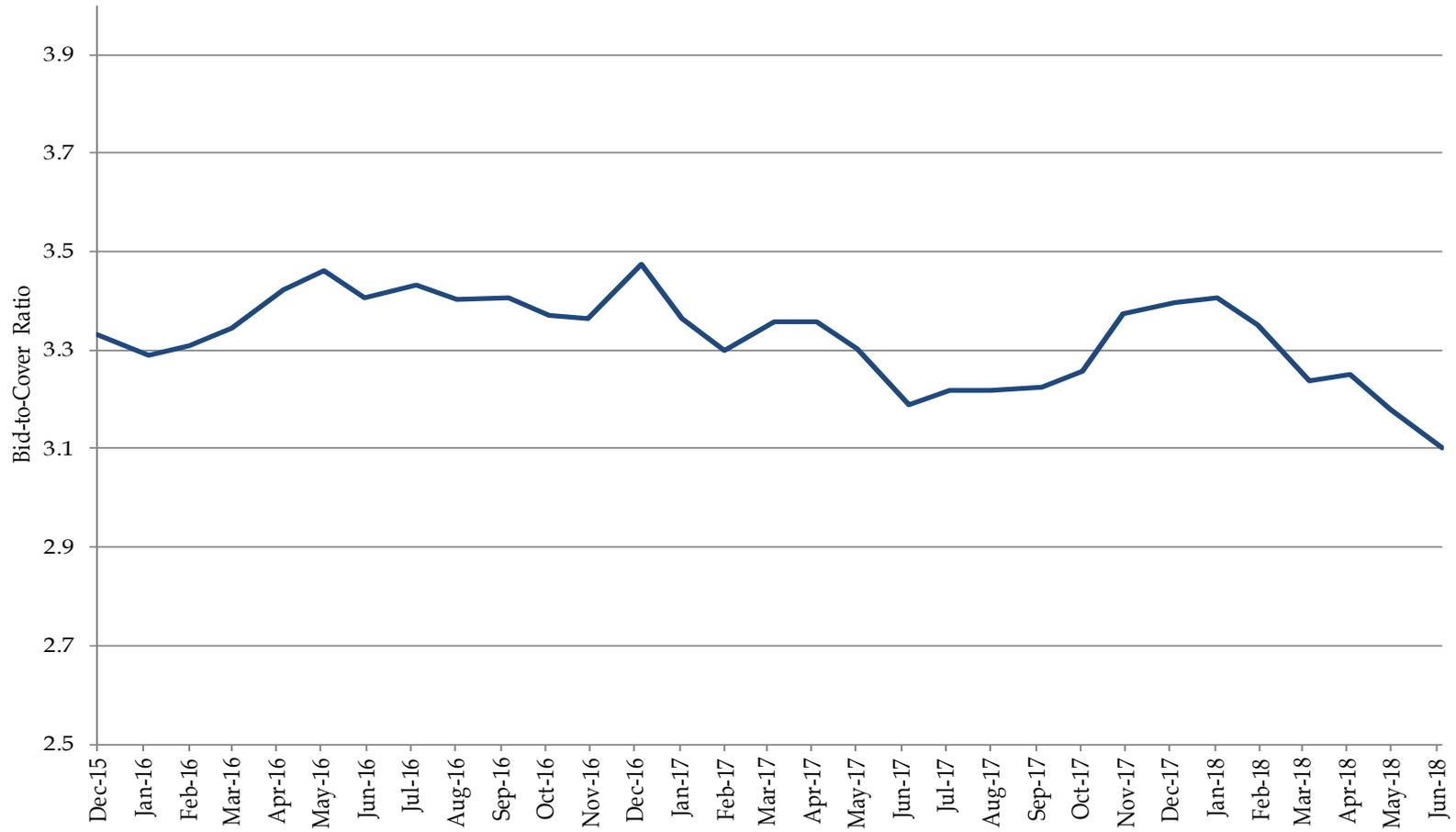
*Weighted averages of Competitive Awards.

**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.

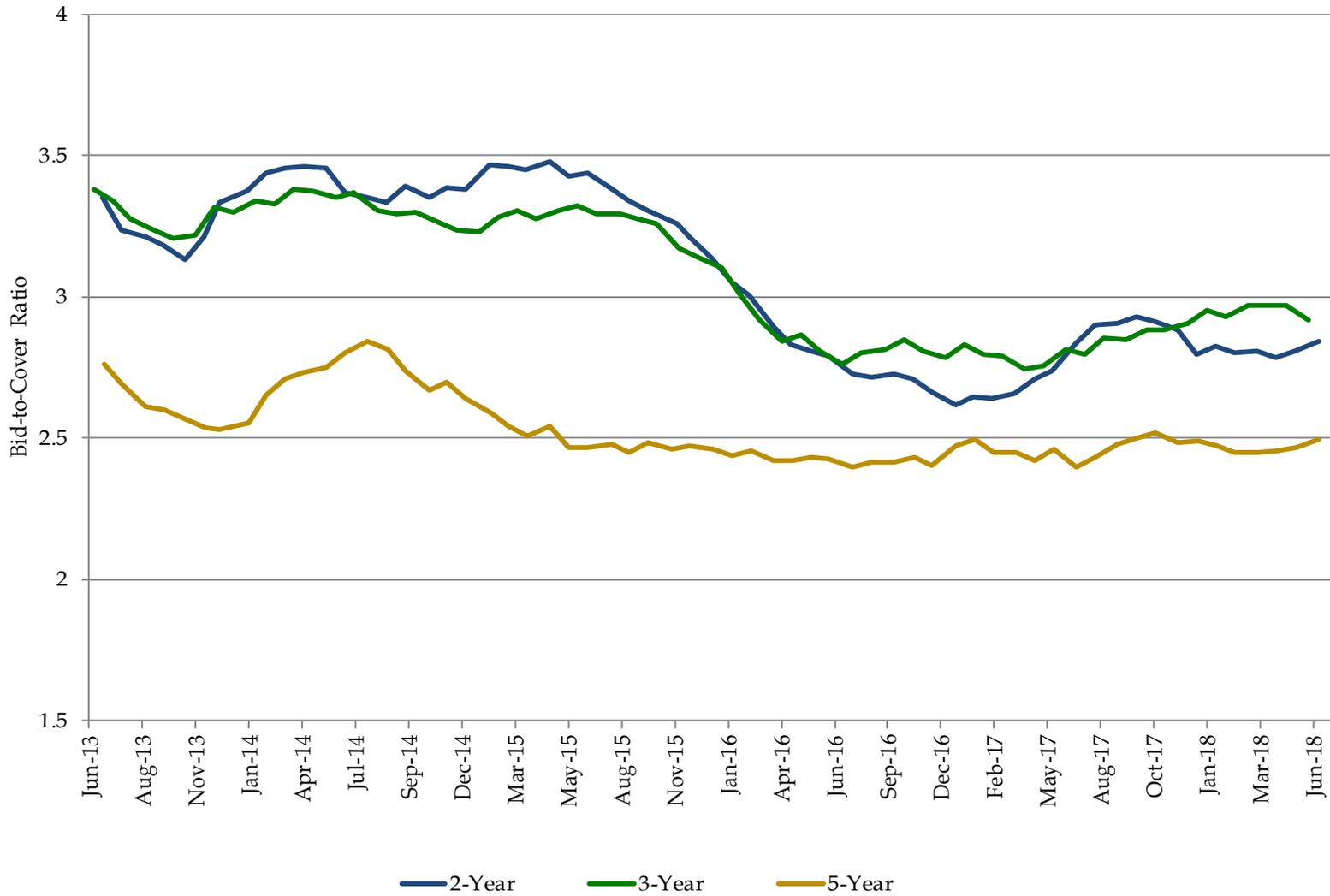
Bid-to-Cover Ratios for Treasury Bills



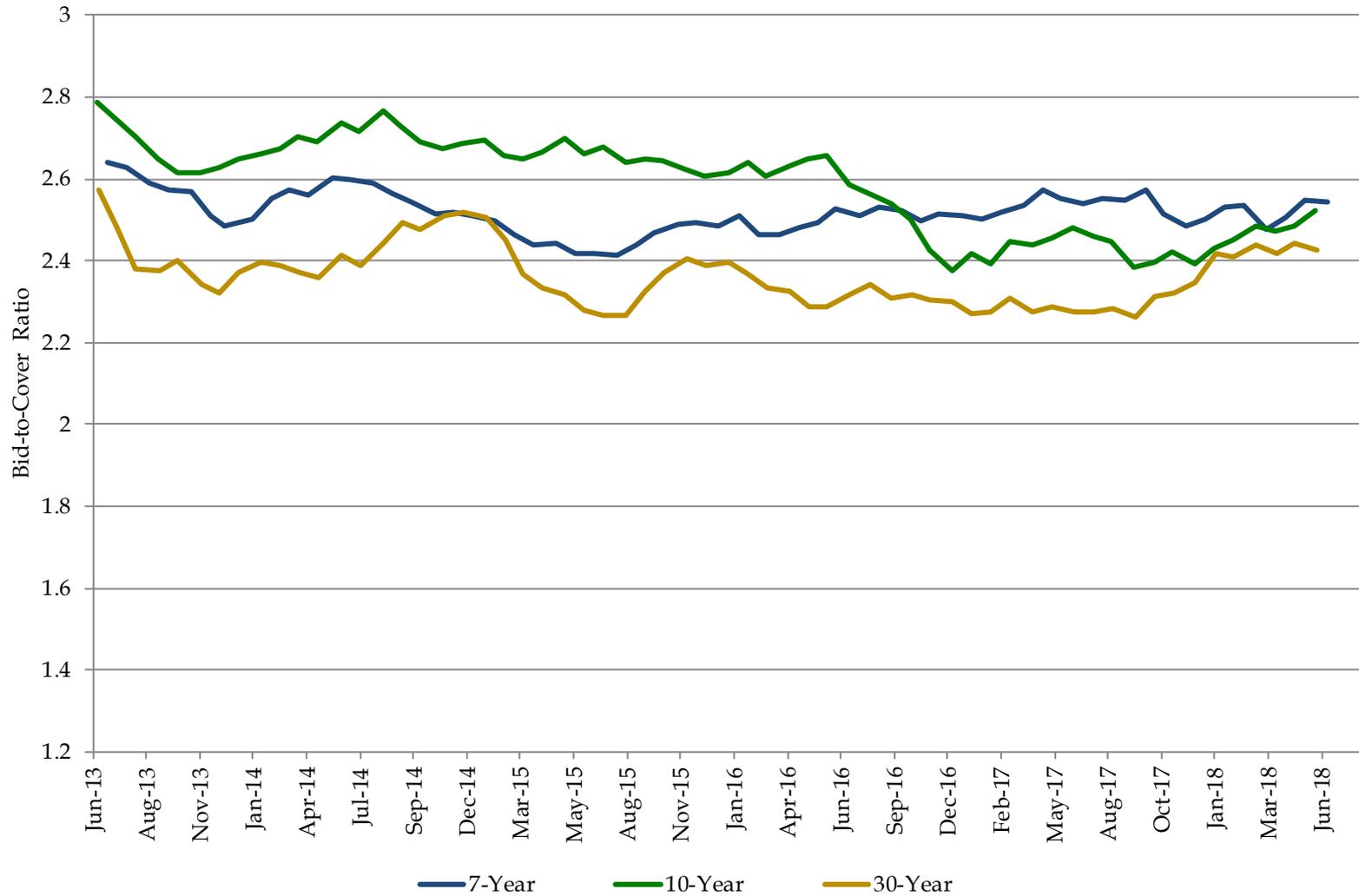
Bid-to-Cover Ratios for FRNs (6-Month Moving Average)



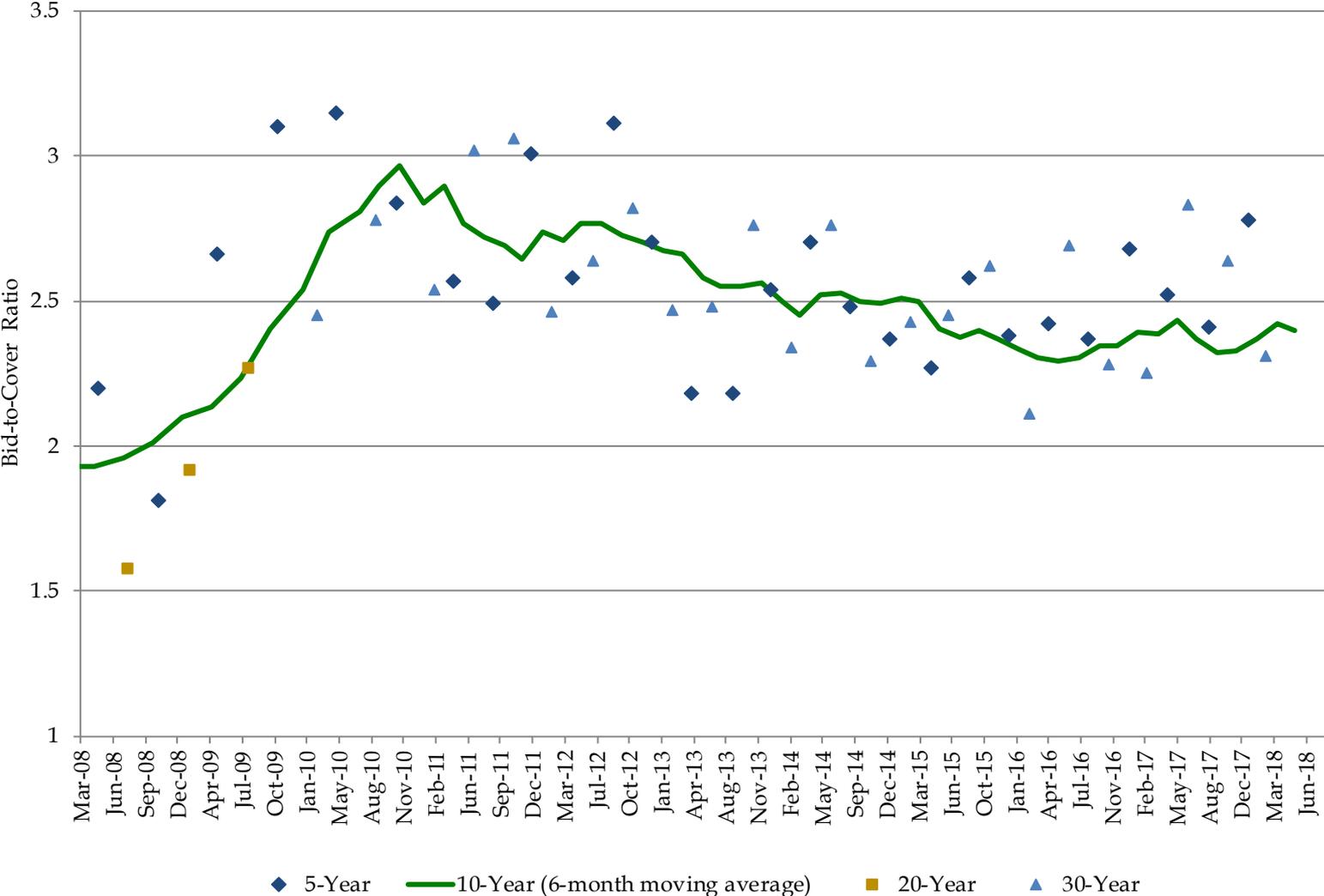
Bid-to-Cover Ratios for 2-, 3-, and 5-Year Nominal Securities (6-Month Moving Average)



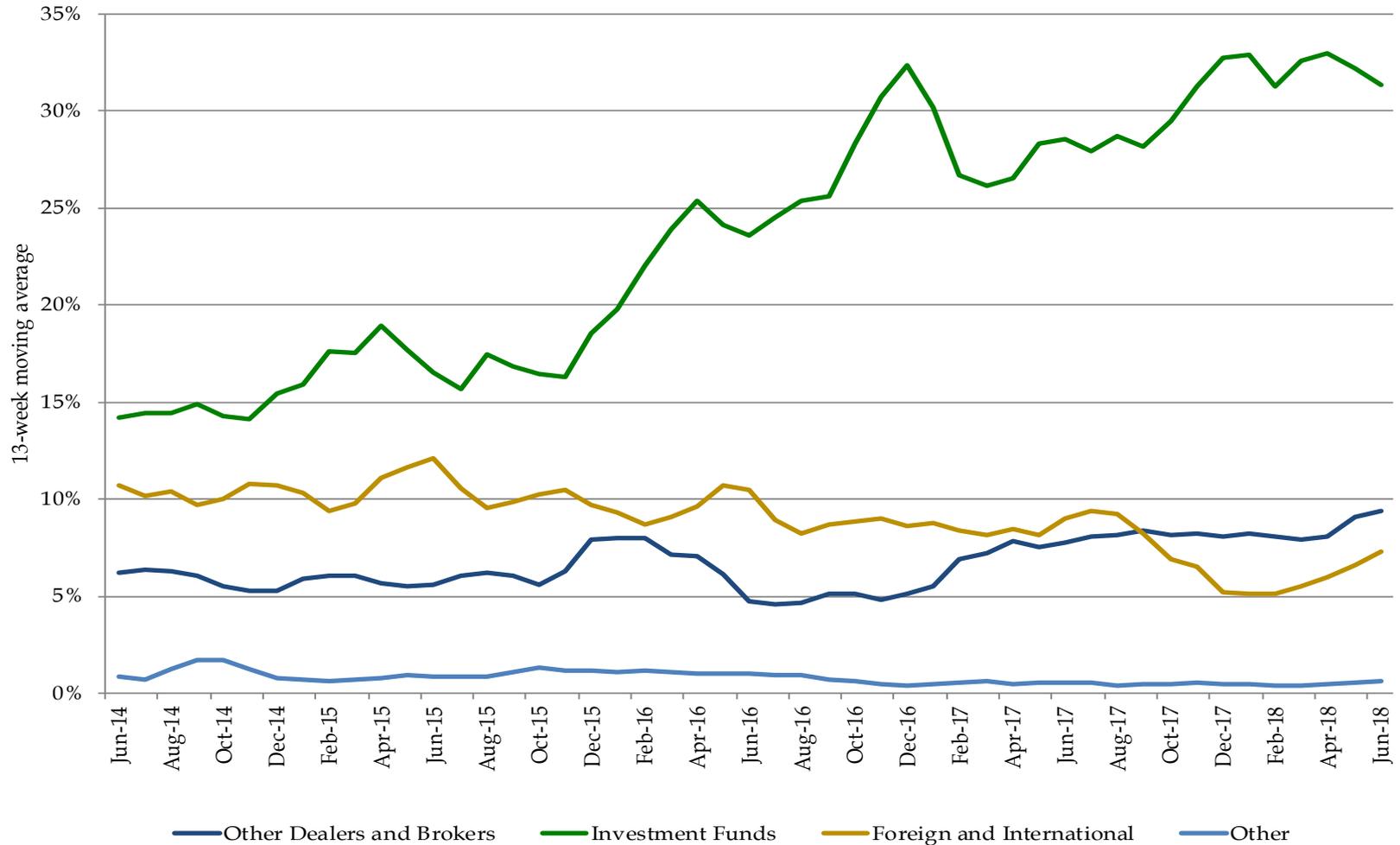
Bid-to-Cover Ratios for 7-, 10-, and 30-Year Nominal Securities (6-Month Moving Average)



Bid-to-Cover Ratios for TIPS

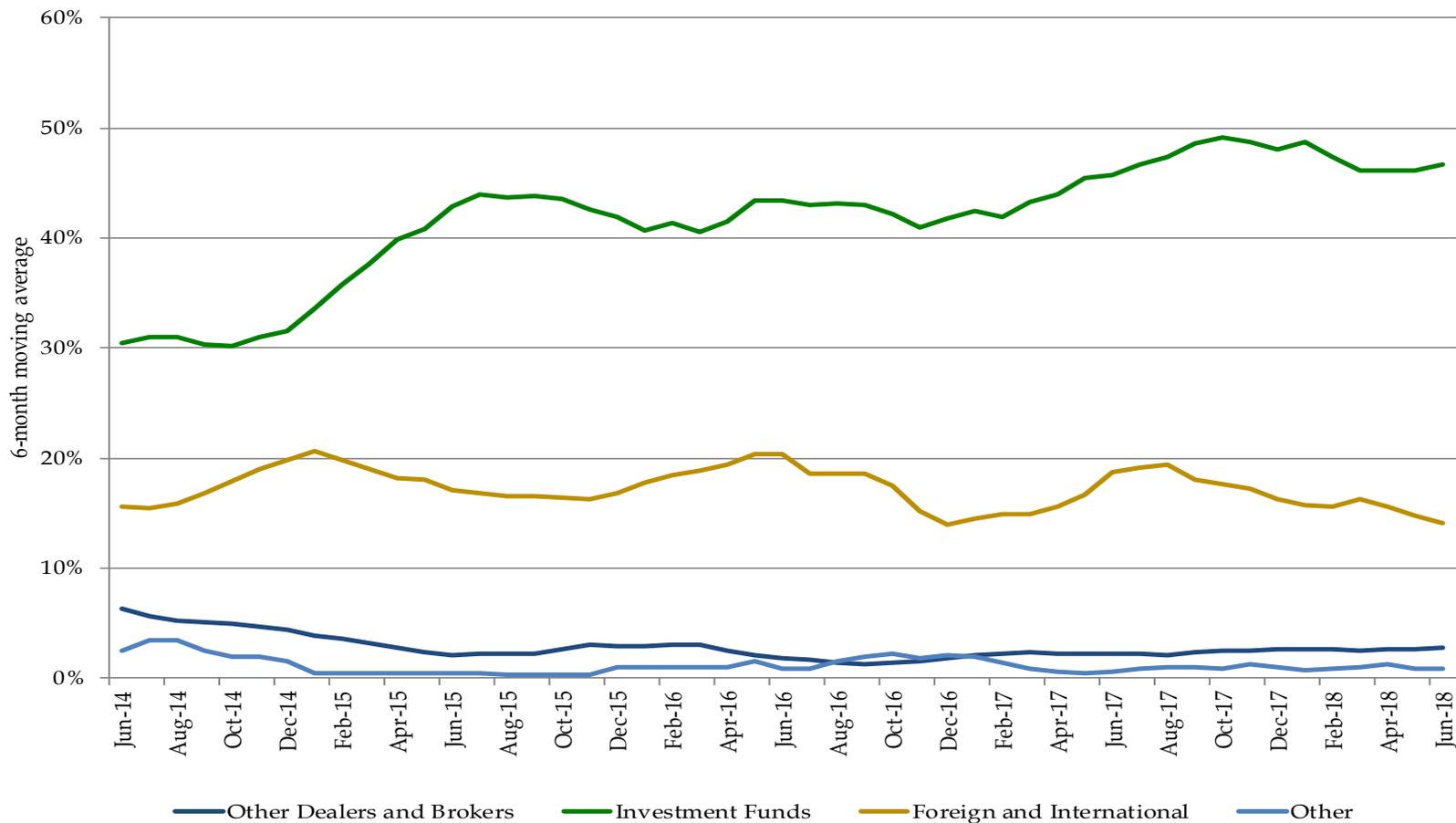


Percent Awarded in Bill Auctions by Investor Class (13-Week Moving Average)



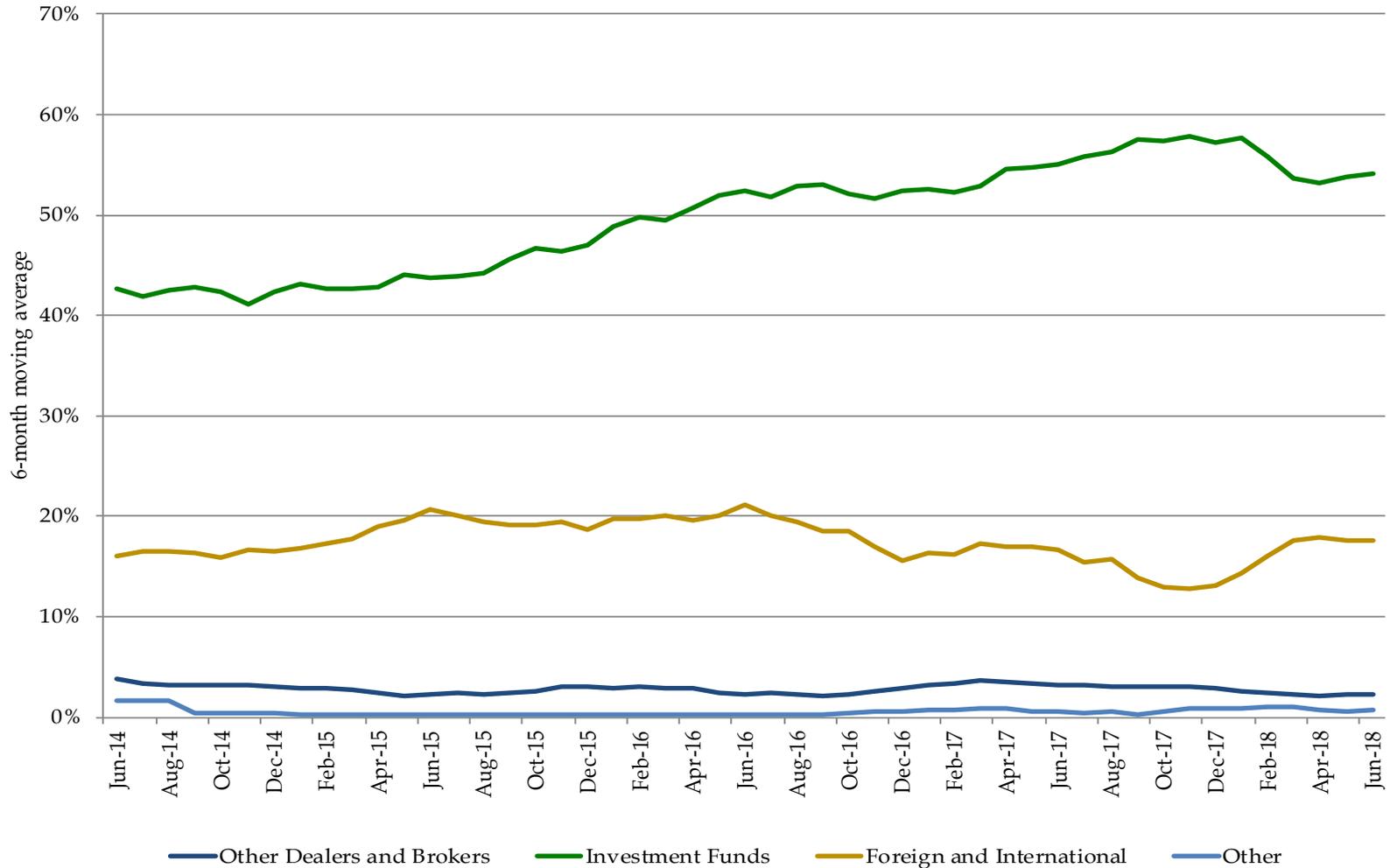
Excludes SOMA add-ons. The “Other” category includes categories that are each less than 5%, which include Depository Institutions, Individuals, Pension and Insurance.

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



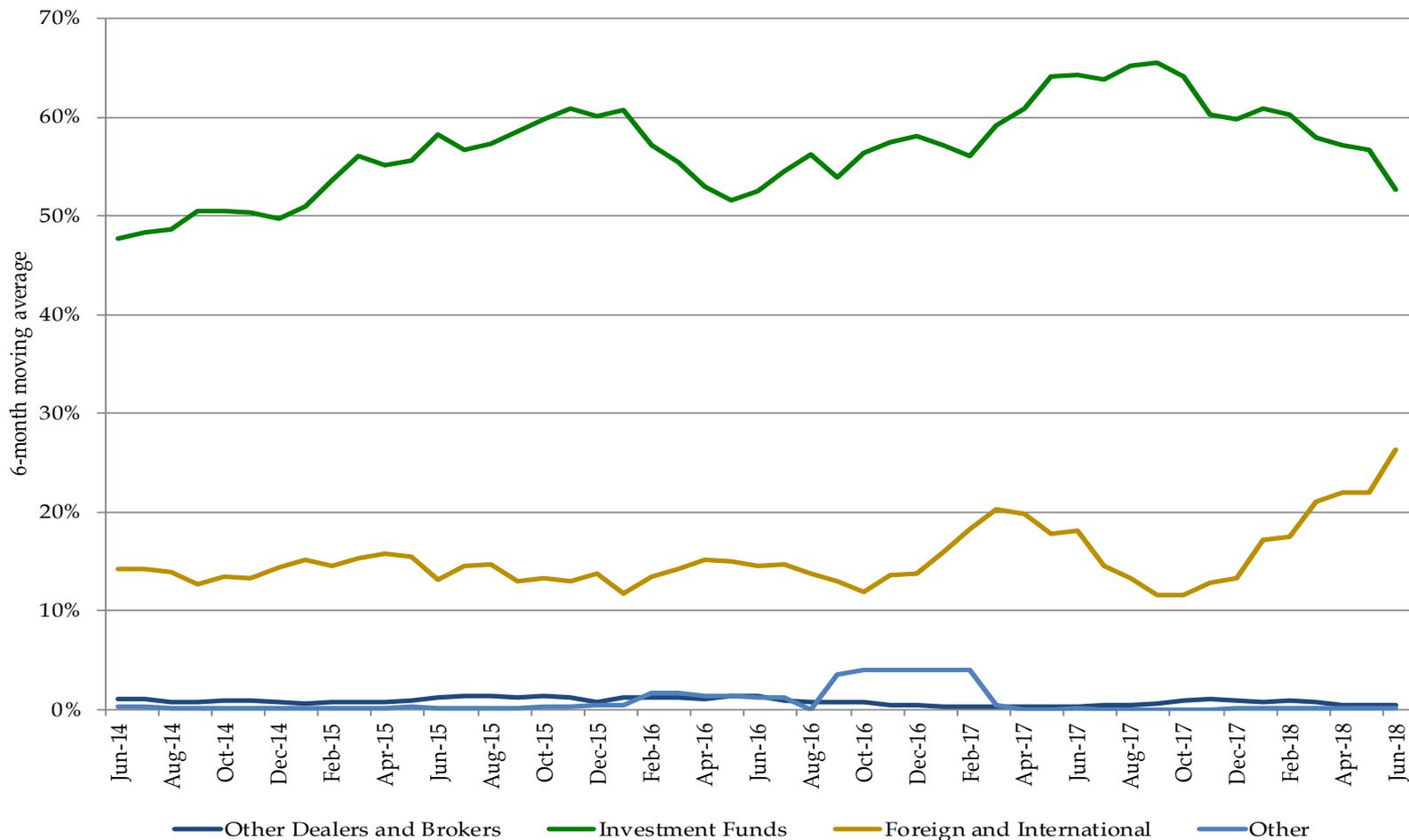
Excludes SOMA add-ons. The “Other” category includes categories that are each less than 5%, which include Depository Institutions, Individuals, Pension and Insurance.

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



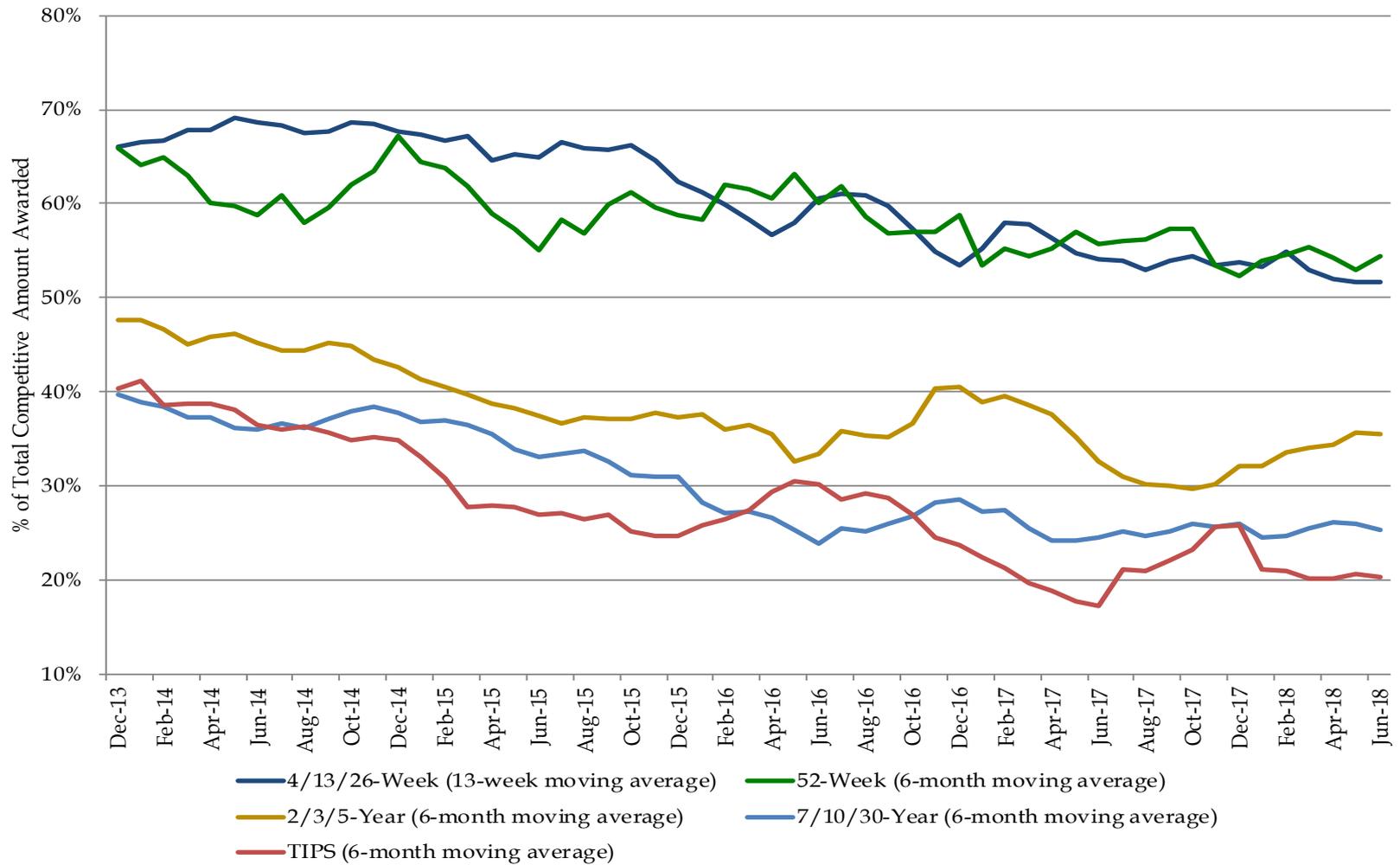
Excludes SOMA add-ons. The “Other” category includes categories that are each less than 5%, which include Depository Institutions, Individuals, Pension and Insurance.

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



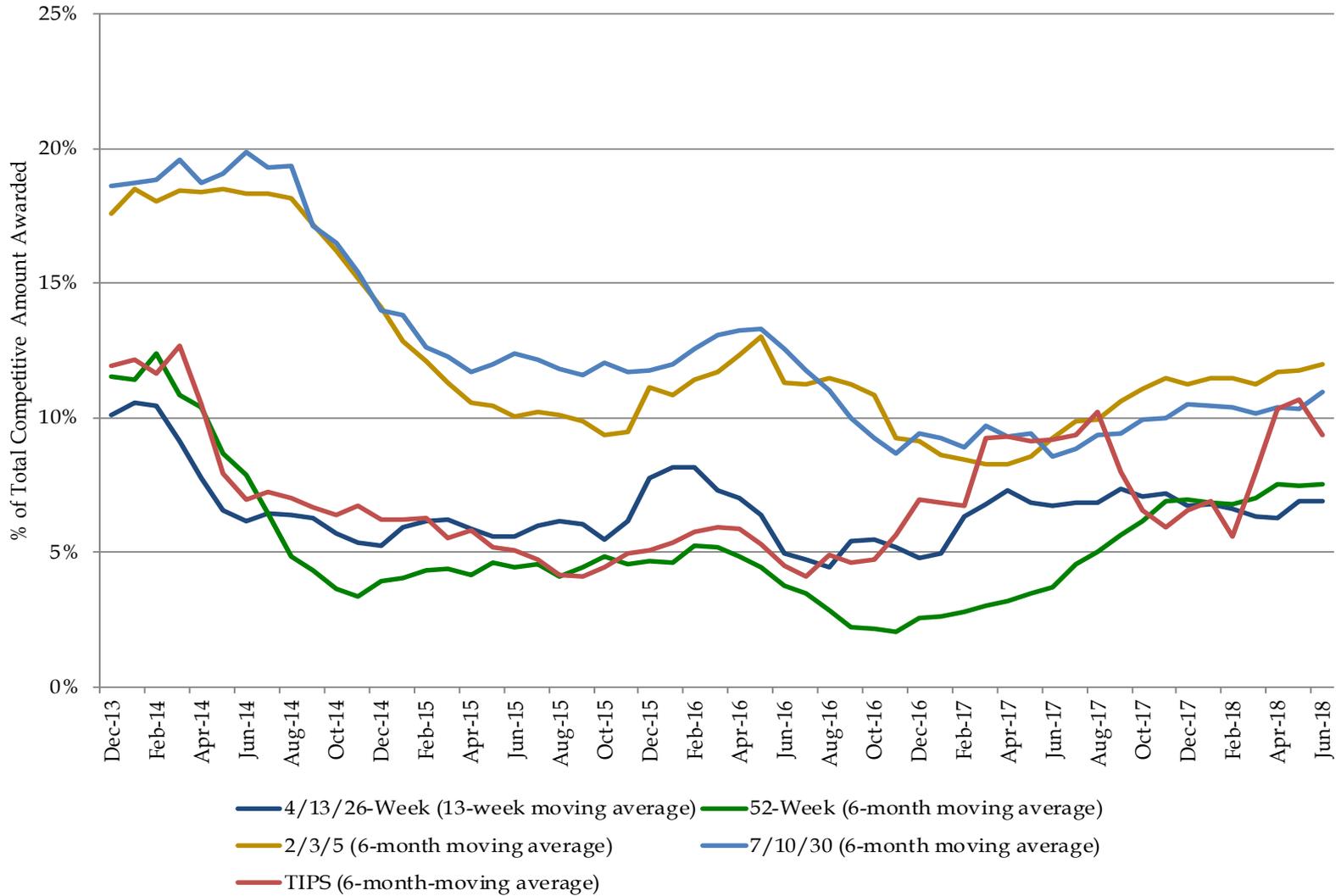
Excludes SOMA add-ons. The “Other” category includes categories that are each less than 5%, which include Depository Institutions, Individuals, Pension and Insurance.

Primary Dealer Awards at Auction



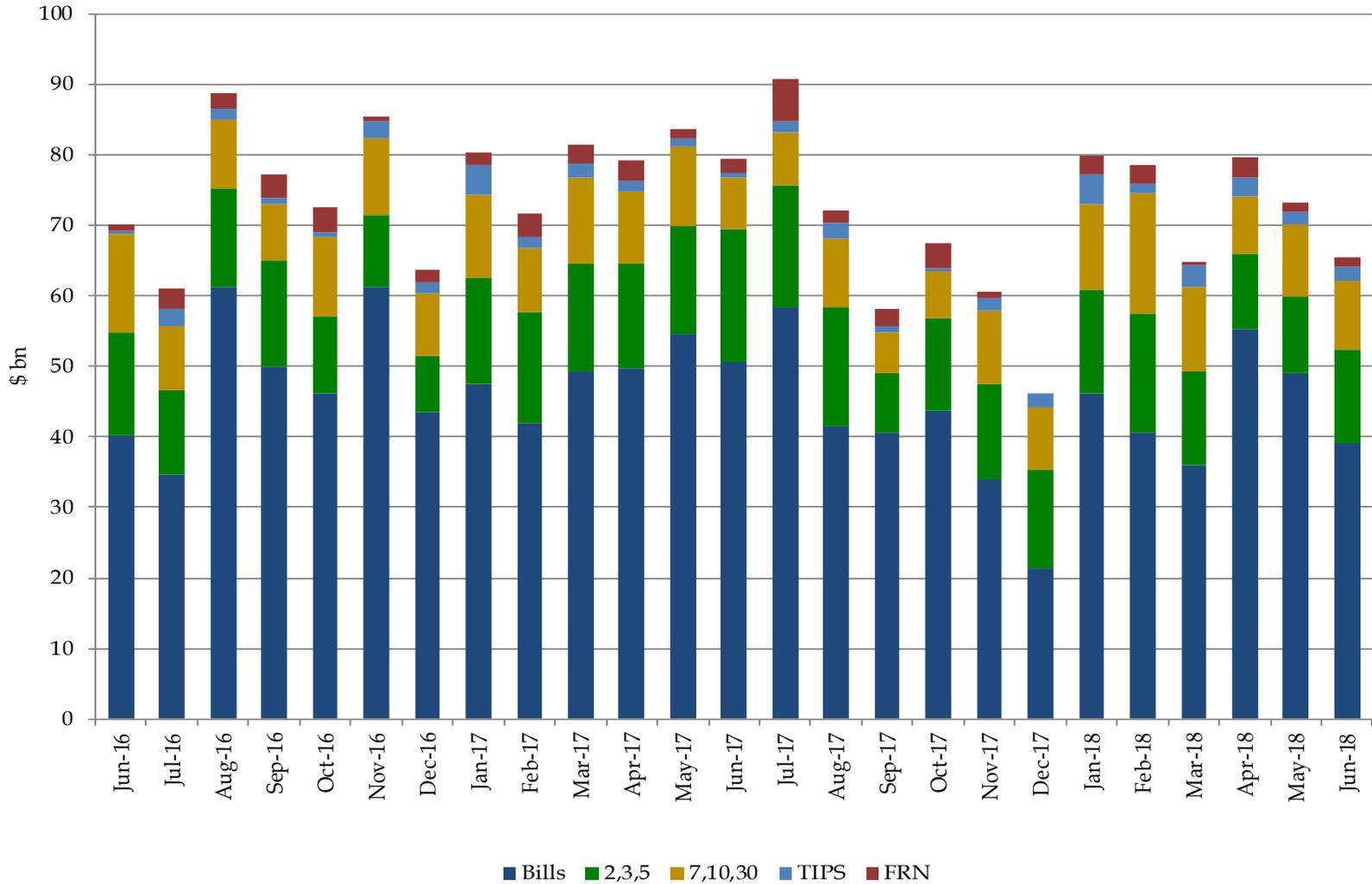
Excludes SOMA add-ons.

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

The seal of the U.S. Department of the Treasury is centered behind the word "Appendix". The seal is circular and features a shield with a scale of justice, a sword, and a chevron with stars. The text "THE DEPARTMENT OF THE TREASURY" is written around the top inner edge of the seal, and "1789" is at the bottom.

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	4/5/2018	1.695	2.90	54.2	47.7	9.1	43.1	0.8	0.0	0.5
4-Week	4/12/2018	1.620	3.25	44.2	53.3	9.2	37.5	0.8	0.0	0.4
4-Week	4/19/2018	1.630	3.08	44.2	59.1	9.8	31.1	0.8	0.0	0.4
4-Week	4/26/2018	1.680	3.16	44.1	50.0	12.1	37.9	0.9	0.0	0.4
4-Week	5/3/2018	1.650	3.04	44.2	59.4	11.5	29.1	0.8	0.0	0.4
4-Week	5/10/2018	1.660	3.22	44.2	58.6	9.9	31.5	0.8	0.0	0.4
4-Week	5/17/2018	1.655	3.13	44.2	48.5	11.6	39.9	0.8	0.0	0.4
4-Week	5/24/2018	1.720	3.10	44.1	56.3	7.2	36.5	0.9	0.0	0.4
4-Week	5/31/2018	1.750	3.25	39.3	39.9	12.6	47.4	0.7	0.0	0.4
4-Week	6/7/2018	1.780	3.04	34.2	63.6	6.3	30.1	0.8	0.0	0.3
4-Week	6/14/2018	1.790	3.36	34.1	47.8	6.0	46.2	0.9	0.0	0.3
4-Week	6/21/2018	1.815	3.16	34.2	59.5	12.1	28.4	0.8	0.0	0.3
4-Week	6/28/2018	1.770	3.05	34.2	46.0	11.3	42.7	0.8	0.0	0.3
13-Week	4/5/2018	1.740	2.88	47.3	52.0	8.7	39.3	0.7	0.0	1.4
13-Week	4/12/2018	1.715	2.92	47.1	64.1	9.3	26.7	0.9	0.0	1.4
13-Week	4/19/2018	1.760	3.13	46.7	45.3	7.3	47.4	1.3	0.0	1.4
13-Week	4/26/2018	1.830	2.98	46.2	58.7	6.9	34.4	1.8	0.0	1.4
13-Week	5/3/2018	1.835	2.87	46.2	54.7	5.8	39.4	1.8	0.0	1.4
13-Week	5/10/2018	1.840	2.95	47.0	59.9	7.2	33.0	1.0	0.0	1.4
13-Week	5/17/2018	1.890	3.04	46.6	59.3	7.9	32.8	1.4	0.0	1.4
13-Week	5/24/2018	1.895	3.10	46.6	47.7	7.1	45.2	1.4	0.0	1.4
13-Week	5/31/2018	1.895	2.82	46.2	66.2	6.5	27.4	1.8	0.0	1.4
13-Week	6/7/2018	1.910	3.16	46.8	50.9	4.3	44.8	1.2	0.0	1.4
13-Week	6/14/2018	1.910	3.01	47.0	54.6	4.3	41.1	1.0	0.0	1.4
13-Week	6/21/2018	1.900	3.12	46.7	48.5	4.8	46.7	1.3	0.0	1.4
13-Week	6/28/2018	1.900	2.89	46.1	53.1	5.7	41.2	1.9	0.0	1.4
26-Week	4/5/2018	1.905	3.10	40.3	48.2	6.0	45.8	1.7	0.0	2.4
26-Week	4/12/2018	1.880	3.04	40.3	49.7	4.8	45.5	1.7	0.0	2.4
26-Week	4/19/2018	1.945	3.12	40.8	48.3	4.1	47.6	1.2	0.0	2.4
26-Week	4/26/2018	1.985	3.27	40.2	38.1	3.2	58.7	1.8	0.0	2.4
26-Week	5/3/2018	1.990	3.17	40.6	41.9	4.6	53.4	1.4	0.0	2.4
26-Week	5/10/2018	2.000	3.12	41.1	52.0	6.1	42.0	0.9	0.0	2.4
26-Week	5/17/2018	2.035	2.98	41.0	46.6	5.5	47.9	1.0	0.0	2.4
26-Week	5/24/2018	2.080	3.16	40.9	46.0	4.2	49.8	1.1	0.0	2.4
26-Week	5/31/2018	2.030	3.10	40.6	52.1	4.8	43.0	1.4	0.0	2.4
26-Week	6/7/2018	2.070	3.27	40.9	41.3	3.9	54.9	1.1	0.0	2.4
26-Week	6/14/2018	2.075	3.59	41.0	28.3	2.3	69.4	1.0	0.0	2.4
26-Week	6/21/2018	2.075	2.78	41.0	63.3	2.1	34.6	1.0	0.0	2.4
26-Week	6/28/2018	2.085	3.00	40.3	48.1	4.8	47.1	1.7	0.0	2.4
52-Week	4/26/2018	2.200	3.39	25.3	51.8	9.4	38.7	0.7	0.0	3.0
52-Week	5/24/2018	2.275	3.68	25.4	42.3	7.5	50.1	0.6	0.0	3.0
52-Week	6/21/2018	2.275	3.41	25.4	47.1	6.9	45.9	0.6	0.0	3.0

*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	4/30/2018	2.498	2.61	31.5	43.1	15.3	41.6	0.5	4.1	8.3
2-Year	5/31/2018	2.590	2.88	32.4	45.4	15.3	39.3	0.6	5.7	8.7
2-Year	7/2/2018	2.538	2.73	33.5	42.3	15.4	42.3	0.5	4.2	8.7
3-Year	4/16/2018	2.450	2.85	29.8	40.9	11.6	47.6	0.2	0.1	10.1
3-Year	5/15/2018	2.664	2.76	30.8	42.2	12.3	45.6	0.2	7.5	13.1
3-Year	6/15/2018	2.664	2.83	31.8	39.4	9.2	51.4	0.2	0.0	10.7
5-Year	4/30/2018	2.837	2.49	34.9	26.2	13.7	60.2	0.1	4.5	21.6
5-Year	5/31/2018	2.864	2.52	35.9	32.9	10.9	56.2	0.1	6.3	22.8
5-Year	7/2/2018	2.719	2.55	36.0	28.5	9.5	62.0	0.0	4.5	22.1
7-Year	4/30/2018	2.952	2.56	29.0	21.6	12.7	65.8	0.0	3.7	24.3
7-Year	5/31/2018	2.930	2.62	30.0	21.6	12.9	65.5	0.0	5.2	25.8
7-Year	7/2/2018	2.809	2.53	30.0	24.1	15.2	60.6	0.0	3.7	25.0
10-Year	4/16/2018	2.795	2.46	21.0	38.4	8.4	53.2	0.0	0.0	21.0
10-Year	5/15/2018	2.995	2.56	25.0	28.7	8.3	63.0	0.0	6.0	31.7
10-Year	6/15/2018	2.962	2.59	22.0	27.7	16.3	56.0	0.0	0.0	22.0
30-Year	4/16/2018	3.044	2.41	13.0	24.4	14.6	61.0	0.0	0.0	29.7
30-Year	5/15/2018	3.130	2.38	17.0	28.9	8.3	62.7	0.0	4.1	48.5
30-Year	6/15/2018	3.100	2.38	14.0	27.5	10.3	62.2	0.0	0.0	31.6
2-Year FRN	4/30/2018	0.033	3.65	17.0	49.1	13.0	38.0	0.0	2.2	0.0
2-Year FRN	5/25/2018	0.028	3.26	16.0	43.1	7.5	49.3	0.0	0.0	0.0
2-Year FRN	6/29/2018	0.042	2.79	16.0	55.3	7.2	37.5	0.0	0.0	0.0

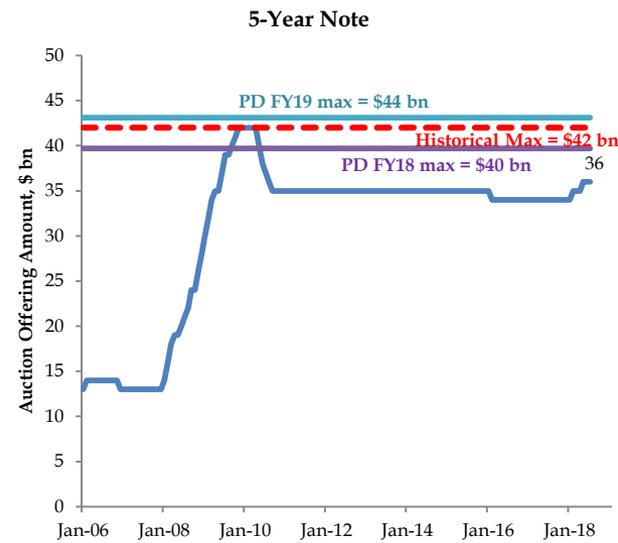
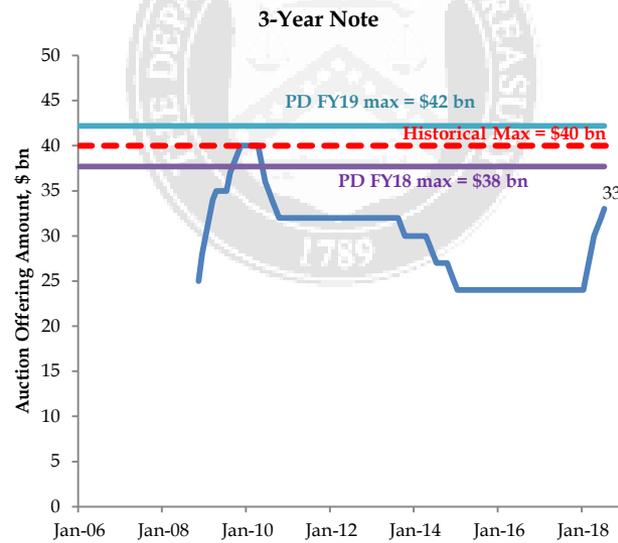
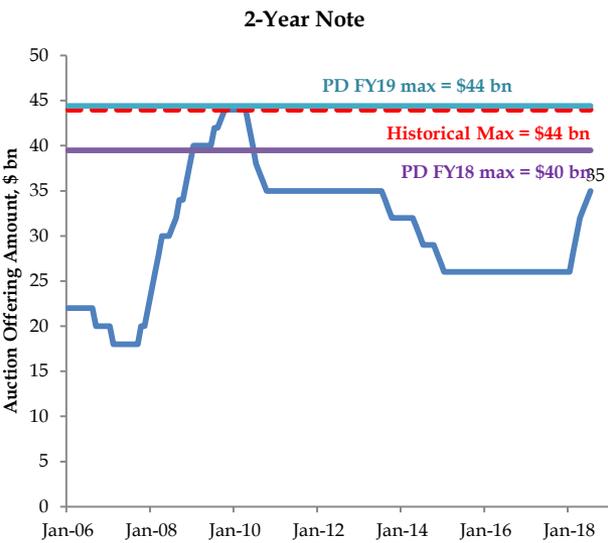
TIPS										
Issue	Settle Date	Stop Out Rate (%)*	Bid-to-Cover Ratio*	Competitive Awards (\$bn)	% Primary Dealer*	% Direct*	% Indirect*	Non-Competitive Awards (\$bn)	SOMA "Add Ons" (\$bn)	10-Year Equivalent (\$bn)*
5-Year TIPS	4/30/2018	0.631	2.55	15.9	23.2	14.3	62.4	0.1	2.0	10.4
10-Year TIPS	5/31/2018	0.934	2.42	11.0	29.0	6.7	64.3	0.0	1.9	14.0
30-Year TIPS	6/29/2018	0.934	2.62	5.0	14.6	4.6	80.8	0.0	0.0	15.0

*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.

Perspectives on Auction Sizes at Short-end versus “Belly” of the Curve

- Prior to increases in coupon sizes announced with the February 2018 quarterly refunding, the 2-, 3-, and 5-year note auction sizes were below historical maximums by \$18bn, \$16bn, and \$8bn, respectively.
- Currently, this gap has decreased to \$9bn, \$7bn, and \$6bn for the 2-, 3-, and 5-year notes, respectively.
- In April 2018, dealers provided updates on the auction sizes that wouldn’t surprise them for the end of FY2018: \$40bn, \$38bn, and \$40bn for the 2-, 3-, and 5-year notes, respectively, with higher levels for the end of FY2019.



Primary dealer auction size survey can be found via the following link:

<https://www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Pages/archived-auction-survey.aspx>

TBAC charge: *We would like the Committee to comment on commercial bank demand for HQLA and, more specifically, the role of Treasury holdings within banks' HQLA portfolios. Given projections for SOMA portfolio normalization over the coming years, please also comment on how bank demand for Treasury securities is likely to evolve over the medium-term (3-5 years).*

July 31, 2018

Agenda

- Evolution of bank balance sheets in the post-crisis LSAP era
- Impact of SOMA portfolio normalization on balance sheets
- HQLA composition shifts and replacement needs
- Projected bank demand for Treasuries
- Impact of economic and rate cycle dynamics on HQLA composition and demand

Executive summary

- Bank balance sheet liquidity has increased significantly over the last few years
 - Response to the credit crisis, Fed balance sheet actions, and regulatory changes
- SOMA portfolio normalization will ripple through banks' balance sheets over the next few years
 - We project deposit growth will slow, loan-to-deposit ratios will likely rise, and reserve balances will decline as the Fed balance sheet normalization progresses
- Decline in available fed balances will likely create a large shift in HQLA composition
 - LCR ratios will face downward pressure and additional new HQLA will be needed to replace declining fed balances
 - Extent of additional HQLA needed will vary based on the size and pace of the Fed balance sheet reduction, deposit run-off sensitivity, and loan demand
 - New HQLA likely to be funded with a combination of reduced loan growth, wholesale debt funding, and a shift in banks' securities portfolio composition
- Bank demand for Treasuries is estimated to rise by up to \$500bn by 2021
 - Treasuries are likely to become a larger part of HQLA in the coming years, leading to a sharp increase in bank demand
 - Treasury bills are likely to play an increasingly important role in bank liquidity management
 - Treasury demand may also be impacted by a need to add duration and lower credit risk given the broader economic, interest rate, and credit cycle dynamics



Evolution of bank balance sheets

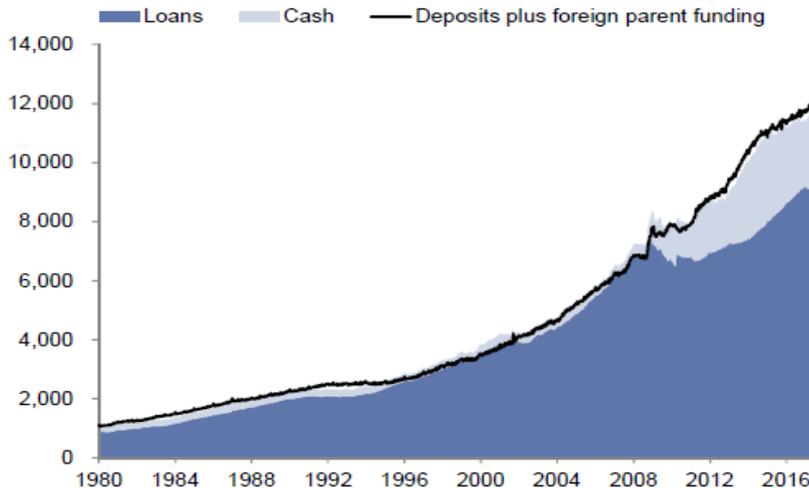
Balance sheet of consolidated U.S. banking organizations

Federal Reserve Balance Sheet (\$bn)	1997	2002	2007	2012	2014	2017	10yr Change*	CAGRs (%)					
								1997- 2002	2002- 2007	2007- 2012	2012- 2017	2007- 2017	
Excess Reserves	2	2	2	1,459	2,524	2,121	2,119						
Consolidated U.S. Banks (\$bn)													
Total Assets	5,282	8,255	13,985	17,054	17,980	20,406	6,421	9.3	11.1	4.0	3.7	3.9	
Cash incl. Central Bank Balances	314	403	547	1,398	1,939	1,927	1,380	5.1	6.3	20.6	6.6	13.4	
Securities	939	1,515	1,775	2,901	3,077	3,401	1,626	10.0	3.2	10.3	3.2	6.7	
Loans	3,012	4,279	7,144	7,487	8,091	9,564	2,420	7.3	10.8	0.9	5.0	3.0	
Other Assets	1,017	2,058	4,518	5,268	4,873	5,513	995	15.1	17.0	3.1	0.9	2.0	
Total Liabilities	4,826	7,494	12,834	15,248	16,003	18,137	5,302	9.2	11.4	3.5	3.5	3.5	
Deposits	3,466	4,788	7,232	9,698	10,622	12,193	4,961	6.7	8.6	6.0	4.7	5.4	
Other Liabilities	1,360	2,706	5,603	5,551	5,382	5,944	341	14.8	15.7	-0.2	1.4	0.6	
Equity	456	761	1,150	1,805	1,977	2,270	1,119	10.8	8.6	9.4	4.7	7.0	
Nominal GDP	8,578	10,936	14,452	16,197	17,522	19,485	5,033	5.0	5.7	2.3	3.8	3.0	
Ratios (%)													
Cash incl. Central Bank Balances/Total Assets	5.9	4.9	3.9	8.2	10.8	9.4	5.5						
Securities/Total Assets	17.8	18.4	12.7	17.0	17.1	16.7	4.0						
Loans/Deposits	86.9	89.4	98.8	77.2	76.2	78.4	(20.3)						
Deposits/Total Liabilities	71.8	63.9	56.3	63.6	66.4	67.2	10.9						
Equity/Total Assets	8.6	9.2	8.2	10.6	11.0	11.1	2.9						
Equity/Total Loans	15.1	17.8	16.1	24.1	24.4	23.7	7.6						

Source (All Charts): Federal Reserve Bank of New York (Quarterly Trends for Consolidated U.S. Banking Organizations), Federal Reserve Bank of St. Louis
 * Change from 2007 to 2017

Impact of balance sheet reduction on deposit flows remains uncertain

- Historically, loan and deposit growth have tracked each other very closely
- Deposit growth has significantly outpaced loan growth after the commencement of LSAPs
- Large banks and foreign banks have seen the most significant build-up in excess reserves
- It is reasonable to expect that deposit growth will be negatively impacted as the Fed reduces its balance sheet
- However, estimating a precise impact of balance sheet reduction on deposit growth remains challenging
- We estimate about a 50% “flow-through” from excess reserve reduction into “non-core” deposit run-off for the U.S. banks, but acknowledge that considerable uncertainty remains
- We expect solid growth in core deposits to continue, resulting in modest growth in total deposits

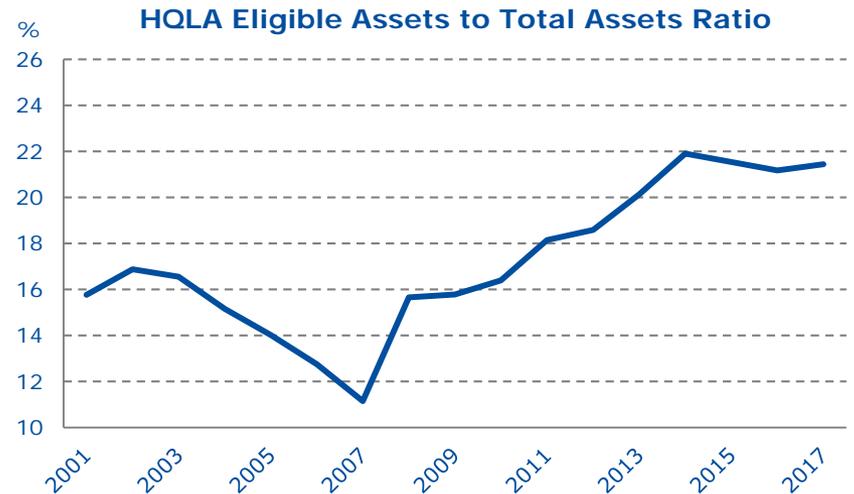
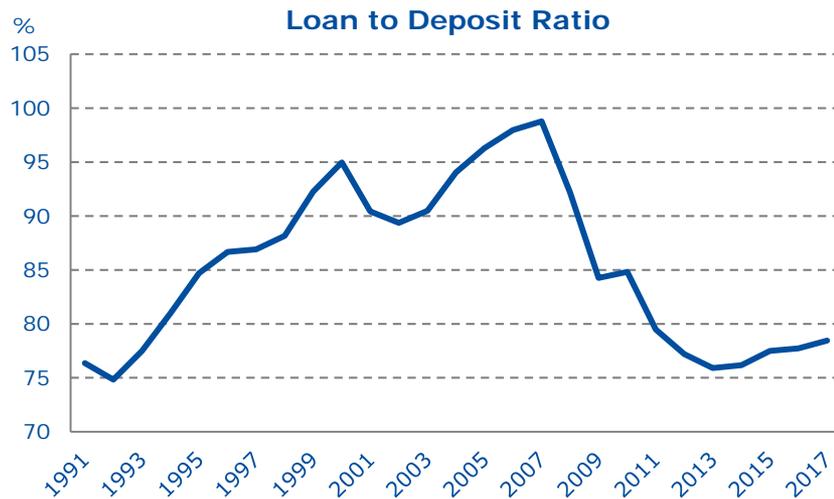
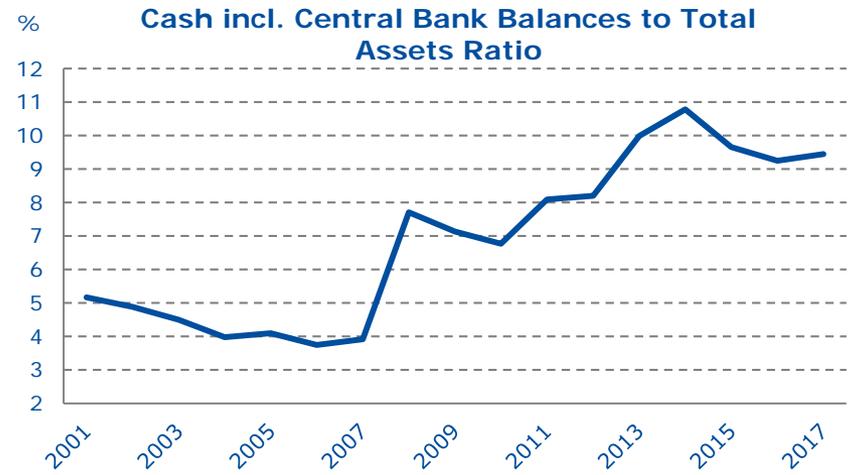
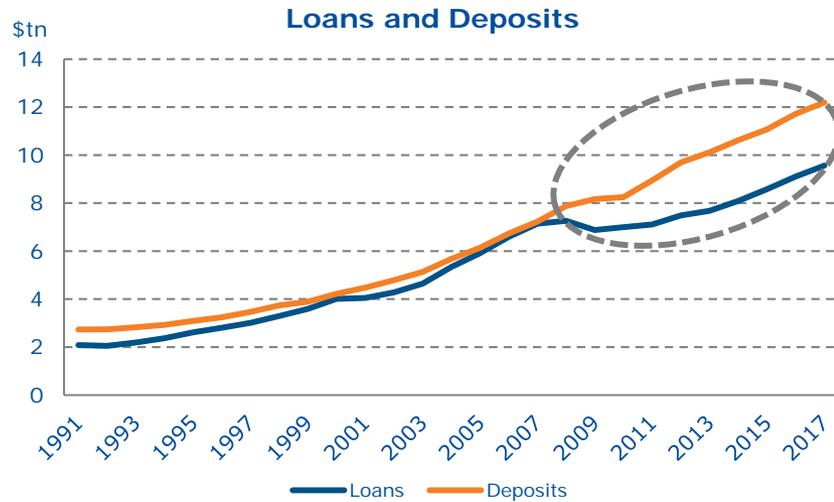


Foreign Bank Deposits Have Not Ramped with Deposits: QE Liquidity vs Deposit Growth (2008-17)

Difference between where QE liquidity has landed vs deposit growth				
(\$mn)	Large banks	Small banks	Foreign banks	Total
Increase in cash assets	839	247	815	1,900
Increase in loans	1,044	886	251	2,181
Increase in assets	1,883	1,133	1,066	4,081
Increase in deposits	3,166	1,557	(61)	4,661
Delta b/w asset growth and deposits	1,283	424	(1,128)	580
Change in funding from abroad	(408)	(87)	720	225
Net gap	875	337	(407)	804

Source (All Charts/Tables): Fitzgerald et al “The impact of the Fed reducing its balance sheet on the financial system”, Goldman Sachs Global Investment Research, June 19, 2017.

LSAPs and regulatory changes have significantly impacted balance sheet composition post the great recession



Source (All Charts): Federal Reserve Bank of New York (Quarterly Trends for Consolidated U.S. Banking Organizations)

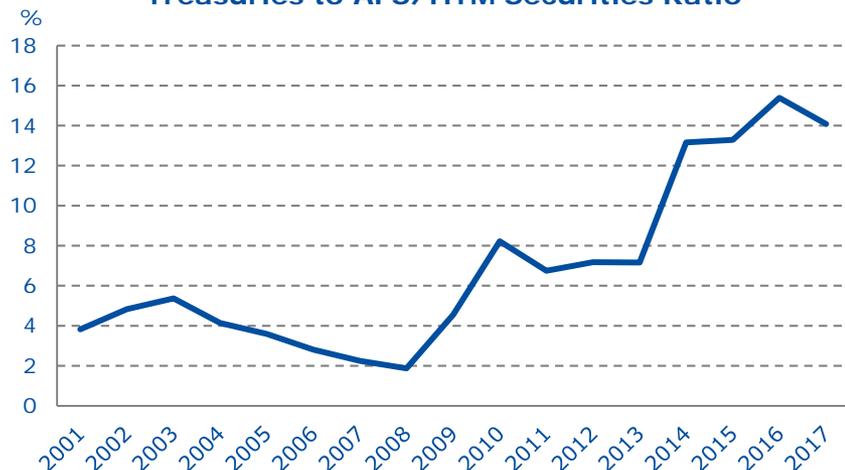
Securities portfolios have shifted to more liquid products

- Bank securities portfolios have increased significantly in recent years
- Most of the growth has come in Treasuries and Agency MBS holdings
 - Treasury holdings have grown both outright and as a portion of the overall portfolio
- Private label holdings are a smaller portion of the overall portfolio
 - Private label securities have fallen from 43% of total securities holdings in 2007 to only 28% in 2017

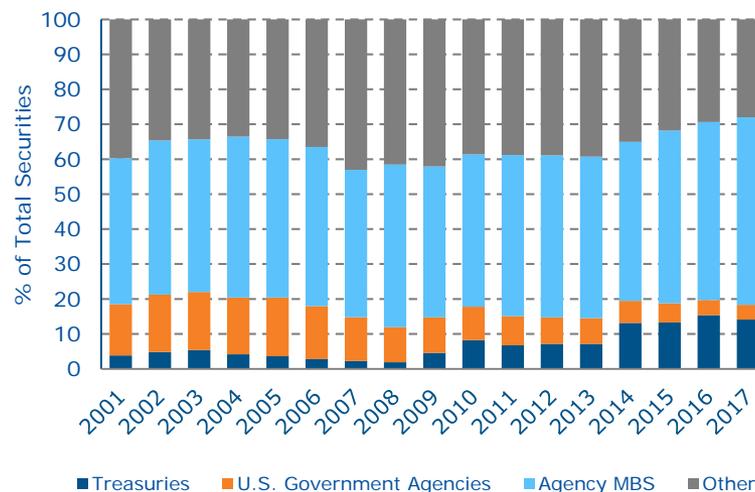
Consolidated U.S. Banking Organizations Securities Portfolio

	2001Q4	2007Q4	2017Q4
<i>AFS/HTM Securities (\$bn)</i>			
Treasuries	52	40	479
U.S. Government Agencies	201	222	144
Agency MBS	572	749	1,825
Other	545	764	953
Total AFS/HTM Securities	1,370	1,775	3,401
<i>AFS/HTM Securities (%)</i>			
Treasuries	3.8	2.2	14.1
U.S. Government Agencies	14.7	12.5	4.2
Agency MBS	41.8	42.2	53.7
Other	39.7	43.0	28.0
Total AFS/HTM Securities	100.0	100.0	100.0

Treasuries to AFS/HTM Securities Ratio



Securities Portfolio Distribution



Source (All Charts/Tables): Federal Reserve Bank of New York (Quarterly Trends for Consolidated U.S. Banking Organizations)



Impact of SOMA portfolio normalization on bank balance sheets

Liquidity Coverage Ratio (LCR)

$$\text{LCR} = \frac{\text{High-Quality Liquid Assets (HQLA)}}{\text{Total Net Cash Outflows (TNCO)}} \geq 100\%$$

High Quality Liquid Assets: Key Drivers

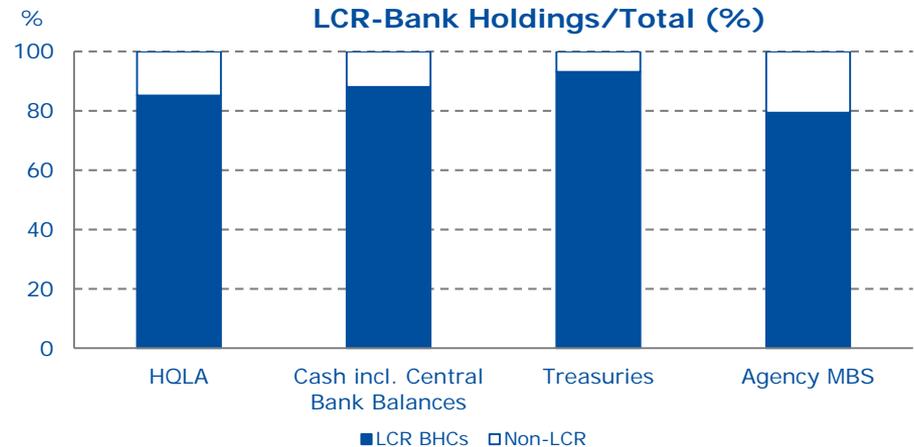
- Central Bank Balances
- Treasuries and Other Government Securities
- Agency Debentures and Agency MBS

Total Net Cash Outflows: Key Drivers

- Retail Deposit Balances and Composition
- Corporate and Institutional Deposit Balances and Composition
- Unfunded Loan Balances and Composition
- Net Derivatives and Secured Funding Outflows

LSAP unwind will primarily impact large “LCR” banks

- The demand for additional HQLA will be primarily driven by banks subject to LCR (“LCR BHCs”)
 - Smaller non-LCR regional banks were likely not impacted by LSAPs
- Projections do not take into account changes in non-U.S. central bank balances



As of 12/31/2017	Cons. U.S. Banks (\$bn)	LCR BHCs				Non-LCR	
		All LCR BHCs		GSIBs		\$bn	% of Total
		\$bn	% of Total	\$bn	% of Total		
Total Assets	20,406	16,207	79	10,988	54	4,199	21
Cash incl. Central Bank Balances	1,927	1,697	88	1,354	70	230	12
Securities	3,401	2,638	78	1,748	51	763	22
Treasuries	479	446	93	319	67	33	7
Other Securities	2,922	2,192	75	1,429	49	730	25
Loans	9,564	6,712	70	3,893	41	2,852	30
Other Assets**	5,513	5,160	94	3,993	72	354	6
Total Liabilities	18,137	14,425	80	9,830	54	3,712	20
Deposits	12,193	8,921	73	5,777	47	3,272	27
Other Liabilities***	5,944	5,504	93	4,053	68	439	7
Equity	2,270	1,782	79	1,158	51	487	21
HQLA*	3,649	3,109	85	2,304	63	540	15
Loans/Deposits (%)	78	75		67		87	
Cash incl. Central Bank Balances/Assets (%)	9	10		12		5	

Source (All Charts/Tables): Federal Reserve Bank of New York (Quarterly Trends for Consolidated U.S. Banking Organizations) and SNL Financial

* HQLA represents HQLA net of haircuts and eligibility. Non-LCR banks follow assumptions of non-GSIB LCR banks.

** Other Assets include Trading Assets, Fed Funds Sold & Reverse Repos, and Other Assets

*** Other Liabilities include Fed Funds Purchased & Repos and Other Liabilities

Fed balance sheet reduction will result in a shift in HQLA composition

- We project excess reserve reduction to result in a run-off in “non-core” deposits which will likely offset some of the growth in “core” deposits
- Our base case scenario is consistent with the SOMA “median scenario” reduction in excess reserves of about \$1.6tn
 - We model a 50% “flow-through” to deposits which results in a loss of about \$800bn in “non-core” deposits
 - Key balance sheet line items other than deposits are assumed to continue growing at growth rates observed over past five years
- HQLA is projected to decline by about \$480bn as bank lose “non-core” deposits, leading to a decrease in Level 1 assets
- As available fed balances decline, banks will need to increase Treasury holdings to prevent a further sharp decline in HQLA and LCR

Projected Balance Sheets

\$bn	2017	2018	2019	2020	2021	CAGR ^s (%) [*]
Federal Reserve Balance Sheet						
Excess Reserves	2,121	1,621	1,121	821	481	
LCR BHCs Balance Sheet						
<u>Assets</u>						
Central Bank Balances**	1,697	1,447	1,197	1,047	878	
Securities	2,638	2,760	2,886	3,014	3,145	
Treasuries	446	498	550	603	656	
Other Securities	2,192	2,263	2,336	2,411	2,489	3.2
Loans & Leases	6,712	7,049	7,403	7,775	8,165	5.0
Other Assets	5,160	5,207	5,255	5,303	5,351	0.9
Total Assets	16,207	16,464	16,741	17,139	17,539	
<u>Liabilities</u>						
Deposits	8,921	9,018	9,130	9,359	9,585	
Core Deposits	7,860	8,208	8,570	8,949	9,344	4.4
Non-Core Deposits***	1,060	810	560	410	241	
Other Liabilities	5,504	5,580	5,657	5,735	5,814	1.4
Total Liabilities	14,425	14,598	14,788	15,094	15,399	
Equity	1,782	1,866	1,953	2,045	2,140	4.7
HQLA	3,109	2,942	2,776	2,712	2,630	
<u>Key Ratios</u>						
Loan/Deposits (%)	75.2	78.2	81.1	83.1	85.2	
Central Bank Balances/Assets (%)	10.5	8.8	7.2	6.1	5.0	
HQLA/Assets (%)	19.2	17.9	16.6	15.8	15.0	

- * Other Securities, Loans & Leases, Other Assets, Core Deposits, Other Liabilities and Equity projected to grow using 2012-2017 compound annual growth rate (“CAGR”)
- ** Fed balances at LCR BHCs are modeled to be 50% of overall excess reserves on the Fed balance sheet. Central Bank balances also include balances held at foreign central banks
- *** Non-core deposits are modeled to be 50% of overall excess reserves on the Fed balance sheet

Furthermore, additional HQLA will be needed to comply with LCR requirements

- LCR ratio will face downward pressure as “non-core” deposits run-off and reserve balances decline
 - Deposit run-off is expected to be concentrated in non-operational wholesale deposits that have large run-off rates in the LCR calculation
 - Growth in “core deposits” and loan commitments is expected to create additional new outflows, offsetting outflow decline from attrition in “non-core” deposits
- We estimate that banks will **need to rebuild \$250-350bn in HQLA by 2021** to maintain an LCR level of 110%

Projected LCR BHCs HQLA Need						
\$bn	2017	2018	2019	2020	2021	Change
Federal Reserve Balance Sheet						
Excess Reserves	2,121	1,621	1,121	821	481	(1,640)
LCR BHCs Balance Sheet						
Loans	6,712	7,049	7,403	7,775	8,165	1,453
Deposits	8,921	9,018	9,130	9,359	9,585	664
<i>Core Deposits</i>	7,860	8,208	8,570	8,949	9,344	1,484
<i>Non-Core Deposits</i>	1,060	810	560	410	241	(820)
HQLA	3,109	2,942	2,776	2,712	2,630	(479)
Central Bank Balances	1,697	1,447	1,197	1,047	878	(820)
Treasuries	446	498	550	603	656	210
Other Securities	966	997	1,029	1,062	1,097	131
Total Net Outflows	2,605	2,598	2,587	2,622	2,654	49
Core Deposit Net Outflows	1,173	1,225	1,279	1,335	1,394	221
Non-Core Deposit Net Outflows	457	350	242	177	104	(354)
Other Net Outflows	975	1,024	1,066	1,110	1,156	181
LCR (%)	119	113	107	103	99	(20)
LCR Target (%)	119	117	115	112	110	(9)
HQLA need for LCR Target	0	98	198	224	289	289

Additional bank demand for Treasuries projected to increase by up to \$500bn by 2021

- Pro-forma balance sheet projected under base case scenario
 - Assume banks issue \$289bn in term debt to rebuild HQLA by investing in Treasuries
- Dwindling fed balances imply that the HQLA rebuild would likely comprise mostly of Level 1 securities
- Further, Treasury bills are likely to become an important substitute for a portion of the declining reserve balances
- T-bill versus T-note split within the Treasury holdings will vary over time based on balance sheet duration and liquidity needs

Projected Pro-Forma Balance Sheets

\$bn	2017	2018	2019	2020	2021	Change
Federal Reserve Balance Sheet						
Excess Reserves	2,121	1,621	1,121	821	481	(1,640)
LCR BHCs Balance Sheet						
<u>Assets</u>						
Central Bank Balances**	1,697	1,447	1,197	1,047	878	(820)
Securities	2,638	2,859	3,084	3,239	3,434	796
Treasuries	446	596	748	827	945	499
Other Securities*	2,192	2,263	2,336	2,411	2,489	297
Loans & Leases*	6,712	7,049	7,403	7,775	8,165	1,453
Other Assets*	5,160	5,207	5,255	5,303	5,351	192
Total Assets	16,207	16,562	16,939	17,363	17,828	1,621
<u>Liabilities</u>						
Deposits	8,921	9,018	9,130	9,359	9,585	664
Core Deposits*	7,860	8,208	8,570	8,949	9,344	1,484
Non-Core Deposits***	1,060	810	560	410	241	(820)
Other Liabilities*	5,504	5,678	5,855	5,960	6,103	599
Total Liabilities	14,425	14,696	14,986	15,319	15,688	1,263
Equity*	1,782	1,866	1,953	2,045	2,140	358
<u>LCR</u>						
HQLA	3,109	3,040	2,975	2,937	2,919	(190)
Total Net Outflows	2,605	2,598	2,587	2,622	2,654	49
LCR (%)	119	117	115	112	110	(9)
<u>Key Ratios</u>						
Loan/Deposits (%)	75.2	78.2	81.1	83.1	85.2	9.9
Central Bank Balances/Assets (%)	10.5	8.7	7.1	6.0	4.9	(5.6)
HQLA/Assets (%)	19.2	18.4	17.6	16.9	16.4	(2.8)
<u>Rebuild LCR Target</u>						
Term Debt Issuance	0	98	198	224	289	289
Treasury Purchases	0	98	198	224	289	289

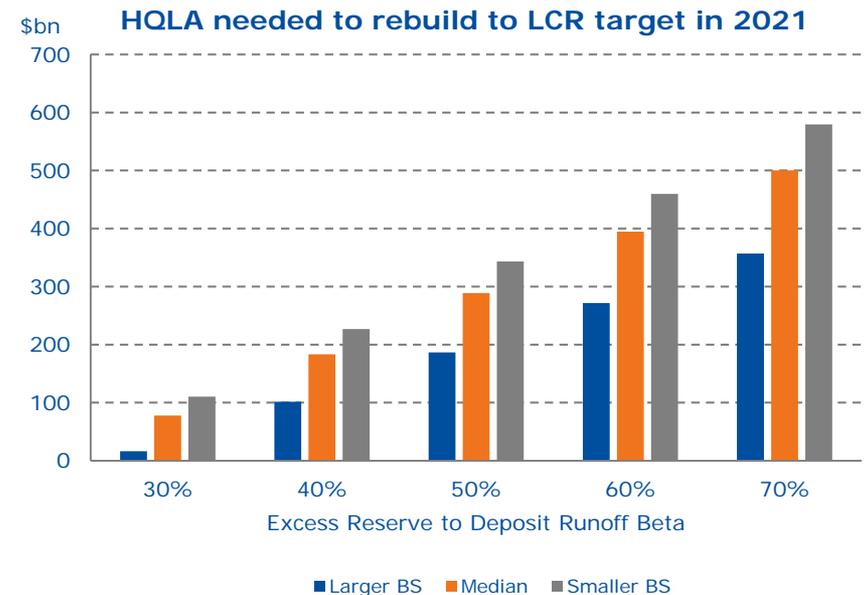
* Other Securities, Loans & Leases, Other Assets, Core Deposits, Other Liabilities and Equity projected to grow using 2012-2017 compound annual growth rate ("CAGR"); Other Liabilities includes New Debt to rebuild LCR Target

** Fed balances at LCR BHCs are modeled to be 50% of overall excess reserves on the Fed balance sheet. Central Bank balances also include balances held at foreign central banks

*** Non-core deposits are modeled to be 50% of overall excess reserves on the Fed balance sheet

Size and pace of reduction in excess reserves, along with loan growth, will be the key drivers of incremental HQLA required

- A smaller reduction* in the Fed balance sheet leads to a \$102bn decrease in the amount of HQLA, while a larger reduction* leads to a \$54bn decrease in the amount of HQLA needed
- 10% increase in the “flow-through” rate to “non-core” deposit run-off will result in \$107bn more HQLA needed
- **Increasing loan growth from 5% to 6% annually leads to a sharp increase in HQLA needed**
- Deposit mix has a relatively low impact on incremental HQLA need



HQLA needed to rebuild to LCR target in 2021

Annualized Loan Growth	Larger BS		Median		Smaller BS	
	HQLA Need (\$bn)	Loans/Deposits Ratio (%)	HQLA Need (\$bn)	Loans/Deposits Ratio (%)	HQLA Need (\$bn)	Loans/Deposits Ratio (%)
3%	(502)	77.2	(400)	78.8	(345)	79.7
4%	(166)	80.3	(64)	81.9	(9)	82.8
5%	187	83.5	289	85.2	343	86.1
6%	535	86.6	654	88.4	722	89.4
7%	982	90.0	1,110	91.8	1,178	92.8

*Source: SOMA projection annual report

Banks have several options to rebuild their HQLA

Option 1

- Issue term debt and use funds to grow the Treasury portfolio
 - Investing all of the proceeds in Treasuries would increase HQLA by 1:1
 - Issuing debt and using funds to grow securities using current HQLA securities composition would increase HQLA by 0.93:1

Option 2

- Alter composition of the securities portfolio
 - Reducing Level 2A securities to add Treasuries would increase HQLA by 0.18:1
 - Reducing Level 3 securities to add Treasuries would increase HQLA by 1:1

Option 3

- Decrease loan-to-deposit ratio and grow the securities portfolio
 - Reducing loans to invest the proceeds in Treasuries would increase HQLA by 1:1



Factors influencing HQLA composition

Drivers of securities portfolio composition

- Securities portfolio and swaps are used to manage interest rate risk and deploy excess liquidity
- Liquidity and LCR constraints, duration needs, and yield and income considerations drive allocation decisions across the various alternatives
 - Treasuries are an important source of duration and also offer more attractive yields versus central bank balances
 - Level 2 assets have more attractive yields, but have less liquidity and less attractive HQLA benefits
 - Level 3 assets have no HQLA benefit, but offer attractive yields
 - Relative value considerations play an important role as banks will often think about optimizing total return over a medium term horizon
- Decline in reserve balances will likely result in T-bills playing a more significant role in liquidity management

Bank HQLA/Securities Matrix

Asset Type	Liquidity/HQLA	Duration	Yield/Income
Central Bank Balances	Highest	Zero	Low
Treasuries	Highest	Low/Medium/High	Low/Medium
Agency MBS	High	Medium	Medium
Other Level 2	Medium	Medium	Medium/High
Level 3	Low	Low/Medium	High

Banks have been very asset sensitive over the past several years

- Banks use duration of equity (DoE) and net interest income (NII) sensitivity to interest rate changes as key metrics for evaluating and managing interest rate risk
 - DoE measures the sensitivity of the economic value of equity to changes in interest rate levels
- Record low interest rates combined with strong deposit growth has resulted in banks being very asset sensitive (income and economic equity value benefit from rising rates)
 - Strong growth in commercial loans relative to consumer loans (that tend to have longer duration) has further increased the asset sensitivity
- We estimate that banks will likely need to add duration in the coming years as the rate cycle matures
 - Banks have started to add duration recently as rates have risen
 - We estimate that banks will need to add an additional 1-2 years of duration of equity in the next few years
- We estimate one year of DoE for the top 100 banks equates to \$750bn five year note dv01 equivalents*

Weighted Average NII Sensitivity: % Change over the Next 12 Months

Year End	2017	2016	2007	2006	2005
Instantaneous +100 bps	4.6	5.9	-1.2	-0.7	0.1
Gradual +100 bps	2.4	2.7	-0.4	-0.4	0.3
Gradual +200 bps	3.2	3.6	-0.3	-0.5	0.1

Source: Bank 10Ks. NII changes are weighted averages based on total assets of each bank at each year end
*DoE calculation assumes economic value of equity for top 100 banks to be the same as their market capitalization which was calculated using SNL and Bloomberg data to be around \$3.5tn as of 12/31/2017

Overall Treasury demand highly dependent on the economic and rate regime

- Treasury demand tends to be very pro-cyclical in the later stages of an expansion and the early stages of an economic slowdown
- Treasury demand starts to pick-up as the rate cycle matures and well before the start of an easing cycle
 - Long-end Treasury yields tend to peak before short-end and intermediate Treasury yields
 - Treasury OASs tend to bottom-out even sooner
- Yields fall and spreads widen when the economy slows indicating an increase in Treasury demand
- Intermediate Treasuries tend to lead the rally in the early stages of a downturn and then hand off the baton to the short-end once the Fed starts easing

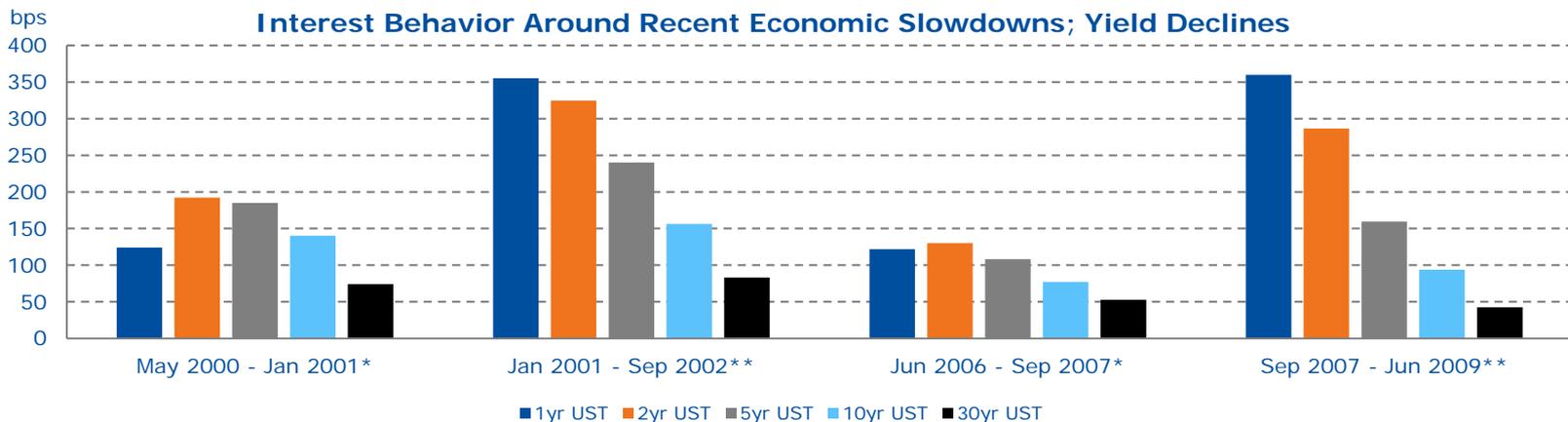
Tightening Regimes

Tightening Cycle	Trough Level		Change (bps) *			
	Fed Funds	Index OAS	Fed Funds	2yr UST	5yr UST	10yr UST
Feb 1994 – Feb 1995	3.00	(31)	300	403	333	287
Jun 2004 – Jun 2006	1.00	(150)	425	382	259	193
Dec 2015 – Current	0.25	(36)	175	204	200	175
Average	1.42	(72)	300	330	264	218

Easing Regimes

Easing Cycle	Trough Level		Change (bps) **			
	Fed Funds	Index OAS	Fed Funds	2yr UST	5yr UST	10yr UST
Jul 1990 – Mar 1991	8.25	27	(525)	(537)	(449)	(390)
Mar 2001 – Nov 2001	6.50	47	(550)	(493)	(388)	(277)
Dec 2007 – Jun 2009	5.25	222	(500)	(483)	(447)	(373)
Average	6.67	99	(525)	(504)	(428)	(347)

Source: Bloomberg, Index OAS is for Bloomberg Barclays Aggregate Index (Monthly data prior to 2000)
 * Trough-to-Peak calculated over 6 months prior to first FF hike through 36 months after last FF hike for UST and 18 months prior for Index OAS (Peak-to-Trough)
 ** Peak-to-Trough calculated over 6 months prior to start of NBER defined recession through 36 months after the end of NBER defined recession for UST and 18 months prior for Index OAS (Trough-to-Peak)



Source: Bloomberg, U.S. Department of Treasury

* Change from date of peak in 5yr UST in period 24 months prior to NBER defined recession to 1st Fed Funds easing before NBER defined recession

** Change from 1st Fed Funds easing before NBER defined recession to 18 months after the NBER defined recession start

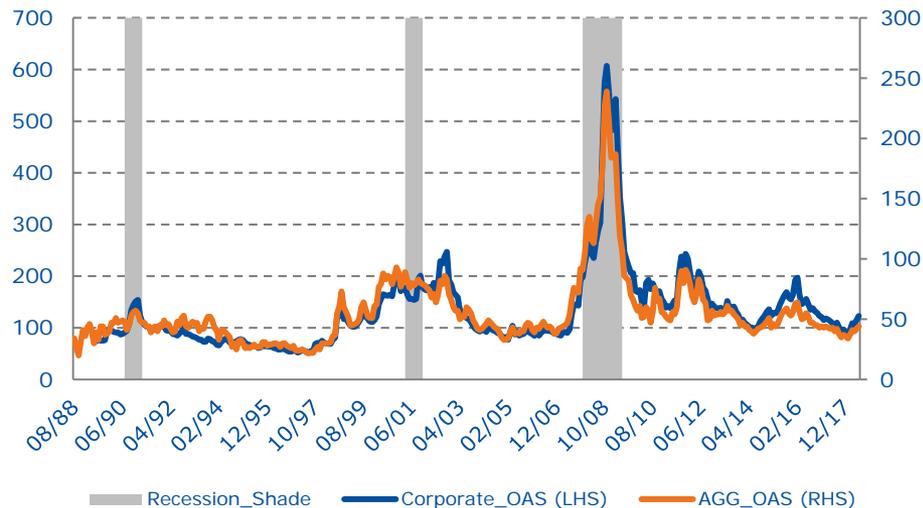
Relative value picture in Treasuries is mixed

- Term premiums and overall yield levels remain unattractive
 - Cyclically-adjusted term premium is quite low compared to the past
- However, Treasuries look cheap relative to other spread product (tight spread levels)
- We expect Treasury demand to increase in the coming years
 - Money manager performance YTD would indicate under-weights in Treasuries
 - Banks portfolios will continue shift asset mix towards Treasuries as well

10yr ACM Term Premium



Treasury OAS (bps)



Source: Bloomberg

Expected Treasury demand and preferred habitat along Treasury curve

- Bank demand has historically favored Treasuries in the short-to-intermediate part of the curve and intermediates will continue to be a significant portion of new demand
- Low term premiums will discourage demand for long term Treasuries and they will likely remain a small portion of the overall bank holdings
- Treasury bills are expected to play an increasingly important role in liquidity management as fed balances decline
- Bank demand for T-bills is likely to increase in the coming years

**US Treasury & Government Agencies:
Contractual Maturity Distribution (% of Carrying Value)**

As of: 3/31/2018	<= 1 Year	>1 Year; <= 5 Years	>5 Years; <= 10 Years	> 10 Years	Estimated WAL (years)
Estimated Total WAL (years)	0.5	3.0	7.5	12.0	4.1
Total (%)	9.3	64.3	23.4	3.0	100
Total (\$mm)	36,215	245,355	89,914	10,786	382,270

Source: Banks' 100s

Other factors relevant to future Treasury demand

- Policy tightening and lackluster deposit growth likely to increase deposit betas
 - Betas typically tend to rise as the rate cycle progresses
 - This behavior might be further exacerbated by the expected decline in “non-core” deposits
 - Betas could also be impacted by the digital disruption and the move towards mobile banking
- A larger than expected rise in deposit betas could reduce bank duration needs
- GSE reform and introduction of an UMBS pass-through security
 - Any adjustment in the HQLA classification of the new security could impact demand for both MBS and Treasuries
- LIBOR reform efforts may reduce reliance on the interest rate swaps market and may result in increased Treasury demand

Appendix

Glossary

- LSAP – Large Scale Asset Purchases
- SOMA – System Open Market Account
- LCR – Liquidity Coverage Ratio
- Cash – very liquid cash like assets, including interest-bearing deposits at the Fed and other central banks
- Fed balances – interest bearing reserve balances held at the Federal Reserve
- Central Bank balances – balances held at the Federal Reserve and foreign central banks (cash and non-interest bearing deposits are also included for purposes of this analysis)
- Non-core Deposits – deposits we project will decline as the Fed balance sheet normalizes
- Core Deposits – deposits we project that banks will maintain as the fed balance sheet normalizes
- LCR Banks/BHCs – Bank holding companies (BHCs) with assets greater than \$50bn which are subject to regulatory liquidity guidelines
- GSIBs – global systemically important banks
- CIC – Currency in Circulation
- HQLA – High Quality Liquid Assets, net of haircuts and eligibility criteria
- Level 1 – Central Bank Balances, Treasuries, and other government guaranteed securities
- Level 2A – Agency securities
- Level 2B – Non-Financial Corporates (not counted towards HQLA in this analysis)
- Level 3 – All securities not classified as Level 1, Level 2A or Level 2B
- CAGR – Compound Annual Growth Rate

Fed SOMA balance sheet: median, large, and small balance sheet scenarios

Median Federal Reserve Balance Sheet Projection (\$bn), \$613bn Total Fed Reserves, Total Reserves Runoff \$1,631bn												
Year End	Total Assets	Agency MBS Runoff	TRSY Runoff	Total Runoff	Total Liabilities	Excess Reserves	Req Reserves	Total Reserves	Currency	Other Liability	Equity	Ex Reserve Runoff
2017	4,449	12	18	30	4,407	2,121	124	2,244	1,612	551	41	
2018	4,062	158	229	387	4,020	1,621	124	1,745	1,709	567	41	500
2019	3,606	185	271	456	3,564	1,121	127	1,247	1,811	506	41	500
2020	3,258	166	182	348	3,216	821	129	950	1,920	346	41	300
2021	2,934	151	173	324	2,892	481	132	613	2,035	244	41	340
				1,515								1,640
Small Federal Reserve Balance Sheet Projection (\$bn), \$406bn Total Fed Reserves, Total Reserves Runoff \$1,838bn												
Year End	Total Assets	Agency MBS Runoff	TRSY Runoff	Total Runoff	Total Liabilities	Excess Reserves	Req Reserves	Total Reserves	Currency	Other Liability	Equity	Ex Reserve Runoff
2017	4,449	12	18	30	4,407	2,121	124	2,244	1,612	551	41	
2018	4,062	158	229	387	4,020	1,621	124	1,745	1,709	567	41	500
2019	3,606	185	271	456	3,564	1,121	127	1,247	1,811	506	41	500
2020	3,258	166	182	348	3,216	621	129	750	1,920	546	41	500
2021	2,934	151	173	324	2,892	274	132	406	2,035	451	41	347
				1,515								1,847
Large Federal Reserve Balance Sheet Projection (\$bn) \$1,000bn Total Fed Reserves, Total Reserves Runoff \$1,244bn												
Year End	Total Assets	Agency MBS Runoff	TRSY Runoff	Total Runoff	Total Liabilities	Excess Reserves	Req Reserves	Total Reserves	Currency	Other Liability	Equity	Ex Reserve Runoff
2017	4,449	12	18	30	4,407	2,121	124	2,244	1,612	551	41	
2018	4,062	158	229	387	4,020	1,621	124	1,745	1,709	567	41	500
2019	3,606	185	271	456	3,564	1,121	127	1,247	1,811	506	41	500
2020	3,258	166	182	348	3,216	871	129	1,000	1,920	296	41	250
				1,191								1,250

Source: SOMA projection annual report

▪ SOMA Balance Sheet Projection Methodology:

- 2017 are year-end historical balances
- Total Assets are reduced by yearly Agency MBS and Treasury securities run-off amount, estimates of Agency MBS and Treasury run-off are from Citi Research
- Total Liabilities are reduced by yearly Agency MBS and Treasury securities run-off amounts
- Required Reserves are assumed to grow at 2% per year
- Excess Reserves are reduced yearly by Excess Reserve run-off amount
- Other Liability is comprised of Reverse Repurchase Agreements, US Treasury General Account (TGA) and Other Liabilities
- Currency growth is assumed to be 6% per year

Projecting balance sheet evolution for LCR BHCs

- **Projecting the key balance sheet metrics**

- Loans, other securities, other assets, core deposits, other liabilities and equity projected using 2012-2017 CAGRs
- Excess reserves are projected based on scenarios provided in the SOMA projection annual report
- We project a certain portion of bank deposits (“non-core” deposits) decline as a function of excess reserve reduction using a simple beta (“flow-through rate”)
- Fed balances at LCR BHCs are modeled to be 50% of overall excess reserves on the Fed balance sheet. Central Bank balances also include balances held at foreign central banks which are assumed to be held constant

- **Total net outflows key metrics**

- Deposit balances are segmented into key LCR deposit categories – retail, wholesale operational and wholesale non-operational, based on disclosed starting balance for GSIBs and a proxy segmentation for non-GSIBs
 - Each LCR deposit category is further segmented into core and non-core
- Core deposit balances are projected to grow at stated CAGR and non-core deposit balances decline proportionally by category to the total non-core deposit decline
- Net deposit outflows are projected by applying LCR outflow rates for each deposit category to the projected deposit balances in each category
- Other Net Outflows are projected using a simple CAGR linked to loan growth

- **Total HQLA key metrics**

- Projected HQLA calculated using projected Fed and securities balances with prescribed LCR haircuts and disclosed/proxy eligibility criteria

- **Pro-forma balance sheet to rebuild HQLA**

- New HQLA is funded by issuing term debt and investing in Treasuries

Base case assumptions

Assumption	GSIBs	Non-GSIBs	Comment
<u>Growth Rates</u>			
Non-Treasury Securities	3.2%		2012-2017 CAGR
Loans	5.0%		2012-2017 CAGR
Other Assets	0.9%		2012-2017 CAGR
Core Deposits	4.4%		2012-2017 CAGR
Other Liabilities	1.4%		2012-2017 CAGR
Equity	4.7%		2012-2017 CAGR
<u>Impact of LSAP unwind</u>			
Flow-through rate	50%		
Split of deposit run-off	80%	20%	
Proportion of run-off in retail	5%		
Proportion of run-off in wholesale	95%		
Operational Split of wholesale run-off	25%		
Non-operational Split of wholesale run-off	75%		
<u>Starting Deposit Mix</u>			
Retail	50.3%	63%	GSIBs from disclosures/SNL Financial
Wholesale – Operational	26.4%	18%	GSIBs from disclosures/SNL Financial
Wholesale – Non-operational	19.7%	15%	GSIBs from disclosures/SNL Financial
Other	3.6%	4%	
<u>Deposit Outflow Rates</u>			
Retail	9.4%	5%	GSIBs from disclosures
Wholesale – Operational	24.9%	25%	GSIBs from disclosures
Wholesale – Non-operational	59.9%	50%	GSIBs from disclosures
Other	0.0%	0.0%	
<u>Other Outflow Growth Rates</u>			
Other Net Outflow Growth Rate	4%		

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TBAC Charge: Housing Finance Related Securities

Evaluate the use of Treasury securities versus the range of housing finance related securities (specifically debt and MBS issued by Ginnie Mae, Fannie Mae and Freddie Mac) in investment portfolios. Please discuss the extent to which different investor types view Agency debt and MBS as substitutes for Treasury securities. How do investors determine the premium required to invest in Agency debt and MBS compared to Treasuries? How have different policy changes or market conditions affected this premium over the years? What policy changes or market conditions could affect this premium?

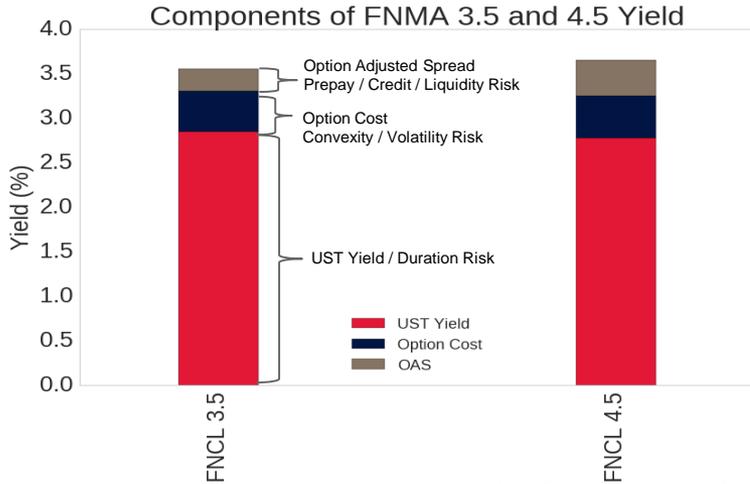
Executive Summary

- Housing related securities are less liquid and are exposed to a range of risk factors which do not affect U.S. Treasuries. Investors are compensated for these differences in liquidity and risk through excess yield and return compared to U.S. Treasuries. These differences make agency MBS only weakly substitutable with U.S. Treasuries.
- Heavy UST supply and conservatorship reduced the spread over Treasuries associated with GSE debentures and MBS securities. Declining UST term premia suggests the increase in demand for safe assets post-crisis has been more than sufficient to meet the additional supply of U.S. Treasuries. Excess demand has been driven primarily by foreign investors and large-scale asset purchases (LSAP) by the Federal Reserve, and to a lesser extent bank regulation.
- The risks associated with a change in U.S. government's commitment to GSE MBS are asymmetric:
 - Withdrawal of government support could potentially cause a substantial increase of spread premia for housing related securities.
 - Extending a full faith and credit guarantee and HQLA Level 1 status to agency MBS would likely cause a realignment of GNMA and agency MBS spreads, but US Treasury term premia will likely not be materially impacted.

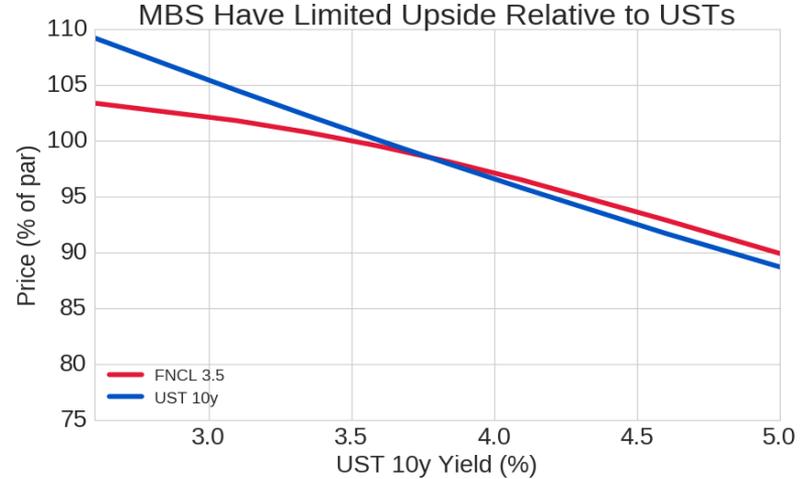
MBS Risk Characteristics

Agency MBS are Weakly Substitutable with US Treasuries Due to Differences in Risk

MBS yield premia to US Treasuries can be attributed to convexity, prepay, and to a lesser extent credit and liquidity risk.

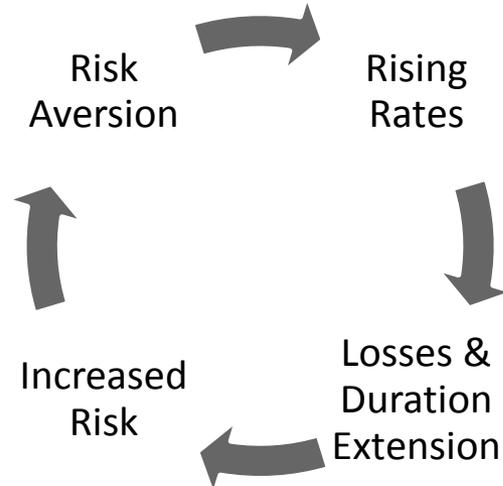
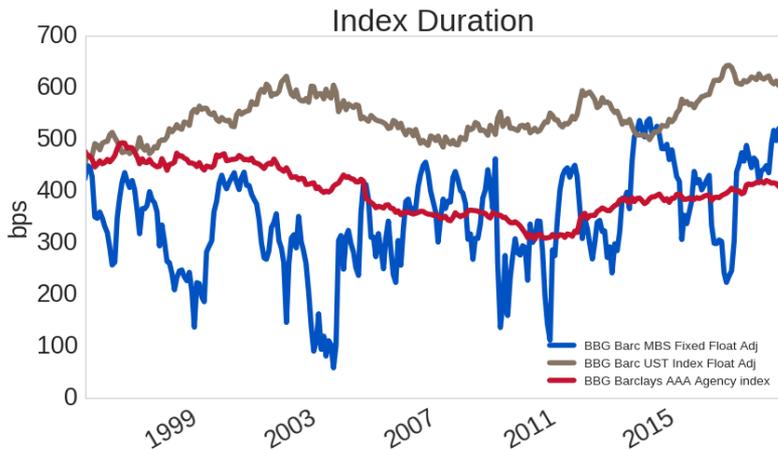


MBS are callable bonds and have a negatively convex price/yield relationship.



Negative convexity causes prices and risk to move with rates in a way that adversely affects MBS investors.

Negative convexity can amplify interest rate volatility, and increase expected returns of USTs and MBS over short horizons.



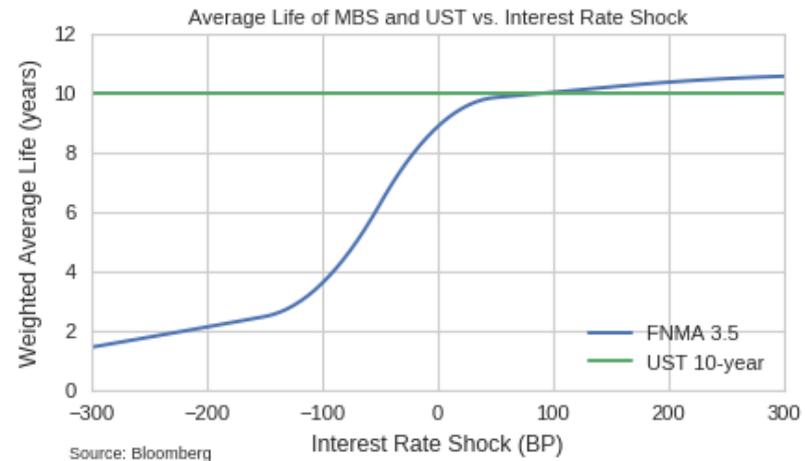
Convenience Yield of US Treasuries

To explain the existence of a convenience yield, Krishnamurthy and Vissing-Jorgensen (2012)¹ cite several unique characteristics of USTs which do not apply to MBS even with a full faith and credit guarantee.

- MBS are subject to prepayment and convexity risk, which require extensive expertise to understand. It is unlikely that investors lacking this expertise will see MBS as a substitute for UST.
- “Suppose that some investors face **costs of understanding investment in risky assets**... These investors will have a unique demand for riskless assets, driving up the price of riskless assets.”³

- Conventional and GNMA MBS are accepted as collateral for certain derivatives transactions, but haircuts are often higher than for UST regardless of government guarantee status.
- “There is a **substantial demand for collateral for purposes of mitigating counterparty risk in derivatives and settlement systems**. The collateral in these transactions is required to be extremely safe, thus also driving the demand for a safety attribute.”³

- The timing of MBS cash flows is uncertain, and average maturity can vary widely with interest rates². The use of MBS to match longer dated liabilities would be problematic.
- “[Some investors] have a **special demand for certain long-term payoffs to back long-term nominal obligations**”³ :
 - Defined benefit pension funds
 - Insurance companies
 - Municipalities collateralizing their own debt issuance



¹Krishnamurthy, Arvind and Annette Vissing-Jorgensen, “The Aggregate Demand for Treasury Debt”, Journal of Political Economy, Vol. 120, No. 2 (April 2012), pp. 233-267. http://faculty.haas.berkeley.edu/vissing/demandtreas_jan6.pdf

²A more stable average maturity profile can be achieved through CMO structuring, but at a substantial cost to liquidity.

³Emphasis added.

Liquidity and Risk Characteristics Summary

		US Treasury Total	On-the-Run UST	Off-the-Run UST	TIPS	GNMA MBS	Conventional MBS	Agency Debentures	Corporates
Liquidity	Balance Outstanding (\$T)	14.93	0.42	13.2	1.3	1.83	4.56	1.91	9.07
	Daily Trading Volume (\$B) ¹	559.7	361.3	180.7	17.7	52.1	182.1	2.9	34.4
	Turnover Ratio ²	27	1	73	73	35	25	659	264
	% of Repo Market Collateral ³		~50%			~28%		~2%	~5%
	CME Collateral Haircut ⁴	1%-6%	1%-6%	1%-6%	1%-6%	11%	11%	3.5%	20%
	HQLA Status / Contribution %	Level 1 / 100%	Level 1 / 100%	Level 1 / 100%	Level 1 / 100%	Level 1 / 100%	Level 2A / 85%	Level 2A / 85%	Level 2B / 50%
Risk	B3S Risk Weight ⁵	0%	0%	0%	0%	0%	20%	20%	20%/100%
	Government Support	Explicit	Explicit	Explicit	Explicit	Explicit	Conservatorship	Conservatorship	N/A
	Principal Repayment Timing	Certain / 4w-30Y	Certain / 4w-30Y	Certain / 4w-30Y	Certain / 5Y, 10Y, 30Y	Uncertain / WAL ~2Y- 11Y	Uncertain / WAL ~2Y- 11Y	Certain / WAL ~5Y ⁶	Certain / WAL ~10Y ⁶
	Duration Risk	✓	✓	✓	✓	✓	✓	✓	✓
	Prepay Risk					✓	✓		
	Credit Risk						✓	✓	✓
	Liquidity Risk	✓		✓	✓	✓	✓	✓	✓
	Convexity Risk					✓	✓	✓ ⁶	✓ ⁶

1) On-the-Run / Off-the-Run UST trading volume split is assumed to be 2/3 On-the-Run and 1/3 Off-the-Run (<https://www.treasury.gov/press-center/press-releases/Pages/sm0222.aspx>).

2) Turnover Ratio is defined as Balance Outstanding / Daily Trading Volume.

3) June 2018 Fedwire-eligible and non-eligible Triparty Repo data from SIFMA.

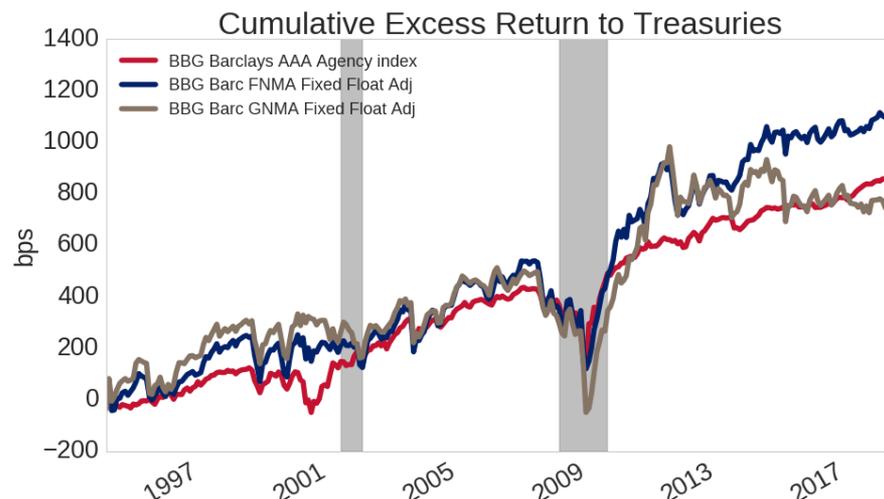
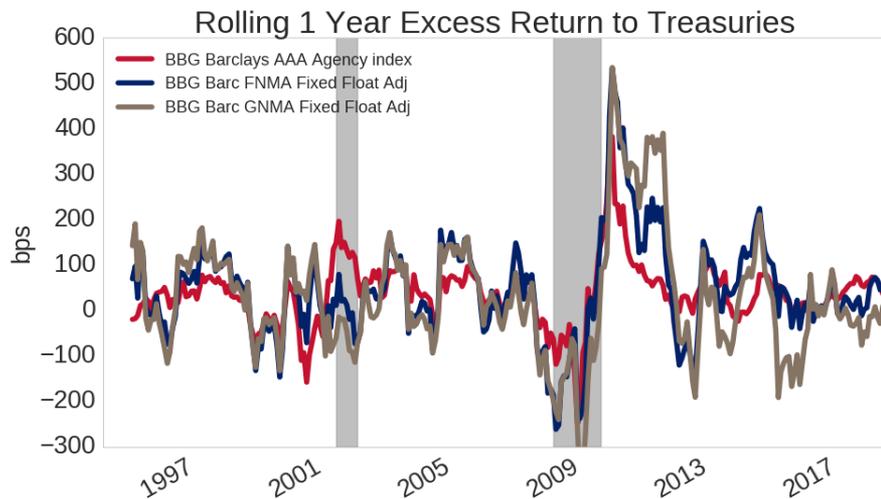
4) UST collateral haircuts vary by tenor as follows: 0-1Y (1%), 1-3Y (2%), 3-5Y (3%), 5-10Y (4.5%), and 10-30Y (6%).

5) Corporate B3S risk weight is 20% for US depository institutions and 100% for US non-depository institutions.

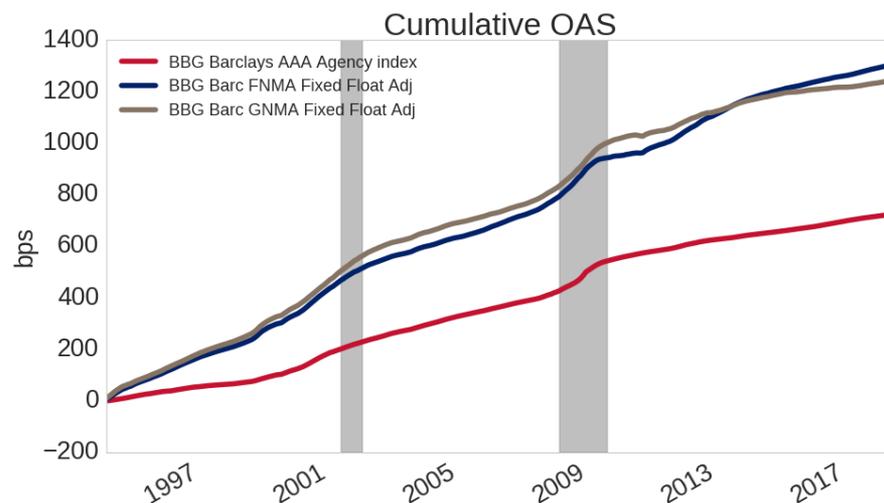
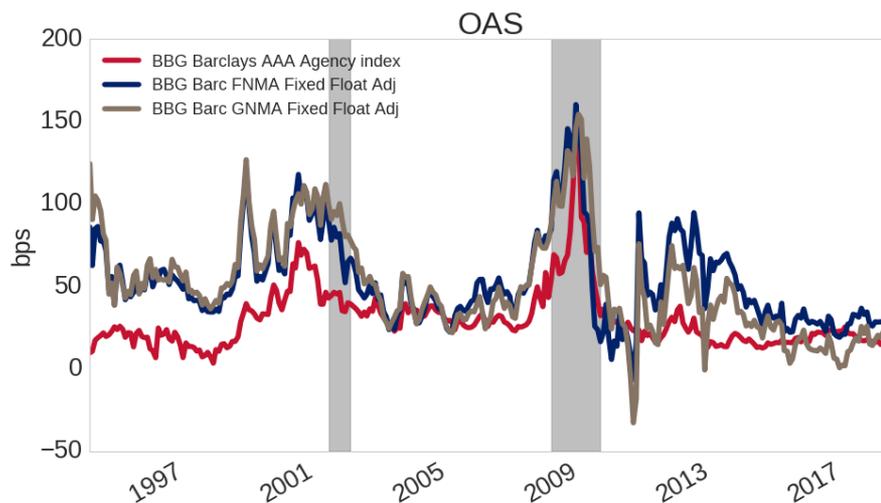
6) Agency Debentures and Corporate bonds are often callable, exposing investors to convexity risk and uncertainty of principal repayment timing.

Historical Performance of Housing Related Securities

Historically, housing related securities have produced significant excess returns to US Treasuries. They have also exhibited large drawdowns to US Treasuries, notably during the financial crisis.



Ex-post realized returns are far more volatile than ex-ante measures of expected return such as Option adjusted spread (OAS).



Issuance Patterns

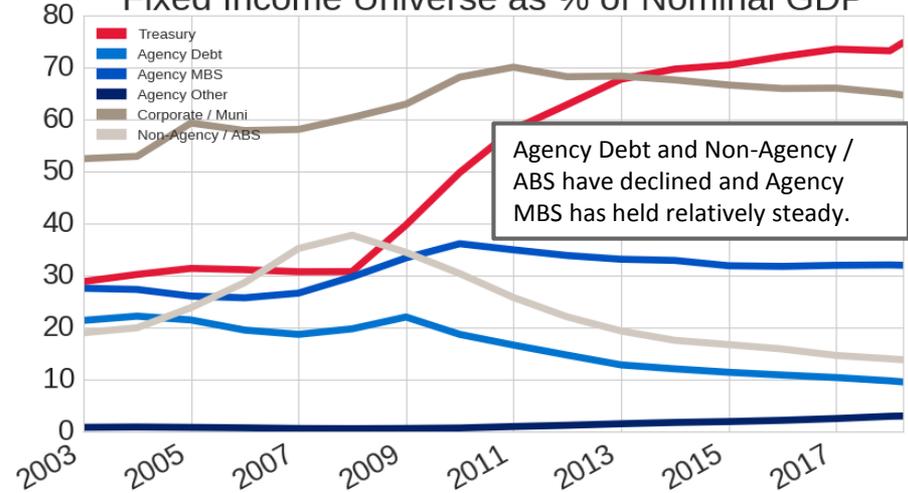
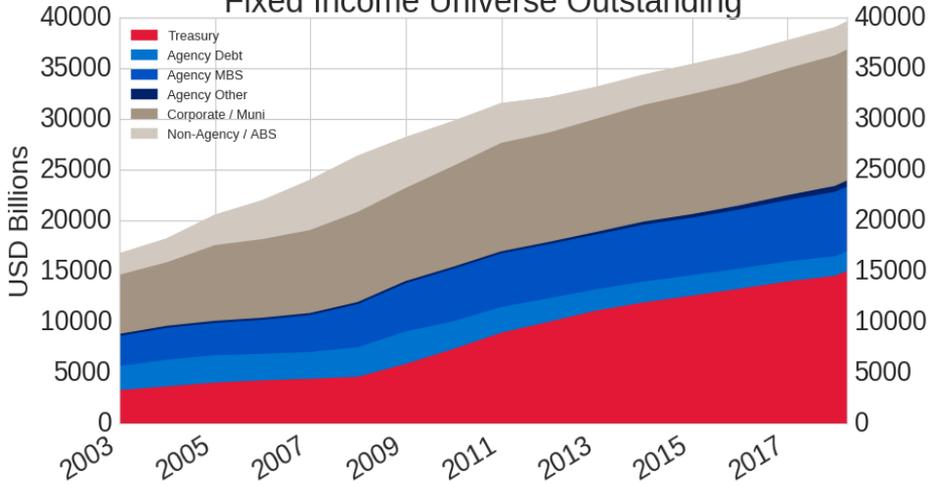
Housing Security Growth has Lagged US Treasury and Corporate Growth

US Treasury and Corporate supply has grown significantly post-crisis

...in absolute terms and, in the case of UST, as a percent of GDP.

Fixed Income Universe Outstanding

Fixed Income Universe as % of Nominal GDP

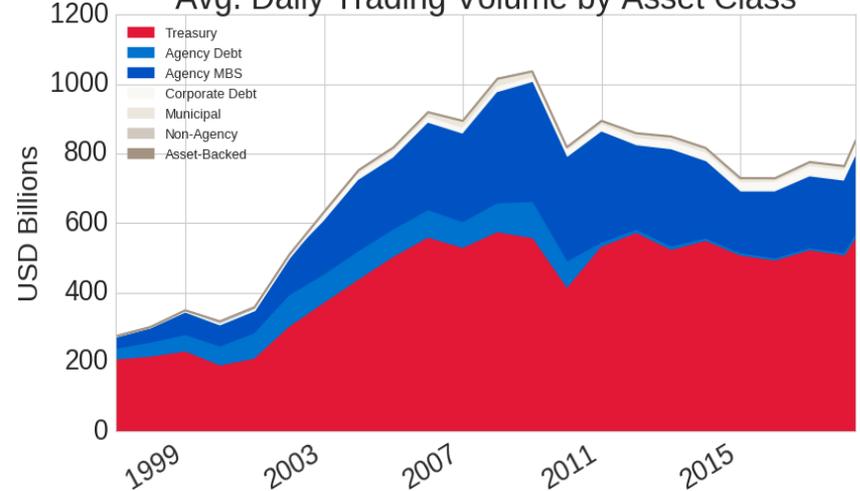
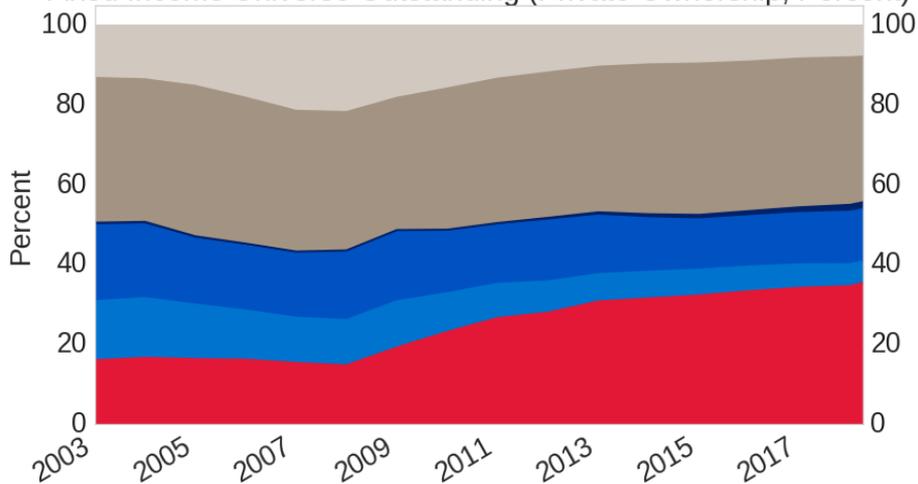


The private sector has absorbed the majority of UST net issuance while the Fed has absorbed a significant portion of MBS net issuance.

USTs and MBS trade volumes are much higher than other sectors.

Fixed Income Universe Outstanding (Private Ownership, Percent)

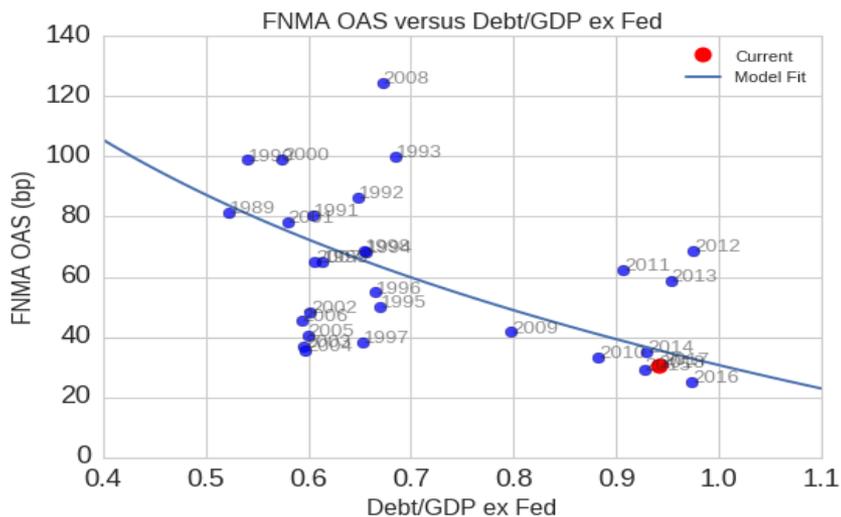
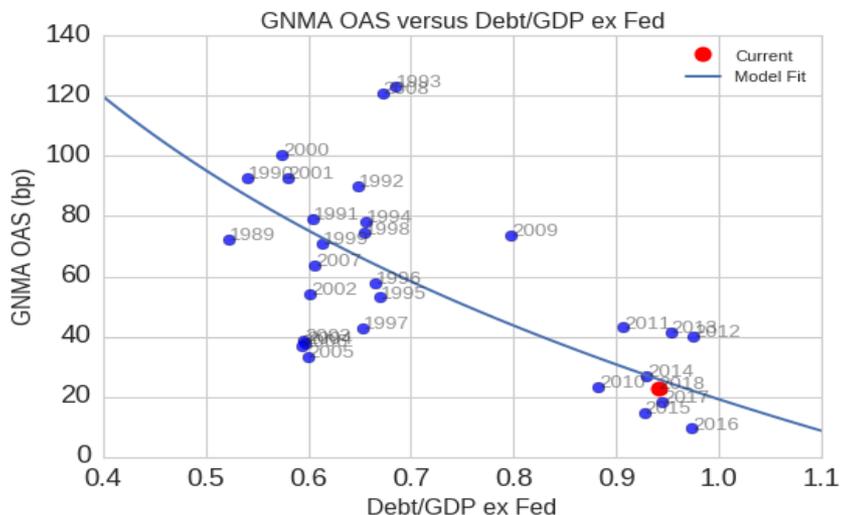
Avg. Daily Trading Volume by Asset Class



Sources: SIFMA, Federal Reserve Bank of St. Louis Economic Research. Note: Private ownership excludes Fed holdings

Supply Effects: Convenience Spread

Extension of Krishnamurthy & Vissing-Jorgensen (2012)¹



- Krishnamurthy & Vissing-Jorgensen (2012) show that UST Debt / GDP is a significant driver of the premium commanded by safe and liquid assets.

A Extending this analysis to FNMA and GNMA OAS shows UST Debt / GDP is a significant driver of both.

B The fact that the GNMA and FNMA coefficients are similar suggests the OAS is primarily driven by liquidity rather than safety considerations.

- Since OAS is unlikely to fall below zero, we expect further compression due to additional supply to be limited.

OLS Regression Results				
	GNMA		FNMA	
	1989-2018 (R2: 34.21%)		1989-2018 (R2: 23.04%)	
	coefficients	p-values	coefficients	p-values
const	0.09	0.34	0.17	0.04
Log([Debt - Fed] / GDP)	-1.10 B	0.00 A	-0.82 B	0.00 A
(Index Cpn - Current Cpn) ²	0.08	0.04	0.18	0.00

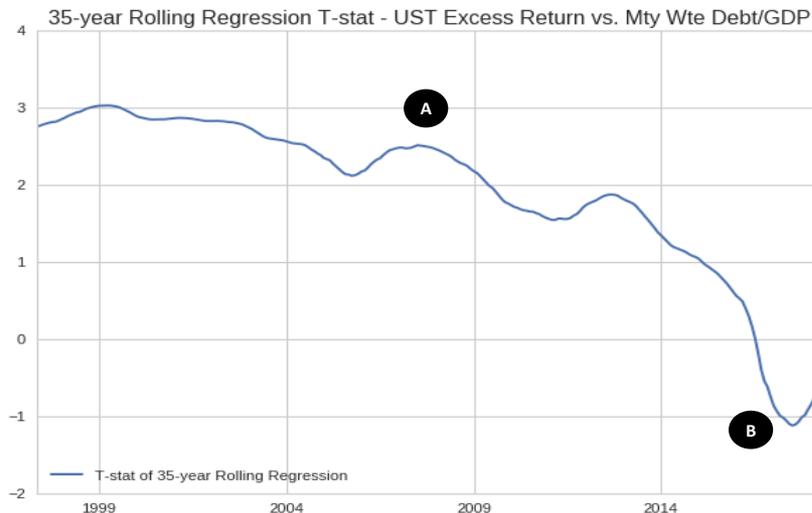
- Regressions are run on monthly data
- In calculating p-values, we compensated for serial correlation in the residuals
- The square of MBS coupon is a proxy for prepayment risk, so we include it as a control variable in the same way Krishnamurthy and Vissing-Jorgensen control for expected loss and credit risk premia in regressions on corporate bond spreads.

¹Krishnamurthy, Arvind and Annette Vissing-Jorgensen, "The Aggregate Demand for Treasury Debt", Journal of Political Economy, Vol. 120, No. 2 (April 2012), pp. 233-267. http://faculty.haas.berkeley.edu/vissing/demandtreas_jan6.pdf

Supply Effects: Term Premia and Excess Returns

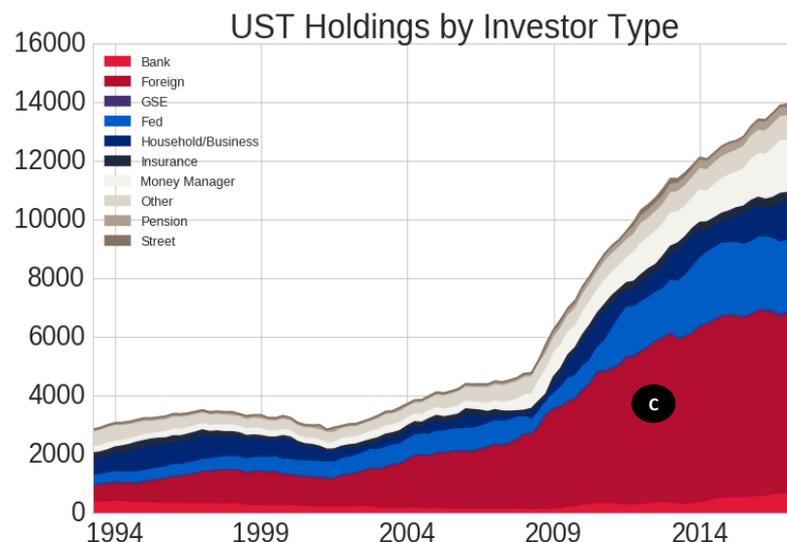
Update of Results Based on Greenwood & Vayanos (2014)¹

- A** Greenwood & Vayanos (2014) argue that shocks to the supply and maturity structure of government debt alter the price of duration risk. Using data from 1916-2007, they find a strong positive relationship between maturity weighted debt / GDP and both current UST yields and future UST excess returns. We reproduce their results over a shorter window of data.
- B** However, this relationship seems to have broken down after the financial crisis.
- C** It seems likely that the post crisis supply shock has been offset primarily by surging foreign sector demand and LSAP, and to a lesser extent post crisis regulation.



OLS Regression Results					
1-year Rolling UST 10y Excess Return vs. Maturity Weighted UST Debt / GDP					
Time Range	R-Squared	Constant Coefficient	MWD/GDP Coefficient ²	Constant P-value	MWD/GDP P-value
1/1/1970 - 12/31/2008	0.09.0736	-4.08	2.76	0.26	0.02 A
1/1/1980 - 6/30/2018	0.022	-1.55	1.87	0.84	0.38 B

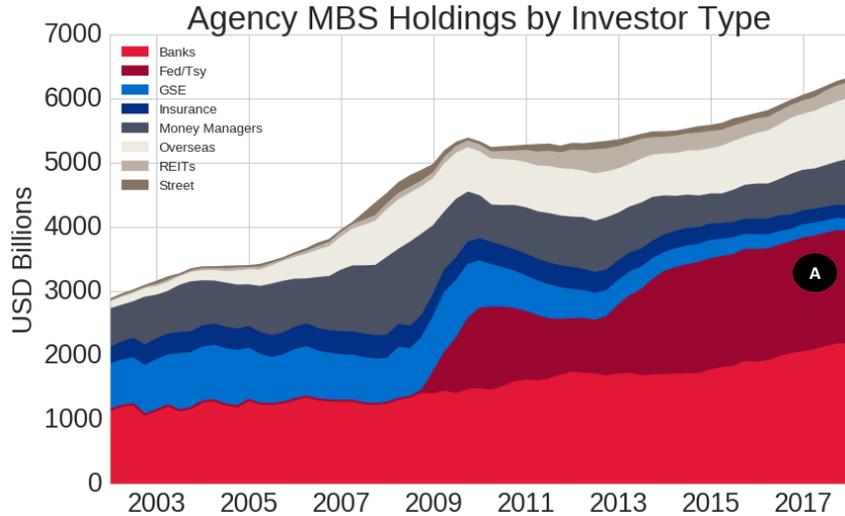
²Regression terminating in 2008 has UST return increasing 0.31 std dev for each 1 std dev increase in MWD/GDP. Regression terminating in 2018 has UST return increasing 0.22 std dev for each 1 std dev increase in MWD/GDP.



¹Greenwood, Robin, and Dimitri Vayanos. "Bond Supply and Excess Bond Returns." Review of Financial Studies 27, no. 3 (March 2014): 663–713. https://dash.harvard.edu/bitstream/handle/1/12748550/greenwood,vayanos_BSEBR_RSff.pdf

MBS Investor Universe and Trends

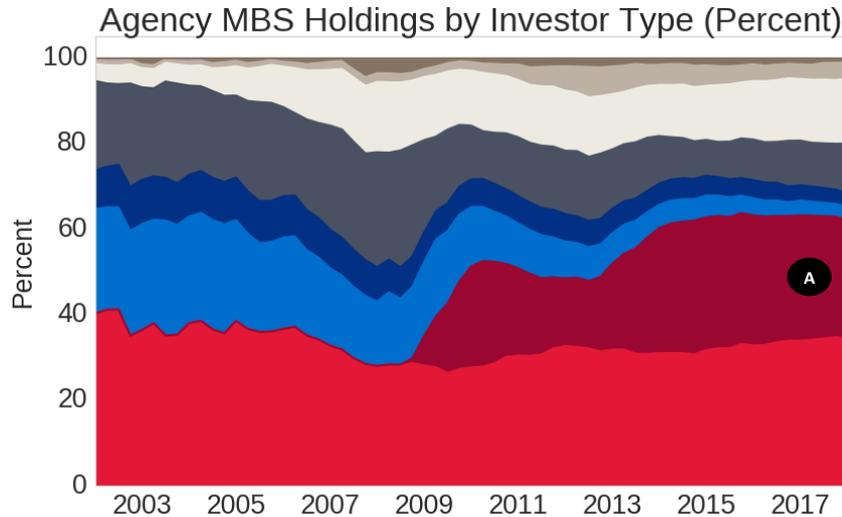
The Fed Facilitated a Large Private to Public Risk Transfer Post-Crisis but is Now Tightening



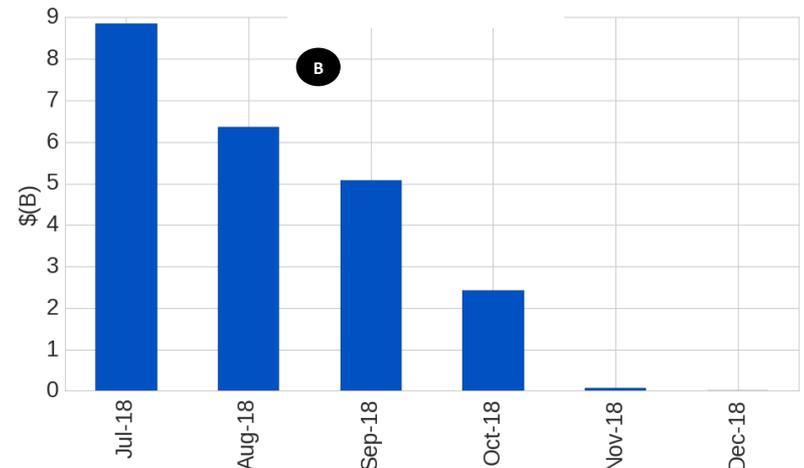
A Domestic public holdings have grown as a % of total issuance as Fed LSAPs have more than offset the decline in GSE holdings.

- GSEs actively hedge the convexity of their MBS holdings, leading to higher levels of interest rate volatility. Thus, as their MBS holdings have declined, the net impact has been to decrease interest rate volatility.
- Banks and the Fed, on the other hand, are generally not active convexity hedgers. As their respective MBS portfolios have grown, this has produced a dampening impact on interest rate volatility, and has contributed to lower rates and tighter mortgage spreads.

B Fed runoff will accelerate in the second half of 2018, requiring additional market participation from other investors.

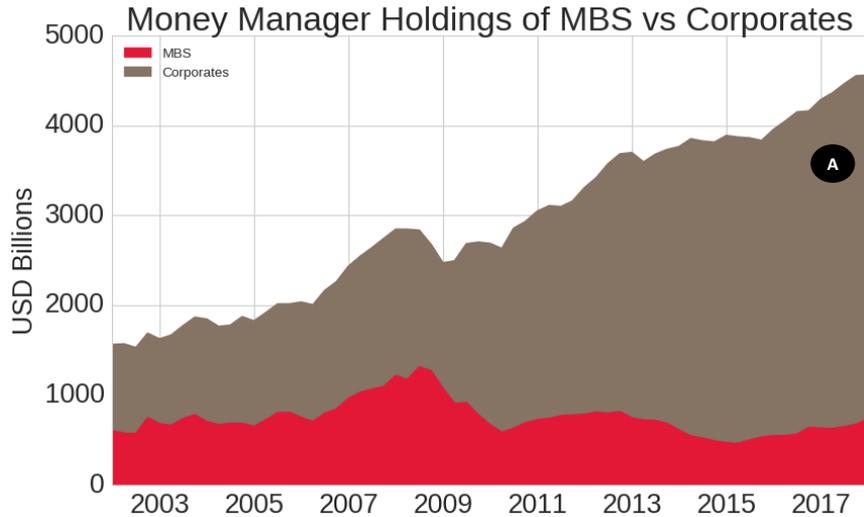


Fed MBS Reinvestment

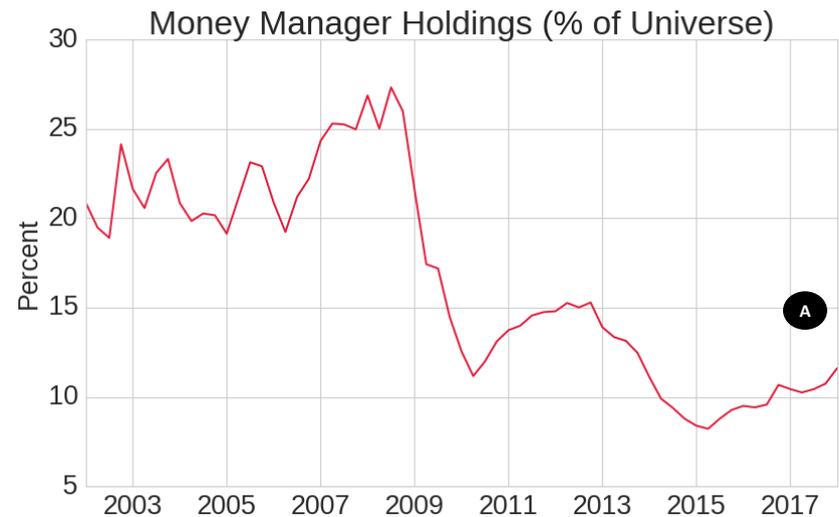
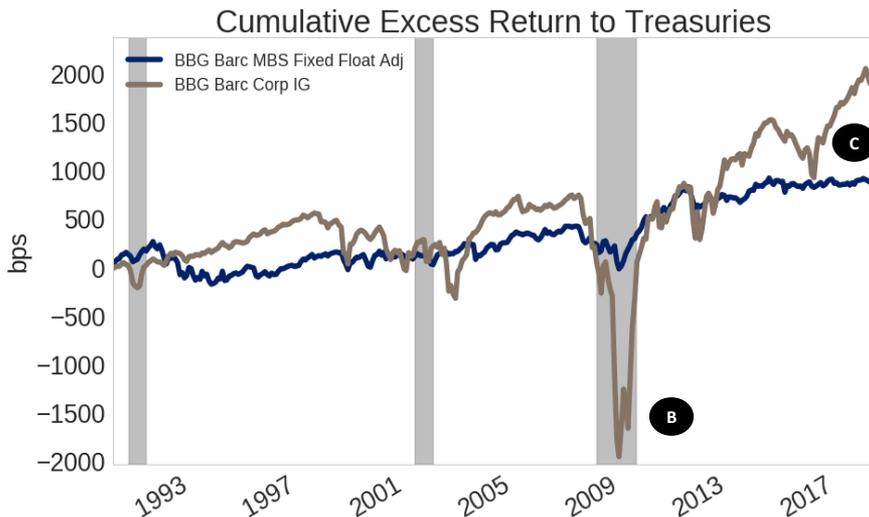


MBS Investor Universe and Trends

Money Managers are Well Positioned to Add MBS into Fed Runoff



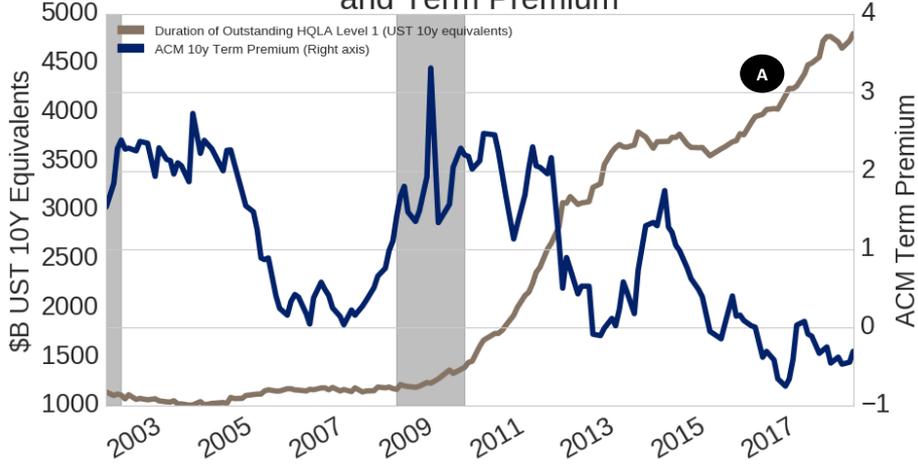
- A** Money manager holdings of MBS relative to corporate holdings have shrunk dramatically since the crisis. As a result, they are well positioned to reallocate back into mortgages and absorb a significant portion of the Fed portfolio runoff.
- B** Since the crisis, corporates have outperformed MBS, but are more susceptible to large drawdowns.
- C** Corporates have significantly outperformed MBS since 2012, creating a potentially attractive opportunity to rebalance into MBS to improve liquidity and limit drawdown risk.



Extending FFC Guarantee to Agency MBS

Applying a full faith and credit guarantee to conventional MBS is unlikely to have a material impact on UST pricing

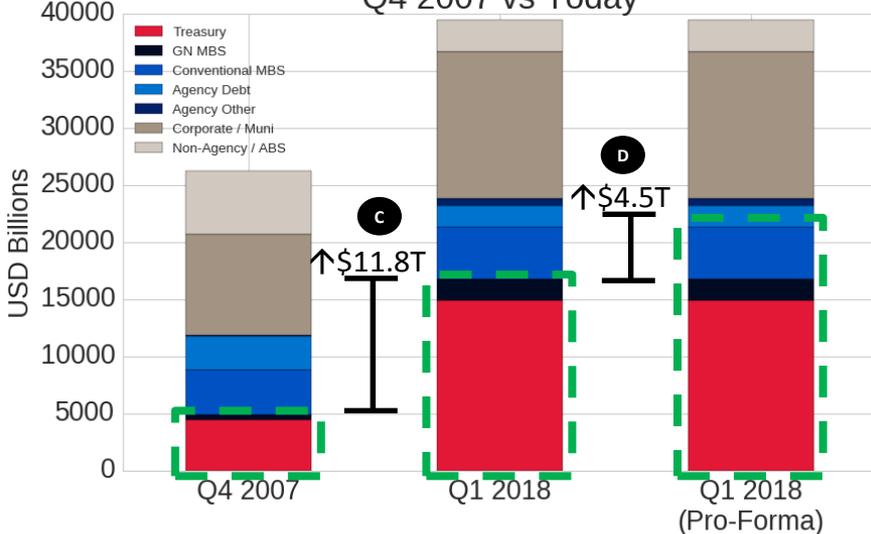
US Sovereign Supply (GN + UST) and Term Premium



Note: Sovereign supply calculated using Bloomberg Barclays Index data which excludes Treasury securities with less than 1 year to maturity as well as Fed holdings of UST and GN MBS

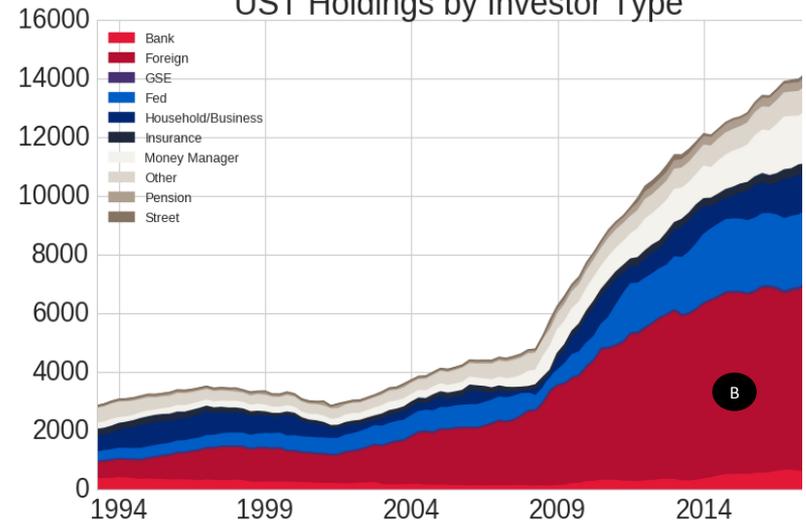
- A** US Treasuries have steadily richened since the financial crisis in spite of rapidly growing supply of UST and GNMA MBS.
- B** A large portion of the net issuance in USTs post-crisis was absorbed by foreign investors. This increase in demand helps explain the disconnect between supply and term premium.
- C** Between Q4 2007 and Q1 2018, the fixed income universe grew by \$13T, and HQLA Level 1 assets grew by \$11.8T.
- D** In contrast, extending the FFC guarantee to conventional MBS would only increase the stock of FFC guaranteed assets by ~\$4.5T, and would have no impact on the amount of interest rate risk borne by investors or the amount of private sector balance sheet required.

Fixed Income Universe Snapshot: Q4 2007 vs Today



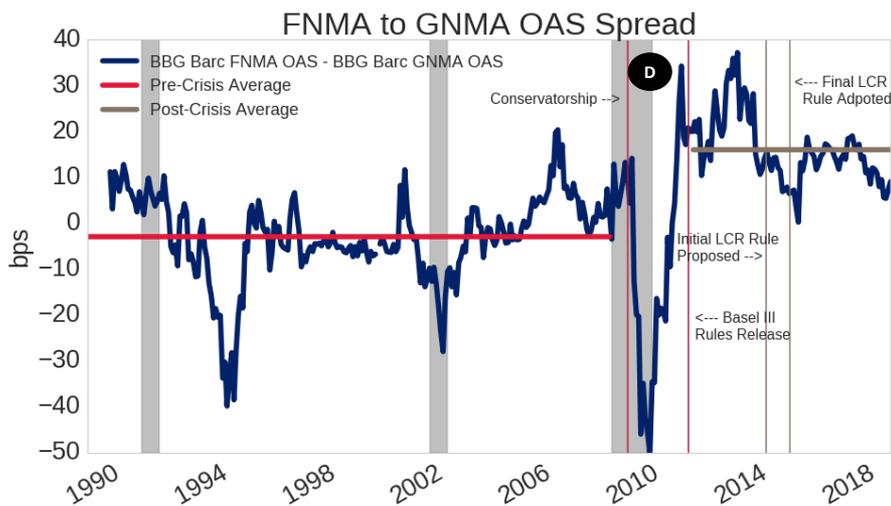
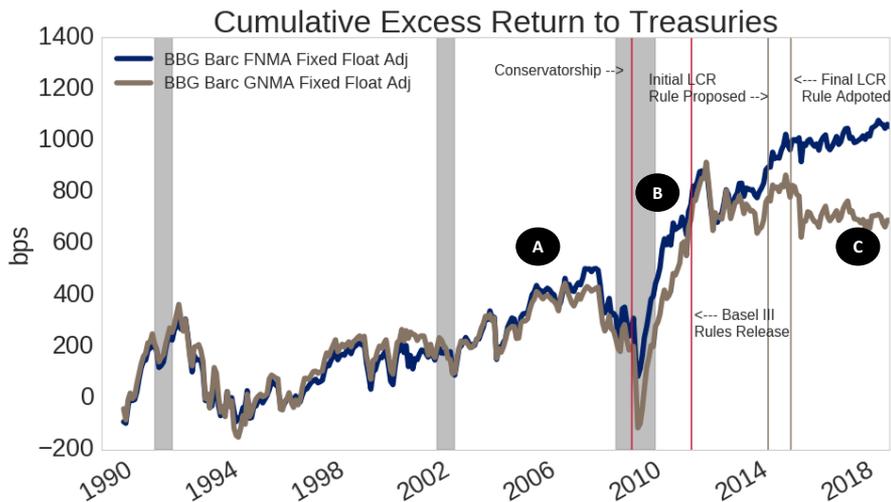
Sources: SIFMA, Bloomberg, Federal Reserve Z1 Report

UST Holdings by Investor Type



Extending FFC Guarantee to Agency MBS

Applying a full faith and credit guarantee to conventional MBS could cause GNMA and conventional OAS to realign



FN Rich / GN Cheap

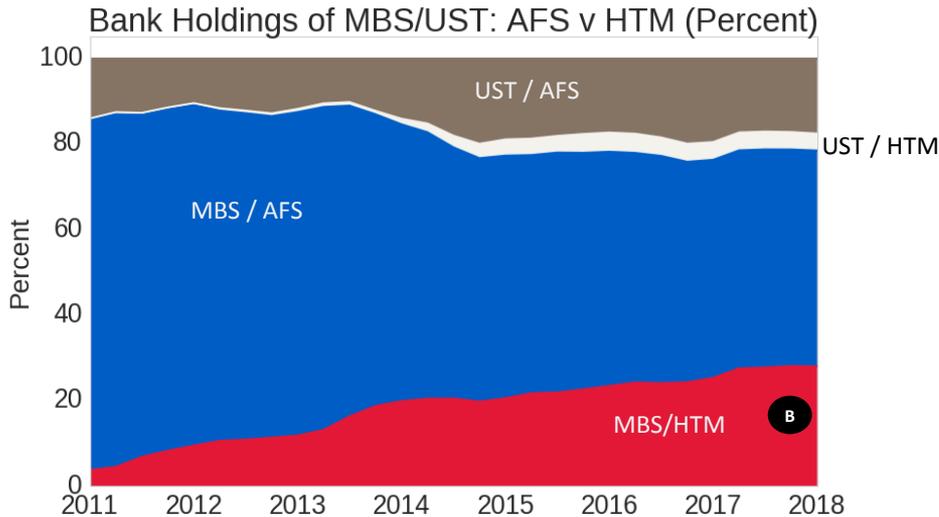
GN Rich / FN Cheap

- A** GNMA and FNMA MBS exhibited similar excess returns to US Treasuries from 1990-2007.
- B** Conventional MBS richened relative to GNMA after the GSEs entered conservatorship in 2008.
- C** Since the announcement of the LCR rule in October 2013, GNMA actual and expected excess returns have underperformed FNMA significantly.
- D** GNMA MBS remain somewhat rich relative to FNMA MBS in the post-conservatorship, post-LCR regime.

- Conservatorship was a significant step toward equalizing the credit quality of conventional and GNMA MBS. This suggests that the elevated spread between conventional and GNMA during the post-crisis era was due primarily to HQLA status rather than credit quality considerations.
- Assuming HQLA Level 1 status accompanies a FFC guarantee for conventional MBS, it would likely result in a realignment between GNMA and conventional OAS. The FNMA – GNMA OAS spread may fall to or below zero given the superior liquidity characteristics of the conventional MBS market.

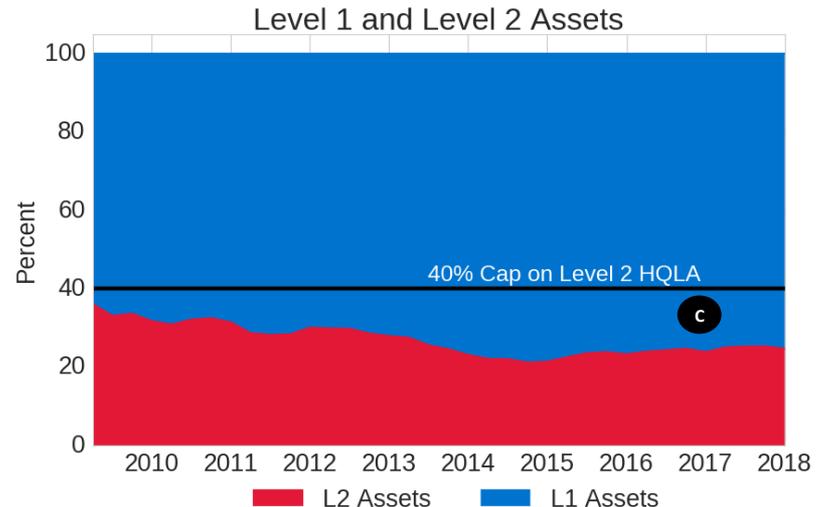
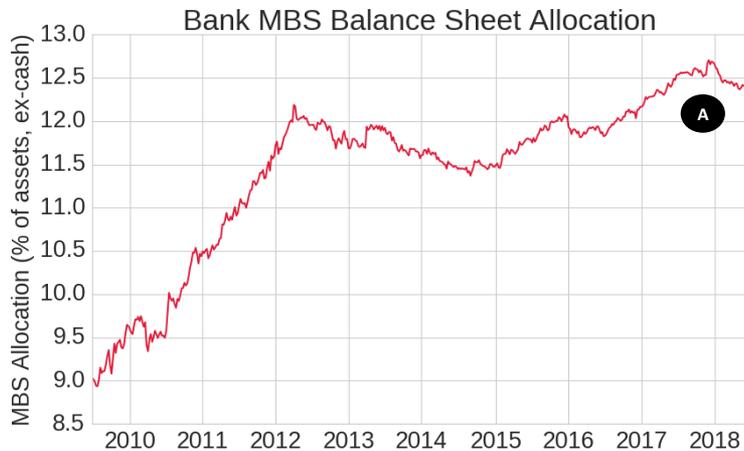
- Government support for conventional MBS is already priced in to a great extent, as evidenced by the proximity of OAS to the effective zero lower bound (see slides 6 and 8). Explicitly removing this support would likely be very disruptive for credit markets and the housing sector.

HQLA Status and Bank Asset Allocation



It is unlikely that applying Level 1 HQLA¹ status to conventional MBS would cause banks to allocate out of US Treasuries into conventional MBS. Risk considerations are the binding constraints for banks to increase allocations to MBS out of USTs.

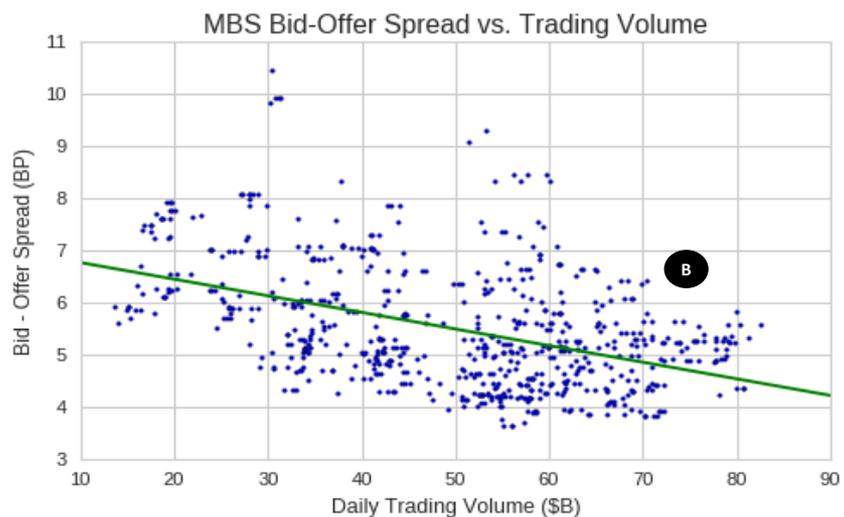
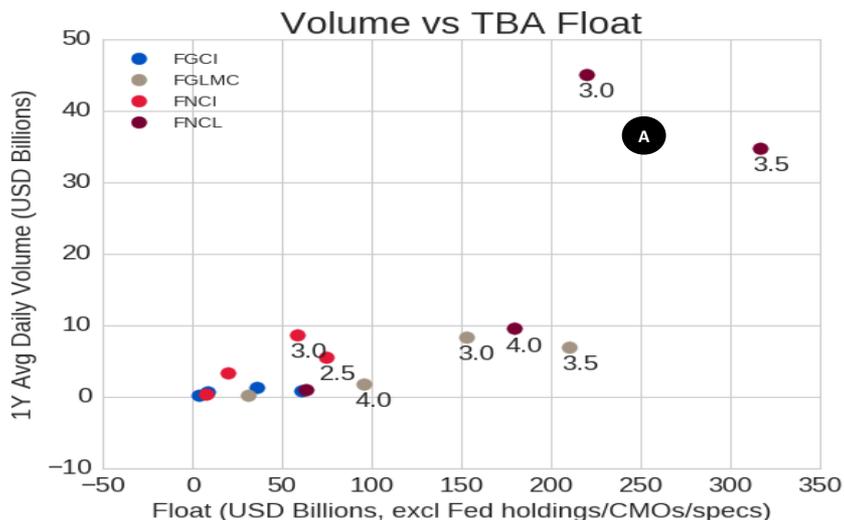
- A** Currently bank allocations to MBS (as a % of total assets, less cash) are at multi-year highs.
- B** Banks have increased HTM allocations with the inclusion of AOCI in CET1, an indication that they are becoming increasingly concerned about capital risk.
 - However, portfolio liquidity requirements will limit further increases in HTM holdings.
- C** In aggregate, banks currently have nearly \$600B in unused Level 2A cap capacity, meaning that banks could add conventional MBS today and receive 85% credit toward HQLA.



¹ Level 1 assets contribute to banks' HQLA with no haircut, and there is no cap on the amount for which a bank may receive credit. Level 1 assets include cash, US Treasuries and GNMA MBS. Level 2A assets such as conventional MBS contribute to HQLA with a 15% haircut, and are capped at 40% of a banks' total HQLA assets. Any holdings beyond the 40% receive no credit toward HQLA.

MBS Liquidity Characteristics

Agency MBS have similar liquidity to USTs; UMBS should lower bid-offer spreads



- A** Federal Reserve volume data shows a clear positive relationship between outstanding float and trading volumes for MBS.
 - UMBS will effectively combine the outstanding float of FNMA and FHLMC; the uniform TBA will likely have higher trading volume than either FNMA or FHLMC individually.
 - Almgren, Thum, Hautpmann and Li (2005)¹ estimate that market impact cost of trading is inversely proportional to average trading volume, so costs should be lower as volume increases.
- B** The inverse relationship between trading volume and bid-offer spreads formulated by Almgren et al is also evident in data from a 2014 Federal Reserve study².
- C** Regression analysis on this data set confirms higher trading volume is a significant predictor of lower bid-offer spreads.
 - A one standard deviation increase in trading volumes results in a 0.43 standard deviation reduction in bid-offer spreads.

OLS Regression Results						
MBS Bid-Offer Spread vs. Volatility and Trading Volume						
R-Squared	Constant Coefficient	Volatility Coefficient	Volume Coefficient	Constant P-value	Volatility P-value	Volume P-value
0.35	5.9	1.4	-0.0306	0.000	0.000	0.000

¹Almgren, Robert, C. Thum, E. Hauptmann, and H. Li. Direct Estimation of Equity Market Impact. Risk, 2005. <http://www.cims.nyu.edu/~almgren/papers/costestim.pdf>.

²Campbell, Sean D., Canlin Li, and Jay Im (2014). "Measuring Agency MBS Market Liquidity with Transaction Data," FEDS Notes. Washington: Board of Governors of the Federal Reserve System, January 31, 2014. <https://doi.org/10.17016/2380-7172.0007>

Appendix: Agency MBS Investor Types

	Objectives	Risk Considerations	Key Constraints	Net Impact
GSEs	Support pricing and liquidity for their MBS products Earn arbitrage profit on a hedged portfolio of MBS	Capital risk (primarily spread and convexity) Liquidity	Caps instituted under conservatorship agreements	Tighter MBS spreads and lower spread volatility Higher interest rate volatility due to convexity hedging Impact greatly diminished post crisis due to portfolio downsizing
The Federal Reserve	Lower borrowing costs by reducing rates and spreads	Avoid unnecessary market disruption (unintended value distortions, funding stress, diminished liquidity)	US Treasury and Agency Securities	Lower rates and tighter spreads Lower interest rate volatility due to reduced convexity in private portfolios Tighter roll markets
Banks	Maintain a liquidity buffer Hedge deposit liabilities Diversify credit sensitive assets. Earn yield & interest margin ROE and ROA	Capital risk (interest rate, convexity, spread risk) HQLA Value Asset monetization costs	RWA capital requirements LCR SLR	Lower rates and tighter spreads Lower interest rate volatility Tighter roll markets Tighter GNMA – conventional spreads
REITs	Earn arbitrage profit on a hedged portfolio of MBS ROE, ROA	Capital risk (interest rate, MBS spread, convexity) Funding risk Liquidity	Mortgage-related assets only Leverage / haircuts	Tighter MBS Higher interest rate volatility due to convexity hedging

Appendix: Agency MBS Investor Types (Continued)

	Objectives	Risk Considerations	Key Constraints	Net Impact
Asset Managers	Index matching Total return	Underperformance / index tracking (interest rate risk, convexity, spread risk, relative value) Liquidity (meeting redemptions)	Various fund-dependent constraints (e.g., Govt only, long only, limited leverage)	Tighter MBS spreads and lower spread volatility Lower interest rate volatility
Insurance	Income Total return Asset-liability matching	Capital risk (interest rate, MBS spread, convexity) Liquidity	Various insurance-related regulations	Tighter MBS spreads and lower spread volatility Lower interest rate volatility
Overseas	Maintain liquid currency reserves Income Total return Currency carry arbitrage	Currency Credit (prefer full faith and credit) Interest rate / convexity / MBS spread Funding Liquidity	Various (sovereign wealth constraints, insurance regulation, bank regulation)	Lower interest rates and MBS spreads Lower volatility (rates and spreads) Tighter GNMA – conventional spreads