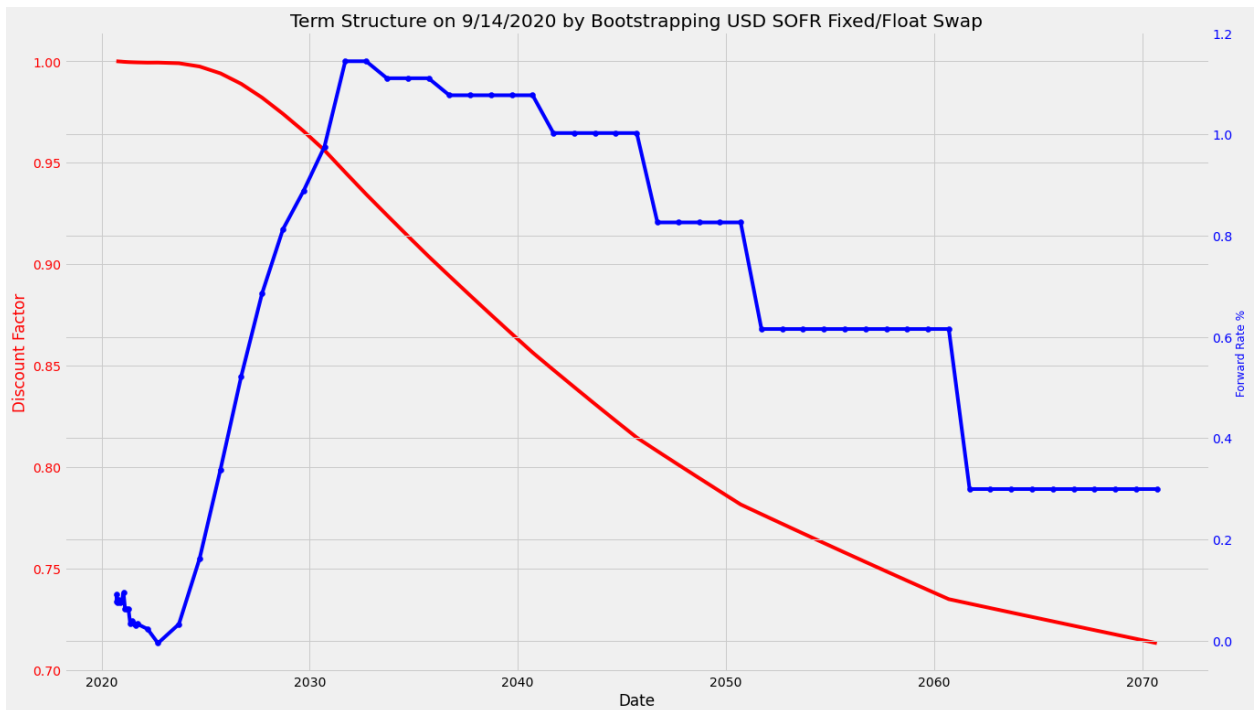


Laurent Lanteigne/12279717

April 29th, 2021

**Question 1.** See Figure below to see the result the term structure discount rate and forward rate through bootstrapping USD SOFR Fixed/Float Swap.



See next pages for the result of the table of the bootstrapping and the associated Python code to see how it was done.

Instrument Type	Tenor	Accrual Begin	Accrual End	Quote	Discrete Forward Rate	Discount Factor
USD SOFR Rate	O/N	9/14/2020	9/15/2020	0.0009	0.000912499	1
USD SOFR Fixed/Float Swap	1 Week	9/16/2020	9/23/2020	0.00077	0.000780689	0.999982889
USD SOFR Fixed/Float Swap	2 Weeks	9/16/2020	9/30/2020	0.000758	0.000756344	0.999968384
USD SOFR Fixed/Float Swap	3 Weeks	9/16/2020	10/7/2020	0.000769	0.000801956	0.999953005
USD SOFR Fixed/Float Swap	1 Month	9/16/2020	10/16/2020	0.00078	0.000816812	0.999932865
USD SOFR Fixed/Float Swap	2 Months	9/16/2020	11/16/2020	0.000766	0.000762828	0.999868084
USD SOFR Fixed/Float Swap	3 Months	9/16/2020	12/16/2020	0.000766	0.000776513	0.999804271
USD SOFR Fixed/Float Swap	4 Months	9/16/2020	1/19/2021	0.000811	0.000944154	0.999716344
USD SOFR Fixed/Float Swap	5 Months	9/16/2020	2/16/2021	0.000775	0.000622627	0.999668595
USD SOFR Fixed/Float Swap	6 Months	9/16/2020	3/16/2021	0.00075	0.000621693	0.999620921
USD SOFR Fixed/Float Swap	7 Months	9/16/2020	4/16/2021	0.00073	0.000621492	0.999568158
USD SOFR Fixed/Float Swap	8 Months	9/16/2020	5/17/2021	0.000679	0.000334664	0.999539747
USD SOFR Fixed/Float Swap	9 Months	9/16/2020	6/16/2021	0.000646	0.000383778	0.999508219
USD SOFR Fixed/Float Swap	10 Months	9/16/2020	7/16/2021	0.000615	0.000337354	0.999480505
USD SOFR Fixed/Float Swap	11 Months	9/16/2020	8/16/2021	0.000586	0.000306588	0.999454448
USD SOFR Fixed/Float Swap	1 Year	9/16/2020	9/16/2021	0.000564	0.000331324	0.999426356
USD SOFR Fixed/Float Swap	18 Months	9/16/2020	3/16/2022	0.000451	0.000230539	0.999312106
USD SOFR Fixed/Float Swap	2 Years	9/16/2020	9/16/2022	0.000325	-4.96602E-05	0.999337123
USD SOFR Fixed/Float Swap	3 Years	9/16/2020	9/18/2023	0.000324	0.000326213	0.999009394
USD SOFR Fixed/Float Swap	4 Years	9/16/2020	9/16/2024	0.000643	0.001623771	0.997392985
USD SOFR Fixed/Float Swap	5 Years	9/16/2020	9/16/2025	0.001183	0.003376503	0.994030963
USD SOFR Fixed/Float Swap	6 Years	9/16/2020	9/16/2026	0.001851	0.005220165	0.988855478
USD SOFR Fixed/Float Swap	7 Years	9/16/2020	9/16/2027	0.002566	0.006852712	0.982102301
USD SOFR Fixed/Float Swap	8 Years	9/16/2020	9/18/2028	0.003274	0.008124083	0.974090897
USD SOFR Fixed/Float Swap	9 Years	9/16/2020	9/17/2029	0.003912	0.008886698	0.965496302
USD SOFR Fixed/Float Swap	10 Years	9/16/2020	9/16/2030	0.00452	0.009754562	0.956149646
	11 years		9/16/2031		0.011440671	0.94527299
USD SOFR Fixed/Float Swap	12 Years	9/16/2020	9/16/2032	0.00547	0.011440671	0.93452006
	13 years		9/16/2033		0.011104354	0.924200223
	14 years		9/16/2034		0.011104354	0.913994346
USD SOFR Fixed/Float Swap	15 Years	9/16/2020	9/17/2035	0.0065	0.011104354	0.903901172
	16 years		9/16/2036		0.010768525	0.894219712
	17 years		9/16/2037		0.010768525	0.884641946
	18 years		9/16/2038		0.010768525	0.875166766
	19 years		9/16/2039		0.010768525	0.865793072
USD SOFR Fixed/Float Swap	20 Years	9/16/2020	9/17/2040	0.007445	0.010768525	0.85651977
	21 years		9/16/2041		0.01002279	0.84797793
	22 years		9/16/2042		0.01002279	0.839521276
	23 years		9/16/2043		0.01002279	0.831148957
	24 years		9/16/2044		0.01002279	0.822860134
USD SOFR Fixed/Float Swap	25 Years	9/16/2020	9/18/2045	0.007876	0.01002279	0.81465396
	26 years		9/16/2046		0.008257982	0.807954263
	27 years		9/16/2047		0.008257982	0.801309665
	28 years		9/16/2048		0.008257982	0.794719712
	29 years		9/16/2049		0.008257982	0.788183955
USD SOFR Fixed/Float Swap	30 Years	9/16/2020	9/16/2050	0.00791	0.008257982	0.781701947
	31 years		9/16/2051		0.006153298	0.776906671
	32 years		9/16/2052		0.006153298	0.77214081
	33 years		9/16/2053		0.006153298	0.767404186
	34 years		9/16/2054		0.006153298	0.762696618
	35 years		9/16/2055		0.006153298	0.758017927
	36 years		9/16/2056		0.006153298	0.753367938
	37 years		9/16/2057		0.006153298	0.748746474
	38 years		9/16/2058		0.006153298	0.74415336
	39 years		9/16/2059		0.006153298	0.739588422
USD SOFR Fixed/Float Swap	40 Years	9/16/2020	9/16/2060	0.007503	0.006153298	0.735051487
	41 years		9/16/2061		0.002993375	0.732854492
	42 years		9/16/2062		0.002993375	0.730664064
	43 years		9/16/2063		0.002993375	0.728480183
	44 years		9/16/2064		0.002993375	0.726302829
	45 years		9/16/2065		0.002993375	0.724131983
	46 years		9/16/2066		0.002993375	0.721967626
	47 years		9/16/2067		0.002993375	0.719809737
	48 years		9/16/2068		0.002993375	0.717658298
	49 years		9/16/2069		0.002993375	0.71551329
USD SOFR Fixed/Float Swap	50 Years	9/16/2020	9/16/2070	0.006717	0.002993375	0.713374693