

## Overview

This folder contains the replication code for The U.S. Public Debt Valuation Puzzle, by Zhengyang Jiang, Hanno N. Lustig, Stijn Van Nieuwerburgh, and Mindy Z. Xiaolan.

The majority of the code was written in Matlab 2022b, while some R code was used for auxiliary purposes.

The code FullPsi/Run\_All.m file runs all the code to generate the data for the figures and tables in the paper. The replicator should expect the code to run for about 30 minutes.

## Data Availability and Provenance Statements

### Statement about Rights

We certify that the author(s) of the manuscript have legitimate access to and permission to use the data used in this manuscript.

### Summary of Availability

The paper uses data obtained from the following public sources: National Income and Product Accounts (NIPA) by the Bureau of Economic Analysis, the Federal Reserve Economic Data (FRED) by the Federal Reserve Bank of St. Louis, Macrohistory Database by Jordà, Schularick, and Taylor (2017), Short-term yields from Organization for Economic Co-operation and Development (2021). All the public data sources have the full URL in the reference section at the end of this document. We provide a variable list table with detailed instructions on the construction of each variable using the public data source below.

We use the Center for Research in Security Prices, LLC (CRSP) Treasuries Database and CRSP Stock Files. While most researchers have access to CRSP via their academic institutions, CRSP does not currently allow redistribution of the raw data. We include the data constructed and the codes for data construction using the raw data in the RawData\code\_for\_data\_construction folder. Similarly, we use data from the Global Financial Database, which many academic institutions have access to, but which does not allow public distribution of its raw data. We include the processed data in the file MaindatafileA\_Feb2021\_longsample.xlsx in RawData folder. We list the exact series used in the data construction in the README file and the reference.

We also obtain publicly available data from published papers: Historical Public Debt series by Hall, Payne, and Sargent (2018), The U.S. Treasury yield curve by Gürkaynak, Sack, and Wright (2007), Price-Dividend ratios for dividend strips by Van Binsbergen, Brandt, and Koijen (2012).

## Dataset list

The table below includes all the datasets that are used in the analysis. The code FullPsi/Run\_All.m reads the dataset directly and generates results in the paper.

### Dataset list

Data file	Source	Notes	Provided
RawData/ MaindatafileA_Feb 2021_longsample.x lsx	National Income and Product Accounts (2021); Federal Research Economic Data (FRED) (2021); Center for Research in Security Prices, LLC (CRSP) (2021); Global Financial Database (2021); Jordà, Schularick, and Taylor (2017)	Public source. In the Readme tab in this datafile, we provided detailed instructions for the construction of each variable in the file.	Yes
RawData/APdata.xl sx	Van Binsbergen, Brandt, and Kojen (2012)	Price dividend ratios for dividend strips.	Yes
RawData/BA3M.xls	Federal Research Economic Data (FRED) (2021);	Public source. 3-Month Bankers Acceptance Rate.	Yes
RawData/duration_ aggr_46_20.mat	Center for Research in Security Prices, LLC (CRSP) (2021);	Combined CRSP bond data into a clean format of duration.	Yes
RawData/feds20062 8.csv	Gurkaynak, Sack, and Wright (2007)	Public source. The yield curve data from the federal reserve board.	Yes
RawData/FRB_Z1_b1 03.csv	Federal Research Economic Data (FRED) (2021);	Public source. Financial Accounts of the U.S. – Z.1 Table B.103 Balance Sheet of Nonfinancial Corporate Business.	Yes

RawData/IR3TCD01U SM156N.xls	Organization for Economic Co- operation and Development (2021);	Public source. 3-Month or 90-day Rates and Yields: Certificates of Deposit for the United States.	Yes
RawData/nominal_a ggr_debt_ 1946_2020_annual. xlsx	Center for Research in Security Prices, LLC (CRSP) (2021);	Aggregate CRSP bond market value into one time series.	Yes
RawData/TB3MS.xls	Federal Research Economic Data (FRED) (2021);	Public source. 3-Month Treasury Bill Secondary Market Rate.	Yes
RawData/Treasurie s_crsp_46_20.xlsx	Center for Research in Security Prices, LLC (CRSP) (2021);	CRSP monthly treasury data.	No

## Variable List

The table below includes additional details of the variables that were constructed for our analysis. All datasets used are listed in the above Dataset list section. The table below includes three sections. Section A provides all the details of our main state variable construction in the estimation. Section B provides details of other variables that are used as targeted moments in the estimation. Section C provides details of other variables that we used in the main text for discussions only. We provide hyperlinks to all public data sources.

## Variable List and Construction

### Section A

Data file	Variable	Source	Provided
RawData/ MaingroupfileA_Feb 2021_longsample. xlsx "VAR2"	Column B tau	<a href="#">NIPA Table 3.2</a> Line 1 divided by <a href="#">NIPA Table 1.1.5</a> Line 1	Yes

RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column C g	<a href="#">NIPA Table 3.2</a> Line 24 divided by <a href="#">NIPA Table 1.1.5</a> Line 1	Yes
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column E x	Log change of <a href="#">NIPA Table 1.1.5</a> Line 1 minus the log change of <a href="#">NIPA Table 1.1.4</a> Line 1	Yes
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column F pi	Log change of <a href="#">NIPA Table 1.1.4</a> Line 1	Yes
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column I y1	1-year CMT from <a href="#">Global Financial Database</a> . Ticker (IGUSA1D) for 1940-2020; 1- year CMT from 1929 to 1939 is from <a href="#">Global Financial Database</a> 3-month CMT (ITUSA3CM)	Yes
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column I y5	5-year CMT from 1953 to 2020 is directly from <a href="#">FRED DGS5</a> and <a href="#">FRASER G.14</a> for the pre-1953 period.	Yes
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column N pdm	RawData/code_for_data_const ruction/CRSP/equity moment/createpdratiostocks_ Nov2021.m produces this variable. The source data is from <a href="#">CRSP Stock file</a> through WRDS. After logging into WRDS, please go to CRSP -> Annual Update -> Stock/Security Files -> Monthly Stock File. Select and download all variables.	Yes

RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column O divgrm	RawData/code_for_data_const ruction/CRSP/equity moment/createpdratiostocks_ Nov2021.m produces this variable. The source data is from <a href="#">CRSP Stock file</a> retrieved from WRDS. See above for detailed instruction of retrieving data.	Yes
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR_international"	Column AK Global inflation	RawData/code_for_data_const ruction/JST/ global_exUS_construction.R produces this variable. The source data is from Jordà, Schularick, and Taylor (2017).	Yes
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR_international"	Column AL Global real GDP growth	RawData/code_for_data_const ruction/JST/ global_exUS_construction.R produces this variable. The source data is from Jordà, Schularick, and Taylor (2017).	Yes
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR_international"	Column AM Global total equity return	RawData/code_for_data_const ruction/JST/ global_exUS_construction.R produces this variable. The source data is from Jordà, Schularick, and Taylor (2017).	Yes

## Section B

Data file	Variable	Source	Provided
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column H- Column M, Column T term structure of nominal yields	3-month CMT is from Global Financial Database (ITUSA3CM); 1-yr CMT (see Section A of this table); 2-yr CMT from 1977 to 2020 is from FRED series DGS2. The observation of 2-yr CMT for 1976 is the last quarter 2-yr CMT in 1976; 5-yr CMT (see Section A of this table); 10-yr CMT from 1962 to 2020 is from FRED series DGS10, AND	Yes

		1953-1961 is from FRED series GS10; 20-yr CMT is from FRED series DGS20; 30-yr CMT is from FRED series DGS30.	
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column AF- Column AJ term structure of real yields	5-yr TIPS yield is from FRED series DFII5; 7-year TIPS yield is from FRED series FII7; 10-year TIPS yield is from FRED series DFII10; 20-year TIPS yield is from FRED series DFII20; 30-year TIPS yield is from FRED series DFII30.	Yes
RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column Q Historical debt-to-gdp ratio	Market value of marketable debt from <a href="#">Hall, Payne and Sargent</a> "US Federal Debt 1776-1960: Quantities and Prices" divided by GDP from <a href="#">JST Database</a> .	Yes
RawData/nominal_ aggr_debt_1946_20 20_annual.xlsx	Column P debt-to-gdp ratio	RawData/code_for_data_const ruction/CRSP/gdebt/ treasuries_crsp_46_2020.m produces this variable. The source data is from <a href="#">CRSP Treasuries database</a> , retrieved from WRDS. After logging into WRDS, please go to CRSP -> Annual Update -> Treasuries -> Monthly Time Series. Select and download all variables.	

## Section C

Data file	Variable	Source	Provided
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RawData/ MaindatafileA_Feb 2021_longsample.x lsx "VAR2"	Column AK return	RawData/code_for_data_construction/CRSP/return/position_const_coupon_newissue_2022.m produces this variable. Treasuries issuance level data from <a href="#">CRSP Treasuries database</a> , retrieved from WRDS. See above for detailed instruction of retrieving data.	Yes
RawData/ duration_aggr_46_ 20.mat	duration	RawData/code_for_data_construction/CRSP/duration/bond_duration_46_20_only.m produces this variable. The source data is from <a href="#">CRSP Treasuries database</a> , retrieved from WRDS. See above for detailed instructions of retrieving data.	Yes

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## Computational requirements

The computation for this project was done on a computer running Windows 10 Enterprise x64 with the following specifications:

- AMD Threadripper Pro 3955WX Processor
- 16GB DDR4 3200MHz RDIMM ECC
- 2TB SSD Storage

Running the analysis takes less than 30 minutes.

## Software Requirements

- R version 4.3.1

The following R packages are loaded and used in the analysis:

- o R.matlab\_3.7.0, zoo\_1.8-12, readxl\_1.4.3, roll\_1.1.6, plyr\_1.8.8, data.table\_1.14.8, tseries\_0.10-54
- Matlab 2022b

## Controlled Randomness

Random seed is set at the following locations with default seed number 0:

- line 138 of program FullPsi/Plot\_TG\_Beta.m
- line 19 of program FullPsi/Plot\_FiscalImpulseResponses.m

- line 60 of program FullPsi/Campbell\_Shiller.m
- line 47 of program FullPsi/Campbell\_Shiller\_LongSample
- line 49 of program FullPsi/Campbell\_Shiller\_ConvYield
- line 47 of program FullPsi/Campbell\_Shiller\_WithDebt
- line 56 of program FullPsi\_Global/Campbell\_Shiller\_Global.m

## Description of programs/code

- All programs are available under the main replication directory.
- Run FullPsi/Run\_All.m to run all programs in the appropriate order. It also contains comments which explain what each line produces.
- Besides this main code,
  - o FullPsi contains the main code for the baseline exercises in the paper.
  - o FullPsi\_ConvYield implements the asset pricing exercise in the model with convenience yield in the VAR.
  - o FullPsi\_Global implements the asset pricing exercise in the model with global variables in the VAR.
  - o ConvYield imports and cleans the convenience yield data.
  - o RawData contains raw files.
- The final output of these programs is placed in the following directories.
  - o All figures are saved in the figures directory in the pdf format.
  - o All tables are saved in the tables directory in the tex format.

## List of tables and programs

The provided code reproduces:

- All numbers provided in text in the paper
- All tables and figures in the paper

Figure/Table #	Program	Line Number	Output file	Note
Table 1	FullPsi/Run_All.m	11	Table1.tex	
Figure 1	FullPsi/Run_All.m	95	pic-surplus_2020.pdf pic-taxspend_2020.pdf	
Figure 2	FullPsi/Run_All.m	14	pic-beta_G.pdf pic-beta_T.pdf	
Figure 3	FullPsi/Run_All.m	16	pic-3CI_x_annual.pdf pic-3CI_dtau_annual.pdf pic-3CI_dg_annual.pdf	
Figure 4	FullPsi/Run_All.m	18	pic-forecast_1yr_dt.pdf pic-forecast_1yr_dg.pdf	

			pic-forecast_5yr_dt.pdf pic-forecast_5yr_dg.pdf pic-forecast_10yr_dt.pdf pic-forecast_10yr_dg.pdf cs30.pdf
Figure 5	FullPsi/Run_All.m	28	
Figure 6	FullPsi/Run_All.m	29, 60	cs-pd30.pdf cs_EvaluateAtDetrended.pdf
Figure 7	FullPsi/Run_All.m	57	cs_summary.pdf
Figure 8	FullPsi/Run_All.m	95	pd_ratio.pdf pgdp_ratio.pdf
Figure 9	FullPsi/Run_All.m	95	puzzle_actualCF.pdf
Figure 10	FullPsi/Run_All.m	95	cum_rp_term_annual.pdf
Figure 11	FullPsi/Run_All.m	95	pic-peso.pdf
Table B.1	FullPsi/Run_All.m	13	TablePsi.tex
Table C.1	FullPsi/Run_All.m	NA	NA
Table E.1	FullPsi/Run_All.m	117	Table_globalECMA.tex
Figure B.1	FullPsi/Run_All.m	21	pic-cy.pdf, pic-sgnrev.pdf
Figure C.1	FullPsi/Run_All.m	63	pic-wedge_cyclicality_CS.pdf
Figure C.2	FullPsi/Run_All.m	66	cs25.pdf
Figure C.3	FullPsi/Run_All.m	71	cs_vary_rp.pdf, cs_rp015_pdx.pdf
Figure C.4	FullPsi/Run_All.m	75	cs-pd-TVRP.pdf, cs-pv- delta-TVRP.pdf
Figure C.5	FullPsi/Run_All.m	36	cs-WithDebt30.pdf, cs- WithDebt25.pdf
Figure C.6	FullPsi/Run_All.m	45	cs_longsample_30.pdf, cs_longsample_25.pdf
Figure C.7	FullPsi/Run_All.m	54	cs_cy_27.pdf
Figure D.1	FullPsi/Run_All.m	95	peso_cum_rp.pdf
Figure E.1-E.6	FullPsi/Run_All.m	86	pic-yields-step1.pdf, pic- realyields-step1.pdf, pic- avgyieldbrp-step1.pdf, pic-equitypd-step1.pdf, pic-puzzle-step1.pdf, pic- rptermstr-step1.pdf
Figure E.7-E.11	FullPsi/Run_All.m	92	pic-yields-step3.pdf, pic- realyields-step3.pdf, pic- avgyieldbrp-step3.pdf, pic-equitypd-step3.pdf, puzzle_actualCF_GDP.pdf
Figure E.12	FullPsi/Run_All.m	111	cs_global_30.pdf
Figure E.13	FullPsi/Run_All.m	113	pic-global-puzzle- step3.pdf

## References

U.S. Bureau of Economic Analysis National Income and Product Accounts. 2021.

“Table 3.2. Federal Government Current Receipts and Expenditures,”

[https://apps.bea.gov/iTable/?reqid=19&step=2&isuri=1&categories=survey&\\_gl=1\\*pm29kn\\*\\_ga\\*MTc2ODA2ODMxOC4xNzExMzg1NjYz\\*\\_ga\\_J4698JNNFT\\*MTcxMTM4NTY2Mi4xLjEuMTcxMTM4NjMyOS4xNy4wLjA.#eyJhcHBpZCI6MTksInN0ZXBzIjpbMSwyLDNdLCJkYXRhIjpbWyJkYXRlZ29yaWVzIiwuU3VydmV5Il0sWyJOSVBBX1RhYmxlX0xpc3QiLCI4NyJdXX0=,](https://apps.bea.gov/iTable/?reqid=19&step=2&isuri=1&categories=survey&_gl=1*pm29kn*_ga*MTc2ODA2ODMxOC4xNzExMzg1NjYz*_ga_J4698JNNFT*MTcxMTM4NTY2Mi4xLjEuMTcxMTM4NjMyOS4xNy4wLjA.#eyJhcHBpZCI6MTksInN0ZXBzIjpbMSwyLDNdLCJkYXRhIjpbWyJkYXRlZ29yaWVzIiwuU3VydmV5Il0sWyJOSVBBX1RhYmxlX0xpc3QiLCI4NyJdXX0=,)

“Table 1.1.4. Price Indexes for Gross Domestic Product”,

[https://apps.bea.gov/iTable/?reqid=19&step=2&isuri=1&categories=survey&\\_gl=1\\*pm29kn\\*\\_ga\\*MTc2ODA2ODMxOC4xNzExMzg1NjYz\\*\\_ga\\_J4698JNNFT\\*MTcxMTM4NTY2Mi4xLjEuMTcxMTM4NjMyOS4xNy4wLjA.#eyJhcHBpZCI6MTksInN0ZXBzIjpbMSwyLDNdLCJkYXRhIjpbWyJkYXRlZ29yaWVzIiwuU3VydmV5Il0sWyJOSVBBX1RhYmxlX0xpc3QiLCI0Il1dfQ==,](https://apps.bea.gov/iTable/?reqid=19&step=2&isuri=1&categories=survey&_gl=1*pm29kn*_ga*MTc2ODA2ODMxOC4xNzExMzg1NjYz*_ga_J4698JNNFT*MTcxMTM4NTY2Mi4xLjEuMTcxMTM4NjMyOS4xNy4wLjA.#eyJhcHBpZCI6MTksInN0ZXBzIjpbMSwyLDNdLCJkYXRhIjpbWyJkYXRlZ29yaWVzIiwuU3VydmV5Il0sWyJOSVBBX1RhYmxlX0xpc3QiLCI0Il1dfQ==,)

“Table 1.1.5. Gross Domestic Product”,

[https://apps.bea.gov/iTable/?reqid=19&step=2&isuri=1&categories=survey&\\_gl=1\\*pm29kn\\*\\_ga\\*MTc2ODA2ODMxOC4xNzExMzg1NjYz\\*\\_ga\\_J4698JNNFT\\*MTcxMTM4NTY2Mi4xLjEuMTcxMTM4NjMyOS4xNy4wLjA.#eyJhcHBpZCI6MTksInN0ZXBzIjpbMSwyLDNdLCJkYXRhIjpbWyJkYXRlZ29yaWVzIiwuU3VydmV5Il0sWyJOSVBBX1RhYmxlX0xpc3QiLCI1Il1dfQ==,](https://apps.bea.gov/iTable/?reqid=19&step=2&isuri=1&categories=survey&_gl=1*pm29kn*_ga*MTc2ODA2ODMxOC4xNzExMzg1NjYz*_ga_J4698JNNFT*MTcxMTM4NTY2Mi4xLjEuMTcxMTM4NjMyOS4xNy4wLjA.#eyJhcHBpZCI6MTksInN0ZXBzIjpbMSwyLDNdLCJkYXRhIjpbWyJkYXRlZ29yaWVzIiwuU3VydmV5Il0sWyJOSVBBX1RhYmxlX0xpc3QiLCI1Il1dfQ==,)

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Market Yield on U.S. Treasury Securities at 2-Year Constant Maturity, Quoted on an Investment Basis [DGS2], retrieved from FRED, Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/DGS2,>

Market Yield on U.S. Treasury Securities at 5-Year Constant Maturity, Quoted on an Investment Basis [DGS5], retrieved from FRED, Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/DGS5,>

Market Yield on U.S. Treasury Securities at 5-Year Constant Maturity, Quoted on an Investment Basis [GS5], retrieved from FRED, Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/GS5,>

Market Yield on U.S. Treasury Securities at 10-Year Constant Maturity, Quoted on an Investment Basis [DGS10], retrieved from FRED, Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/DGS10,>

Market Yield on U.S. Treasury Securities at 10-Year Constant Maturity, Quoted on an Investment Basis [GS10], retrieved from FRED, Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/GS10,>

Market Yield on U.S. Treasury Securities at 20-Year Constant Maturity, Quoted on an Investment Basis [DGS20], retrieved from FRED, Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/DGS20>,

Market Yield on U.S. Treasury Securities at 30-Year Constant Maturity, Quoted on an Investment Basis [DGS30], retrieved from FRED, Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/DGS30>,

Market Yield on U.S. Treasury Securities at 5-Year Constant Maturity, Quoted on an Investment Basis, Inflation-Indexed [DFII5], retrieved from FRED, Federal Reserve Bank of St. Louis <https://fred.stlouisfed.org/series/DFII5>,

Market Yield on U.S. Treasury Securities at 10-Year Constant Maturity, Quoted on an Investment Basis, Inflation-Indexed [DFII10], retrieved from FRED, Federal Reserve Bank of St. Louis <https://fred.stlouisfed.org/series/DFII10>,

Market Yield on U.S. Treasury Securities at 20-Year Constant Maturity, Quoted on an Investment Basis, Inflation-Indexed [DFII20], retrieved from FRED, Federal Reserve Bank of St. Louis <https://fred.stlouisfed.org/series/DFII20>,

Market Yield on U.S. Treasury Securities at 30-Year Constant Maturity, Quoted on an Investment Basis, Inflation-Indexed [DFII30], retrieved from FRED, Federal Reserve Bank of St. Louis <https://fred.stlouisfed.org/series/DFII30>,

Market Yield on U.S. Treasury Securities at 7-Year Constant Maturity, Quoted on an Investment Basis, Inflation-Indexed [FII7], retrieved from FRED, Federal Reserve Bank of St. Louis <https://fred.stlouisfed.org/series/FII7>,

3-Month Bankers Acceptance Rate [BA3M], retrieved from FRED, Federal Reserve Bank of St. Louis <https://fred.stlouisfed.org/series/BA3M>,

Table B.103 Balance Sheet of Nonfinancial Corporate Business, retrieved from FRED, Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/release/tables?rid=52&eid=809913>,

3-Month Treasury Bill Secondary Market Rate, Discount Basis [TB3MS], retrieved from FRED, Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/TB3MS>.

G.14 U.S. Government Security Yields and Prices. 1944-1976, retrieved from FRASER, Federal Reserve Archival System for Economic Research. <https://fraser.stlouisfed.org/title/1259>.

Organization for Economic Co-operation and Development. 2021. Interest Rates: 3-Month or 90-Day Rates and Yields: Certificates of Deposit: Total for United States [IR3TCD01USM156N], retrieved from FRED, Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/IR3TCD01USM156N>.

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