Replication Files

A Fiscal Theory of Inflation Persistence

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Computational Requirements

All the results of this paper can be replicate by following the directions contained in this document. All codes can be run in Matlab©**.** The Control System Toolbox and Parallel Programming Toolbox are required.

We first show how to reproduce the figures in the paper using the output of a pre-run estimation. Second, we describe how to estimate the model and reproduce the posterior moments of the parameters shown in Table 1 and 2 of the article.

Note that estimation takes several hours to carry out because we solve multiple maximization of the posterior distribution starting from a large number of starting values to improve accuracy. Multiple-core computer is highly recommended.

Instructions for Data Preparation and Analysis

To construct Figure I through Figure X in the paper, execute the following routines sequentially in Matlab©.

Do_Figure_I.m

To create Figure I run Do_Figure_I.m. The figure (Figure_I.pdf) is stored in the subfolder \.Figures of the main folder ReplicationFiles. The Fisherian Model's linearized equations are specified in ReplicationFiles\Fig_I\gammas_R.m (for the case of the traditional monetary and fiscal rules) and ReplicationFiles\Fig_I\gammas_ShockSpecific_R.m (for the case of the shock-specific monetary and fiscal rules). The parameters of the two versions of the Fisherian Model are set in the main file Do_Figure_I.m–lines 25 through 39.

Do_Figure_II.m

To create Figure II run Do_Figure_II.m. The figure (Figure_II.pdf) is stored in the subfolder \.Figures of the main folder ReplicationFiles. The Production Economy's linearized equations are specified in ReplicationFiles\Fig_II\Mod\ mod_production_economy_SSrules.m. The parameter values of the Production Economy are fetched from ReplicationFiles\Fig_II\params\CalibratedParameters.xlsx.

Do_Figure_III.m

To create Figure III and data, run Do_Figure_III.m. The figure (Figure_III.pdf) is stored in the subfolder \.Figures of the main folder ReplicationFiles. Data is downloaded from Wharton Research Data Center (WRDS) CRSP US Treasury database (monthly frequency). The years to maturity is taken by subtracting the calendar date (MCALDT) from the maturity date at time of issue (TMATDT). The simple average (green line) is taken by month across all unique Treasury products. The weighted average (red line) is weighted by the total amount outstanding (TMTOTOUT) of each unique Treasury product at the given time. Output data is stored here: \ReplicationFiles\Results\MaturityStructureSummary.xlsx.

QM_replication.m

To create Figure IV, Figure V, Figure VI, Figure VII, Figure VIII, and Figure IX run QM_replication.m. The code draws from the folders containing estimation outputs (Estimation/BFM_mod/ver01). The paths are shown inside QM_replication.m (see lines 25 through 53). To replicate Figure IV, Figure V, Figure VI, Figure VII, and Figure VIII of the paper, set long_sample==1 in line 21 of QM_replication.m, requiring the routine to fetch the estimation output when the Quantitative Model is estimated through the third quarter of 2022 – the baseline case. To reproduce Figure IX, set long_sample==0 in line 21 of QM_replication.m, requiring the routine to fetch the estimation output when the Quantitative Model is estimated using vintage data (2021:Q2) through the fourth quarter of 2020. In this case the code will treat the post-2020 period as out of sample (see ***Section V.E Real-Time Predictions of the Effects of the ARPA***). The figures (Figure_IV.pdf, Figure_V.pdf, Figure_VI.pdf, Figure_VII.pdf, Figure_VIII.pdf, and Figure_IX.pdf) are stored in the subfolder \.Figures of the main folder ReplicationFiles.

Do_Figure_X.m

To create Figure X, run Do_Figure_X.m. The figure (Figure_X.pdf) is stored in the subfolder \.Figures of the main folder ReplicationFiles. The Stylized Economy's linearized equations are specified in ReplicationFiles\Fig_X\Mod\mod_flexprice_SSrules.m. The parameters of the Stylized Model are fetched from ReplicationFiles\Fig_X\params\CalibratedParameters.xlsx. The estimated shocks used to simulate the models are fetched from the file ReplicationFiles\Fig_X\EstimatedUnfundedTransferShocks.csv, which is an output of QM_replication.m. The inflation rate simulated from the Quantitative Model is not simulated again and is fetched from the file ReplicationFiles\Fig_X\RoleUnfunded.csv, which is an output of QM_replication.m. Additional explanation is available in the code.

Estimating the Quantitative Model

We first show how we estimate the Quantitative Model using the long sample (1960:Q1-2022:Q3) and then we explain how to change commands to perform the estimation of the same model over the shorter-sample period using real-time data to construct Figure IX.

Long-sample estimation: We estimate the Quantitative Model with Bayesian methods over two subsamples: Sample 1 (1960:Q1-2007:Q4) and Sample 2 (2008:Q1-2022:Q3). The estimation can be replicated by performing the next four steps:

1) Run \ReplicationFiles\Estimation\ modeFinderRun.m to estimate the model over Sample 1. Make sure that line 56 reads *location.subfolder='FirstSampleOutput'*. \ReplicationFiles\Estimation\BFM_mod\ver01\FirstSampleOutput. Make sure that the m-file settings.m in the output folder settings reads "flags.initialCond=0;" in line 162.
2) Initialize the state vector for Sample 2 estimation by copying the file KFLast.mat you can find the output folder (see Step 1) into the folder \ReplicationFiles\Estimation\BFM_mod\ver01\SecondSampleOutput.
3) Go to line 56 of \ReplicationFiles\Estimation\modeFinderRun.m and set *location.subfolder='SecondSampleOutput'*. Now if you run \ReplicationFiles\Estimation\ modeFinderRun.m, you will estimate the model over Sample 2. Estimation outputs are saved in the output folder located at \ReplicationFiles\Estimation\BFM_mod\ver01\SecondSampleOutput. Make sure that the m-file settings.m in the output folder settings reads "flags.initialCond=1;" in line 164. The routine uses KFLast.mat in the output folder to set the initial condition for the estimation over Sample 2.[1]
4) Run \ReplicationFiles\Estimation\MH_Run.m to launch the posterior simulator from the posterior mode found in Step 1. One needs to set the folder where the output of the posterior maximization can be found. To do so, specify the path to the output in line 66. To replicate Table I and Table II of the article, write "load .\BFM_mod\ver01\FirstSampleOutput\end 2007.75 csminwel BFMPrior 02 03 23/workspace" in line 66. One can set the number of stochastic draws (*Nsim*) in line 10 of \ReplicationFiles\Estimation\lmjtoolbox\MH\MH_Routines.m. This routine will return the posterior mean and standard deviation of the parameters estimated over Sample 1 and shown in Table I and Table II of the article.[2]

Data: The data set for estimation are stored in \ReplicationFiles\Estimation\BFM_mod\data. The file named usdata_S1.xlsx contains data that is used to estimate the model over Sample 1 and does not include the expected federal funds rate and the breakeven inflation rate. The file named usdata.xlsx contains the full sample including the expected federal funds rate from the Overnight Interest Swap (OIS) and the five-year breakeven inflation expectations data. This file contains the data used to estimate the Quantitative Model over Sample 2. The data set to be used in estimation is selected in line 107 (file name) and line 109 (the location/path) of the mfile settings.m, located in the output folders. In the same file, go to lines 113, 115, and 117 of and write "dataStru.start =2008", "dataStru.startest =2008"; "dataStru.finish =2022.5," respectively, so as to set the start and the beginning of the second sample properly.

[1] This command should be set to be equal to zero in the output folder of Sample 1 estimation (Step 1.)
[2] Posterior moments may differ slightly from the one shown in the paper due to the fact that the posterior distribution of the parameters is approximated with stochastic simulations. We set the number of draws to be equal to 500,000 to construct the table. A smaller number of draws is likely to give rise to sizable deviations from the numbers reported in the tables due to poor approximation of the moments.

Model specification: The log-linearized equations of the model are coded in modBFM_modver01.m in the folder \ReplicationFiles\Estimation\lmjtoolbox\BFM_mod. This file also solves the model and spells out the measurement equations. More details and explanations can be found in in modBFM_modver01.m. The measurement equations must be ordered consistently with the columns of the dataset used in estimation and stored in the folder \ReplicationFiles\Estimation\BFM_mod\data. These equations are listed in the Online Appendix. Line 53 and 55 of modeFinderRun.m selects the model to be estimated in the folder \ReplicationFiles\Estimation\lmjtoolbox\BFM_mod.

Prior specification: Prior distributions for the estimation over Sample 1 can be found at \ReplicationFiles\Estimation\BFM_mod\ver01\FirstSampleOutput\BFMPrior.xls. Prior specifications for the estimation over Sample 2 can be found at \ReplicationFiles\Estimation\BFM_mod\ver01\SecondSampleOutput\BFMPrior.xls. Column A lists the name of the model parameters. Column B of the spreadsheet says the type of the prior (N=Normal, G=Gamma, B=Beta, U=Uniform, I=Inverse Gamma, C=Constant/the parameter is fixed and not estimated.) Columns C and D show the prior mean and the standard deviation.[3] Columns E and F show the lower and upper bounds for the value of the parameters. The prior is selected in the file name setting.m in the output folder. In this mfile, one can select the spreadsheet and tab name detailing the prior distributions on line 15 and 16. The order of parameters in the spreadsheet of the prior distributions must follow the order in the model specification file (e.g., modBFM_modver01.m in the folder \ReplicationFiles\Estimation\lmjtoolbox\BFM_mod.)

Short-sample estimation for Section V.E: Step 1 and Step 2 above unchanged except that when you run Step 1, one needs to change the m-file settings.m in the output folder so that the vintage data are uploaded from the spreadsheet usdata_S1v.xlsx. Before implementing Step 3, go to lines 113, 115, and 117 of the m-file settings.m –located in the output folder (\ReplicationFiles\Estimation\BFM_mod\ver01\SecondSampleOutput– and write "dataStru.start =2008", "dataStru.startest =2008"; "dataStru.finish =2020.75," respectively, so as to set the start and the beginning of the second sample properly. In the same file, make sure that the data set uploaded is the one with older vintage (i.e., usdatav1.xlsx). To do so, set the data set's file name its location/path in line 107 and 109, respectively, of the m-file settings.m located in the output folders. The model specification and the prior distributions are identical to those used in the long-sample estimation.

Detailed Directions to Construct the Data Sets

In \ReplicationFiles\DataConstruction you can find the excel files where the construction of the time series used in estimation is explained in details. See also the Appendix E in the Online Appendix for additional details concerning the construction of the data. Specifically, for the long-sample data set

[3] The prior standard deviation of calibrated/fixed parameters must be set to zero.

- DataConstruction_RealActivities&Inflation&RealWages.xlsx concerns the construction of Real GDP growth, real consumption growth, real investment growth, GDP deflator (tab name: Real Activity&GDP Deflator) and real wage growth (tab name: Real Wages).
- FiscalDataConstruction.xls concerns the construction of the fiscal variables: real federal transfers growth rate (tab name: Transfers), the growth rate of real government consumption and investment (tab name: Gov C&I), and the debt-to-GDP ratio (tab name: Debt2GDP Ratio).
- HoursConstruction.xls concerns the construction of the time series of hours. We de-trend this time series using a fourth degree polynomial (see Appendix E in the Online Appendix). This de-trending is implemented by running hoursgap.m. The m-file draws from HoursConstruction.xls and returns the trend of hours worked.
- Data for the expected Federal Funds Rates are constructed from Overnight Index Swap rates $OIS_{i,t}$, where the underlying interest rate is the average Federal Funds over the next i quarters, starting from time t. OIS data have been downloaded from Bloomberg over the period 2002Q1 to 2022Q3, and are averaged over the final five business days of quarter t. OIS are available with horizon of 1 to 8 quarters and then at 12 quarters. We construct OIS rates with horizon 9 and 10 quarters by interpolating the rates available between horizons 8 and 12 quarters using the formula $OIS_{i,t} = OIS_{8,t} + \frac{i-8}{4}\left(OIS_{12,t} - OIS_{8,t}\right) \; for \; i = \{9,10\}$. Expected Federal Funds Rates (EFFR) are constructed from OIS rates using the formula $EFFR_{i,t} = OIS_{i,t} * i - OIS_{i-1,t} * (i-1) \; for \; i > 1$ and $EFFR_{i,t} = OIS_{i,t} \; for \; i = 1$.

To construct the data set used for the shorter sample period, we follow the same steps described above. We show these steps in the files stored in the subfolder .\Vintage2021Q2.

- DataConstruction_RealActivities&Inflation&RealWages_v2021.xlsx concerns the construction of Real GDP growth, real consumption growth, real investment growth, GDP deflator (tab name: Real Activity&GDP Deflator) and real wage growth (tab name: Real Wages).
- FiscalDataConstruction_v2021.xls concerns the construction of the fiscal variables: real federal transfers growth rate (tab name: Transfers), the growth rate of real government consumption and investment (tab name: Gov C&I), and the debt-to-GDP ratio (tab name: Debt2GDP Ratio).
- HoursConstruction_v2021.xls concerns the construction of the time series of hours. We de-trend this time series using a fourth degree polynomial (see Appendix E in the Online Appendix). This de-trending is implemented by running hoursgap_v2021.m. The m-file draws from HoursConstruction_v2021.xls and returns the trend of hours worked.