Replication Package for

Understanding Regressions with Observations Collected at High Frequency over Long Span

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Overview

The code in this replication package constructs the analysis file from the following two data sources:

1. Empirical data (all publicly available)
2. Monte-Carlo simulated data (replicable by the MATLAB code provided) using MATLAB (code was run with MATLAB Release 2023b).

Two main MATLAB scripts **Main/Empirical_illustrations.m** and **Main/Simulations.m** run all the code to generate all 11 figures and 13 tables presented in the paper. Additional three scripts in **MC/src**/ are used to generate Monte-Carlo simulated data which are saved in **MC/**. Raw empirical data are available in **Data/** and all the produced figures and tables are saved in **Figures/** and **Tables/** respectively. The folder **Functions/** contains all the MATLAB functions that are used in the main MATLAB scripts.

Data Availability Statement

All the original empirical data used in this paper are publicly available and free. They can be accessed through the links provided in the Data Citations section below.

Description of Empirical Data

The original data used for the empirical illustrations in Sections 2,4,5, and 6 of the paper can be found in the directory **Data/**. A summary is provided in the following table.

Name	Format	Data Description	Data Source
DED3	csv	3-month Eurodollar deposit rate, daily, 1971-Jan-04 to 2016-Oct-07	Data citation [1]
DGS10	csv	Market yield on U.S. treasury securities at 10-year constant maturity (10-year T-bond rate), daily, 1962-Jan-02 to 2019-Dec-31	Data citation [2]
DTB3	csv	3-month treasury bill secondary market rate (3-month T-bill rate), daily, 1962-Jan-01 to 2019-Dec-31	Data citation [3]
SP500	csv	S&P 500 index prices, daily, 1997-Sep-10 to 2018-Mar-29	Data citation [4]
SP500F	csv	S&P 500 index futures prices, daily, 1997-Sep-10 to 2018-Mar-29	Data citation [5]
USUKF	csv xls	US/UK forward exchange rate, daily, 1979-Jan-02 to 2017-Dec-29	Data citation [6]
USUKS	csv xls	US/UK spot exchange rate, daily, 1979-Jan-02 to 2017-Dec-29	Data citation [7]

Data Citations

[1] Board of Governors of the Federal Reserve System (US), U.S. Short-Term Interest Rates: Daily 3-Month Eurodollar Deposit Rate (DISCONTINUED) [DED3], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DED3.

[2] Board of Governors of the Federal Reserve System (US), 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.

[3] Board of Governors of the Federal Reserve System (US), 3-Month Treasury Bill Secondary Market Rate, Discount Basis [DTB3], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DTB3.

[4] Historical data for S&P 500 (GSPC), retrieved from Yahoo Finance; https://finance.yahoo.com/quote/%5EGSPC/history/.

[5] Historical data for S&P 500 Futures, retrieved from Investing.com; https://au.investing.com/indices/us-spx-500-futures-historical-data.

[6] Bank of England (UK) Database, Forward Exchange Rates, US Dollar into Sterling, [XUDLDS1, XUDLDS3, XUDLDS6, XUDLDSY], retrieved from https://www.bankofengland.co.uk/boeapps/database/fromshowcolumns.asp?Travel=NIxIRxSUx&FromSeries=1&ToSeries=50&DAT=RNG&FD=1&FM=Jan&FY=1979&TD=31&TM=Dec&TY=2017&FNY=&CSVF=TT&html.x=165&html.y=35&C=DSG&C=64R&C=167&C=DSH&Filter=N

[7] Bank of England (UK) Database, Spot Exchange Rates, US Dollar into Sterling, [XUDLUSS], retrieved from https://www.bankofengland.co.uk/boeapps/database/fromshowcolumns.asp?Travel=NIxSUx&FromSeries=1&ToSeries=50&DAT=RNG&FD=2&FM=Jan&FY=1979&TD=31&TM=Dec&TY=2017&FNY=&CSVF=TT&html.x=129&html.y=41&C=C8P&Filter=N

Data Cleaning

MATLAB function for cleaning the raw empirical data described in the previous section is provided in **Functions/data_cleaning.m**. This function produces four datasets saved in four csv files in a prescribed directory as well as four MATLAB timetables as its output. These datasets are used for the analysis of the four empirical models, Models I-IV, used in the paper. The following table summarizes the variables contained in these four datasets.

File Names	Variables	Variable Description
M1_TB.csv	Time	Daily trading dates from 1962-Jan-02 to 2019-Dec-31
	TB3m	3-month T-bill rates
	TB10y	10-year T-bond rates
M2_TBEU.csv	Time	Daily trading dates from 1971-Jan-04 to 2016-Oct-07
	TB3m	3-month T-bill rates
	Eudollar	3-month Eurodollar rates
M3_logFX.csv	Time	Daily dates from 1979-Jan-02 to 2017-Dec-29
	Spot	Log US/UK spot exchange rate
	Frwd3m	Log US/UK 3-month forward exchange rate
M4_logSP500.csv	Time	Daily dates from 1997-Sep-10 to 2018-Mar-29
	SP500	Log S&P 500 index price
	SP500futures	Log S&P 500 index future price

Replication of Figures and Tables for Empirical Analysis

MATLAB code for replicating all figures and tables for empirical illustrations and analysis is provided in the file **Main/Empirical_illustration.m**. The total execution time is about 90 seconds on iMac with 3.3 GHz 6-Core Intel Core i5 and 16GB 2667 MHz DDR4 Memory. The following table summarizes the figures and tables produced by the code.

File Produced	Figure or Table Reported in the Paper	Section
Figures/Figure1.png	Figure 1: Data plots for Models I-IV	Section 2
Figures/Figure2.png	Figure 2: Wald tests in Models I-IV	Section 2
Figures/Figure3.png	Figure 3: Estimated residual AR coefficients in Models I-IV	Section 4
Figures/Figure4.png	Figure 4: Robust Wald tests in Models I-IV	Section 5
Figures/Figure5.png	Figure 5: Short and long rates before and after the observed Greenspan conundrum at quarterly, monthly and daily frequencies	Section 6
Tables/Table1.txt	Table 1: Testing results from quarterly regressions	Section 6
Tables/Table2.txt	Table 2: Testing results from monthly regressions	Section 6
Tables/Table3.txt	Table 3: Testing results from daily regressions	Section 6
Tables/Table4.txt	Table 4: Testing results from quarterly cointegrating regressions	Appendix B
Tables/Table5.txt	Table 5: Testing results from monthly cointegrating regressions	Appendix B
Tables/Table6.txt	Table 6: Testing results from daily cointegrating regressions	Appendix B
Tables/Table7.txt	Table 7: Testing results from quarterly stationary regressions (financial crisis samples)	Appendix C
Tables/Table8.txt	Table 8: Testing results from monthly stationary regressions (financial crisis samples)	Appendix C
Tables/Table9.txt	Table 9: Testing results from daily stationary regressions (financial crisis samples)	Appendix C
Tables/Table10.txt	Table 10: Testing results from quarterly cointegrating regressions (financial crisis samples)	Appendix C
Tables/Table11.txt	Table 11: Testing results from monthly cointegrating regressions (financial crisis samples)	Appendix C
Tables/Table12.txt	Table 12: Testing results from daily cointegrating regressions (financial crisis samples)	Appendix C

Replication of Figures and Tables for Monte Carlo Simulations

MATLAB programs for generating Monte Carlo (MC) simulation data are available in the folder **MC/src/**. There are three MATLAB m-files:

- **MC/src/MC_Section7.m**: generates MC data for the analysis presented in Section 7 and Appendix D, except the size-adjusted power results presented in Table 13 in Appendix D. The execution time is about 6.42 hours on MacBook Air with M2 Chip, 8-Core CPU and 8GB Unified Memory.
- **MC/src/MC_Section7_power.m**: generates MC data for the size-adjusted power results presented in Table 13 in Appendix D. The execution time is about 8.22 hours on MacBook Air with M2 Chip, 8-Core CPU and 8GB Unified Memory.
- **MC/src/MC_AppendixE.m**: generates MC data for the simulation analysis presented in Appendix E. The execution time is about 8.31 hours on iMac with 3.3 GHz 6-Core Intel Core i5 and 16GB 2667 MHz DDR4 Memory.

All the MC data generated are provided in the folder **MC/**.

The main MATLAB code for replicating all figures and tables for simulation analysis is provided in the file **Main/Simulations.m**. The total execution time is about 7.5 seconds on iMac with 3.3 GHz 6-Core Intel Core i5 and 16GB 2667 MHz DDR4 Memory. The following table summarizes the figures and tables produced by the code.

File Produced	Figures or Tables in the Paper	Section
Figures/Figure6.png	Figure 6: Simulated means of robust Wald test statistics	Section 7
Figures/Figure7.png	Figure 7: Simulated rejection probabilities of robust Wald tests	Appendix D
Figures/Figure8.png	Figure 8: Simulated means of robust Wald test statistics and instability of test results caused by one-day change in sampling frequency	Appendix D
Figures/Figure9.png	Figure 9: Simulated means of robust Wald test statistics under joint asymptotics	Appendix D
Figures/Figure10.png	Figure 10: Simulated means of robust Wald test statistics	Appendix E
Figures/Figure11.png	Figure 11: Simulated rejection probabilities of robust Wald tests	Appendix E
Tables/Table13.txt	Table 13: Simulated size-adjusted power	Appendix D