

# README: Replication of *Time-Varying Parameters as Ridge Regressions*

## Overview

This repository, named "**rc\_final**" contains the necessary data and code to replicate all the figures and tables from the paper "**Time-Varying Parameters as Ridge Regressions**" by Philippe Goulet Coulombe. This README will guide you through the replication process for each figure. This README provides step-by-step instructions to guide you through the replication process for each figure and table. The scripts are written in **R** and **MATLAB**:

- Files with the .R extension are R scripts.
- Files with the .m extension are MATLAB scripts.

By following these instructions, you will be able to reproduce all the results presented in the paper.

## Repository Structure

The repository is organized into two subfolders (Empirical and Simulation), each corresponding to a figure or set of figures. Each folder contains the specific data and code needed to replicate the respective figure(s):

### Folder Descriptions

1. **Empirical/**
  - **00\_prog/:**
    - **local\_projection\_figure3\_TVPLP.R** – Generate results for Figure 3 : (f), (g) and (h)
    - **plots\_local\_projections\_TVPLP.R** – Process results for Figure 3 : (f), (g) and (h).
    - **local\_projection\_figure3\_VAR.m** – Generate results for Figure 3 : (a), (b), (c), (d) and (e). This code also output the Figure 5
    - **forecasting\_table16to17.R** - Generate results for the tables 16 to 17 and Figure 2
    - **results\_table16to17.R** - Process results for the tables 16 to 17 and Figure 2.
    - **forecasting\_table18.R** - Generate results for the table 18
    - **results\_table18.R** - Process results for the table 18
    - **forecasting\_bayes\_figure2.R** – Generate results for the “Bayes” models in Figure 2

- **results\_figure2.R** – Process results for the Figure 2
  - **10\_data/**: contains the data that are used in the exercise
  - **20\_tools/**: contains the model's functions and forecasting tools
    - **functions/**:
  - **30\_output/**: contains all the raw outputs
    - **figure3/**:
  - **40\_results/**: contains all the processed outputs
- 2. Simulation/**
- **00\_prog/**:
    - **simulation\_table1.R** – Simulation producing results for table 1
    - **results\_figure1.R** – Process results for figure 1
    - **simulation\_table2to5.R** – Simulation producing results for tables 2 to 5
    - **simulation\_table6to9.R** – Simulation producing results for tables 6 to 9
    - **simulation\_table10to13.R** – Simulation producing results for tables 10 to 13
    - **results\_table2to13.R** – Process results for tables 2 to 13 and output LaTeX tables.
    - **simulation\_table14.R** – Simulation producing results for the table 14
    - **simulation\_table15.R** and **simulation\_table15\_only2srr.R** – Simulation producing results for table 15
    - **results\_table15.R** – Process results for table 15
    - **results\_figure1.R** – Process results from tables 2 to 5 and generate figure 1.
  - **10\_tools/** : contains the necessary tools functions and models to replicate the results.
    - **functions/** : contains the model's functions
    - **simul\_types/**: contains the data generating process function
  - **20\_output/**: contains all the raw outputs
    - **Table1/**:
    - **Table2to13/**:
    - **Table14/**:
    - **Table15/**:
  - **30\_results/**: contains all the processed outputs

## Data Sources

The empirical exercise relies on data from both the United States and Canada.

### United States

We utilize the FRED-QD database, a comprehensive quarterly macroeconomic dataset designed for big data analysis in empirical research. For more details, see:

- **McCracken, M.W., Ng, S. (2020):** *FRED-QD: A Quarterly Database for Macroeconomic Research*, Federal Reserve Bank of St. Louis Working Paper No. 2020005. [DOI: 10.20955/wp.2020.005](https://doi.org/10.20955/wp.2020.005)

## Canada

The Canadian data is sourced from **Statistics Canada**.

### Dataset Descriptions

File name	Data Source	Description
FRED_QD_stationnary.csv	<a href="#">FRED</a>	Used for Tables 16–18. Contains stationarized data from FRED-QD. The data as been transform as in McCracken, M.W., Ng, S. (2020)
newQ_targets.csv	<a href="#">FRED</a>	Used for Tables 16–18. Contains five target variables used in the US forecasting exercise.
cs18_fig4_ppuzzle.csv	<a href="#">Statistic Canada</a>	Used for Figure 3. Contains eight target variables used in the Canadian exercise. Monthly data as in Champagne and Sekkel (2018)

## Instructions for Replication

The replication codes for this paper are organized into two main sections: Empirical and Simulation. Below are the specific instructions for replicating each figure and table. Note that the required packages are automatically installed within the provided scripts.

### Empirical

This section replicates the empirical results, including Figures 2, 3, and 5, as well as Tables 16 to 18.

#### 1. Tables 16 to 18:

- Run the script `forecasting_table16to17.R` to replicate the results of the U.S. forecasting exercise for Tables 16 and 17. This script leverages parallel computing, allowing you to utilize multiple CPU cores to speed up the process. **Set the number of CPU cores:** Specify the number of cores to use for parallel computing (change value of the object “ncores”). If set to 1, the script will run sequentially without parallel processing. **Adjust the working directory:** Modify the relative path variable (wd) to point to your working directory. The script generates results for all combinations of targets, forecasting horizons, and models, covering a total of 60 combinations.

- b. Output: `30_output/table16to18/TVP_***.RData` where \*\*\* is the target's position, horizon and model.
  - c. Run the script `results_table16to17.R` to replicate the table 16 and 17. You must modify the relative path variable (wd) to your working directory.
  - d. Output: `40_results/table16.tex`, `40_results/table17.tex`
  - e. To replicate the Table 18, run the script `forecasting_table18.R`. This exercise also run using parallel computing. The same steps apply to this table.
  - f. Output: `30_output/table16to18/TVP_***_block.RData` where \*\*\* is the target's position, horizon and model.
  - g. Run the script `results_table18.R` to replicate the table 18. You must modify the relative path variable (wd) to your working directory.
  - h. Output: `40_results/table18.tex`
  - i. The script `results_figure2.R` regenerate the Figure 2. You must modify the relative path variable (wd) to your working directory. It will output the barplots for all variables and horizons.
2. **Figure 2:**
- a. The script `forecasting_bayes_figure2.R` the Bayes models in the Figure 2. As for tables 16-18, the script leverages parallel computing, allowing you to utilize multiple CPU cores to speed up the process. **Set the number of CPU cores:** Specify the number of cores to use for parallel computing (change value of the object "ncores"). If set to 1, the script will run sequentially without parallel processing. **Adjust the working directory:** Modify the relative path variable (wd) to point to your working directory. The script generates results for all combinations of targets, forecasting horizons, and models, covering a total of 30 combinations (AR and ARDI).
  - b. The script `results_figure2.R` regenerate the Figure 2. You must modify the relative path variable (wd) to your working directory. It will output the barplots for all variables and horizons.
3. **Figures 3 and 5:**
- a. Run the MATLAB script `local_projection_figure3_VAR.m` to replicate the VAR results. Modify the relative path variable (wd) to your working directory. This script generates Figures 3(a)–(e) and Figure 5. The results are stored in the `40_results/` folder.
  - b. Output: `40_results/figure3_inflation_VAR.png`, `figure3_GDP_VAR4.png`, `figure3_inflation_VAR8.png`, `figure3_GDP_VAR8.png`, `figure3_UR_VAR8.png` and `figure5.png`
  - c. Run the script `local_projection_figure3_TVPLP.R` to replicate the TVP-LP VAR results. Modify the relative path variable (wd) to your working directory. The simulation results will be stored in the `20_output/table/` folder. This script generates Figures 3(f)–(h)
  - d. Output: `40_results/figure3_TVP-LP_Inflation.html`, `figure3_TVP-LP_GDP.html` and `figure3_TVP-LP_Unemp.html`

## Simulation

This section replicates simulation exercises, including Tables 1 to 15 and Figures 1 and 4.

### 1. Table 1:

- a. Run the script `simulation_table1.R` to generate the simulation results. Modify the relative path variable (wd) to your working directory. The simulation results will be stored in the `20_output/table1/` folder.
- b. Use the script `results_table1.R` to create Table 1. Modify the path variable ("wd") in the code.
- c. Output: `40_results/table1.csv`

### 2. Tables 2 to 13:

- a. Run the scripts `simulation_table2to5.R`, `simulation_table6to9.R` and `simulation_table10to13.R` to replicate the simulation results. Modify the relative path variable (wd) to your working directory. The scripts can be run in any order, and results will be saved in respective folders (`20_output/table2to5`, `20_output/table6to9/` or `20_output/table10to13/`, one file per simulation)
- b. Use the script `results_table2to13.R` to generate Tables 2 to 13. Modify the relative path variable (wd) to your working directory.
- c. Output: `40_results/table_*.tex`. (where "\*" is the table number).

### 3. Table 14:

- a. Run the script `simulation_table14.R` to replicate the simulation results. Modify the relative path variable (wd) to your working directory. The simulation results will be stored in the `20_output/table14/` folder.
- b. The table will output in the console
- c. Output: `30_results/table14.csv`

### 4. Table 15:

- a. Run the scripts `simulation_table15.R` and `simulation_table15_only2srr.R` to replicate the simulation results. Modify the relative path variable (wd) to your working directory. The simulations results will be stored in the `20_output/table15/` folder.
- b. Run the script `results_tables15.R` to generate the table. Only modify the relative path variable ("wd") in the code. The table output in the console and in the folder `30_results/` (one file per simulation)
- c. Output: `30_results/table15.csv`

### 5. Figure 1

- a. Run the script `results_figure1.R` to replicate the figure. Modify the relative path variable (wd) to your working directory. The results come from `simulation_table2to5.R`.
- b. Output: `30_results/figure1a.png` and `30_results/figure1b.png`

## 6. Figure 4

- a. Run the script `results_figure4.R` to replicate the figure. Modify the relative path variable (`wd`) to your working directory.
- b. Output: `30_results/figure4.png`

# Software Requirements

To replicate the figures, the following software and packages are required:

- R version 4.1.2
- **MATLAB 2023a**

*The results have been produced on a MacBook Air M1.*

## R Packages:

- bvarsv
- pracma
- matrixcalc
- MASS
- glmnet
- fGarch
- shrinkTVP
- Hmisc
- Readr
- GA
- e1071
- glmnet
- timeSeries
- doParallel
- foreach
- extrafont
- ggplot2
- htmlwidgets
- RColorBrewer
- reshape2
- grid
- ggthemes

# Troubleshooting

If you encounter any issues, please ensure the following:

- All necessary R packages are installed.
- The data files are correctly placed in the specified folders.
- The relative path variable “path” or “wd” is correct.