

README: Monte Carlo Experiments.

Learning from crises: A new class of time-varying parameter VARs with observable adaptation

This document describes the Monte Carlo simulation framework used in the replication package to compare AVP model and the benchmark time-varying parameter VAR (TVP-VAR). All referenced MATLAB scripts and functions are located in the `MonteCarlo/` folder.

1. Overview

The main script,

`MONTE_CARLO.m`,

runs a large-scale simulation study under two alternative data-generating processes (DGPs):

- **DGP1 (Jump/Outlier TVP)** Implemented in `functions/outtvpsv_reg_dgp5.m`. Includes persistent TVP dynamics, discrete jumps in coefficients, stochastic volatility, and informative/non-informative instruments.
- **DGP2 (Nonlinear Regime-Switching TVP)** Implemented in `functions/nonlinear_tvp_dgp.m`. Features smooth transition regimes, predictor interactions, threshold effects, heterogeneous persistence, and regime-dependent variance.

Each DGP returns

$$(y_t, X_t, Z_{m,t}, \beta_t, \sigma_t), \quad t = 1, \dots, T,$$

where each instrument matrix $Z_{m,t}$ corresponds to a specific version of the AVP-VAR model.

2. Simulation Design

The Monte Carlo loop in `MONTE_CARLO.m` runs over:

- Number of replications: $n_{MC} = 1000$
- Sample sizes: $T \in \{50, 100, 200\}$
- Predictor correlation: $\rho \in \{0, 0.5, 0.95\}$
- Number of predictors: $p = 4$
- MCMC specifications: $ngibbs = 10,000$, thinning $nthin = 10$

For each (T, ρ) configuration, 1000 datasets are simulated and seven competing models are estimated.

3. Models Estimated

For each Monte Carlo replication the following seven models are estimated:

1. **TVP-VAR Benchmark (KR1)** Implemented in `MODELS/KR1.m`. Called via:

`KR1(y,X,ngibbs,nburn,3).`

2. **Agnostic AVP-VAR models** Implemented through `AP_RW.m` using non-informative driver sets:

- Z_1 : 20 drivers
- Z_2 : 40 drivers
- Z_3 : 60 drivers

3. **Targeted AVP-VAR models** Drivers contain structural information:

- Z_4 : 20 drivers
- Z_5 : 40 drivers
- Z_6 : 60 drivers

All AVP-VAR specifications use:

`AP_RW(y, X, Zm, ngibbs, nburn).`

Thinning is applied to reduce autocorrelation in MCMC chains.

4. Stored Outputs

For each replication iMC and model k , the script stores:

- **Posterior mean coefficients**

`BETA(:, :, iMC, k)`

- **Posterior mean volatilities**

`SIGMA(:, iMC, k)`

- **Squared forecast error (SFE)** for each coefficient

$$\text{SFE}_{iMC}(j, k) = \frac{1}{T} \sum_{t=1}^T \left(\beta_{t,j}^{\text{true}} - \hat{\beta}_{t,j}^{(k)} \right)^2, \quad j = 1, \dots, p.$$

- **Metadata and model labels**

Configuration files are automatically saved using the naming convention:

`Monte_Carlo_DGPX_T_YYY_rho_ZZ.mat.`

A master file storing all configurations is also produced:

`Monte_Carlo_DGPX_All_Configurations.mat.`

5. Figures

Illustrative figures of DGPs and estimated coefficients are generated by:

- `Figures1_2.m`

This script produces:

- **Figure 1:** DGP1 (jump TVP) — true vs. TVP vs. AP-VAR
- **Figure 2:** DGP2 (nonlinear TVP) — regime effects and nonlinear coefficients

Both figures are saved as vector PDFs.

6. Monte Carlo Tables (Online Appendix)

The script:

`Appendices_Tables_2_3.m`

generates all tables reported in the Online Appendix:

- **Table 2:** DGP1 (jump/outlier TVP)
- **Table 3:** DGP2 (nonlinear TVP)

Each table reports relative MSFE values:

$$\text{MSFE_relative} = \frac{\text{MSFE}_{\text{model}}}{\text{MSFE}_{\text{TVP}}}$$

for each coefficient $\beta_1, \beta_2, \beta_3, \beta_4$.