This form documents the artifacts associated with the article (i.e., the data and code supporting the computational findings) and describes how to reproduce the findings.

Part 1: Data

☐ This paper does not involve analysis of external data (i.e., no data are used or the only data are generated by the authors via simulation in their code).

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

Abstract

The data contains 15 financial institutions studied in Acharya et al. [2017] with a market capitalization in excess of 5 billion USD as of the end of June 2007. The S&P 500 index (GSPC) is used as a system proxy. The sample period is from January 1, 2000 to December 30, 2021, consisting of 5535 daily closing price records for each time series.

Availability

☒ Data **are** publicly available.
☐ Data **cannot be made** publicly available.

If the data are publicly available, see the *Publicly available data* section. Otherwise, see the *Non-publicly available data* section, below.

Publicly available data

☒ Data are available online at: https://github.com/menglinzhou/msCoVaR/tree/main/data

☐ Data are available as part of the paper's supplementary material.

☐ Data are publicly available by request, following the process described here:

☐ Data are or will be made available through some other mechanism, described here:

Non-publicly available data

Description

File format(s)

☐ CSV or other plain text.
☐ Software-specific binary format (.Rda, Python pickle, etc.): pkcle
☐ Standardized binary format (e.g., netCDF, HDF5, etc.):
☐ Other (please specify):

Data dictionary

☐ Provided by authors in the following file(s):
☐ Data file(s) is(are) self-describing (e.g., netCDF files)
☒ Available at the following URL: https://github.com/menglinzhou/msCoVaR/tree/main/data

Additional Information (optional)

Part 2: Code

Abstract

We provide the code to reproduce the simulation studies in Sections 3.3 and application studied in Section 4. This URL contains

- `functions.R`: The functions used to simulation and real data analysis.
- `code_simulation.R`: The main code to generate simulation results in Section 3.3.
- `code_application.R`: The main code to conduct dynamic forecasting in Section 4.

Description

Code format(s)

- ☐ Script files
  - ☒ R
  - ☐ Python
  - ☐ Matlab
  - ☐ Other:
- ☐ Package
  - ☐ R
  - ☐ Python
  - ☐ MATLAB toolbox
  - ☐ Other:
- ☐ Reproducible report
  - ☐ R Markdown
  - ☐ Jupyter notebook
  - ☐ Other:
- ☐ Shell script
- ☐ Other (please specify):

Supporting software requirements

Version of primary software used R version 4.1.2

Libraries and dependencies used by the code

- `mvtnorm`: 1.1.3
- `evd`: 2.3.3
- `cubature`: 2.0.4.2
- `parallel`: 4.1.2
- `doParallel`: 1.0.16
- `foreach`: 1.5.1
- `rugarch`: 1.4.4
- `evir`: 1.7.4
- `sn`: 2.0.1
- `MASS`: 7.3.60
- `Matrix`: 1.4.0
- `data.table`: 1.14.2
- `timeSeries`: 3062.100
- `PerformanceAnalytics`: 2.0.4

Supporting system/hardware requirements (optional)

Parallelization used

- ☐ No parallel code used
- ☒ Multi-core parallelization on a single machine/node
  - Number of cores used: 6
- ☐ Multi-machine/multi-node parallelization
  - Number of nodes and cores used:

License

- ☒ MIT License (default)
- ☐ BSD
- ☐ GPL v3.0
- ☐ Creative Commons
- ☐ Other: (please specify)

Additional information (optional)

Part 3: Reproducibility workflow

Scope

The provided workflow reproduces:

- ☐ Any numbers provided in text in the paper
- ☒ The computational method(s) presented in the paper (i.e., code is provided that implements the method(s))
- ☐ All tables and figures in the paper
- ☐ Selected tables and figures in the paper, as explained and justified below:

Workflow

Location

The workflow is available:

- ☐ As part of the paper's supplementary material.
- ☒ In this Git repository: https://github.com/menglinzhou/msCoVaR
- ☐ Other (please specify):

Format(s)

- ☒ Single master code file
- ☐ Wrapper (shell) script(s)
- ☐ Self-contained R Markdown file, Jupyter notebook, or other literate programming approach
- ☐ Text file (e.g., a readme-style file) that documents workflow
- ☐ Makefile
- ☐ Other (more detail in *Instructions* below)

Instructions

The code_simulation.R can be used to reproduce the simulation studies in Section 3 and the code_application.R can be used to reproduce the application studies in Section 4.

Expected run-time

Approximate time needed to reproduce the analyses on a standard desktop machine:

- ☐ < 1 minute
- ☐ 1-10 minutes
- ☐ 10-60 minutes
- ☐ 1-8 hours
- ☒ > 8 hours
- ☐ Not feasible to run on a desktop machine, as described here:

Additional information (optional)

Notes (optional)