REAME FILE FOR "VARYING RESPONSES TO COMMON SHOCKS AND COMPLEX CROSS-SECTIONAL DEPENDENCE: ..."

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The replication materials includes one replication dataset of sovereign default used in the empirical application in the paper and the R code for estimating the linear, probit, and logistic multilevel multifactor error structure models with a *p*th order autoregressive process (MESMLM-AR(p) model) and This file documents these dataset and R code and explains how to reproduce the results and fit the proposed model with different link functions.

1 R Code

There are four R files, namely, MESMLM-ARp.R, MESMLMLogit-AR0.R, MESMLMLinear-ARp.R, and hidden.function.R

- hidden.function.R: the file includes small functions which are called in in the MCMC updating process executed using the main functions in the other three R files, *i.e.,* MESMLM-ARp.R, MESMLMLogit-AR0.R, MESMLMLinear-ARp.R. The file is sourced in the beginning of those files.
- MESMLM-ARp.R: the file includes two major functions MulFac.AR and MulFac.AR0 for estimating the probit multilevel multifactor error structure models with or without serial correlation presenting in the idiosyncratic error term, using MCMC. The user needs to copy and past the whole file into R or simply using the function source("MESMLM-ARp.R") (make sure that the file is in the same directory as the working directory, or include the directory of the file in the source function). And then use the following function to fit the MESMLM-AR(p) model:

```
MulFac.AR <- function(y,X1, Wi, Ai, Ut, TP, Unit.Index, Time.Index,
m=10000, burnin=5000, init.phi, init.ystar=0,...)
```

```
MulFac.AR0 <- function(y,X1, Wi, Ai, Ut, TP, Unit.Index, Time.Index,
m=10000, burnin=5000, init.ystar=0,...)
```

Arguments

y	response variable (dichotomous (0/1))
X1	matrix of covariates with fixed effects
Wi	matrix of covariates with subject-varying effects
Ut	matrix of covariates with time-varying effects
Ai	matrix of covariates explaining the subject-varying effects
TP	number of unobserved factors
Unit.Index	index of subjects
Time.Index	index of time periods
timeint.add	whether to add an time-specific intercept? "TRUE" or "FALSE"
unitint.add	whether to add an unit-specific intercept? "TRUE" or "FALSE"
m	number of iterations to be returned
burnin	number of initial iterations which are discarded
priors	beta0— mean vector of the multivariate normal distribution of beta, all the fixed effects (beta in the reduced form of the model) B0— variance matrix of the multivariate normal distribution of beta, all the fixed effects (beta in the reduced form of the model) d0, D0 — degree of freedom and scale matrix of the Wishart prior on b_i, the subject-level residual e0, E0 — degree of freedom and scale matrix of the Wishart prior on c_t, the time-level residual
nlag	the lag order p, integer >=0
initial values	init.phi — vector of initial values of the autoregressive coef. init.beta, init.b, and init.c — initial values of the fixed and random coefficients init.ystar — initial values of the latent response variable
tracking	every "tacking" iterations, return the information about how many iterations in total have been done
monitor	a string contains the names of parameters whose MCMC output are will be returned. The string has to be a subset of ("rho", "beta", "bi", "ct", "D", "E", "ystar", "u") which is the default
thin	thin the chain by recording each "thin" iterations

Value

MulFac.AR and MulFac.AR0 return the MCMC draws for the parameters included in the argument monitor as a list. The user can use the functions in the R package coda to summarize the posteriors and conduct convergence diagnostics.

- MESMLMLinear-ARp.R : the file includes two major functions MulFacLinear.AR and MulFacLinear.AR0 for estimating the linear multilevel multifactor error structure models with or without serial correlation presenting in the idiosyncratic error term, using MCMC. The two functions are simplified version of the functions MulFac.AR and MulFac.AR0 and do not have the data augmentation updating block.The user needs to copy and past the whole file into R or simply using the function source("MESMLMLinear-ARp.R") (make sure that the file is in the same directory as the working directory, or include the directory of the file in the source function). And then use the following function to fit the MESMLM-

AR(p) model:

```
MulFacLinear.AR <- function(y,X1, Wi, Ai, Ut, TP, Unit.Index, Time.Index,
m=10000, burnin=5000, init.phi, init.ystar=0,...)
```

```
MulFacLinear.AR0 <- function(y,X1, Wi, Ai, Ut, TP, Unit.Index, Time.Index,
m=10000, burnin=5000, init.ystar=0,...)
```

Arguments: meanings and usage of the arguments are the same as those in the probit model

Values

`MulFacLinear.AR` and `MulFacLinear.AR0` return the MCMC draws for the parameters included in the argument `monitor` as a list. The user can use the functions in the `R` package `coda` to summarize the posteriors and conduct convergence diagnostics.

- `MESMLMLogit.R`: the file includes several small functions for using the rejection sampler to update λ_i in the MCMC updating and a major function `MulFacLogit.AR0` for estimating the logit multilevel multifactor error structure models with serially independent idiosyncratic error term, using MCMC. The user needs to copy and past the whole file into `R` or simply using the function `source("MESMLMLogit-ARp.R")` (make sure that the file is in the same directory as the working directory, or include the directory of the file in the `source` function). And then use the following function to fit the MESMLM-AR(p) model:

```
MulFacLogit.AR0 <- function(y,X1, Wi, Ai, Ut, TP, Unit.Index,
Time.Index, mm, m=10000, burnin=5000, init.phi, init.ystar=0,...)
```

Arguments: meanings and usage of the arguments are almost the same as those in the probit model. There is a new argument in this function, `mm`, which is the number of iterations in the squeezing functions for approximating λ_i.

Values

`MulFacLogit.AR0` returns the MCMC draws for the parameters included in the argument `monitor` as a list. The user can use the functions in the `R` package `coda` to summarize the posteriors and conduct convergence diagnostics.

- The `R` code for computing the Bayes factor of the MESMLM-AR(p) model is the same code for estimating the posterior distributions (the MCMC updating algorithms executed using the functions listed above). To do the reduced runs, simply fixed the values of certain parameters or parameter vectors following the algorithm presented in Appendix B of the paper.

2 Replication Data

In the paper I applied the multivariate change-point model to test the "democratic advantage" hypothesis about sovereign default. using TSCS data of 134 developing countries from 1990 to 2003.

To replicate the results in Section 6, please use the replication dataset `RepDefault.RData` or `RepDefault.csv` in this replication archive. The variable labels in Figure 3 have their corresponding the variables names in the dataset as following:

Country Name: `Country`	Year: `Year`
Default*: `Default2025`	Default **: `Default4050`
Default***: `Default6075`	duration: `durable`
democracy: `polity2`	anocracy*: `anocracy3`
anocracy**: `anocracy5`	debt/GDP(t-1): `debt2GDP`
GDP.percapita(t-1): `GDPpercalag`	GDPGrowth.1lag: `GDPGrowth(t-1)`
Openness(t-1): `Opennesslag`	short.debt/total.debt(t-1): `RatioSDlag`
Reserves/Debt(t-1): `RatioRDlag`	CABlag1: `current.account balance(t-1)`
world growth: `GDPGrowth`	Us.interest: `Usinterest`

Note:

Default* `Default`$= 1$ if the stock of total arrears increases by more than 2%, or rescheduled debt exceeds 2.5% of the total debt stock unless the stock of total arrears decreases more than the amount of rescheduled debt in the same year

Default** `Default`$= 1$ if the stock of total arrears increases by more than 4%, or rescheduled debt exceeds 5% of the total debt stock unless the stock of total arrears decreases more than the amount of rescheduled debt in the same year

Default*** `Default`$= 1$ if the stock of total arrears increases by more than 6%, or rescheduled debt exceeds 7.5% of the total debt stock unless the stock of total arrears decreases more than the amount of rescheduled debt in the same year

anocracy*: polity score falling in the interval $[-5,\ 5]$

anocracy*: polity score falling in the interval $[-3,\ 3]$

When fitting the model, the variable `Default` is the response variable and should be specified as `y` in the `R` functions for MCMC simulation; the rest of the above, except `GDPGrowth` and `Usinterest`, should be specified as the `Xi` argument in those `R` functions; and `GDPGrowth` and `Usinterest` are the two observed common factors forming the design matrix Ut. The definitions, measures, and data sources for the variables can be found in Section 6 of the paper and Section 3 of the file with supplementary materials.