**Readme File**

**Replication material for “Reorganization or Liquidation: Bankruptcy Choice and Firm Dynamics”**

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The accompanying replication\_23975.zip file contains two folders.

1. “Data”
   * This folder contains the programs (Stata) and available data used for the analysis of corporate bankruptcy.
2. “Fortran Codes and Model Output”
   * This folder contains the Fortran codes used to compute the model as well the Matlab codes and model output to create Figures and Tables.

**Data Availability and Provenance Statements**

We use data from three sources:

*1. Compustat - Capital IQ, North America, Fundamentals Annual*

Data is subject to distribution restrictions as it is proprietary data. We access this data trough Wharton Research Data Service (WRDS).

To request an account and access the data please visit: <https://wrds-www.wharton.upenn.edu/register/>

* Downloading Instructions for Compustat - Capital IQ, North America, Fundamentals Annual data
  + Once you have access to WRDS, follow the link “Get Data”, “Compustat – Capital IQ”, “Other Compustat – North America Annual Updates” and then “Fundamentals Annual”
  + We download the data manually.
    - Step 1: Data Date, (1980 – 2014)
    - Step 2: Select “GVKEY”, “Search the entire database”.
      * GVKEY provides a unique firm-date identifier.
    - Step 3: Select “Data Items” and “Data Codes” and click on the variable name of the variables you want to download. The variables we use are listed in \Data\vars\_compustat.txt.
      * We download the “footnote” of AT (total assets) in a separate file that we merge into the sample with all the other variables to avoid generating an unnecessary large file. To download footnotes, in addition to “Data Items” select “Footnotes” and select “AT” as the variable to be downloaded.
      * We include identifying Information: Company Name, Ticker Symbol, DLDTE, DLRSN, NAICS, SIC
    - We download the data in Stata format (“\*.dta”)

*2. The UCLA-LoPucki Bankruptcy Research Database (BRD)*

Data is subject to distribution restrictions as it is proprietary data. To request an account and access the data please visit <https://lopucki.law.ucla.edu/buy_cases_table.htm>

Once you have been granted access to the data, the data owner will email you an excel file with the sample and Stata codes to convert the sample into Stata format:

* The Excel file consists of about 200 fields of regression ready data on each BRD case. To download the Cases table, you must either
  + We keep GVKEY, Xnamecorp (name of the firm), emerge (an indicator for whether the firm emerges from bankruptcy or not), year, yfilled (year bankruptcy filled).
* We merge Compustat - Capital IQ, North America, Fundamentals Annual data and The UCLA-LoPucki Bankruptcy Research Database using gvkey codes and year. Once the sample is merged we use the do files that we describe in “Description of Programs”.

*3. Federal Reserve Bank of St Louis Economic Data (FRED)*

We retrieve the data from FRED, Federal Reserve Bank of St Luis: https://fred.stlouisfed.org/

We use the following variables

* Consumer Price Index from the U.S. Bureau of Labor Statistics, Consumer Price Index for All Urban Consumers: All Items in U.S. City Average [CPIAUCSL] which can be access at <https://fred.stlouisfed.org/series/CPIAUCSL>
* 1-Year Constant Maturity Treasury Bill Rate from the Board of Governors of the Federal Reserve System (US), retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/DGS1>

**Dataset list**

|  |  |  |  |
| --- | --- | --- | --- |
| **Data File** | **Source** | **Notes** | **Provided** |
| \Data\usdata.csv | FRED | Data on Consumer Price Index and Federal Funds Rate | Yes |
| \Data\compustat\_and\_lopucki.dta | Compustat and UCLA-Lopucki Bankruptcy Data | Proprietary. Combines multiple data sources. | No\* |
| \Data\mydata01.dta | All listed | Combines multiple data sources, serves as input for Table 1 | No |
| \Data\mydata01\_new.dta | All listed | Combines multiple data sources, serves as input for Table 1, 2, 3, Figure 4, Figure 5, and Figure 6 | No |
| \Fortran Codes and Model Output\output\_model\_baseline.mat | Model Output | This file provides the model output that is used to generate Figure 1, Figure 2, Figure 3, Figure 4 (model), Figure 7, Figure 8, Figure 9. | Yes |
| \Fortran Codes and Model Output\output\_model\_ahm.mat | Model Output | This file provides additional model output that is used to generate Figure 7, Figure 8, and Figure 9. | Yes |

\* We are not allowed to distribute Compustat Data or the LoPucki Bankruptcy Data since they are proprietary data.

**Computational Requirements**

**Software Requirements**

* Stata (code was last run with version MP 14.2 for Windows)
  + estout: Additional Package: package st0085\_2 Installed from http://www.stata-journal.com/software/sj14-2 “Making regression tables from stored estimates”
* Linux: CentOS 7.4 distribution
* Intel Fortran Compiler version 17.0.4
  + Intel(R) MPI Library for Linux\* OS, Version 2017 Update 3 Build 20170405
* Matlab (code was run with Matlab Release 2019a)
  + Symbolic Math Toolbox
  + Optimization Toolbox
  + Global Optimization toolbox
  + Statistics and Machine Learning Toolbox
  + Parallel Computing Toolbox
  + Econometrics Toolbox

**Memory and Runtime Requirements**

The Stata code was last run on a 4-core Intel based laptop with Windows 10.

The Matlab code was last run on a 4-core Intel based laptop with Windows 10.

The Fortran Codes were run on a Linux cluster running Intel Fortran and MPI (as described in Software Requirements) with 64-core Intel server with 1024 GB ram.

**Description of Programs**

**Data Programs (folder \Data)**

1. aux01.do: basic cleaning of data and naming some variables (see Appendix 1 for a description of derived variables and cleaning).

2. aux02.do: cleans outliers, define some variables (net debt, assets, cash-flow, equity issuance,...), computes ratios to assets, computes time series std for some variables and statistics for equity issuance, computes distance to default measure and z-score

3. aux03.do: creates entry, exit, bankruptcy indicators, bankruptcy stats

4. aux04.do: computes entry, exit, bankruptcy rates reported in Table 1 and Table 3.

5. aux05.do: computes moments of distributions conditional on firm status (non-bankruptyc, Chapter 11 bankruptcy, and Chapter 7 bankruptcy)

* Non-bankrupt firm = dummy for ch11\_ind=0, del\_ch7=0, exit =0
* CH 11 firms: first year of ch 11 bankruptcy
* CH 7 deleted firms that are liquidated

This file generates data values reported in Table 1, Table 3, and Figure 4.

6. aux06.do: Runs regression to compute autocorrelation and standard deviation of z presented in Table 2.

7. aux07.do: Performs Event analysis (data) presented in Figures 5 and 6.

**Fortran and Matlab Programs (See inside folder \** **Fortran Codes and Model Output)**

*Directory “Codes Baseline Model”*

1. globals04.f90: this file sets parameters, options for extensions and creates global functions.

Relevant Options for experiments:

* + benchmark = 1 if wage=1 (baseline calibration to estimate kappa)

or set to 0 if iterate on wage (all counterfactuals)

* + run\_panel = 1 runs panel used to construct event analysis (Figures 5 and 6)
  + run\_stats\_bysize = 1 computes model moments by firm size
  + Set theta = 0.01000000 and benchmark = 0 to find solution for Case "Lender All Bargaining Power" in Table 4

1. functions04.f90: this file contains set of functions used during optimization routines.
2. subroutines04.f90: this file contains the routines that sets the grids, solves the firm problem, price function, recovery rate, and simulates the model to generate moments.

Note: subroutines from "Numerical Recipes in FORTRAN; The Art of Scientific Computing" not included as they are proprietary. See: http://www.nrbook.com/a/bookf90pdf.html to find the book and obtaining a license

1. mysimplex04.f90: this file contains auxiliary routines to estimate the parameters of the model.
2. fb\_mpi04.f90: this code makes the call to all other routines and saves the functions

*Directory “Codes AHM Reform”*

1. globals04c.f90: this file sets parameters, options for extensions and creates global functions.
   1. Relevant Options for experiments
      1. benchmark = 1 if wage=1.000488 (equilibrium wage)
   2. or set to 0 to iterate on wage
2. functions04c.f90: this file contains set of functions used during optimization routines.
3. subroutines04c.f90: this file contains the routines that sets the grids, solves the firm problem, price function, and simulates the model to generate moments.

Note: subroutines from "Numerical Recipes in FORTRAN; The Art of Scientific Computing" not included as they are proprietary. See: http://www.nrbook.com/a/bookf90pdf.html to find the book and obtaining a license

1. fb\_mpi04c.f90: this code makes the call to all other routines and saves the functions

*Directory “Codes Efficient Case”*

1. globals\_simple01.f90: this file sets parameters, options for extensions and creates global functions.
   1. Relevant Options for experiments

benchmark = 1 if wage=1 (baseline calibration to estimate kappa)

or set to 0 if iterate on wage (all counterfactuals)

1. functions\_simple01.f90: this file contains set of functions used during optimization routines.
2. subroutines\_simple01.f90: this file contains the routines that sets the grids, solves the firm problem, and simulates the model to generate moments.

Note: subroutines from "Numerical Recipes in FORTRAN; The Art of Scientific Computing" not included as they are proprietary. See: http://www.nrbook.com/a/bookf90pdf.html to find the book and obtaining a license

1. mysimplex01.f90: this file contains auxiliary routines to estimate the parameters of the model.
2. main\_simple01.f90: this code makes the call to all other routines and saves the functions

**Instructions to Replicators**

**Details Data**

* The file \Data\data\_appendix.pdf provides a list of variables downloaded from Compustat.

**Details Fortran Codes**

1. To obtain the output for the baseline model, using codes in (\Fortran Codes and Model Output\Codes Baseline Model) on a machine/cluster running Intel Fortran and MPI, we compiled the codes with the following command:
   * 1. mpiifort -c globals04.f90 functions04.f90 subroutines04.f90 mysimplex04.f90 fb\_mpi04.f90
     2. mpiifort -o fb04 \*.o
        1. The file fb04 (to be created when compiling the files) is the executable file that is run to make the computation
        2. Run the file using as initial conditions the files in subdirectory "initial conditions baseline"
        3. The code was run using 4 cores with 16 cpus.
2. To obtain the output for the case with Lender All Bargaining Power (Table 4), using the codes in (\Fortran Codes and Model Output\Codes Baseline Model) we compiled the codes as in point (1) and
   1. Modify globals04.f90 in directory (\Fortran Codes and Model Output\Codes Baseline Model) in the following way
      1. set benchmark = 0 (which will set the code to iterate on the wage until the free entry condition is satisfied)
      2. set theta = 0.01000000
3. To obtain the output for the AHM reform model, using the codes on (\Fortran Codes and Model Output\Codes AHM Reform) on a machine/cluster running Intel Fortran and MPI, we compiled the codes using following command:

mpiifort -c globals04c.f90 functions04c.f90 subroutines04c.f90 fb\_mpi04c.f90

mpiifort -o fb04c \*.o

* 1. The file fb04c (to be created when compiling the files) is the executable file that is run to make the computation
  2. Run the file using as initial conditions the files in subdirectory "initial conditions AHM"
  3. The code was run using 4 cores with 16 cpus.

1. To obtain the output for the efficient case, using the codes on (\Fortran Codes and Model Output\Efficient case), we compiled the codes using the following command:

mpiifort -c globals\_simple01.f90 functions\_simple01.f90 subroutines\_simple01.f90 mysimplex01.f90 main\_simple01.f90

mpiifort -o fb01s \*.o

The file fb01s (to be created when compiling the files) is the executable file that is run to make the computation

* + To obtain the output for the case with different tax combinations (reported in the Appendix) modify globals\_simple01.f90

**List of Tables and Programs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Figure/Table #** | **Program** | **Line #** | **Output File** | **Note** |
| Table 1, Table 3 (Data) | \Data\aux04.do | 21 | \Data\Table1\_stats01.log | This file presents the estimates for Exit and Bankruptcy rates |
| Table 1 and Table 3 (Data) | \Data\aux05.do | 56-59 | \Data\Table01\_avg.csv | This file presents the averages for Non-Bankrupt, Chapter 11, and Chapter 7 firms |
|  |  | 76-81 | \Data\Table01\_meantest\_nbch7.csv | This file presents the means tests for Non-Bankrupt and Chapter 7 firms |
|  |  | 66-71 | \Data\Table01\_meantest\_nbch11.csv | This file presents the means tests for Non-Bankrupt and Chapter 11 firms |
|  |  | 87-92 | \Data\Table01\_meantest\_ch11ch7.csv | This file presents the means tests for Chapter 11 and Chapter 7 firms |
|  |  | 104-107 | \Data\Table01\_median.csv | This file presents the medians for Non-Bankrupt, Chapter 11, and Chapter 7 firms |
| Table 2 | \Data\aux06.do | 34-35  52-53 | \Data\Table02\_z\_proc.csv  \Data\Table02\_z\_proc\_sigma.csv | These files present the estimates from equation (29) that provide the autocorrelation for z and the standard deviation for the error |
| Table 3 (Model), Table 4 (Model), Table 5 (Benchmark Model Column) | \Fortran Codes and Model Output\ Codes Baseline model\globals04.f90, functions04.f90, subroutines04.f90, mysimplex04.f90, fb\_mpi04.f90 |  | \Fortran Codes and Model Output\res01rep.txt | Output from Baseline Model |
| Table 4 (AHM Reform), Table 5 (AHM reform) | \Fortran Codes and Model Output\ Codes AHM Reform\globals04c.f90, functions04c.f90, subroutines04c.f90, fb\_mpi04c.f90 |  | \Fortran Codes and Model Output\res03rep.txt | Output from AHM reform model |
| Table 4 (Efficient Economy), Table 5 (Efficient Economy) | \Fortran Codes and Model Output\Codes Efficient Case\globals\_simple01.f90, functions\_simple01.f90, subroutines\_simple01.f90, mysimples01.f90, main\_simple01.f90 |  | \Fortran Codes and Model Output\res04rep.txt | Output from Efficient Case Model |
| Figure 1 | \Fortran Codes and Model Output\figures\_rep01.m | 64-106 | fig\_paper03.eps | The files loads the model output (\Fortran Codes and Model Output\output\_model\_baseline.mat) and generates the figure |
| Figure 2 | \Fortran Codes and Model Output\figures\_rep01.m | 110-143 | fig\_paper02.eps | The files loads the model output (\Fortran Codes and Model Output\output\_model\_baseline.mat)and generates the figure |
| Figure 3 | \Fortran Codes and Model Output\figures\_rep01.m | 170-188 | fig\_paper05.eps | The files loads the model output (\Fortran Codes and Model Output\output\_model\_baseline.mat)and generates the figure |
| Figure 4 | \Fortran Codes and Model Output\figures\_rep01.m | 224-235 | fig\_dist\_5bins.eps | The files loads the model output (\Fortran Codes and Model Output\output\_model\_baseline.mat) and generates the figure. The file var\_data.mat not included as it requires proprietary data (Compustat) |
| Figure 5 | \Fortran Codes and Model Output\fig\_event\_analysis.m | 109-169 | fig\_paper\_eventch11.eps | The files loads the model output (\Fortran Codes and Model Output\output\_model\_baseline.mat) and generates the figure. The file data\_event.mat not included as it requires proprietary data (Compustat) |
| Figure 6 | \Fortran Codes and Model Output\fig\_event\_analysis.m | 270-328 | fig\_paper\_eventch7.eps | The files loads the model output and generates the figure. data\_event.mat not included as it requires proprietary data (Compustat) |
| Figure 7 | \Fortran Codes and Model Output\figures\_rep01.m |  | fig\_count05.eps | The files loads the model output output (\Fortran Codes and Model Output\output\_model\_baseline.mat and \Fortran Codes and Model Output\ output\_model\_ahm.mat) and generates the figure |
| Figure 8 | \Fortran Codes and Model Output\figures\_rep01.m |  | fig\_count07.eps | The files loads the model output (\Fortran Codes and Model Output\output\_model\_baseline.mat and \Fortran Codes and Model Output\ output\_model\_ahm.mat) and generates the figure |
| Figure 9 | \Fortran Codes and Model Output\figures\_rep01.m |  | fig\_count01\_5bins.eps | The files loads the model output (\Fortran Codes and Model Output\output\_model\_baseline.mat and \Fortran Codes and Model Output\ output\_model\_ahm.mat) and generates the figure |

**References**

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Compustat Industrial Annual Data. (1984-2014). Available: Standard & Poor's Compustat. Retrieved from Wharton Research Data Service (<https://wrds-www.wharton.upenn.edu/>).

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