This is a replication package for Pietro Bonaldi: "Motives and Consequences of Libor Strategic Reporting: How Much Can We Learn from Banks' Self-Reported Borrowing Rates?" (Review of Economic Studies). This package contains:

1) 4 "`Main_*.R`" files that replicate all tables and plots in the paper and the Appendix
2) 14 additional `.R` files that are called by the "`Main_*.R`" files
3) A 'Results' folder with all tables and plots in the paper
4) 5 additional folders with temporary files and results, all generated by the `.R` files included in the package

This document contains: a data available statement, a statement about rights, data citations, descriptions of the analysis datasets, hardware and software requirements, and instructions to replicators.

## Data Availability Statement

**Bloomberg L.P.: access via university terminal subscription**

Libor submissions provided by banks in the 3-month USD Libor panel from 09/03/2005 to 12/31/2010. The Bloomberg symbols are: US2003M, US6703M, US0303M, US1403M, US1603M, US2803M, US3403M, US5603M, US7503M, US0103M, US7103M, US1903M, US4803M, US1803M, US3303M, USBN03M, US7603M, USSM03M, US9903M, US2303M, US2203M.

3-month USD Libor from 09/03/2005 to 12/31/2010. The Bloomberg symbol is: US0003M.

New York Funding Rate from 06/02/2008 to 12/31/2010. The Bloomberg symbol is: NYFR3M.

**Board of Governors of the Federal Reserve System: Freely available online at FRED**

U.S. Short-Term Interest Rates: Daily 3-Month Eurodollar Deposit Rate (DED3) 2005 – 2010

3-Month Treasury Bill Secondary Market Rate, Discount Basis (DTB3) 2005 – 2010

TED Spread (TEDRATE) 2005 – 2010

**IHS Markit: access via Wharton Research Data Services (WRDS)**

Credit Default Swaps Spreads for 5-year senior unsecured debt issued by banks in the USD Libor panel 2005–2010. Markit RedCode: 06DABK, 0G655D, JJ4650, 189BFD, HK9FHL, 2H6677, 4G425R, 4I75AU, 4C933G, GLA86Z, 6BB62B, NP4897, NUD88R, 8B69AP, HPHB2J, DMFCCI, Tier: SNRFOR, Ccy: EUR, DocClause: CR.

## Statement about Rights

I certify that I am the author of the manuscript and have legitimate access to and permission to use the data used in this manuscript.

I acknowledge that I do not have permission to redistribute or publish the data listed in the Data Citation below.

## Data Citation

Bloomberg L.P., 2014, Libor submissions provided by banks in the 3-month USD Libor panel from 01/01/2005 to 12/31/2010. The Bloomberg symbols are: US2003M, US6703M, US0303M, US1403M, US1603M, US2803M, US3403M, US5603M, US7503M, US0103M, US7103M, US1903M, US4803M, US1803M, US3303M, USBN03M, US7603M, USSM03M, US9903M, US2303M, US2203M. Subscription Service (accessed 2014).

Bloomberg L.P., 2014. 3-month USD Libor from 09/03/2005 to 12/31/2010. Bloomberg symbol: US0003M. (Accessed 2014)

New York Funding Rate from 06/02/2008 to 12/31/2010. Bloomberg symbol: NYFR3M. (Accessed 2014)

Board of Governors of the Federal Reserve System (US), 2014, U.S. Short-Term Interest Rates: Daily 3-Month Eurodollar Deposit Rate (DED3) 2005 – 2010, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DED3. (Accessed 2014).

Board of Governors of the Federal Reserve System (US), 2014, 3-Month Treasury Bill Secondary Market Rate, Discount Basis (DTB3) 2005 – 2010, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DTB3. (Accessed 2014).

Board of Governors of the Federal Reserve System (US), 2014, TED Spread (TEDRATE) 2005 – 2010, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/TEDRATE. (Accessed 2014).

Markit, 2014, Credit Default Swaps Spreads for 5-year senior unsecured debt issued by banks in the USD Libor panel 2005–2010. Markit RedCode: 06DABK, 0G655D, JJ4650, 189BFD, HK9FHL, 2H6677, 4G425R, 4I75AU, 4C933G, GLA86Z, 6BB62B, NP4897, NUD88R, 8B69AP, HPHB2J, DMFCCI, Tier: SNRFOR, Ccy: EUR, DocClause: CR. (Accessed 2014).

**Analysis Datasets**

Please refer to the Data Availability Statement above for information on how to access the raw data. The file `Code/Main_estimation.R` loads two analysis datasets described below (not included with this package).

**Data file 1:** `Libor_3M_USD_data.RData`

Sample: All daily Libor submissions for the 3-month USD Libor by all banks in the USD Libor panel from 01/04/2005 to 12/31/2010

Data structure: An R data.frame with daily panel data from 09/03/2005 to 12/31/2010. Contains the following variables:

date.r: date of the Libor submissions (R class: Date, format: "%Y-%m-%d")
name: name of the bank submitting a Libor quote (R class: character)
libor3m: Libor submission (R class: numeric)
libor3m_fix: 3-month USD Libor benchmark rate (R class: numeric)
H15_M3: Daily 3-Month Eurodollar Deposit Rate (R class: numeric)
nyfr3m: daily New York Funding Rate (06/02/2008 – 12/31/2010) (R class: numeric)
ted: TED spread (R class: numeric)
tbill3m: 3-month Treasury bill rate (R class: numeric)

Data construction: Download the daily Libor submissions by all banks in the panel using the symbols below and merge all other variables by date. To match these Data with the CDS spreads data described below, use the following names:

| Bloomberg symbol | Name |
|---|---|
| US0303M | Barclays |
| US6703M | BOA |
| US2003M | BTMU |
| US1603M | Citi |
| US2803M | Credit Suisse |
| US3403M | Deutsche |

| | |
|---|---|
| US9903M | HBOS |
| US7503M | HSBC |
| US1403M | JPM |
| US0103M | Lloyds |
| US7103M | Norinchuckin |
| US1903M | Rabobank |
| US4803M | RBC |
| US1803M | RBS |
| US5603M | Societe Generale |
| US3303M | UBS |
| US2303M | WestLB |

**Data file 2**: `CDSspreads_2005_2010.RData`

Sample: All daily Credit Default Swap (CDS) spreads for 5-year senior unsecured debt issued by banks in the USD Libor panel from 09/03/2005 to 12/31/2010:

Data structure: An R data.frame with daily panel data from 09/03/2005 to 12/31/2010. Contains the following variables:

date.r: date of CDS spread (R class: Date, format: "%Y-%m-%d")
name: name of the bank (R class: character)
spread5y: CDS spread (R class: numeric)

Data construction: Start with the daily CDS spreads by banks in the panel. Banks are identified by their Markit RedCode. Use only CDS on unsecured senior debt (Tier: SNRFOR), priced in Euro (Ccy: EUR), and with full restructuring (DocCaluse: CR). Define a new variable 'name' using the rule below. For each bank (name), redefine spread5y as the average daily spread (a few banks may have more than one observation per date) and collapse the data by name and date. Merge all the other variables by date.

| RedCode | name |
|---|---|
| 06DABK | Barclays |
| 0G655D | BOA |
| JJ4650 | BTMU |
| 189BFD | Citi |
| HK9FHL | Credit Suisse |
| 2H6677 | Deutsche |
| 4G425R | HBOS |
| 4I75AU | HSBC |
| 4C933G | JPM |
| GLA86Z | Lloyds |
| 6BB62B | Norinchuckin |
| NP4897 | Rabobank |
| NUD88R | RBS |
| 8B69AP | Societe Generale |
| HPHB2J | UBS |
| DMFCCI | WestLB |

**Hardware and Software Requirements**

All the programs were run on a PC with the following configuration.

Hardware: AMD Ryzen Threadripper 3970X 32-Core Processor, 128 GB of RAM

Software: R version 4.1.3 (64-bit), Windows 10 Pro
R packages: data.table, kSamples, lmtest, optimx, parallel, sandwich, stargazer, truncnorm

Total running time is approximately 155 minutes.

To install the latest versions of the R packages on the default library directory run the following line on the R console:

```
install.packages(pkgs = c("data.table","kSamples","lmtest","optimx","parallel","sandwich","stargazer","truncnorm"))
```

**Instructions to Replicators**

1. Set the R working directory to the 'Code' folder included in this package by running setwd('[Location of the folder in your local machine]/Code")
2. Build the datasets 'Libor_3M_USD_data.RData' and 'CDSspreads_2005_2010.RData' following the data construction steps indicated in the Analysis Datasets section above. Save them in the folder 'Code'.
3. Run 'Code/Main_estimation.R'. For faster execution, edit the file and set:
   bootstrap.flag = FALSE (if FALSE uses pre-stored confidence intervals. If TRUE uses the bootstrap to compute confidence intervals)
   counterfactual.flag = FALSE (If FALSE uses pre-stored counterfactual libor rates. If TRUE simulates counterfactual equilibria)
4. Run 'Code/Main_BNE_simulation.R' (This works even if you skipped steps 2-3)
5. Run 'Code/Main_estimation_monte_carlo.R' (This works even if you skipped steps 2-4)
6. Run 'Main_BNE_uniqueness_test.R' (This works even if you skipped steps 2-5 using preloaded results)
7. All Figures and Tables are stored in 'Code/Results' as described below.

**Code/Main_estimation.R:** Loads two datasets: Libor_3M_USD_data.RData and CDSspreads_2005_2010.RData, estimates all model parameters, performs inference using the bootstrap (bootstrap.flag = TRUE), simulates counterfactuals (counterfactual.flag = TRUE), and produces:

| | |
|---|---|
| Figure 1 (left): | 'Code/Results/cds_mean_spread.eps' |
| Figure 1 (right): | 'Code/Results/libor_edr_nyfr.eps' |
| Figure 4 (left): | 'Code/Results/Libor_common_cost_spread.eps' |
| Figure 4 (right): | 'Code/Results/Libor_common_other_costs_spread.eps' |
| Figure 5: | 'Code/Results/Libor_common_other_costs_spread_2005_2008.eps' (using 'Libor_common_cost_pre_BNP_plot.R') |
| Figure 6: | 'Code/Results/Libor_common_cost_no_signal.eps' |
| Figure 7: | 'Code/Results/counterfactual_libor_manipulation.eps' |
| Figure 9 Appendix: | 'Code/Results/usd_libor_ted_2007_2010.eps' |
| Table 1: | 'Code/Results/Table1_signaling_exposure.csv' (using 'exposure_signal_tables.R') |
| Table 2: | 'Code/Results/table2_reg_signal_cds_spreads.tex' (using 'reg_signaling_cds_spreads.R') |
| Table 3: | 'Code/Results/Table3_signal_exposure_robustness_means.csv' (using 'exposure_signal_table_robustness.R') |
| Table 4: | 'Code/Results/Table4_Costs_sd.csv' |
| Table 6 Appendix: | 'Code/Results/Table6_appendix_alpha_signal.csv' (using 'exposure_signal_tables.R') |
| Table 7 Appendix: | 'Code/Results/Table7_appendix_signal_exposure_robustness.csv' (using 'exposure_signal_table_robustness.R') |
| Table 8 Appendix: | 'Code/Results/Table8_Costs_sd_all_banks.csv' |

**Code/Main_BNE_simulation.R**: Simulates the Bayes-Nash Equilirium of the game and produces:

Figure 2 (left): 'Code/Results/strategy_no_signal_B0.eps'
Figure 2 (right): 'Code/Results/strategy_with_signal_B0.eps'
Figure 3 (left): 'Code/Results/quotes_distribution_only_signal_B0.eps'
Figure 3 (right): 'Code/Results/quotes_distribution_signal_beta_B0.eps'

**Code/Main_estimation_monte_carlo.R**: Performs a Monte Carlo simulation to evaluate the estimation method and produces:

Figure 8 Appendix: 'Code/Results/estimation_MC_simulation.eps'
Table 5 Appendix: 'Code/Results/Table_5_estimation_MC_results_table.csv'

**Code/Main_BNE_uniqueness_test.R:** Loads 'Code/BNE_unique_test/estimation_parameters_p2.RData' produced by 'Code/Main_estimation.R' and produces:

Table 9 Appendix: 'Code/Results/Table_equilibrium_uniqueness_test.csv' (using 'BNE_unique_test_table.R')