**Read me file – matlab subdirectory**

The matlab subdirectory includes all the programs for the replication of:

* Panel B of Table 3
* Tables 5 through 10
* Figures 1 and 2

The directory includes the following files:

|  |  |
| --- | --- |
| File name | Type |
| **Input files** |  |
| external\_estimates.csv | CSV file |
| moments.csv | CSV file |
| moments\_nk.csv | CSV file |
| moments\_nontarget.csv | CSV file |
| SIGMA.csv | CSV file |
| SIGMA\_atus.csv | CSV file |
| SIGMA\_psid.csv | CSV file |
| THETA.csv | CSV file |
|  |  |
| **Programs** |  |
| calcU.m | Matlab file |
| calc\_dc.m | Matlab file |
| calc\_elasticities.m | Matlab file |
| calc\_pi.m | Matlab file |
| cell2csv.m | Matlab file |
| foc\_corA.m | Matlab file |
| foc\_corA\_nk.m | Matlab file |
| foc\_corH1.m | Matlab file |
| foc\_corH1H2.m | Matlab file |
| foc\_corH1H2\_nk.m | Matlab file |
| foc\_corH1\_nk.m | Matlab file |
| foc\_corH1\_terminal\_nk.m | Matlab file |
| foc\_corH2.m | Matlab file |
| foc\_corH2\_nk.m | Matlab file |
| foc\_corH2\_terminal\_nk.m | Matlab file |
| foc\_cor\_A\_H1.m | Matlab file |
| foc\_cor\_A\_H1H2.m | Matlab file |
| foc\_cor\_A\_H1\_nk.m | Matlab file |
| foc\_cor\_A\_H2.m | Matlab file |
| foc\_cor\_A\_H2\_nk.m | Matlab file |
| foc\_int.m | Matlab file |
| foc\_int\_nk.m | Matlab file |
| foc\_int\_terminal\_nk.m | Matlab file |
| hermquad.m | Matlab file |
| impulse\_responses.m | Matlab file |
| interpexp.m | Matlab file |
| interpexp\_mex.mexw64 | Matlab MEX file |
| IR\_figure.m | Matlab file |
| IR\_tables.m | Matlab file |
| main\_estimation.m | Matlab file |
| main\_estimation\_policy.m | Matlab file |
| main\_estimation\_se.m | Matlab file |
| mexLab.mexw64 | Matlab MEX file |
| moment\_match.m | Matlab file |
| mytemp.m | Matlab file |
| policy\_calc.m | Matlab file |
| ppvalshort.m | Matlab file |
| simul\_all.m | Matlab file |
| simul\_all\_het.m | Matlab file |
| simul\_all\_IR.m | Matlab file |
| solve\_E2\_0.m | Matlab file |
| solve\_E2\_0\_nk.m | Matlab file |
| solve\_E2\_1.m | Matlab file |
| solve\_E2\_1\_nk.m | Matlab file |
| solve\_terminal\_E2\_0.m | Matlab file |
| solve\_terminal\_E2\_1.m | Matlab file |
| solve\_value\_function\_kid\_lbar.m | Matlab file |
| solve\_value\_function\_kid\_lbar\_short.m | Matlab file |
| wage\_grids.m | Matlab file |
| wrapper.m | Matlab file |
| wrapper\_policy.m | Matlab file |
| wrapper\_se.m | Matlab file |
|  |  |
| c\_source\_files | Subdirectory (see notes below) |

**Running the Matlab code:**

There are three main entry points to the Matlab code:

* **wrapper.m**: This file can either be used to perform SMM estimation, or for a single function call, calculating the value of the objective function for the call. The calculation of the objective is using the moments from the data, which are provided in “moments.csv” and “moments\_nk.csv” in the directory. These moments can be replicated using the programs in the stata directory. To replicate the *point estimates* in *panel B of Table 3*, choose “estimate=1”. This will run SMM with a simulated annealing procedure. This procedure however can take days (up to weeks) to run, because each function call could take minutes (run time could be decreased by using a machine with multiple cores, and adjusting the parallel preferences to use more cores in the code). Choosing “estimate=0” will only run a single function call, for the parameters given by the used through the external CSV file “THETA.csv”. Note that the “THETA.csv” file provided in this directory is the point estimates file obtained from the simulated annealing procedure. Each function call will output the value of the moments (targeted and non-targeted), hence running the function with the provided “THETA.csv” will replicate *Table 4*. If requested, the function returns also the elasticities calculations (irflag==1). This will provide all inputs for replicating all results in *Tables 5-9*, as well as generate figures *1, 2*.
* **wrapper\_se.m**: This file will calculate the *standard errors* for the point estimates in Panel B of Table 3. It would take as inputs the point estimates in the file “THETA.CSV” and calculate standard errors around them. It makes use of the “SIGMA.csv”, “SIGMA\_atus.csv” and “SIGMA\_psid.csv” input files, all provided in the matlab directory, but could be also replicated using the STATA programs which are provided in the stata subdirectory.
* **wrapper\_se.m**: This file will calculate the policy exercises for replication of *Table 10* in the paper.

**Other files:**

The wrappers call multiple matlab functions. For ease of tracking functions, we keep each function as a separate file, so that file name is the same as the function name.

**Mex files:**

The code makes use of two mex files:

* interpexp\_mex: this is a complied C code that calculates the expectations within the value function solution. This mex file can be obtained by using matlab code generator on the interpexp.m file provided in the directory.
* mexLab: this file is a complied version of the C code which is at the core of the value function solution. The source files are provided in the c\_source\_files directory (see notes below about this directory). The entire C functionality is provided also in matlab through the functions “solve\_E2\_0.m”, “solve\_E2\_1.m”, “solve\_E2\_0\_nk.m”, “solve\_E2\_1\_nk.m” and “foc\_\*.m”, however running the solution to the value function using the matlab functions instead of the mexLab function, is extremely slow. An example of how to call those function is provided starting line 520 in the “solve\_value\_function\_kid\_lbar.m” file.

**Changing parameters for the Matlab code:**

* The parameters that characterize the wage process are received through the file “external\_estimates.csv”. The order of the parameters in this file is (see Table 2 and the discussion around it for the value of these parameters).
* The rest of parameters are set directly in the matlab code:
  + The first stage estimates, as well as some of the tax parameters are set in the wrapper files.
  + The rest of the parameters are set in the “main\_estimation.m” files (as well as the corresponding “main\_estimation\_se.m” and “main\_estimation\_policy.m”).

**C source files**

The subdirectory “c\_source\_files”, contains all the source files required for the compilation of the mexLab mex file. These are written in C++ and are used in the solution of the value function.

Users who wish to make changes to the c code, can use these source files. The project was developed in a visual studio environment and compiles on windows 7,8 and 10 machines (choose the “Release” option when compiling).