

Macroeconomic Model Data Base 3.0 - User Guide

This user guide describes how to install and use the Macroeconomic Model Data Base, version 3.0 (hereafter the Modelbase). Section 1 deals with the installation and the software requirements. Section 2 introduces the menu of the MMB 3.0 and describes how to run the software and conduct comparison exercises employing the models and options contained in the Modelbase. Section 3 explains the structure of the key files that govern the simulations carried out by the MMB 3.0. Lastly, section 4 lays out the structure of the model files. These are usual Dynare files, which have been amended with extra lines and commands to suit the MMB. For the time being we exclude instructions on how to alter the MMB by adding models or policy rules, which are planned to be included in the next release.

This guide is platform independent and can be applied to Windows, Linux and macOS operating systems.

1 Installation and software requirements

The MMB 3.0 can be downloaded from macromodelbase.com/download. The version for windows is `mmb-electron-win.exe`, for macOS it is `mmb-electron-mac.dmg`, and for Linux directly download the source code from the release on github at <https://github.com/IMFS-MMB/mmb-gui-electron/tags>.¹ The Windows version and the Mac version of the file autoinstall the MMB on your computer and opens the redesigned frontend of the MMB.

The files for carrying out the simulations of the models are written in MATLAB, so either some version of MATLAB or a recent version of its freeware clone, OCTAVE, must be installed on your computer. In the case of Matlab, one needs as well the *Optimization Toolbox* as well as the *Statistics Toolbox* in order to be able to run all models in the Modelbase.² For model solution the program utilizes DYNARE, which can be downloaded free of charge from the web.³ Under Windows, double-clicking on the downloaded DYNARE exe-file opens a set of steps that guide you through the installation. Under macOS, locate the downloaded pkg-file in Finder, and Control-click the icon to select Open from the menu, thus creating an exception for the app to be installed. The installer will then guide you through the installation. To install Linux version of Dynare please follow the instructions on the Dynare Wiki⁴.

Compatibility

We have tested the tested the MMB 3.0 with DYNARE 4.5.6 and 4.5.7. Earlier versions may work but have not been tested.

¹Linux users will have to build from source using `npm`. Find more info on our github page.

²For the time being there are some models, which cannot be simulated with Octave. The list of models contains: NK_ET14, NK_FLMF18, NK_GK11, US_AJ16, US_CMR14, US_CMR14noFa, US_FRB08, US_FRB08mx, US_IR15, EA_Q14. The problems with the latter model exist only with Octave 4.4.0.

³<http://www.dynare.org>

⁴The DYNARE Wiki install guide for Ubuntu and Debian can be found at <http://www.dynare.org/DynareWiki/InstallOnDebianOrUbuntu>

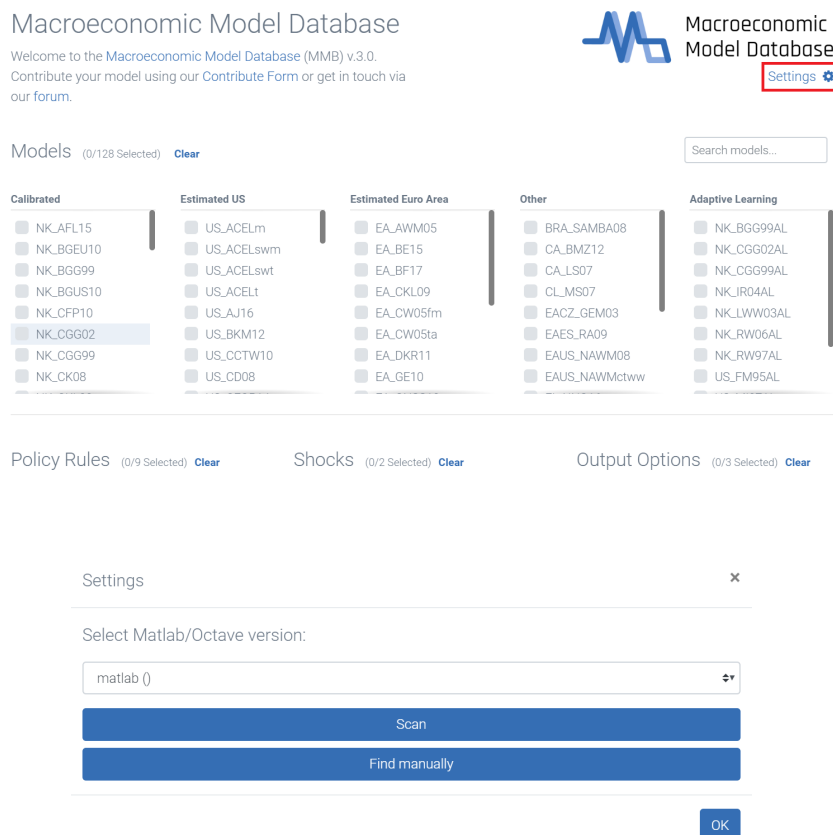
On Windows, DYNARE 4.5.6 is compatible with OCTAVE 4.4.0, whereas DYNARE 4.5.7 is compatible with OCTAVE 4.4.1. Both Dynare versions are compatible with MATLAB R2007b and later. For macOS, the compatibility between DYNARE and MATLAB is the same. However, at the time of this release, the highest OCTAVE-supported version of DYNARE is 4.5.6 (compatible with OCTAVE 4.4.0 on macOS).

Further steps before running comparisons

When using MATLAB, one has to add the DYNARE path to MATLAB. In order to do so, open MATLAB and choose *Set path* from the *File* menu. Use the option *Add folder* and browse to the directory where you have installed DYNARE. The DYNARE subfolder that has to be added is called *MATLAB*.

Before running simulations with the MMB, you need to specify whether you want to run the simulations in MATLAB or OCTAVE. In order to do so, click on settings on the upper-right corner of the MMB as shown in the Figure 'Settings'. It opens a window, in which you have the option either to let the program scan for versions of MATLAB and OCTAVE installed on your computer, or to search manually. If the scan finds more than one version of MATLAB or OCTAVE, you can choose from the list of programs in this subwindow.

Figure 1: SETTINGS



2 The Modelbase: Models, Rules and Options

This section introduces the menu of models, policy rules and options, which can be selected in the MMB 3.0. For the time being, this version of the MMB does not feature the option of model-specific shocks, and does not allow for flexible selection of the states and gain parameters used in the simulations of adaptive learning models. We will reintroduce these features into the MMB in the next release.

Models

For the time being there are some models, which cannot be simulated with Octave. The list of models contains: NK_ET14, NK_FLMF18, NK_GK11, US_AJ16, US_CMR14, US_CMR14noFa, US_FRB08, US_FRB08mx, US_IR15, EA_Q14. The problems with the latter model exist only with Octave 4.4.0. We will address these issues in the next release.

The user can select from the number of models displayed in the frontend, and from the number of policy rules. In contrast to earlier versions, the MMB 3.0 simultaneously allows for the selection of more than one policy rule and more than one model (the earlier versions either only allowed for one model, many rules or one rule, many models).

Figure 2: MODELS AND RULES MENU

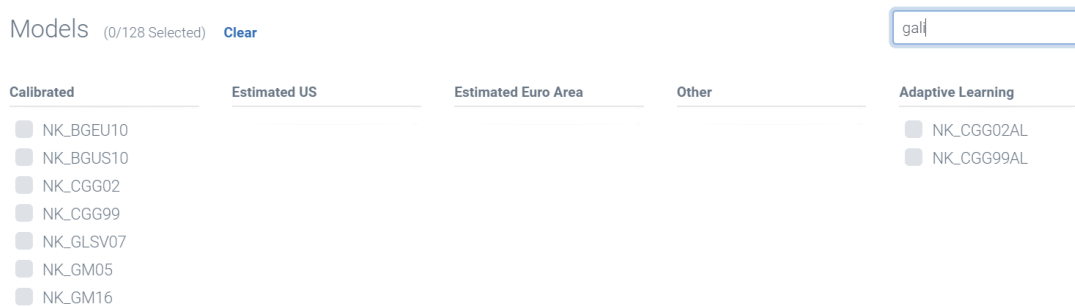
The screenshot shows the 'MODELS AND RULES MENU' interface. At the top, there is a search bar labeled 'Search models...'. Below it, the 'Models' section is titled '(0/128 Selected) Clear'. It is organized into five columns: 'Calibrated', 'Estimated US', 'Estimated Euro Area', 'Other', and 'Adaptive Learning'. Each column contains a list of model names with a selection checkbox. For example, under 'Calibrated', models include NK_AFL15, NK_BGEU10, NK_BGG99, NK_BGUS10, NK_CFP10, NK_CGG02, NK_CGG99, and NK_CK08. Under 'Estimated US', models include US_ACELm, US_ACELswm, US_ACELswt, US_ACELt, US_AJ16, US_BKM12, US_CCTW10, and US_CD08. Under 'Estimated Euro Area', models include EA_AWM05, EA_BE15, EA_BF17, EA_CKL09, EA_CW05fm, EA_CW05ta, EA_DKR11, and EA_GE10. Under 'Other', models include BRA_SAMBA08, CA_BMZ12, CA_LS07, CL_MS07, EACZ_GEM03, EAES_RA09, EAUS_NAWM08, and EAUS_NAWMctww. Under 'Adaptive Learning', models include NK_BGG99AL, NK_CGG02AL, NK_CGG99AL, NK_IR04AL, NK_LWW03AL, NK_RW06AL, NK_RW97AL, and US_FM95AL. Below the models section, there are three more sections: 'Policy Rules (0/9 Selected) Clear' with options like 'User specified rule', 'Model specific rule', and various academic references; 'Shocks (0/2 Selected) Clear' with 'Monetary Policy Shock' and 'Fiscal Policy Shock'; and 'Output Options (0/3 Selected) Clear' with 'Autocorrelation Function', 'Impulse Response Function', and 'Unconditional Variances', plus a 'Horizon: 20' slider. At the bottom center, there is a blue 'Compare' button.

The models are sorted in columns, the first of which contains model that have been calibrated to match a closed economy. The second column lists models that have been estimated on US data.

The third column lists models that have been estimated on Euro area data. The column 'Other' contains models that have been either calibrated or estimated on multi-country data, or have been estimated on other countries, such as 'CA_BMZ12', which has been estimated on Canadian data, or 'EAUS_NAWM08', which has been estimated on Euro area and US data in a two-economy-setting. The column on the right contains models in which agents form their expectations via adaptive learning. **For the time being, until the options for the adaptive learning models are reintroduced into the MMB, all states are selected by default and the gain parameter is fixed to 0.01.**

Hovering with the mouse over the models in the list and over the common policy rules displays some basic information such as the title, author and academic reference of the article, in which the model was used. To search for models in the MMB, one can also use the search line on top of the menu. Here one can search for the name of the author or words that appear in the title of the articles, in which the models were used. For instance, searching for Galí, yields the results shown in Figure 3

Figure 3: MODELS SEARCH: GALÍ



In addition, the user can download a complete list of all models currently used in the MMB on macromodelbase.com/downloads. Lastly, short descriptions of the models and their features are available on the same page. The menu of the MMB contains a direct link to the model descriptions below the 'Compare' button as shown in Figure 4.

Figure 4: MODEL DOCUMENTATION



Monetary policy rules

Currently, we consider nine monetary policy rules that are taken from Taylor (1993), Levin et al. (2003), Smets and Wouters (2007), among others. Next to these common rules that can (in principle) be used for all models, the selection menu also features the options model specific rule and user-

specific rule. The model specific rules are taken from the original articles, in which the models were used. Not all models can be simulated with their model-specific rule, as all interest rate rules that can be used in the modelbase, have to be expressed in terms of the common variables. These common variables are the quarterly output gap, quarterly output, the year-on-year rate of inflation and the policy interest rate in annual terms. As some of the interest rate rules used in the literature feature responses to financial indicators, exchange rates, etc. these rules cannot be included in the modelbase. Therefore only 93 of the 128 models included in the MMB 3.0 feature a model-specific rule.

The user specific rule allows the user to directly determine the feedback coefficients in the interest rate rule. In order to do so, the user has to click on '(edit)' next to the entry 'User specific rule'. Then, the subwindow shown in figure 5 opens. In this example, the coefficients for current and lagged inflation rates, as well as for the current output gap are chosen such as to mimic the pre-programmed Taylor rule.

Figure 5: MODEL DOCUMENTATION

User Specified Rule
✕

	interest	inflation	output gap	output
t		0.375	0.5	0
t-1	0	0.375	0	0
t-2	0	0.375	0	0
t-3	0	0.375	0	0
t-4	0	0	0	0
t+1		0	0	0
t+2		0	0	0
t+3		0	0	0
t+4		0	0	0

Cancel
OK

The user can edit the coefficients of the responses of the policy rates to the leads and lags of the variables in this submenu. However, it is not guaranteed that the Blanchard-Kahn conditions will hold and a determined equilibrium is obtained in the solution of the models with this rule.

In general, when a model (or a rule) is chosen that is not compatible with a policy rule (or a model) in the way that a simulation of this model-rule-combination does not render the rational expectation equilibrium locally unique, the respective policy rule (or model) is faded out in the menu and cannot be selected for the comparison exercise. Unselecting the model (or rule), makes the rule (or model) again accessible for selection.

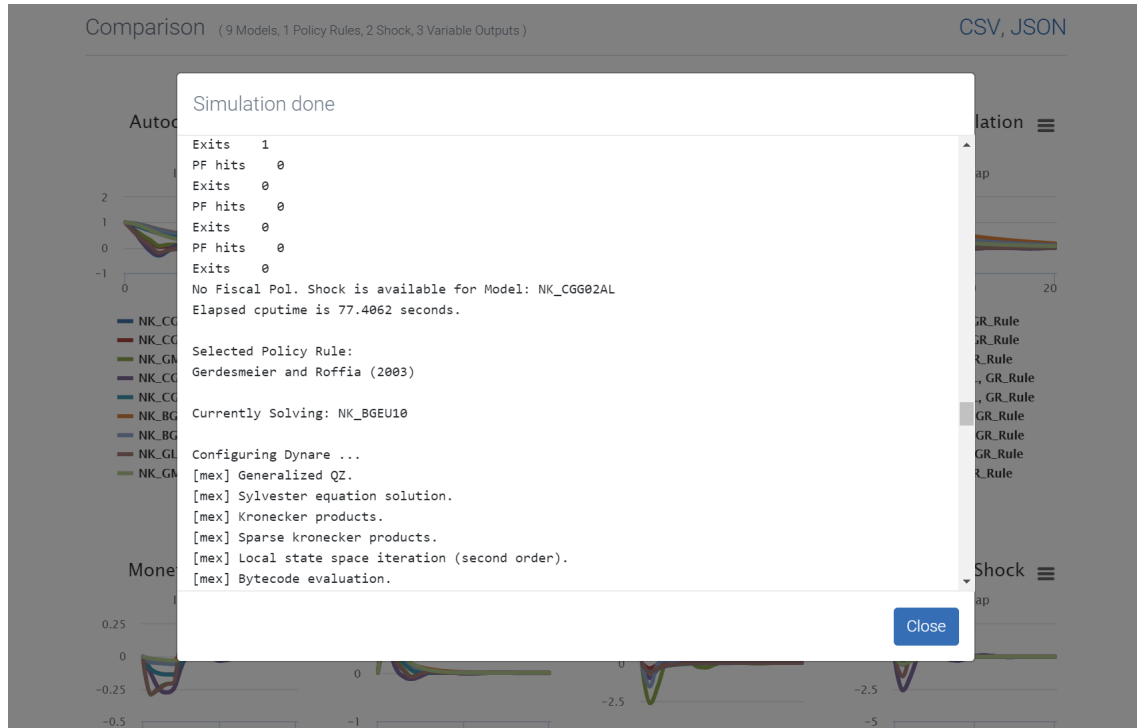
Output options

Having chosen the models and a policy rule, the user can make some non-exclusive choices regarding the exercise outcomes to be displayed. The user can decide whether to see the unconditional variances and plot autocorrelation functions of the common variables, both of which are computed using theoretical moments of the solution for each variable. Also the user can opt for plotting impulse response functions of the common variables and specify the horizon for the analysis that is set to twenty periods as a default. One can choose impulse responses to a unit monetary policy shock (one percent point increase in the monetary policy shock), and/or to a unit fiscal policy shock (one percent increase in GDP share of government expenditures). Note that all models of the Modelbase have a monetary policy shock, but a significant number of them do not have a fiscal policy shock. If this is the case, the impulse responses to a fiscal policy shock will not be available. Lastly, for certain models, the unconditional variances are not defined and the autocorrelation functions do not exist. This is the case for some models which feature unit roots. The presence of unit roots prevents a calculation of unconditional moments of some or all variables. Nonetheless, for these model IRFs can still be generated.

Running a comparison exercise

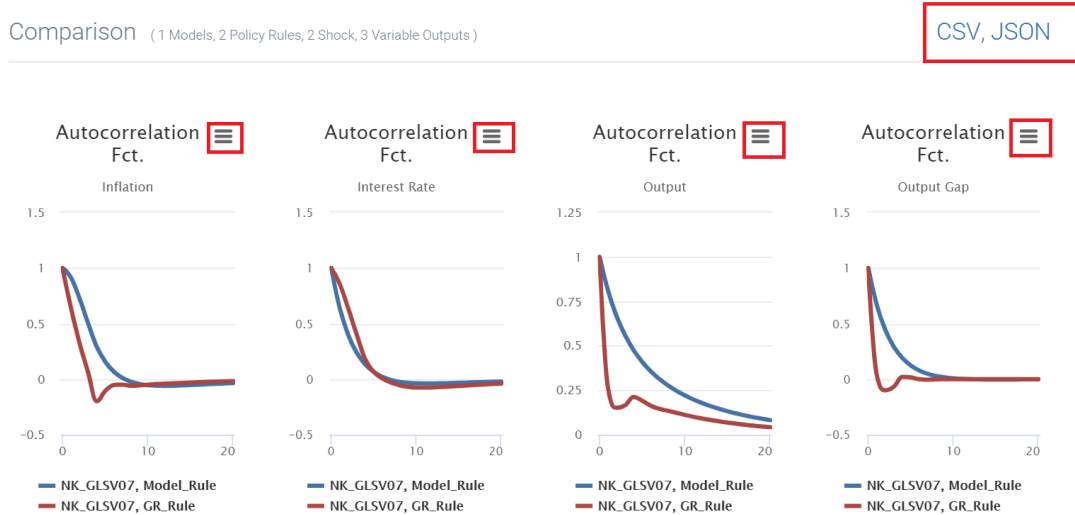
Once you have selected a number of models, rules and output options, you can simply run the comparison exercise by clicking on the button 'Compare'. If you have chosen to run your simulations using OCTAVE, the command window from OCTAVE will be embedded and you see the running output (see, Figure 6). If you are using MATLAB, a second window opens, in which the simulations are displayed as in MATLAB's command window. This second window closes automatically when the simulations are done.

Figure 6: MODEL SIMULATION



As a result, the selected Impulse response functions and autocorrelation functions are plotted, and the variances are displayed in a table at the bottom of the frontend. The results of the comparison exercise can be exported and saved in two ways. Either, one exports all the data, by clicking on CSV or JSON above the figures to receive a batch export in the respective file format, or one can export the figures one by one, by clicking on the menu on the upper right corner of each figure. Both options are marked with red boxes in Figure 7

Figure 7: EXPORT OPTIONS



3 Structure of the Modelbase

This section describes the key folders, in which the models, options, and rules are stored and briefly sketches the structure of the key files, which are used in the execution of the modelbase.

Key Folders

Your installation of the MMB 3.0 contains a subdirectory 'resources/app/dist/electron/static/mmclicli', which contains the .m-files and .mod-files for the models, rules and options being used in the comparison exercises. The subfolder *MODELS* contains a specific folder for every model included in the MMB. The specific folders contain a single Dynare mod-file in which the particular model is specified as well as related MATLAB files, some of which are created by DYNARE. The subfolder *MMB_OPTIONS* contains specific MATLAB files related to the usage of the Modelbase for policy analysis and comparison, as well as explanatory notes for models and policy rules. The folder *AL-TOOLS* contains scripts for the use of models with adaptive learning.

Some Key files

The files discussed in this subsections are stored in the folder *MMB_OPTIONS*.

- **CMB_MMB.m**

This file receives the information on the selection of models rules and options that the user determines in the frontend of the modelbase. It checks, which operation platform is used, whether MATLAB or OCTAVE is employed and which version of Dynare is being used. Then it adds all other folders from the directory 'mmclicli' to the path of MATLAB or OCTAVE. Then it loads relevant settings from *MMB_settings.m* and defines key variables and names as

well as a blank structure for the JSON, which will contain the simulation results as they are passed on to the frontend. The core of the file is a large loop over each selected model (index 'epsilon') and each selected policy rule (index 'i'). In each run of the loop, it sets the coefficients of the policy rule, solves the model in dynare, stores the results in the structure Modelbase.mat and passes the demanded output of the simulation on to the file Modelbase.json. The files Modelbase.mat and Modelbase.json are available in the same folder even after the simulations.

- **MMB_settings.m**

Among others this file contains the list of model names in the vector 'names', it sorts the models into categories calibrated, estimated on US data, etc. and stores for each model the dimension of the shocks in the original model ('variablenum'). Furthermore it contains the vectors with the rulenames and specifies which models have a model-specific rule, and which have not. In the next part, it defines the coefficients of the common policy rules. Lastly, it defines some options for the adaptive learning models.

- **MSR_COEFFS.m**

This file contains the list of coefficients for all model specific rules.

4 Structure of the model files

The model files are written in the syntax of DYNARE and have a common structure. As an example we take the simple New-Keynesian model by Rotemberg and Woodford (1997) to explain the structure of the mod-files, its model specific parts and the common model data base blocks. The current example is based on the DYNARE 4.5.6 version of the Modelbase. The mod-file is shown in **Figure 8** and **Figure 9**. However, the explanations apply to all models. In the following, the two main parts of a mod-file, the preamble and the model block, are described step by step.

Figure 8: STRUCTURE OF THE MODEL FILES: THE PREAMBLE

```

1 // Model: NK_RW97
2
3 var pi y ynat rnat i x u g g_
4 /*******
5 // Modelbase Variables //*
6     interest inflation inflationq outputgap output fispol; //*
7 /*******
8
9 varexo u_
10 /*******
11 // Modelbase Shocks //*
12     interest_ fiscal_; //*
13 /*******
14
15 parameters
16 /*******
17 // Modelbase Parameters //*
18 //*
19     cofintintb1 cofintintb2 ... coffispol //*
20 /*******
21     beta sigma alpha theta omega kappa rhou rhog stdinflation_ stdfiscal_;
22
23 beta = 1/(1+0.035/4); // 0.9913
24 sigma= 6.25;
25 alpha= 0.66;
26 theta= 7.66;
27 omega= 0.47;
28 kappa= (((1-alpha)*(1-alpha*beta))/alpha)*(((1/sigma)+omega)/(1+omega*theta));
29 rhou=0;
30 stdinflation_=0.154;
31 rhog= 0.8;
32 stdfiscal_=1.524;
33
34 /*******
35 // Specification of Modelbase Parameters //*
36 //*
37 // Load Modelbase Monetary Policy Parameters //*
38 thispath = cd; cd('..');
39 load policy_param.mat;
40 for i=1:33
41     deep_parameter_name = M_.param_names(i,:);
42     eval(['M_.params(i) = ' deep_parameter_name ' ;'])
43 end
44 cd(thispath);
45 // Definition of Discretionary Fiscal Policy Parameter //*
46 coffispol = 1; //*
47 /*******

```

Figure 9: STRUCTURE OF THE MODEL FILES: THE MODEL BLOCK

```

49 model(linear);
50
51 //*****
52 // Definition of Modelbase Variables in Terms of Original Model Variables /**
53
54 interest = i*4; //
55 inflation = (1/4)*(4*pi+4*pi(-1)+4*pi(-2)+4*pi(-3)); //
56 inflationq = pi*4; //
57 outputgap = x; //
58 output = y; //
59 fispol = g_; //
60 //*****
61
62 //*****
63 // Policy Rule //
64 // //
65 // Monetary Policy //
66 // //
67 interest = cofintintb1*interest(-1) //
68           + cofintintb2*interest(-2) //
69           ... //
70           + cofintoutpf4*output(+4) //
71           + std_r_ *interest_; //
72 // //
73 // Discretionary Government Spending //
74 // //
75 fispol = coffispol*fiscal_; //
76 //*****
77
78 // Original Model Code:
79
80 pi = beta * pi(+1)+ kappa*x+ u;
81 u=rhou*u(-1)+u_;
82 x = x(+1) - sigma *( i - pi(+1) - rnat) ;
83 rnat = sigma^(-1)*((g-ynat)- (g(+1)-ynat(+1)));
84 ynat = sigma^(-1)*g/(sigma^(-1)+omega);
85 x = y-ynat;
86 g = rhog*g(-1) + g_;
87 // i=hipi*pi + phix*x;
88 end;
89
90 shocks;
91 var fiscal_ = 1.524^2;
92 var u_ = 0.154^2;
93 end;
94
95 //stoch_simul (irf = 0, ar=100, noprint);

```

Part 1: The preamble

- Each model file begins with some information about the model. This should include the title, the authors, the publication etc. In front of this description you will find the symbols `//`, which denote a comment in DYNARE.
- The file then starts with the initialization of the model variables. In our example shown in **Figure 8** the model-specific endogenous variables are listed in line 3 after the keyword `var`: `pi`, `y`, `ynat`, `rnat`, `i`, `x`, `u`, `g` and `g_`. The latter in fact represents an exogenous government spending shock, however it has to be initialized as endogenous variable for reasons that will be explained below. It follows a Modelbase block in lines 4 to 7 in which the common variables are introduced. In general, Modelbase blocks are separated through `//*****` symbols from the rest of the file.
- Following the keyword `varexo` in line 9 the exogenous variables are initialized. In our example this is `u_`, a cost push shock as well as the common interest rate shock, `interest_` and the common fiscal policy shock, `fiscal_` in line 12. Note that in some models with no treatment of government spending, the latter Modelbase shock may be left out.
- Following the keyword `parameters` in line 15, the Modelbase parameters in the Modelbase block are initialized. In **Figure 8** line 19 we have, for brevity reasons, only included three policy parameters. In the actual mod-files there are many more leads and lags. These are the parameters of the general monetary policy function, except for the last one, `coffispol`, which enters the common discretionary government spending equation.
- Then the model-specific parameters are initialized in line 21.
- Afterwards numerical values are assigned to the model-specific parameters in lines 23 to 32.
- Finally a block called *Specification of Modelbase Parameters* is added. First in lines 37 to 44 the numeric values of the parameters of the selected monetary policy rule are loaded. They are contained in the file `policy_param.mat` in the subfolder `MODELS`. For models in which the original shocks are expressed in percent/100 the parameter `std_r_` has to be reset to 100 after the parameter-loading command. In our example this would have to be done in line 43. However, the shocks in this model are already expressed in percentage terms. Secondly, the discretionary fiscal policy parameter `coffispol` is defined as a function of the model-specific parameters in order to obtain a government spending shock of one percent of GDP. The exact implementation of the common fiscal policy shock will be described below. In our example no adjustment is needed and hence `coffispol` is set equal to one.

Part 2: The model block

- The model block starts in line 49 of **Figure 9** as indicated by the keyword `model` followed by `linear`, which tells DYNARE that the equations are already linearized and thus reduces computing time.
- In the Modelbase block going from lines 51 to 60 the common variables are defined in terms of the original model variables. The variable `interest` denotes the annualized short-term interest rate, `inflation` is annual inflation, `inflationq` represents annualized quarterly inflation, `outputgap`

and *output* denote the output gap and output, respectively. The common variable *fispol* represents discretionary fiscal policy. It is set equal to the model-specific government spending shock variable, which in the case of our example is *g_*. Note again, that this model-specific shock has to be initialized as an endogenous variable. This allows us to keep the original model equation for government spending unchanged.

- It follows the common *Policy Rule* block. In lines 65 to 71 the common monetary policy rule is specified. Again for reasons of brevity we have not displayed the complete general policy rule in **Figure 9**. Below in line 73, the common equation for discretionary government spending is specified.
- The original model equations are then specified in lines 78 to 87. Note that the model-specific monetary policy rule is commented out because the common policy rule is introduced. On the contrary, the government spending equation in line 86 has remained unchanged. The model section ends in line 88 with the required keyword *end*.
- Finally the variance covariance matrix is specified in lines 91 and 92 between the keywords *shocks* and *end*. Importantly, the variance of the original model-specific government spending shock has been assigned to the common fiscal policy shock variable *fiscal_*. Hence, the common shock *fiscal_* affects the fiscal policy variable *fispol* through the common discretionary government spending expression in line 75 which is set equal to the model-specific government spending shock *g_* in line 59.
- The *stoch_simul* command in line 96 is commented out. Alternatively one can also delete this command.

References

Rotemberg, J.J., Woodford, M., 1997. An optimization-based econometric framework for the evaluation of monetary policy. NBER Macroeconomics Annual 12, 297–346.