

Macroeconometrics of the Global Economy (MaGE)

Version 2.3 (revision 115)

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Contents

1	Licensing	1
2	Model description	2
2.1	Overview of the model	2
2.2	What's new in 2.3	2
3	Model's How To	3
3.1	Run the baseline scenario	3
3.2	Run custom scenarios	3
4	Parametrization	4
5	Results	4
5.1	Full results	4
5.2	Selected Results	7
5.3	Output for MIRAGE	7

1 Licensing

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http://creativecommons.org/licenses/by-nc/3.0/deed.en_US.

The reference documents to be cited are:

Fouré, J., Bénassy-Quéré, A. and L. Fontagné (2012), 'The Great Shift: MaGE Projections for the World Economy at the 2050 Horizon', CEPII Working Paper 2012-03.

and

Fouré, J., Bénassy-Quéré, A. and L. Fontagné (2013), 'Modelling the world economy at the 2050 horizon', *Economics of Transition* 21(4), 617-654.

Please also note that you will need a valid license for Stata 12 or greater to run the model.

2 Model description

2.1 Overview of the model

MaGE is a macroeconomic model of the world economy made for projecting the global shifts of current century. It is based on a three-factor production function of labour, capital and energy, plus two forms of technological progress, we propose a long-run growth scenario for 167 countries and a time horizon of 2050 relying on the model MaGE (Macroeconometrics of the Global Economy). Our model is fitted with United Nations and International Labour Office labour projections, and econometric estimations of (i) capital accumulation, (ii) savings rate, (iii) relationship between savings and investment rate, (iv) education, (v) female participation, and (vi) technological progress (which includes energy and total factor productivity). Our study provides five novelties. First, we account for energy constraints by including its consumption in the production function and by taking account of rents accruing to oil exporting countries. Second, we estimate a non-unitary relationship between savings and investment, departing from assumptions of either a closed economy or full capital mobility. Third, we model female participation rates consistently with education catch-up. Finally, we disentangle real gross domestic product (GDP) growth rates from relative price effects through a consistent Balassa-Samuelsson effect.

2.2 What's new in 2.3

The main new features of this version are the following:

- **Major data update** concerning all data excepted participation to the labor force¹.
- **New countries in the sample**, including now 167 countries. New countries are: Afghanistan, Bosnia and Herzegovina, Comoros, Cyprus, Ecuador, Equatorial Guinea, Croatia, Jamaica, Liberia, Libya, Macao, Macedonia, Namibia, Puerto Rico, El Salvador, Slovenia, Turkmenistan, Tonga, Uzbekistan, Congo Dem. Rep., Zimbabwe. Due to removal of data or missing update, we were constrained to remove support for two countries (Syria, Chad).
- **New modelling of energy productivity**: The new dataset on energy consumption has been widely changed, and our specification was not robust to the change. We designed a new methodology encompassing the same ideas of technological catch-up and level of development but which is valid for both the old and new data.
- **Energy price**: Energy price projections are by default from the World Energy Outlook issued by the International Energy Agency.

Along with these important modification, several bugs have been corrected:

- Computation of relative GDP in savings rate equation: IMF forecasts were used from 2013 to 2018 instead of actual MaGE projections.

¹Though the ILO provided newer estimates for labor force participation, we chose not to use them because, to our knowledge, the data is no more harmonized between countries, with sometimes bad quality indicator

- Inclusion of the impact of migration scenarios on skill level.
- Corrected computation of "reference period averages": normalization was using a wrong number of years in case of missing data
- New rules for energy data completion when missing: WDI is now the main source, EIA is used to fill the gaps and to add data for fully missing countries.
- Introduction of more precise energy unit conversion factors.
- Reference period averages: we introduced flexibility to deal with outlying data points at the edges of our 1995-2008 reference period.

3 Model's How To

3.1 Run the baseline scenario

Once the source code is extracted in a local folder, you only have to modify the file `0.master-file.do` located in the root folder. You have to set the `$BL_directory` variable to the value of the complete absolute path to the root directory of the model.

You can also check that the the scenario selected (its name is contained in the `$BL_scenario` variable) is the one you want to run (typically, it should be `reference_2050` or `reference_2100`).

3.2 Run custom scenarios

If you want to run custom scenarios, you are invited to create a scenario file (let's say `my_scenario.do`) and locate it in the `Scenarios` folder. Our advice is that you base your own scenario on one of our reference scenario, by first loading the reference scenario, and then modify the parameters you want. Details of parametrization are given in Section 4, especially in Table 3. Here is an example of how you could implement a simple scenario with different assumptions on population.

```
** load reference values for parameters
do "Scenarios\reference_2050.do"

** custom parameters
global un_scenario = "low"
```

Once your scenario is defined, you are able to launch it by modifying the `0.master-file.do` file in the following way. The scenario name has to be the same name as your previously created do-file.

```
** define scenario name
global BL_scenario = "my_scenario"

** run the scenario
do "Do\0.scenario.do"
```

TABLE 1: RUN PARAMETERS

Parameter name	Description	Comment
<code>\$BL_directory</code>	Model's location	Absolute path
<code>\$BL_scenario</code>	Scenario name	The scenario <code>.do</code> is needed
<code>\$force_db</code>	Force database creation	Use to force all steps for first scenario

4 Parametrization

There are some parameter that have to be set before running a scenario. These are displayed in Table 1.

The following parameters in Table 2 may **not be modified** without changing the source code of the model.

Finally, parameters listed in Table 3 are used to define scenario variants.

TABLE 2: MODEL GROUND PARAMETRIZATION (DO NOT MODIFY)

Parameter name	Description	Comment
<code>\$BL_version</code>	model version	
<code>\$energy</code>	Energy data source	To be deprecated
<code>\$sigma</code>	KL-E elasticity of substitution	
<code>\$rho</code>	Computed from sigma	
<code>\$alpha</code>	KL share	
<code>\$deprec</code>	Depreciation rate	
<code>\$fe_adapt</code>	Toggle Fixed-effect modification	0 or 1
<code>\$fe_remove</code>	Toggle non-significant fixed effects removal	0 or 1
<code>\$educ_mode</code>	Way of measuring education	To be deprecated
<code>\$moy_start</code>	Starting of reference period	
<code>\$moy_end</code>	End of reference period	
<code>\$sav_mode</code>	Savings rate computation mode	To be deprecated "fe" for fixed effect / "moy" for ref period
<code>\$tfp_mode</code>	TFP computation mode	To be deprecated "fe" for fixed effect / "moy" for ref period
<code>\$tfp_lead</code>	Way of computing TFP leaders	max, mean4 or mean5

5 Results

Results of MaGE are produced in excel `.xls` format or Stata `.dta` format. Several options are available to look at the results.

5.1 Full results

Full results are available in `.dta` format, and are located in the `%MODEL_FOLDER%\Results\DTA` folder. The file corresponding to scenario `scen` is called `mage-2.1-scen-FULL.dta`. Variables of interest are displayed in Table 4.

The first parameters are identifying observations. Several country encodings are available.

The following parameters are the output of econometric estimations. These are the parameter used for projection. Finally, the variables of interest are displayed. Table 5 presents main variables of interest.

TABLE 3: SCENARIO PARAMETRIZATION

Parameter name	Description	Comment
<code>\$sigma_2012</code>	KL-E elasticity for projections	
<code>\$cobbdouglas</code>	Toggle for CES/Cobb-Douglass	
<code>\$end_year</code>	Target projection year	From 2013 to 2100
<code>\$e_price</code>	Energy price scenario	"high", "med" or "low"
<code>\$institutions</code>	Ref period convergence	"cv2100" or nothing
<code>\$un_scenario</code>	UN population variants	"med", "high" or "low"
<code>\$migr_educ</code>	Toggle for the impact of migration on skills	0 or 1
<code>\$migration_eu</code>	Additional migration in thousands	
<code>\$migration_ssa</code>	Additional migration in number of people	
<code>\$migration_med</code>	Additional migration in number of people	
<code>\$migration_sam</code>	Additional migration in number of people	
<code>\$migration_usa</code>	Additional migration in number of people	
<code>\$activity_rate_mode</code>	DEPRECATED	
<code>\$female_participation</code>	Toggle for female participation	0 or 1
<code>\$closed_economy</code>	S-I relation modification	0 for FH / 1 for I=S / 2 for all OCDE value / 3 Deprecated / 4 for convergence towards I=S
<code>\$tfp_slowing</code>	TFP exogenous slowing	≤ 1 for slowing / ≥ 1 for acceleration
<code>\$educ_cv</code>	Convergence modification for education	Half-life time modification in percent (e.g. = 0.5 for half Half-Life time, and then faster growth)
<code>\$energ_exo</code>	Exogenous E productivity modifier	In percentage. Only influences the consequence of B on Y, and not B itself
<code>\$pi_growth</code>	Exogenous price of investment growth rate	In percentages (1 corresponds to a constant price), or -100 for the Penn World Tables (v6.3) average growth
<code>\$p_oil_source</code>	Data source for energy price projections	"weo" for World Energy Outlook by IEA, or "eia" for International Energy Outlook by EIA

TABLE 4: IDENTIFYING OBSERVATIONS

Variable name	Description
code_wb	World Bank country code
name	World Bank country name
code_bit	International Labor Organization country code
code_un	United Nations country code
zone	INGENUE zone classification
year	Year of the observation
code_mirage	GTAP country code
code_gtap	GTAP zone classification
ocde_dummy	0-1 dummy for OECD membership
income_class	United Nations income classification (L ow, M edium or H igh)
ue_dummy	0-1 dummy for European Union membership
code_z	Custom regional classification
US_dummy	0-1 dummy for the USA
CCCP_dummy	0-1 dummy for former USSR membership

TABLE 5: SELECTED VARIABLES FROM FULL RESULTS

Variable name	Description	Unit
age1-age15	Population by age group	number of people
f_actpop	Female active population	thousands of people
p_oil	Oil price	constant 2005 USD
H_pred	Tertiary education	Share of working age population
Hs_pred	Secondary education	Share of working age population
Acorr_pred	Oil-corrected TFP	
Bcorr_pred	Oil-corrected Energy productivity	constant 2005 USD per barrel
A_pred	Non-corrected TFP	
B_pred	Non-corrected energy productivity	constant 2005 USD per barrel
K_pred	Capital stocks	constant 2005 USD
Ycorr_pred	Non-oil GDP	constant 2005 USD
Y_pred	Total GDP	constant 2005 USD
E_pred	Energy consumption	barrels
Srate_pred	Savings rate	% of GDP
Irate_pred	Investment rate (GFCF)	% of GDP
Y_USD_cst05_p05	Total GDP	constant 2005 USD
Y_PPA_cst05_p05	Total GDP	constant 2005 PPP
Y_USD_crt	Total GDP	Including real appreciation
Ycap_PPA_05	GDP per capita	2005 PPP
RER_pred	Real exchange rate	

5.2 Selected Results

Selected variables are displayed in other files. These are located in the %MODEL_FOLDER%\Results\DTA folder. The files are called `mirage-2.1-scen.dta`. These variables are the one to be used in MIRAGE.

TABLE 6: VARIABLES FROM SELECTED RESULTS

Variable name	Description	Unit
Oil_price	World average oil price	2005 constant USD
TotPop	Total population	Number of people
ActPop	Active population	Number of people
H_pred	Tertiary education	Share of working-age population
Hs_pred	Secondary education	Share of working-age population
GDP	Gross Domestic Product	Constant 2005 USD
SAV	Savings rate	Percentage of GDP
INV	Investment rate (fixed capital formation)	Percentage of GDP
GDP_growth	GDP growth	Annual percentage change
Energy_ef	Energy productivity	Constant 2005 USD per barrel
TFP	Total Factor Productivity	
CC	Current Account balance	Constant 2005 USD
SkilledPop	Skilled active population (tertiary)	Number of people
Unskilled_ActPop	Unskilled active population (less than tertiary)	Number of people

5.3 Output for MIRAGE

The selected variables are also directly available to use with MIRAGE. There are a few more steps in order to use the gms file creator. You have to call the file %MODEL_FOLDER%\Do\3.projections\5.export_all.do at the end of your 0.master-file.do, after having set at least a base scenario \$base_scen and optionally other scenarios \$additional_scen separated by empty space (if no additional scenarios, only set the variable to ""). Example:

```
global base_scen = "reference_2100"
global additional_scen = "scenario1 scenario2"

do "Do\3.projections\5.export_all.do"
```

This will generate .gms files in the %MODEL_FOLDER%\Results\XLS\MIRAGE folder. These files can then directly overwrite their antecedents in MIRAGE folder.