```
//var list

% Total number of variables in the model below:
% Endogenous variables (52 variables)
var B % total deposits
B_P % private deposits/bank deposits
B_G % public bonds issued to finance credit policy
C % consumption
C_G % public consumption
E % energy aggregate
E_F % fossil energy
E_L % low-carbon energy
I_F % investment fossil sector
I_L % investment low-carbon sector
I_Y % investment production sector
K_F % total capital fossil sector
K_L % capital low-carbon sector
K_Y % capital production sector
lambda % Lagrange multiplier
LAMBDA % households' stochastic discount factor
MC % marginal costs production sector
N % labor
NU % marginal value of net worth
NW % net worth
NW_E % net worth existing bankers
NW_NEW % net worth new bankers
P_E % real aggregate energy price
P_EF % real fossil energy price
P_EL % real low-carbon energy price
PHI % leverage ratio
PI % inflation
Q_F % price of capital fossil sector
Q_L % price of capital low-carbon sector
Q_Y % price of capital production sector
R % real interest rate
R_F % stochastic return on fossil sector's assets
R_L % stochastic returns on low-carbon sector's assets
R_Y % stochastic return on production sector's assets
RN % nominal interest rate N.B. in the tex file RN=(1+i)
S_F % total intermediated assets fossil sector
S_L % total intermediated assets low-carbon sector
S_Y % total intermediated assets production sector
S_FP % privately intermediated assets fossil sector
S_LP % privately intermediated low-carbon sector
```

```
S_YP % privately intermediated assets production sector
S_FG % assets fossil sector intermediated via government assistance
S_LG % assets low-carbon sector intermediated via government assistance
S_YG % assets production sector intermediated via government assistance
T % lump-sum taxes
U % utility
V % loss supported by bankers/value function
VA_Y % value added production sector
VA_F % value added fossil sector
W % real wage
X % polluting input
Y; % production


%price of X (1 variable)
var P_X; % carbon price - exogenously set + policy shock

%credit policy variables (3 variables)
var CREDIT_L % credit policy low-carbon sector
CREDIT_F % credit policy fossil sector
CREDIT_Y; % credit policy production sector

%tax rates (1 variable)
var
TAU_X; % carbon tax

%exogenous process and additional variables (11 variables)

var A_F % technology fossil sector
A_L % technology low-carbon sector
A_Y % technology
LEV % leverage ratio (non-risk adjusted)
SPREAD_Y % spread= return on Y - safe rate
SPREAD_F % spread= return on F - safe rate
SPREAD_L % spread= return on L - safe rate
G % total public expenditure
XI_F % quality of capital fossil sector
XI_L % quality of capital low-carbon sector
XI_Y; % quality of capital production sector



% shock processes (13 variables)
var A_F_SHOCK % tech process fossil sector
```

```
A_L_SHOCK % tech process low-carbon sector
A_Y_SHOCK % tech process production sector
XI_F_SHOCK % capital quality process fossil sector
XI_L_SHOCK % capital quality process low-carbon sector
XI_Y_SHOCK % capital quality process production sector
X_SHOCK % reduction emission
TAU_X_SHOCK; % carbon tax policy shock


varexo eps_A_F % tech shock fossil sector
eps_A_L % tech shock low-carbon sector
eps_A_Y % tech shock production sector
eps_XI_F % capital quality shock fossil sector
eps_XI_L % capital quality shock low-carbon sector
eps_XI_Y % capital quality shock production sector
eps_X; % emission reduction
%eps_TAU_X; % carbon tax policy shock

//baseline parametrization
//Authors: F. Diluiso B. Annicchiarico
//May 2021

% Calibrated parameters
% preferences
parameters BET HABIT RISK VARPHI SIGMA;
% adjustment costs
parameters GAMMA_F GAMMA_L GAMMA_Y GAMMA_P;
% depreciation rates
parameters DELTA_F DELTA_L DELTA_Y;
% technology
parameters EPSILON_E EPSILON_Y VAROMEGA_VAY VAROMEGA_E VAROMEGA_EF VAROMEGA_EL
ALPHA_Y EPSILON_F VAROMEGA_VAF VAROMEGA_X;
% policy paramteres - Taylor rule and price indexation and cost of intermediation
parameters KAPPA_RN KAPPA_Y KAPPA_PI KAPPA_P TAU_CP;
% banking sector
parameters OMEGA THETA RHO;
% Implied parameters
parameters CHI PSI_F PSI_L;

% Shock parameters
% autocor
parameters RHO_AF RHO_AL RHO_AY RHO_XIF RHO_XIL RHO_XIY RHO_X RHO_TAUX;
% sigmas
parameters
```

```
SIGMA_AF SIGMA_AL SIGMA_AY SIGMA_XIF SIGMA_XIL SIGMA_XIY SIGMA_X SIGMA_TAUX;


%Steady state values of all the variables
parameters
B_SS % total deposits
B_P_SS % private deposits/bank deposits
B_G_SS % public bonds issued to finance credit policy
C_SS % consumption
C_G_SS % public consumption
E_SS % energy aggregate
E_F_SS % fossil energy
E_L_SS % low-carbon energy
I_F_SS % investment fossil sector
I_L_SS % investment low-carbon sector
I_Y_SS % investment production sector
lambda_SS % Lagrange multiplier
LAMBDA_SS % households' stochastic discount factor
MC_SS % marginal costs production sector
N_SS % labor
NU_SS % marginal value of net worth
NW_SS % net worth
NW_E_SS % net worth existing bankers
NW_NEW_SS % net worth new bankers
K_F_SS % total capital fossil sector
K_L_SS % capital low-carbon sector
K_Y_SS % capital production sector
P_E_SS % real aggregate energy price
P_EF_SS % real fossil energy price
P_EL_SS % real low-carbon energy price
PHI_SS % leverage ratio
PI_SS % inflation
Q_F_SS % price of capital fossil sector
Q_L_SS % price of capital low-carbon sector
Q_Y_SS % price of capital production sector
R_SS % real interest rate
R_F_SS % stochastic return on fossil sector's assets
R_L_SS % stochastic returns on low-carbon sector's assets
R_Y_SS % stochastic return on production sector's assets
RN_SS % nominal interest rate N.B. in the tex file RN=(1+i)
S_F_SS % total intermediated assets fossil sector
S_L_SS % total intermediated assets low-carbon sector
S_Y_SS % total intermediated assets production sector
S_FP_SS % privately intermediated assets fossil sector
```

```
S_LP_SS % privately intermediated low-carbon sector
S_YP_SS % privately intermediated assets production sector
S_FG_SS % assets fossil sector intermediated via government assistance
S_LG_SS % assets low-carbon sector intermediated via government assistance
S_YG_SS % assets production sector intermediated via government assistance
T_SS % lump-sum taxes
U_SS % utility
V_SS % loss supported by bankers/value function
VA_Y_SS % value added production sector
VA_F_SS % value added fossil sector
W_SS % real wage production sector
X_SS % polluting input
Y_SS; % production
%price of X
parameters P_X_SS; % carbon price

% Credit policy variables
parameters CREDIT_L_SS % credit policy low-carbon sector
CREDIT_F_SS % credit policy fossil sector
CREDIT_Y_SS; % credit policy production sector

%tax rates
parameters
TAU_X_SS; % carbon tax

%exogenous process and additional variables
parameters A_F_SS % technology fossil sector
A_L_SS % technology low-carbon sector
A_Y_SS % technology
LEV_SS %leverage ration (non-risk adjusted)
SPREAD_Y_SS % spread= return on Y - safe rate
SPREAD_F_SS % spread= return on F - safe rate
SPREAD_L_SS % spread= return on L - safe rate
G_SS % total public expenditure
XI_F_SS % quality of capital fossil sector
XI_L_SS % quality of capital low-carbon sector
XI_Y_SS; % quality of capital production sector

%total public credit
S_FG_SS=0; % assets fossil sector intermediated via government assistance
S_LG_SS=0; % assets low-carbon sector intermediated via government assistance
S_YG_SS=0; % assets final good sector intermediated via government assistance
B_G_SS=S_FG_SS+S_LG_SS+S_YG_SS; % public bonds issued to finance credit policy
%credit policy coefficients
```

```
CREDIT_L_SS=0;
CREDIT_F_SS=0;
CREDIT_Y_SS=0;
% tax rates
TAU_X_SS=0; %carbon tax

% target inflation
PI_SS=(1+1.9/100)^0.25;

% variables that collapse to one in steady state
% The Qs
Q_F_SS=1; % price of capital fossil sector
Q_L_SS=1; % price of capital low-carbon sector
Q_Y_SS=1; % price of capital production sector
%quality of capital
XI_F_SS=1; % capital quality process fossil sector
XI_L_SS=1; % capital quality process low-carbon sector
XI_Y_SS=1; % capital quality process production sector
% stochastic discount
LAMBDA_SS=1; % households' stochastic discount factor

% policy parameters
TAU_CP=0.00001; %credit policy cost
% Monetary parameters and idexation to past inflation
KAPPA_RN=0.6571; % smoothing parameter of the Taylor rule
KAPPA_P=0.6018; % price backward indexation
KAPPA_Y=0.0684; % output gap coefficient of the Taylor rule
KAPPA_PI=2.9985 ; % inflation coefficient of the Taylor rule

%real interest rate
R_SS=1.00466815332819;

% Preferences parameters
SIGMA=6; % elasticity of substitution between final goods varieties
HABIT=0.6326; % habit parameter 0.62
RISK=1.5365; % risk aversion coefficient
VARPHI=0.7223; % inverse of the Frisch elasticity of labor supply production
sector

%Some implied variables
BET=1/R_SS; % discount rate
RN_SS=PI_SS/BET; % nominal interest factor
MC_SS=(SIGMA-1)/SIGMA; % marginal costs production sector
```

```
%depreciation rate see Baldwin et al. 2020 - JEEM
DELTA_Y=0.025;
DELTA_F=DELTA_Y/2;
DELTA_L=4*DELTA_Y/5;

%Adjustment cost parameters 10.78
GAMMA_F=13.3921;
GAMMA_L=14.5498;
GAMMA_Y=9.4913;
GAMMA_P=54.5121;

%Normalizations and consumption
Y_SS=1; %production
N_SS=0.1843;% labor production sector
C_SS=0.560183207168559;

% Spreads and risky rates
R_Y_SS=1.007858206077421;
SPREAD_Y_SS=R_Y_SS-R_SS;
%Spreads US data
% Spreads and risky rates: keep the same relative size
%SPREAD_Y_SS=0.006641842;
%R_Y_SS=R_SS+SPREAD_Y_SS;
%SPREAD_F_SS=0.007185803;
%R_F_SS=R_SS+SPREAD_F_SS;
%SPREAD_L_SS=0.008239136;%0.0002;
%R_L_SS=R_SS+SPREAD_L_SS;
SPREAD_F_SS=0.007185803*SPREAD_Y_SS/0.006641842;
SPREAD_L_SS=0.008239136*SPREAD_Y_SS/0.006641842;
R_F_SS=R_SS+SPREAD_F_SS;
R_L_SS=R_SS+SPREAD_L_SS;
%financial sector I block: PSIs
PSI_L=SPREAD_L_SS/SPREAD_Y_SS; % additional abscording rate of low-carbon
sector assets
PSI_F=PSI_L*SPREAD_F_SS/SPREAD_L_SS; % additional abscording rate of fossil
sector assets

%production sector Y
EPSILON_Y=0.5; % elasticity of substitution between value added in the
production sector and energy
ALPHA_Y=0.36; % capital share production sector
VAROMEGA_E=0.1;%
VAROMEGA_VAY=1-VAROMEGA_E; % factor share of value added in the production
sector
```

```
EPSILON_Y_FAC=(EPSILON_Y-1)/EPSILON_Y;
INV_EPSILON_Y_FAC=EPSILON_Y/(EPSILON_Y-1);
INV_EPSILON_Y=1/EPSILON_Y;
E_SS=0.165;%0.0527; % energy aggregate
VA_Y_SS=((Y_SS^(EPSILON_Y_FAC)-(VAROMEGA_E^(INV_EPSILON_Y))*E_SS^(EPSILON_Y
_FAC))/(VAROMEGA_VAY^(INV_EPSILON_Y)))^(INV_EPSILON_Y_FAC); % value added
production sector
K_Y_SS=(MC_SS*(Y_SS^(INV_EPSILON_Y))*(VAROMEGA_VAY^(INV_EPSILON_Y))*(VA_Y_S
S^(EPSILON_Y_FAC))*(ALPHA_Y))/(XI_Y_SS*(R_Y_SS*Q_Y_SS/XI_Y_SS-Q_Y_SS+DELTA_
Y));
A_Y_SS=VA_Y_SS/(((XI_Y_SS*K_Y_SS)^ALPHA_Y)*(N_SS^(1-ALPHA_Y)));
W_SS=MC_SS*(Y_SS^(1/EPSILON_Y))*(VAROMEGA_VAY^(1/EPSILON_Y))*(VA_Y_SS^(EPSI
LON_Y_FAC))*(1-ALPHA_Y)/N_SS; % real wage production sector
%energy sector
P_E_SS=((MC_SS^EPSILON_Y)*VAROMEGA_E*Y_SS/E_SS)^(INV_EPSILON_Y); % real
aggregate energy price

%energy sector
EPSILON_E=5;%0.5; % elasticity of substitution between low-carbon and fossil
energy
VAROMEGA_EL=0.2; % factor share of low-carbon energy in the production sector
VAROMEGA_EF=1-VAROMEGA_EL; % factor share of fossil energy in the production
sector
P_EF_SS=P_E_SS; % real fossil energy price
P_EL_SS=P_E_SS; % real low-carbon energy price
E_F_SS=VAROMEGA_EF*(P_EF_SS/P_E_SS)^(-EPSILON_E)*E_SS; % fossil energy
E_L_SS=VAROMEGA_EL*(P_EL_SS/P_E_SS)^(-EPSILON_E)*E_SS; % low-carbon energy
%low carbon energy
K_L_SS=P_EL_SS*E_L_SS/(XI_L_SS*(R_L_SS*Q_L_SS/XI_L_SS-Q_L_SS+DELTA_L));
A_L_SS=E_L_SS/(XI_L_SS*K_L_SS); % technology low-carbon sector

%fossil energy
X_SS=0.033; %this is calibrated so as to generate a vlue for I_F_SS so that I_SS
is about 0.2 and to match Px*X
EPSILON_F=0.3; % elasticity of substitution between value added in the fossil
sector and fossil resource
VAROMEGA_VAF=0.7; % factor share of value added in the fossil energy sector
VAROMEGA_X=1-VAROMEGA_VAF; % factor share of natural resource in the fossil
energy sector
EPSILON_F_FAC=(EPSILON_F-1)/EPSILON_F;
INV_EPSILON_F_FAC=EPSILON_F/(EPSILON_F-1);
INV_EPSILON_F=1/EPSILON_F;
VA_F_SS=((E_F_SS^(EPSILON_F_FAC)-(VAROMEGA_X^(INV_EPSILON_F))*X_SS^(EPSILON
_F_FAC))/(VAROMEGA_VAF^(INV_EPSILON_F)))^(INV_EPSILON_F_FAC);
```

```
K_F_SS=(P_EF_SS*(E_F_SS^INV_EPSILON_F)*(VAROMEGA_VAF^INV_EPSILON_F)*(VA_F_S
S^EPSILON_F_FAC))/(XI_F_SS*(R_F_SS*Q_F_SS/XI_F_SS-Q_F_SS+DELTA_F)); %
stochastic return on fossil sector's assets
A_F_SS=VA_F_SS/(XI_F_SS*K_F_SS);
P_X_SS=P_EF_SS*(E_F_SS^INV_EPSILON_F)*(VAROMEGA_X^INV_EPSILON_F)*(X_SS^(-IN
V_EPSILON_F));

%investments
I_F_SS=K_F_SS*DELTA_F;
I_L_SS=K_L_SS*DELTA_L;
I_Y_SS=K_Y_SS*DELTA_Y;

%public spending
G_SS=Y_SS-C_SS-I_F_SS-I_L_SS-I_Y_SS;
C_G_SS=G_SS-TAU_CP*(S_FG_SS+S_LG_SS+S_YG_SS); % total public expenditure



%FINANCIAL SECTOR
THETA=0.95535; %0.899430; %0.89950.8995 (0.09) %0.9055 (0.1);%8206; % survival
rate of the bankers set so that NW_NEW_SS>0 (given the positive spreads this
wouldn't be the case for very high theta)
%total assets
S_F_SS=K_F_SS; % total intermediated assets fossil sector
S_L_SS=K_L_SS; % total intermediated assets low-carbon sector
S_Y_SS=K_Y_SS; % total intermediated assets production sector
%total private credit
S_FP_SS=S_F_SS-S_FG_SS; % privately intermediated assets fossil sector
S_LP_SS=S_L_SS-S_LG_SS; % privately intermediated low-carbon sector
S_YP_SS=S_Y_SS-S_YG_SS; % privately intermediated assets production sector
% banks' net worth
NW_SS=0.09*(S_YP_SS+PSI_L*S_LP_SS+PSI_F*S_FP_SS); %0.09
B_P_SS=S_FP_SS+S_LP_SS+S_YP_SS- NW_SS; % private deposits/bank deposits
PHI_SS=(S_YP_SS+PSI_L*S_LP_SS+PSI_F*S_FP_SS)/NW_SS; % risk-adjusted leverage
ratio
NW_E_SS=THETA*(SPREAD_Y_SS*S_YP_SS/NW_SS+SPREAD_L_SS*S_LP_SS/NW_SS+SPREAD_F
_SS*S_FP_SS/NW_SS+R_SS)*NW_SS; % net worth existing bankers
NW_NEW_SS=NW_SS-NW_E_SS; % net worth new bankers
OMEGA=NW_NEW_SS/(S_FP_SS+S_LP_SS+S_YP_SS);
NU_SS=(PHI_SS*BET*(1-THETA)*SPREAD_Y_SS+BET*(1-THETA)*R_SS)/(1-BET*THETA*R_
SS-PHI_SS*BET*THETA*SPREAD_Y_SS); % marginal value of an increase in assets
RHO=NU_SS/PHI_SS;
V_SS=RHO*(S_YP_SS+PSI_L*S_LP_SS+PSI_F*S_FP_SS); %or V_SS=NU_SS*NW_SS; % loss
supported by bankers/value function
LEV_SS=(S_YP_SS+S_LP_SS+S_FP_SS)/NW_SS; %effective leverage
```

```
%PUBLIC SECTOR
T_SS=-(TAU_X_SS*P_X_SS*X_SS)+G_SS;
B_SS=B_G_SS+B_P_SS; %total deposits
%Other implied
lambda_SS=(C_SS-HABIT*C_SS)^(-RISK)-BET*HABIT*((C_SS-HABIT*C_SS)^(-RISK)); %
with internal habit
%implied values preferences parameters and utility
CHI= lambda_SS*W_SS/(N_SS^VARPHI); % disutility of labor
U_SS=(1/(1-BET))*((((C_SS-HABIT*C_SS)^(1-RISK)-1)/(1-RISK))-CHI*(N_SS^(1+VA
RPHI))/(1+VARPHI));

%U_SS=(1/(1-BET))*((log(C_SS-HABIT*C_SS))-CHI*(N_SS^(1+VARPHI))/(1+VARPHI))
;

%shocks' block
RHO_AF=0.85;
RHO_AL=0.85;
RHO_AY=0.9273;
RHO_XIF=0.75;
RHO_XIL=0.75;
RHO_XIY=0.2101;
RHO_X=0.85;
RHO_TAUX=0.85;

SIGMA_AF=0.005;
SIGMA_AL=0.005;
SIGMA_AY=0.0225;
SIGMA_XIF=0.005;
SIGMA_XIL=0.005;
SIGMA_XIY=0.0186;
SIGMA_X=0.001;
SIGMA_TAUX=0;

//base model
@#include "var_def.mod"

var tot_I;
var tot_S;
var pen;


%this is a policy variable (carbon tax)
```

```
varexo eps_TAU_X;

@#include "base_param_new.mod"

model;

// Eq.1 Marginal utility of consumption
lambda=(C-HABIT*C(-1))^(-RISK)-(BET*HABIT*((C(+1)-HABIT*C)^(-RISK)));

// Eq.2 Labor supply
CHI*N^(VARPHI)=lambda*W;

// Eq.3 Euler's equation
BET*LAMBDA*RN/PI(+1)=1;

// Eq.4 Discount factor
LAMBDA=lambda(+1)/lambda;

// Eq.5 Welfare measure
U=(((C-HABIT*C(-1))^(1-RISK)-1)/(1-RISK))-CHI*(N^(1+VARPHI))/(1+VARPHI)+0.9
935*U(+1);

// Eq.6 Production function sector Y
Y=(VAROMEGA_VAY^(1/EPSILON_Y)*VA_Y^(((EPSILON_Y-1)/EPSILON_Y))+VAROMEGA_E^(
1/EPSILON_Y)*E^(((EPSILON_Y-1)/EPSILON_Y)))^(EPSILON_Y/(EPSILON_Y-1));

// Eq.7 Value added production sector
VA_Y=A_Y*(XI_Y*K_Y(-1))^(ALPHA_Y)*N^(1-ALPHA_Y);

// Eq.8 Energy composite
E=((VAROMEGA_EL)^(1/EPSILON_E)*E_L^(((EPSILON_E-1)/EPSILON_E))+(VAROMEGA_EF)
^(1/EPSILON_E)*E_F^(((EPSILON_E-1)/EPSILON_E)))^(EPSILON_E/(EPSILON_E-1));

// Eq.9 Total energy demand
E=MC^(EPSILON_Y)*VAROMEGA_E*Y*(P_E)^(-EPSILON_Y);

// Eq.10 Low-carbon energy demand
E_L=(VAROMEGA_EL)*E*(P_EL/P_E)^(-EPSILON_E);

// Eq.11 Fossil energy demand
E_F=(VAROMEGA_EF)*E*(P_EF/P_E)^(-EPSILON_E);

// Eq.12 NKPC
```

```
MC*SIGMA+1-SIGMA-GAMMA_P*(PI/(PI(-1)^(KAPPA_P)*PI_SS^(1-KAPPA_P))-1)*PI/(PI
(-1)^(KAPPA_P)*PI_SS^(1-KAPPA_P))+BET*(LAMBDA)*GAMMA_P*(PI(+1)/(PI^(KAPPA_P)
*PI_SS^(1-KAPPA_P))-1)*PI(+1)/(PI^(KAPPA_P)*PI_SS^(1-KAPPA_P))*Y(+1)/Y=0;

// Eq.13 Labor demand production sector
W=MC*Y^(1/EPSILON_Y)*VAROMEGA_VAY^(1/EPSILON_Y)*VA_Y^(((EPSILON_Y-1)/EPSILO
N_Y))*(1-ALPHA_Y)*1/N;

// Eq.14 Capital demand production sector
R_Y=((Q_Y-DELTA_Y)+((MC*Y^(1/EPSILON_Y)*VAROMEGA_VAY^(1/EPSILON_Y)*VA_Y^(((
EPSILON_Y-1)/EPSILON_Y))*ALPHA_Y)/(XI_Y*K_Y(-1))))*XI_Y/Q_Y(-1);

// Eq.15 Arbitrage condition production assets
Q_Y*K_Y=Q_Y*S_Y;

// Eq.16 Capital demand low-carbon sector
R_L=(P_EL*(E_L/(XI_L*K_L(-1)))+(Q_L-DELTA_L))*XI_L/Q_L(-1);

// Eq.17 Arbitrage condition low-carbon assets
Q_L*K_L=Q_L*S_L;

// Eq.18 Production function low-carbon sector
E_L=A_L*(XI_L*K_L(-1));

// Eq.19 Capital demand fossil sector
R_F=(P_EF*E_F^(1/EPSILON_F)*VAROMEGA_VAF^(1/EPSILON_F)*VA_F^(((EPSILON_F-1)
/EPSILON_F))*(1/K_F(-1))+(Q_F-DELTA_F)*XI_F)/Q_F(-1);

// Eq.20Arbitrage condition fossil assets
Q_F*K_F=Q_F*S_F;

//Eq.21 Production function fossil sector
E_F=(VAROMEGA_VAF^(1/EPSILON_F)*VA_F^((EPSILON_F-1)/EPSILON_F)+VAROMEGA_X^(
1/EPSILON_F)*X^((EPSILON_F-1)/EPSILON_F))^(EPSILON_F/(EPSILON_F-1));

//Eq.22 Natural resource demand
P_EF*E_F^(1/EPSILON_F)*VAROMEGA_X^(1/EPSILON_F)*X^(-1/EPSILON_F)-P_X=0;

//Eq.23 Value added fossil energy
VA_F=A_F*(XI_F*K_F(-1));

//Eq.24 Evolution of capital production sector
K_Y=XI_Y*K_Y(-1)+I_Y-DELTA_Y*XI_Y*K_Y(-1);
```

```
//Eq.25 Optimal net investment production sector
Q_Y=1+GAMMA_Y/2*((I_Y)/(I_Y(-1))-1)^2+GAMMA_Y*((I_Y)/(I_Y(-1))-1)*(I_Y)/(I_
Y(-1))-BET*(LAMBDA)*GAMMA_Y*((I_Y(+1))/(I_Y)-1)*((I_Y(+1))/(I_Y))^2;

//Eq.26 Evolution of capital low-carbon sector
K_L=XI_L*K_L(-1)+I_L-DELTA_L*XI_L*K_L(-1);

//Eq.27 Optimal net investment low-carbon sector
Q_L=1+GAMMA_L/2*((I_L)/(I_L(-1))-1)^2+GAMMA_L*((I_L)/(I_L(-1))-1)*(I_L)/(I_
L(-1))-BET*(LAMBDA)*GAMMA_L*((I_L(+1))/(I_L)-1)*((I_L(+1))/(I_L))^2;

//Eq.28 Evolution of capital fossil sector
K_F=XI_F*K_F(-1)+I_F-DELTA_F*XI_F*K_F(-1);

//Eq.29 Optimal net investment fossil sector
Q_F=1+GAMMA_F/2*((I_F)/(I_F(-1))-1)^2+GAMMA_F*((I_F)/(I_F(-1))-1)*(I_F)/(I_
F(-1))-BET*(LAMBDA)*GAMMA_F*((I_F(+1))/(I_F)-1)*((I_F(+1))/(I_F))^2;

//Eq.30 Balance sheet
Q_Y*S_YP+Q_L*S_LP+Q_F*S_FP=NW+B_P;

//Eq.31 Total net worth
NW=NW_E+NW_NEW;

//Eq.32 Net worth of new bankers
NW_NEW=OMEGA*(Q_Y*S_YP(-1)+Q_L*S_LP(-1)+Q_F*S_FP(-1));

//Eq.33 Net worth of existing bankers
NW_E=THETA*((R_Y-R(-1))*(Q_Y(-1)*S_YP(-1)/NW(-1))+(R_L-R(-1))*(Q_L(-1)*S_LP
(-1)/NW(-1))+(R_F-R(-1))*(Q_F(-1)*S_FP(-1)/NW(-1))+R(-1))*NW(-1);

//Eq.34 Risk-adjusted private leverage ratio
PHI=(Q_Y*S_YP+PSI_L*Q_L*S_LP+PSI_F*Q_F*S_FP)/NW;

//Eq.35 Marginal value of net worth
NU=(RHO*BET*(LAMBDA)*((1-THETA)+THETA*NU(+1))*(R))/(RHO-(BET*(LAMBDA)*((1-T
HETA)+THETA*NU(+1)))*(R_Y(+1)-R));

//Eq.36 Bank objective function
V=NU*NW;

//Eq.37
PSI_L*(LAMBDA)*((1-THETA)+THETA*NU(+1))*(R_Y(+1)-R)=(LAMBDA)*((1-THETA)+THE
TA*NU(+1))*(R_L(+1)-R);
```

```
//Eq.38
PSI_F*(LAMBDA)*((1-THETA)+THETA*NU(+1))*(R_L(+1)-R)=PSI_L*(LAMBDA)*((1-THET
A)+THETA*NU(+1))*(R_F(+1)-R);

//Eq.39
PHI=NU/RHO;

//Eq.40 Government budget constraint
G=T+TAU_X*X+R_Y*Q_Y*S_YG(-1)+R_F*Q_F*S_FG(-1)+R_L*Q_L*S_LG(-1)-R(-1)*B_G(-1)
;

//Eq.41 Taylor rule
(RN/RN_SS)=((RN(-1)/RN_SS)^(KAPPA_RN)*(((PI/PI_SS)^KAPPA_PI)*((Y/Y(-1))^KAP
PA_Y))^(1-KAPPA_RN));

//Eq.42 Fisher equation
RN=R*PI(+1);

//Eq.43 Aggregate resource constraint
Y=C+G+I_Y+I_L+I_F+GAMMA_Y/2*((I_Y)/(I_Y(-1))-1)^2*(I_Y)+GAMMA_L/2*((I_L)/(I
_L(-1))-1)^2*(I_L)+GAMMA_F/2*((I_F)/(I_F(-1))-1)^2*(I_F)+Y*GAMMA_P/2*(PI/(P
I(-1)^(KAPPA_P)*PI_SS^(1-KAPPA_P))-1)^2;

//Eq.44 Public consumption
C_G=C_G_SS;

//Eq.45 Total assets production sector
S_Y=S_YP+S_YG;

//Eq.46 Total assets fossil sectors
S_F=S_FP+S_FG;

//Eq.47 Total assets low-carbon sector
S_L=S_LP+S_LG;

//Eq.48 Fraction of production assets intermediated via central bank
Q_Y*S_YG=CREDIT_Y*(Q_Y*S_Y);

//Eq.49 Fraction of fossil assets intermediated via central bank
Q_F*S_FG=CREDIT_F*(Q_F*S_F);

//Eq.50 Fraction of low-carbon assets intermediated via central bank
Q_L*S_LG=CREDIT_L*(Q_L*S_L);
```

```
//Eq.51 Public bonds issued to finance credit policy
Q_Y*S_YG+Q_L*S_LG+Q_F*S_FG=B_G;

//Eq.52 Total deposits
B=B_G+B_P;

//Eq. 53 Carbon tax / emission mitigation
P_X=P_X_SS+TAU_X;

//Eq.54 Credit policy production sector
CREDIT_Y=CREDIT_Y_SS;

//Eq.55 Credit policy low-carbon sector
CREDIT_L=CREDIT_L_SS;

//Eq.56 Credit policy fossil sector
CREDIT_F=CREDIT_F_SS;

//Eq.57 carbon tax
TAU_X=TAU_X_SS+TAU_X_SHOCK;

//Eq.58 Technology production sector
A_Y=A_Y_SS*exp(A_Y_SHOCK);

//Eq.59 Technology fossil sector
A_F=A_F_SS*exp(A_F_SHOCK);

//Eq.60 Technology low-carbon sector
A_L=A_L_SS*exp(A_L_SHOCK);

//Eq.61 Leverage (non-risk adjusted)
LEV=(Q_Y*S_YP+Q_L*S_LP+Q_F*S_FP)/NW;

//Eq.62 Spread production sector
SPREAD_Y=R_Y(+1)-R;
//Eq.63 Spread low-carbon sector
SPREAD_L=R_L(+1)-R;

//Eq.64 Spread fossil sector
SPREAD_F=R_F(+1)-R;

//Eq.65 Government expenditures
G=C_G+TAU_CP*(Q_Y*S_YG+Q_L*S_LG+Q_F*S_FG);
```

```
//Eq.66 Capital quality production sector
XI_Y=XI_Y_SS*exp(XI_Y_SHOCK);

//Eq.67 Capital quality low-carbon sector
XI_L=XI_L_SS*exp(XI_L_SHOCK);

//Eq.68 Capital quality fossil sector
XI_F=XI_F_SS*exp(XI_F_SHOCK);

//Eq.69 Exogenous shock process on technology fossil sector
A_F_SHOCK=RHO_AF*A_F_SHOCK(-1)+eps_A_F;

//Eq.70 Exogenous shock process on technology low-carbon sector
A_L_SHOCK=RHO_AL*A_L_SHOCK(-1)+eps_A_L;

//Eq.71 Exogenous shock process on technology fossil sector
A_Y_SHOCK=RHO_AY*A_Y_SHOCK(-1)+eps_A_Y;
//Eq.72 Exogenous shock process on capital quality production sector
XI_Y_SHOCK=RHO_XIY*XI_Y_SHOCK(-1)-eps_XI_Y-0.05*eps_XI_F;

//Eq.73 Exogenous shock process on capital quality low-carbon sector
XI_L_SHOCK=RHO_XIL*XI_L_SHOCK(-1)+eps_XI_L-eps_XI_Y;

//Eq.74 Exogenous shock process on capital quality fossil sector
XI_F_SHOCK=RHO_XIF*XI_F_SHOCK(-1)-eps_XI_F-eps_XI_Y;

//Eq. 75 emission process
X_SHOCK=RHO_X*X_SHOCK(-1)+eps_X;

//Eq. 76 carbon tax process
TAU_X_SHOCK=0.99999*TAU_X_SHOCK(-1)+eps_TAU_X+eps_TAU_X(-1)
+eps_TAU_X(-2)+eps_TAU_X(-3)+eps_TAU_X(-4)+eps_TAU_X(-5)
+eps_TAU_X(-6)+eps_TAU_X(-7)+eps_TAU_X(-8)+eps_TAU_X(-9)
+eps_TAU_X(-10)+eps_TAU_X(-11)+eps_TAU_X(-12)
+eps_TAU_X(-13)+eps_TAU_X(-14)+eps_TAU_X(-15)
+eps_TAU_X(-16)+eps_TAU_X(-17)+eps_TAU_X(-18)
+eps_TAU_X(-19)+eps_TAU_X(-20)+eps_TAU_X(-21)
+eps_TAU_X(-22)+eps_TAU_X(-23)+eps_TAU_X(-24)+eps_TAU_X(-25)
+eps_TAU_X(-26)+eps_TAU_X(-27)+eps_TAU_X(-28)
+eps_TAU_X(-29)
+eps_TAU_X(-30)+eps_TAU_X(-31)+eps_TAU_X(-32)
+eps_TAU_X(-33)+eps_TAU_X(-34)+eps_TAU_X(-35)
+eps_TAU_X(-36)+eps_TAU_X(-37)+eps_TAU_X(-38)+eps_TAU_X(-39);
```

```
//Eq. 77
tot_I=I_F+I_L+I_Y;

//Eq. 78
tot_S=Q_F*S_F+Q_L*S_L+Q_Y*S_Y;

//Eq. 79
pen=P_E*E;



end;



initval;
B=B_SS; % total deposits
B_P=B_P_SS; % private deposits/bank deposits
B_G=B_G_SS; % public bonds issued to finance credit policy
C=C_SS; % consumption
C_G=C_G_SS; % public consumption
E=E_SS; % energy aggregate
E_F=E_F_SS; % fossil energy
E_L=E_L_SS; % low-carbon energy
I_F=I_F_SS; % investment fossil sector
I_L=I_L_SS; % investment low-carbon sector
I_Y=I_Y_SS; % investment production sector
K_F=K_F_SS; % total capital fossil sector
K_L=K_L_SS; % capital low-carbon sector
K_Y=K_Y_SS; % capital production sector
lambda=lambda_SS; % Lagrange multiplier
LAMBDA=LAMBDA_SS; % households' stochastic discount factor
MC=MC_SS; % marginal costs production sector
N=N_SS; % labor production sector
NU=NU_SS; % marginal value of net worth
NW=NW_SS; % net worth
NW_E=NW_E_SS; % net worth existing bankers
NW_NEW=NW_NEW_SS; % net worth new bankers
P_E=P_E_SS; % real aggregate energy price
P_EF=P_EF_SS; % real fossil energy price
P_EL=P_EL_SS; % real low-carbon energy price
PHI=PHI_SS; % leverage ratio
PI=PI_SS; % inflation
P_X=P_X_SS; % carbon price
```

```
Q_F=Q_F_SS; % price of capital fossil sector
Q_L=Q_L_SS; % price of capital low-carbon sector
Q_Y=Q_Y_SS; % price of capital production sector
R=R_SS; % real interest rate
R_F=R_F_SS; % stochastic return on fossil sector's assets
R_L=R_L_SS; % stochastic returns on low-carbon sector's assets
R_Y=R_Y_SS; % stochastic return on production sector's assets
RN=RN_SS; % nominal interest rate N.B. in the tex file RN=(1+i)
S_F=S_F_SS; % total intermediated assets fossil sector
S_L=S_L_SS; % total intermediated assets low-carbon sector
S_Y=S_Y_SS; % total intermediated assets production sector
S_FP=S_FP_SS; % privately intermediated assets fossil sector
S_LP=S_LP_SS; % privately intermediated low-carbon sector
S_YP=S_YP_SS; % privately intermediated assets production sector
S_FG=S_FG_SS; % assets fossil sector intermediated via government assistance
S_LG=S_LG_SS; % assets low-carbon sector intermediated via government
assistance
S_YG=S_YG_SS; % assets production sector intermediated via government
assistance
T=T_SS; % lump-sum taxes
U=U_SS; % utility
V=V_SS; % loss supported by bankers/value function
VA_Y=VA_Y_SS; % value added production sector
VA_F=VA_F_SS; % value added fossil sector
W=W_SS; % real wage production sector
X=X_SS; % extraction/emissions flow
Y=Y_SS; % production
CREDIT_L=CREDIT_L_SS; % credit policy low-carbon sector
CREDIT_F=CREDIT_F_SS; % credit policy fossil sector
CREDIT_Y=CREDIT_Y_SS; % credit policy production sector
TAU_X=TAU_X_SS; % extraction/emissions flow
A_F=A_F_SS; % technology fossil sector
A_L=A_L_SS; % technology low-carbon sector
A_Y=A_Y_SS; % technology
LEV=LEV_SS; %leverage ration (non-risk adjusted)
SPREAD_Y=SPREAD_Y_SS; % spread= return on Y - safe rate
SPREAD_F=SPREAD_F_SS; % spread= return on F - safe rate
SPREAD_L=SPREAD_L_SS; % spread= return on L - safe rate
G=G_SS; % total public expenditure
XI_F=XI_F_SS; % quality of capital fossil sector
XI_L=XI_L_SS; % quality of capital low-carbon sector
XI_Y=XI_Y_SS; % quality of capital production sector
A_F_SHOCK=0; % tech process fossil sector
A_L_SHOCK=0; % tech process low-carbon sector
```

```
A_Y_SHOCK=0; % tech process production sector
XI_F_SHOCK=0; % capital quality process fossil sector
XI_L_SHOCK=0; % capital quality process low-carbon sector
XI_Y_SHOCK=0; % capital quality process production sector
X_SHOCK=0; % emission shock
tot_I=I_F_SS+I_L_SS+I_Y_SS; %total investments
tot_S=S_F_SS+S_L_SS+S_Y_SS; %total investments
pen=P_E_SS*E_SS;
end;

shocks;

var eps_TAU_X=0.0104443^2;

end;


%Some checks are needed before solving the model
%1. compute the equation residuals for the given initial value
resid;
%2. steady state computation (Dynare (re-)computes the steady state given our
initial conditions)...
%steady;
model_diagnostics;
%3. check the Blanchard-Kahn condition
check;


stoch_simul(irf=41,noprint,order=1);

X_eps_TAU_X(40)/X_SS*100
P_X40=P_X_eps_TAU_X(40)+P_X_SS


matrix_XI_F=[];

%decrease value of XI_F
matrix_XI_F(1,:)=Y_eps_TAU_X*100/Y_SS;
matrix_XI_F(2,:)=C_eps_TAU_X*100/C_SS;
matrix_XI_F(3,:)=I_Y_eps_TAU_X*100/I_Y_SS;
matrix_XI_F(4,:)=I_F_eps_TAU_X*100/I_F_SS;
matrix_XI_F(5,:)=I_L_eps_TAU_X*100/I_L_SS;
matrix_XI_F(6,:)=N_eps_TAU_X*100/N_SS;
matrix_XI_F(7,:)=S_F_eps_TAU_X*100/S_F_SS;
```

```
matrix_XI_F(8,:)=S_L_eps_TAU_X*100/S_L_SS;
matrix_XI_F(9,:)=K_Y_eps_TAU_X*100/K_Y_SS;
matrix_XI_F(10,:)=K_F_eps_TAU_X*100/K_F_SS;
matrix_XI_F(11,:)=K_L_eps_TAU_X*100/K_L_SS;
matrix_XI_F(12,:)=E_eps_TAU_X*100/E_SS;
matrix_XI_F(13,:)=E_F_eps_TAU_X*100/E_F_SS;
matrix_XI_F(14,:)=E_L_eps_TAU_X*100/E_L_SS;
matrix_XI_F(15,:)=Q_Y_eps_TAU_X*100/Q_Y_SS;
matrix_XI_F(16,:)=Q_F_eps_TAU_X*100/Q_F_SS;
matrix_XI_F(17,:)=Q_L_eps_TAU_X*100/Q_L_SS;
matrix_XI_F(18,:)=P_E_eps_TAU_X*100/P_E_SS;
matrix_XI_F(19,:)=P_EF_eps_TAU_X*100/P_EF_SS;
matrix_XI_F(20,:)=P_EL_eps_TAU_X*100/P_EL_SS;
matrix_XI_F(21,:)=SPREAD_Y_eps_TAU_X*400;
matrix_XI_F(22,:)=SPREAD_F_eps_TAU_X*400;
matrix_XI_F(23,:)=SPREAD_L_eps_TAU_X*400;
matrix_XI_F(24,:)=R_eps_TAU_X*400;
matrix_XI_F(25,:)=RN_eps_TAU_X*400;
matrix_XI_F(26,:)=PI_eps_TAU_X*400;
matrix_XI_F(27,:)=NW_eps_TAU_X*100/NW_SS;
matrix_XI_F(28,:)=PHI_eps_TAU_X/PHI_SS;
matrix_XI_F(29,:)=LEV_eps_TAU_X/LEV_SS;
matrix_XI_F(30,:)=X_eps_TAU_X*100/X_SS;
matrix_XI_F(31,:)=U_eps_TAU_X+U_SS;
matrix_XI_F(32,:)=S_Y_eps_TAU_X*100/S_Y_SS;
matrix_XI_F(33,:)=S_YP_eps_TAU_X*100/S_YP_SS;
matrix_XI_F(34,:)=S_FP_eps_TAU_X*100/S_FP_SS;
matrix_XI_F(35,:)=S_LP_eps_TAU_X*100/S_LP_SS;
matrix_XI_F(36,:)=CREDIT_Y_eps_TAU_X;
matrix_XI_F(37,:)=CREDIT_L_eps_TAU_X;
matrix_XI_F(38,:)=CREDIT_F_eps_TAU_X;
matrix_XI_F(40,:)=NU_eps_TAU_X*100/NU_SS;
matrix_XI_F(41,:)=S_YG_eps_TAU_X;
matrix_XI_F(42,:)=S_FG_eps_TAU_X;
matrix_XI_F(43,:)=S_LG_eps_TAU_X;
matrix_XI_F(44,:)=100./(PHI_eps_TAU_X+PHI_SS);
matrix_XI_F(45,:)=W_eps_TAU_X*100/W_SS;
matrix_XI_F(46,:)=MC_eps_TAU_X*100/MC_SS;
matrix_XI_F(47,:)=VA_Y_eps_TAU_X*100/VA_Y_SS;
matrix_XI_F(48,:)=NU_eps_TAU_X*100/NU_SS;
matrix_XI_F(49,:)=VA_F_eps_TAU_X*100/VA_F_SS;
matrix_XI_F(50,:)=P_X_eps_TAU_X*100/P_X_SS;
matrix_XI_F(51,:)=(1./(MC_eps_TAU_X+MC_SS)-MC_SS^-1)*MC_SS*100;
```

```
matrix_MIT=matrix_XI_F;
save('results_MIT','matrix_MIT');

%Cumulative emissions
X_SS=0.033;
X_base=((matrix_MIT(30,1:40).*X_SS)./100)+X_SS;
X_base_cum=sum(X_base);
X_SS_cum=X_SS*40;
(X_base_cum-X_SS_cum)*100/X_SS_cum
```