**附录**

**稳态值求解matlab程序**

% 各参数已赋值，此处只列出基准情形稳态值的matlab程序。

>>A=1

>>R=1/beta-(1-delta)

>>e=(tua\*miu/(phi1\*phi2))^(1/(phi2-1))

% 下面需要创建一个.M文件，命名为whu.m保存

function F=whu(x)

F=[(1-eta)\*x(1)-(1-e)\*miu\*(1-gamma1-gamma2\*x(1)-gamma3\*x(1)^2)\*x(2)^(alpha);

R-(1-tua\*(1-e)\*miu-phi1\*e^(phi2))\*alpha\*(1-gamma1-gamma2\*x(1)-gamma3\*x(1)^2)\*x(2)^(alpha-1)];

% 建立非线性方程组函数，本文中为均衡条件中的资本一阶条件和环境演化方程所组成的非线性方程组，其中x（1）表示X，x（2）表示K。

>>fun=@whu; % 然后调用这个函数

>>x0=[200,50]; %赋初值

>>x=fsolve(fun,x0) %调用matlab的fsolve算法来解上述非线性方程组

%下面求解各内生变量稳态值

>>Y=(1-gamma1-gamma2\*x(1)-gamma3\*x(1)^2)\*x(2)^(alpha)

>>Z=(1-e)\*miu\*Y

>>HC=phi1\*e^phi2 %HC表示减排成本

>>ET=tua\*Z

>>I=sigma\*X(2) %X(2)表示K

>>G=fi\*Y

>>C=Y-G-I-HC

**Dynare程序**

**基准情形**

var y z hc et r e x k c g i a;

varexo e\_a;

parameters beta alpha delta sigma rho fi miu eta omega gamma0 gamma1 gamma2 phi1 phi2 tua;

beta=0.948;

alpha=0.6;

delta=0.05;

sigma=0.735;

rho=0.72;

fi=0.19;

miu=0.601;

eta=0.992;

omega=0.335;

gamma0=1.3950\*10^(-3);

gamma1=-6.6722\*10^(-6);

gamma2=1.4647\*10^(-8);

phi1=0.185;

phi2=2.8;

tua=0.02;

model;

y=(1-gamma0-gamma1\*x-gamma2\*x^2)\*a\*k(-1)^(alpha);

z=(1-e)\*miu\*y;

hc=phi1\*e^phi2\*y;

et=tua\*z;

r=(1-tua\*(1-e)\*miu-phi1\*e^phi2)\*alpha\*y/k(-1);

tua\*miu=phi1\*phi2\*e^(phi2-1);

x=eta\*x(-1)+z;

k=i+(1-delta)\*k(-1);

c^(-sigma)=beta\*c(1)^(-sigma)\*(r(1)+(1-delta));

g=fi\*y;

y=c+i+g+hc;

a=a(-1)^rho\*exp(e\_a);

end;

initval;

y=13.2288;

z=6.9678;

hc=0.0070;

et=0.1394;

e=0.1236;

i=3.7414;

r=0.1049;

g=2.5135;

c=6.9669;

k=74.8282;

x=870.9808;

a=1;

end;

steady;

check;

model\_info;

model\_diagnostics;

check;

shocks;

var e\_a;

stderr 1;

end;

stoch\_simul(order=1, periods=0,irf=50, conditional\_variance\_decomposition =[1:50]);

**政府机制情形**

var y z hc et r e x k c g i a;

varexo e\_a;

parameters beta alpha delta sigma rho fi miu eta omega gamma0 gamma1 gamma2 phi1 phi2 tua p;

beta=0.948;

alpha=0.6;

delta=0.05;

sigma=0.735;

rho=0.72;

fi=0.19;

miu=0.601;

eta=0.992;

omega=0.335;

gamma0=1.3950\*10^(-3);

gamma1=-6.6722\*10^(-6);

gamma2=1.4647\*10^(-8);

phi1=0.185;

phi2=2.8;

tua=0.02;

p=0.0236;

model;

y=(1-gamma0-gamma1\*x-gamma2\*x^2)\*a\*k(-1)^(alpha);

z=(1-e)\*miu\*y;

hc=phi1\*e^phi2\*y;

et=tua\*z;

r=(1-tua\*(1-e)\*miu-phi1\*e^phi2)\*alpha\*y/k(-1);

tua\*miu=phi1\*phi2\*e^(phi2-1);

x=eta\*x(-1)+z-omega\*p\*g;

k=i+(1-delta)\*k(-1);

c^(-sigma)=beta\*c(1)^(-sigma)\*(r(1)+(1-delta));

g=fi\*y;

y=c+i+g+hc;

a=a(-1)^rho\*exp(e\_a);

end;

initval;

y=13.2292;

z=6.9681;

hc=0.0070;

et=0.1394;

e=0.1236;

i=3.7415;

r=0.1049;

g=2.5135;

c=6.9671;

k=74.8304;

x=870.3746;

a=1;

end;

steady;

check;

model\_info;

model\_diagnostics;

check;

shocks;

var e\_a;

stderr 1;

end;

stoch\_simul(order=1, periods=0,irf=50, conditional\_variance\_decomposition =[1:50]);

**市场机制情形**

var y z hc et r e x k c g i a;

varexo e\_a;

parameters beta alpha delta sigma rho fi miu eta omega gamma0 gamma1 gamma2 phi1 phi2 tua p;

beta=0.948;

alpha=0.6;

delta=0.05;

sigma=0.735;

rho=0.72;

fi=0.19;

miu=0.601;

eta=0.992;

omega=0.335;

gamma0=1.3950\*10^(-3);

gamma1=-6.6722\*10^(-6);

gamma2=1.4647\*10^(-8);

phi1=0.185;

phi2=2.8;

tua=0.02;

p=0.0236;

model;

y=(1-gamma0-gamma1\*x-gamma2\*x^2)\*a\*k(-1)^(alpha);

z=(1-e)\*miu\*y;

hc=phi1\*e^phi2\*y-p\*g\*e;

et=tua\*z;

r=(1-tua\*(1-e)\*miu-phi1\*e^phi2+p\*fi\*e)\*alpha\*y/k(-1);

tua\*miu+p\*fi=phi1\*phi2\*e^(phi2-1);

x=eta\*x(-1)+z;

k=i+(1-delta)\*k(-1);

c^(-sigma)=beta\*c(1)^(-sigma)\*(r(1)+(1-delta));

g=fi\*y;

y=c+i+g+hc;

a=a(-1)^rho\*exp(e\_a);

end;

initval;

y=13.2354;

z=6.9204;

hc=0.0061;

et=0.1384;

e=0.1300;

i=3.7438;

r=0.1049;

g=2.5147;

c=6.9708;

k=74.8765;

x=865.0523;

a=1;

end;

steady;

check;

model\_info;

model\_diagnostics;

check;

shocks;

var e\_a;

stderr 1;

end;

stoch\_simul(order=1, periods=0,irf=50, conditional\_variance\_decomposition =[1:50]);

**mix shocks**

var y z hc et r e x k c g i a;

varexo\_det p;

varexo e\_a;

parameters beta alpha delta sigma rho fi miu eta omega gamma0 gamma1 gamma2 phi1 phi2 tua;

beta=0.948;

alpha=0.6;

delta=0.05;

sigma=0.735;

rho=0.72;

fi=0.19;

miu=0.601;

eta=0.992;

omega=0.335;

gamma0=1.3950\*10^(-3);

gamma1=-6.6722\*10^(-6);

gamma2=1.4647\*10^(-8);

phi1=0.185;

phi2=2.8;

tua=0.02;

model;

y=(1-gamma0-gamma1\*x-gamma2\*x^2)\*a\*k(-1)^(alpha);

z=(1-e)\*miu\*y;

hc=phi1\*e^phi2\*y-p\*g\*e;

et=tua\*z;

r=(1-tua\*(1-e)\*miu-phi1\*e^phi2+p\*fi\*e)\*alpha\*y/k(-1);

tua\*miu+p\*fi=phi1\*phi2\*e^(phi2-1);

x=eta\*x(-1)+z;

k=i+(1-delta)\*k(-1);

c^(-sigma)=beta\*c(1)^(-sigma)\*(r(1)+(1-delta));

g=fi\*y;

y=c+i+g+hc;

a=a(-1)^rho\*exp(e\_a);

end;

initval;

y=13.2354;

z=6.9204;

hc=0.0061;

et=0.1384;

e=0.1300;

i=3.7438;

r=0.1049;

g=2.5147;

c=6.9708;

k=74.8765;

x=865.0523;

a=1;

p=0.0236;

end;

steady;

check;

model\_info;

model\_diagnostics;

check;

shocks;

var e\_a;

stderr 1;

var p;

periods 1:16;

values 0.05;

end;

stoch\_simul(order=1, periods=0,irf=50, conditional\_variance\_decomposition =[1:50]);

forecast;

**图形matlab程序**

**方法一：**

%将dynare中得到的宏观变量脉冲响应值输入excel表格，命名为irf.xls保存。

%将matlab的文件夹路径设置为irf.xls文件的文件夹。

>>A=xlsread(‘irf.xls’); % matlab读取数据文件irf.xls

>> t=A(:,1); %为各变量赋值，下同。

>> y1=A(:,2);

>> y2=A(:,3);

>> y3=A(:,4);

>> c1=A(:,5);

>> c2=A(:,6);

>> c3=A(:,7);

>> k1=A(:,8);

>> k2=A(:,9);

>> k3=A(:,10);

>> i1=A(:,11);

>> i2=A(:,12);

>> i3=A(:,13);

>> z1=A(:,14);

>> z2=A(:,15);

>> z3=A(:,16);

>> x1=A(:,17);

>> x2=A(:,18);

>> x3=A(:,19);

>> e1=A(:,20);

>> e2=A(:,21);

>> e3=A(:,22);

>> hc1=A(:,23);

>> hc2=A(:,24);

>> hc3=A(:,25);

>> et1=A(:,26);

>> et2=A(:,27);

>> et3=A(:,28);

>> subplot(3,3,1); % 九宫格拼图

>> plot(t,y1,'-k',t,y2,'--k',t,y3,':k'); % 三种减排机制下的产出响应图

>> title('产出') % 图标题

>> subplot(3,3,2);

>> plot(t,c1,'-k',t,c2,'--k',t,c3,':k');

>> title('消费');

>> subplot(3,3,3);

>> plot(t,k1,'-k',t,k2,'--k',t,k3,':k');

>> title('资本存量');

>> subplot(3,3,4);

>> plot(t,i1,'-k',t,i2,'--k',t,i3,':k');

>> title('投资');

>> subplot(3,3,5);

>> plot(t,z1,'-k',t,z2,'--k',t,z3,':k');

>> title('碳排放量');

>> subplot(3,3,6);

>> plot(t,x1,'-k',t,x2,'--k',t,x3,':k');

>> title('碳存量');

>> subplot(3,3,7);

>> plot(t,e1,'-k',t,e2,'--k',t,e3,':k');

>> title('减排努力');

>> subplot(3,3,8);

>> plot(t,hc1,'-k',t,hc2,'--k',t,hc3,':k');

>> title('减排成本');

>> subplot(3,3,9);

>> plot(t,et1,'-k',t,et2,'--k',t,et3,':k');

>> title('排放税');

>> legend('基准情形','市场减排','政府减排') % 图例

图像程序方法二：

>> load('baseline\_results.mat')

>> outputb=oo\_.irfs

>> load('private\_results.mat')

>> output=oo\_.irfs

>> load('public\_results.mat')

>> outputp=oo\_.irfs

>> t=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50]';

>> subplot(3,4,1);

>> plot(t,outputb.y\_e\_a,'-k',t,output.y\_e\_a,'--k',t,outputp.y\_e\_a,':k')

>> title('产出');

>> legend('基准情形','市场机制','政府机制');

>> subplot(3,4,2);

>> plot(t,outputb.z\_e\_a,'-k',t,output.z\_e\_a,'--k',t,outputp.z\_e\_a,':k')

>> title('CO2排放量');

>> subplot(3,4,3);

>> plot(t,outputb.x\_e\_a,'-k',t,output.x\_e\_a,'--k',t,outputp.x\_e\_a,':k')

>> title('CO2存量');

>> subplot(3,4,4);

>> plot(t,outputb.e\_e\_a,'-k',t,output.e\_e\_a,'--k',t,outputp.e\_e\_a,':k')

>> title('减排努力');

>> subplot(3,4,5);

>> plot(t,outputb.hc\_e\_a,'-k',t,output.hc\_e\_a,'--k',t,outputp.hc\_e\_a,':k')

>> title('减排成本');

>> subplot(3,4,6);

>> plot(t,outputb.c\_e\_a,'-k',t,output.c\_e\_a,'--k',t,outputp.c\_e\_a,':k')

>> title('消费');

>> subplot(3,4,7);

>> plot(t,outputb.k\_e\_a,'-k',t,output.k\_e\_a,'--k',t,outputp.k\_e\_a,':k')

>> title('资本存量');

>> subplot(3,4,8);

>> plot(t,outputb.i\_e\_a,'-k',t,output.i\_e\_a,'--k',t,outputp.i\_e\_a,':k')

>> title('投资');

>> subplot(3,4,9);

>> plot(t,outputb.r\_e\_a,'-k',t,output.r\_e\_a,'--k',t,outputp.r\_e\_a,':k')

>> title('利率');

>> subplot(3,4,10);

>> plot(t,outputb.et\_e\_a,'-k',t,output.et\_e\_a,'--k',t,outputp.et\_e\_a,':k')

>> title('环境税收');

>> subplot(3,4,11);

>> plot(t,outputb.g\_e\_a,'-k',t,output.g\_e\_a,'--k',t,outputp.g\_e\_a,':k')

>> title('财政支出');

>> subplot(3,4,12);

>> plot(t,outputb.a\_e\_a,'-k',t,output.a\_e\_a,'--k',t,outputp.a\_e\_a,':k')

>> title('生产率');

Forecast结果图像程序

>> subplot(4,3,1);

>> plot(t,oo\_.forecast.Mean.y,'-k',t,oo\_.forecast.HPDsup.y,'--k',t,oo\_.forecast.HPDinf.y,':k');

>> title('产出')

>> subplot(4,3,2);

>> plot(t,oo\_.forecast.Mean.z,'-k',t,oo\_.forecast.HPDsup.z,'--k',t,oo\_.forecast.HPDinf.z,':k');

>> title('CO2排放量')

>> subplot(4,3,3);

>> plot(t,oo\_.forecast.Mean.x,'-k',t,oo\_.forecast.HPDsup.x,'--k',t,oo\_.forecast.HPDinf.x,':k');

>> title('CO2存量')

>> subplot(4,3,4);

>> plot(t,oo\_.forecast.Mean.e,'-k',t,oo\_.forecast.HPDsup.e,'--k',t,oo\_.forecast.HPDinf.e,':k')

>> title('减排努力')

>> subplot(4,3,5);

>> plot(t,oo\_.forecast.Mean.hc,'-k',t,oo\_.forecast.HPDsup.hc,'--k',t,oo\_.forecast.HPDinf.hc,':k')

>> title('减排成本')

>> subplot(4,3,6);

>> plot(t,oo\_.forecast.Mean.c,'-k',t,oo\_.forecast.HPDsup.c,'--k',t,oo\_.forecast.HPDinf.c,':k')

>> title('消费')

>> subplot(4,3,7);

>> plot(t,oo\_.forecast.Mean.k,'-k',t,oo\_.forecast.HPDsup.k,'--k',t,oo\_.forecast.HPDinf.k,':k')

>> title('资本存量')

>> subplot(4,3,8);

>> plot(t,oo\_.forecast.Mean.i,'-k',t,oo\_.forecast.HPDsup.i,'--k',t,oo\_.forecast.HPDinf.i,':k')

>> title('投资')

>> subplot(4,3,9);

>> plot(t,oo\_.forecast.Mean.et,'-k',t,oo\_.forecast.HPDsup.et,'--k',t,oo\_.forecast.HPDinf.et,':k')

>> title('环境税收')

>> subplot(4,3,10);

>> plot(t,oo\_.forecast.Mean.r,'-k',t,oo\_.forecast.HPDsup.r,'--k',t,oo\_.forecast.HPDinf.r,':k')

>> title('利率')

>> subplot(4,3,11);

>> plot(t,oo\_.forecast.Mean.g,'-k',t,oo\_.forecast.HPDsup.g,'--k',t,oo\_.forecast.HPDinf.g,':k')

>> title('')

>> title('政府支出')

>> subplot(4,3,12);

>> plot(t,oo\_.forecast.Mean.a,'-k',t,oo\_.forecast.HPDsup.a,'--k',t,oo\_.forecast.HPDinf.a,':k')

>> title('生产率')

>> legend('均值','-10%','10%')