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%Calculates optimal taxes  as described in 'Factor Income Taxation in a Horizontal
%Innovation Model when  sigma is bigger than one  and F is given
clear all
disp('New')
n=1.01:0.001:3;
numvec=[];
for s =1.01:0.001:3;
    %This part is just needed to calculate initial F, for benchmark values.
    %For all set variables it is possible to consider alternatives: eg
    %to change  initial labor write  L0=.2 and then add a line L0b=L0,
    %some alternatives are already written to be used like that below.
sb =1.5;%benchmark s
INTMratio=0.45;
INTMratiob=0.45;
a = INTMratio^0.5;
ab = INTMratiob^0.5;
gamma=0.02;
gammab=0.02;
rho=0.04;
rhob=0.04;
tk0=0.25;
GOVEXPtoGDP = 0.1;
GOVEXPtoGDPb = 0.1;
g = (1-INTMratio)*GOVEXPtoGDP;
gb = (1-INTMratiob)*GOVEXPtoGDPb;
TranferstoGDP=0.25;
TranferstoGDPb=0.25;
T=(1-INTMratio)*TranferstoGDP;
Tb=(1-INTMratiob)*TranferstoGDPb;
tw0 = -a*tk0+(g+T)/(1-a);
tw0b = -ab*tk0+(gb+Tb)/(1-ab);
r0=(s*gamma+rho)/(1-tk0);
r0b=(sb*gammab+rhob)/(1-tk0);
L0=0.17;
L0b=0.17;
C1=r0/L0;
C1b=r0b/L0b;
%eta=(1-a)*a^((1+a)/(1-a))/C1;
etab=(1-ab)*ab^((1+ab)/(1-ab))/C1b;
chi1=s*(s-1)*(1-L0)*(1-tw0)/a;
chi2=rho/C1+L0*(tk0-1+s+s/a-s*g/(a*(1-a)));
chi = 1+chi1/chi2;
chi1b=sb*(sb-1)*(1-L0b)*(1-tw0b)/ab;
chi2b=rhob/C1b+L0b*(tk0-1+sb+sb/ab-sb*gb/(ab*(1-ab)));
chib=1+chi1b/chi2b;

if chib<1
        disp('Error: chib must be>1')
    else

Fb=sb.*(1-L0b)./(L0b.*(sb+chib-1));
%above  is the benchmark  Fr
A=1-(ab+(-tw0b+Tb/(1-ab)+s)/(s-1)-gb/(1-ab))*(1/Fb+1)/(1-tw0b);
%A0 in appendix D.5
B=(ab+(-tw0b+Tb/(1-ab)+s)/(s-1)-gb/(1-ab))/(Fb*(1-tw0b))...
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    -1-rhob*etab*(1-ab)^(-1)*ab^(2*ab/(ab-1))*(1/Fb+1)/((s-1)*(1-tw0b));
%A1 in appendix D.5
C=rhob*etab*(1-ab)^(-1)*ab^(2*ab/(ab-1))/(Fb*(s-1)*(1-tw0b));
%A2 in appendix D.5
L0=(-B-(B^2-4*A*C)^(1/2))/(2*A);
%L0 consistent with benchmark Frisch and each varying  sigma
chi1=s*(s-1)*(1-L0)*(1-tw0b)/ab;
chi2=rhob/C1b+L0*(tk0-1+s+s/ab-s*gb/(ab*(1-ab)));
chi=1+chi1/chi2;    %
%chi implied by  each varying  sigma and benchmark F

if chi<1
        disp('Error: chi must be>1')
    else

t=0.01:0.001:0.9;
tw=-ab*t+(gb+Tb)/(1-ab);
LN=s*(1-tw)*(s-1)*(ab*(chi-1))^(-1)- rhob/C1b;
LD=s*(1-tw)*(s-1)*(ab*(chi-1))^(-1)+s-1+t+(s/ab)*(1-gb/(1-ab));
L=LN./LD;
%calculates L for each  value of the tax rates(eq.45)
r=C1b*L;
V1=(2-s-chi)./((1-s).*(1-L))-C1b*(1-t)./(C1b*L.*(1-t)*(s-1)+rhob);
V2=s*(s-1)*(1-L)/(1-chi)+L;
V3=(s/ab)*(1-s)*(1-tw)/(1-chi)-1+t+s+(s/ab)*(1-gb/(1-ab));
V4= ab./(1-tw);
V5=-r./(r.*(1-t)*(s-1)+rhob);
D=V1.*V2.*V3.^(-1)+V4+V5;
%calculates the LHS of inequality 50
[v,i]=min (abs(D));
%equates the LHS of inequality 50 to 0.
topt=t(i);%optimal capital tax
twopt=-ab*topt+(gb+Tb)/(1-ab);% optimal labor tax
Lopt=L(i);%optimal labor

numvec=[numvec,topt];
%numvec1=[numvec1, Lopt];
end
end
end
plot(n, numvec)
xlabel('\sigma') %
ylabel('\tau_{ro}')%
```