

```

%Calculates optimal taxes when R&D is subsidized: all parameters kept at
%their benchmark
clear
disp('New')
%gamma=0.02;
rho=0.04;
sn=0.1;
s =1.5;%s: sigma in the paper
INTMratio=0.45;%INTMratio: share of intermediates in production
a = INTMratio^0.5;% alpha in the paper
GOVEXPtoGDP = 0.1;%GOVEXPtoGDP: share of government expenditures over GDP
g = (1-INTMratio)*GOVEXPtoGDP;
TransferstoGDP=0.25;%TranferstoGDP: share of transfers over GDP
T=(1-INTMratio)*TransferstoGDP;
C1 = 0.5490;%baseline value
C2=C1/(1-sn);% eq. E1
chi=2.0463;%baseline value
eta=(1-a)*a^((1+a)/(1-a))/C1;
%What follows (to next comment) calculates initial L and
%gamma(Ltk0 and gammatk0):
t=0.25; %t: initial capital tax rate
%
A1=(t-1)*(1+(s-1)*sn/(chi-1))/s;
A2=(1-g-a^2)*(1-sn)/(a*(1-a));
A3=((s-1)/(chi-1))*(1-sn)*(1+t*a-(g+T)/(1-a))/a;
A=A1+A2+A3;% A is A0 in the quadratic in eq. E4
B1=rho*(1+sn*(s-1)/(chi-1))/(s*C2);
B2=-A3;
B3=(t-1)*(1-s)*sn/(chi-1)/s;
B=B1+B2+B3;% B is A1 in the quadratic in eq. E4
C =(1-s)*sn*rho/(s*C2*(chi-1));% C is A2 in the quadratic in eq. E4
delta=B.^2-4*A.*C;
Ltk0=(-B+delta.^(1/2))./(2*A)
gammatk0=((1-t)*C2*Ltk0-rho)/s
%From last comment to here calculates initial L and gamma.
tw0 = -a*t+(g+T)/(1-a)-sn*a.*((1-sn)*s)^(-1).*(t-1+rho./(Ltk0*C2))
%combines eq. E3, the following eq in the paper and Ndot=gammatk0*N
Govexpgdp=g/(1-a^2)+eta*sn*gammatk0*a^(2*a/(a-1))/((1-a^2)*Ltk0)
%Govexpgdp is:(government consumption +public
%financing of R&D)/GDP. By changing g we can keep this equal to 0.1
%with initial taxes.
Frisch0 = (1-Ltk0)/Ltk0/(1+(chi-1)/s)%calculates initial Frisch
%WHAT FOLLOWS TILL NEXT COMMENT, CALCULATES L FOR EACH VALUE OF THE TAX
t=0.01:0.00001:0.9;
%t=0.25;
A1=(t-1)*(1+(s-1)*sn/(chi-1))/s;
A2=(1-g-a^2)*(1-sn)/(a*(1-a));
A3=((s-1)/(chi-1))*(1-sn)*(1+t*a-(g+T)/(1-a))/a;
A=A1+A2+A3;% A is A0 in the quadratic in eq. E4
B1=rho*(1+sn*(s-1)/(chi-1))/(s*C2);
B2=-A3;
B3=(t-1)*(1-s)*sn/(chi-1)/s;
B=B1+B2+B3;%B is A1 in the quadratic in eq. E4
C =(1-s)*sn*rho/(s*C2*(chi-1));%is A1 in the quadratic in eq. E4
delta=B.^2-4*A.*C;

```

```

L=(-B+delta.^(1/2))./(2*A);
%FROM LAST COMMENT TO HERE CALCULATES L FOR EACH VALUE OF THE TAX
tw = -a*t+(g+T)/(1-a)-sn*a.*((1-sn)*s)^(-1).*(t-1+rho./(L*C2));
%combines eq. E3, the following eq in the paper and Ndot=gamma*N
r=C2*L;
% WHAT FOLLOWS TILL NEXT COMMENT TESTS DETERMINACY FOR EACH t
%using formula on top of page 46
Bprime1=(1-sn)/a*(1+a-g/(1-a)+(s-1).*(1+a*t-(g+T)/(1-a))/(chi-1))+...
(r.*(1-t)-rho)*sn*(1-s)/(s*C2*(chi-1).*L.^2);
Bprime2=1+sn*(1-s)*(1-L)./((chi-1)*L);
Bprime3=(1-t)/s;
Bprime=Bprime1/Bprime2-Bprime3;
if Bprime <= 0
    disp ('Error: Indeterminacy')
else
%FROM LAST COMMENT TO HERE TESTS DETERMINACY FOR EACH t
%WHAT FOLLOWS CALCULATES OPTIMAL TAXES
V1=(2-s-chi)./((s-1).*(1-L))+C2*(1-t)./(C2*L.*(1-t)*(s-1)+rho);
V211=L*(1-s)*(1-sn)/(chi-1);
V212=-L*(1+sn*(s-1)/(chi-1))/s;
V213=- (1-s)*(1+sn*(1/s-1))/(chi-1);
V21=V211+V212+V213;
V22=2*A+B./L;
V2=V21./V22;
V3=-r./(r.*(1-t)*(s-1)+rho);
V4=- (1-tw).^(-1);
V5=-a-a*sn/(s*(1-sn))+V2*rho*sn*a./(C2.*L.^2.*(1-sn).*s);
D= V1.*V2+V3+V4.*V5; %welfare effect(last displayed eq. page 46).
plot (t,D)%checks its behavior
[v,i]=min (abs(D));%equates to zero welfare effect.
topt=t (i)%optimal capital tax
Lopt=L(i)%optimal labor
twopt=-a*topt+(g+T)/(1-a)-sn*a.*((1-sn)*s)^(-1).*(topt-1+rho./(Lopt*C2))
% optimal labor tax
gammaopt=(C2*Lopt*(1-topt)-rho)/s%optimal growth
Wopt=(1-twopt)^(1-s)*(1-Lopt)^(2-s-chi)*(C2*Lopt*(s-1)*(1-topt)+rho)^(-1)/(1-s);
%increasing transformation of welfare with opt taxes: from eq. 41
%with h=(1-L)^(1-chi), dropping positive constants
L00=L(1)%labor with no tax on capital
tw00=(g+T)/(1-a) -sn*a.*((1-sn)*s)^(-1).*(-1+rho./(L00*C2));
% labor tax with no tax on capital
W00=(1-tw00)^(1-s)*(1-L00)^(2-s-chi)*(C2*L00*(s-1)+rho)^(-1)/(1-s);
%increasing transformation of welfare with zero tax on capital:
diff=(Wopt-W00)/abs(W00)
%gain in welfare from optimal taxes starting from zero capital tax
Govexpgdopt=g/(1-a^2)+eta*sn*gammaopt*a^(2*a/(a-1))/((1-a^2)*Lopt);
%Govexpgd with optimal taxes.

```