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%Calculates optimal taxes as described in
%'Factor Income Taxation in a Horizontal Innovation Model'
%when sigma is bigger than one: the code can be used both for
changes in
%one parameter or for joint changes in parameters
clear all
disp('New')

gammab=0.02;%benchmark growth
gamma=0.02;%alternative growth
rhob=0.04;%benchmark rho
rho=0.03;%alternative rho

TransferstoGDPb = 0.25;% Share of transfers over GDP,
%R-E in the paper, benchmark.
TransferstoGDP=0;% alternative
GOVEXPToGDPb = 0.1;%Share of government expenditures over GDP,
%E in the paper, benchmark
GOVEXPToGDP = 0.2; %alternative
INTMratiob=0.45;%share of intermediates in production,
benchmark
INTMratio=0.5;%alternative
ab = INTMratiob^0.5;% alpha,benchmark
a=INTMratio^0.5;%alternative
Tb=(1-INTMratiob)*TransferstoGDPb; % t in the paper, benchmark
gb = (1-INTMratiob)*GOVEXPToGDPb;%g in the paper, benchmark
%g= (1-INTMratiob)*GOVEXPToGDP; % alternative
sb =1.5;% sigma in the paper,benchmark
s=3% alternative
%if we write for a parameter x xb=x here,chi and eta change
along x:
%so sensitivity will be for joint changes(as in table3).
%%%%%%this is to calculate chib and etab (benchmark chi and
eta).
tk0b=0.25;% initial capital tax rate, trb in the paper,
benchmark
tw0b = -ab*tk0b+(gb+Tb)/(1-ab);%initial labor tax rate, eq.
22,benchmark
r0b=(sb*gammab+rhob)/(1-tk0b);%initial interest rate,eq.
27,benchmark
L0b=0.17;%initial labor(consistent with tk0b)
C1b=r0b/L0b% C1 in the paper, eq.18, benchmark
etab=(1-ab)*ab^((1+ab)/(1-ab))/C1b% eta in the paper,eq.18,
benchmark
chilb=sb*(sb-1)*(1-L0b)*(1-tw0b)/ab;
chi2b=rhob/C1b+L0b*(tk0b-1+sb+sb/ab-sb*gb/(ab*(1-ab)));
chib=1+chilb/chi2b % chi in paper, eq. 45, benchmark

sb=s;
%rhob=rho;
%gb=g
%Tb=T;
%ab=a;
%if we write for a parameter x xb=x here we will do
sensitivity for this
%parameter only(as in table 2).

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%%%%Calculates initial labor consistent with the changed
parameters:
%%%%necessary if only one parameter changes (as in table 2)
tw0b = -ab*tk0b+(gb+Tb)/(1-ab)
LN=sb*(1-tw0b)*(sb-1)*(ab*(chib-1))^(1)- rhob/C1b;
LD=sb*(1-tw0b)*(sb-1)*(ab*(chib-1))^(1)+sb-1+tk0b+(sb/ab)*(1-
gb/(1-ab));
L0=LN./LD % calculates L for initial values of the tax rates,
eq.45
gamma0=((1-tk0b)*C1b*L0-rhob)/sb%gamma for initial values of
the tax rates,
%eq.27
Frisch=(1-L0)*sb/(L0*(sb+chib-1))%eq. 51
%Calculates optimal tax

t=-0.1:0.00001:0.9;%specifies admissible values of tax on
capital

tw=-ab*t+(gb+Tb)/(1-ab);% corresponding tw from eq. 22
LN=sb*(1-tw)*(sb-1)*(ab*(chib-1))^(1)- rhob/C1b;
LD=sb*(1-tw)*(sb-1)*(ab*(chib-1))^(1)+sb-1+t+(sb/ab)*(1-
gb/(1-ab));
L=LN./LD;%corresponding L, eq.45;

%%%%%%%%
r=C1b*L; %corresponding r
V1=(2-sb-chib)./(1-sb).*(1-L))-C1b*(1-t)./(C1b*L.*(1-
t)*(sb-1)+rhob);
V2=sb*(sb-1)*(1-L)/(1-chib)+L;
V3=(sb/ab)*(1-sb)*(1-tw)/(1-chib)-1+t+sb+(sb/ab)*(1-gb/(1-
ab));
V4= ab./(1-tw);
V5=-r./(r.*(1-t)*(sb-1)+rhob);
D=V1.*V2.*V3.^(-1)+V4+V5;%LHS of inequality in proposition 11,
eq.50
plot (t,D)%checks D is decreasing behavior

[v,i]=min (abs(D))%equates to zero LHS of inequality in prop.
11, eq.50

topt=t (i)%optimal capital tax
twopt=-ab*topt+(gb+Tb)/(1-ab)% optimal labor tax
Lopt=L(i)%optimal labor
gammaopt=(C1b*Lopt*(1-topt)-rhob)/sb%optimal growth
Wopt=(1-twopt)^(1-sb)*(1-Lopt)^(2-sb-
chib)*(C1b*Lopt*(sb-1)*(1-topt)+...
rhob)^(-1)/(1-sb);
%increasing transformation of welfare with opt taxes:
%with h=(1-L)^(1-chi), dropping positive constants
Frischopt=(1-Lopt)*sb/(Lopt*(sb+chib-1))%optimal Frisch
tw00=(gb+Tb)/(1-ab);% labor tax with no tax on capital

L00=L(1)%initial labor with no tax on capital
W00=(1-tw00)^(1-sb)*(1-L00)^(2-sb-chib)*(C1b*L00
*(sb-1)+rhob)^(-1)/(1-sb);

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%increasing transformation of welfare with zero tax on
capital:
diff=(Wopt-W00)/abs(W00)%gain in welfare from introducing
optimal capital
%tax starting from zero capital tax
R=topt/twopt%optimal tax ratio
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