```
function Ch16
% This program computes the steady state of our model with capital and
% linear taxes. The code examines the impact of changing the tax rate on
% labor and capital.



%%%%%%%%%%%%%%%%% Parameters %%%%%%%%%%%%%%%%%

gama = 0.5; % Frisch elasticity (1/gama) parameter for labor
% micro (0,0.5) macro (2,4)

g = .01; % growth rate of labor productivity

beta = 1/1.02; % discount rate given risk-free rate

alpha = 1/3; % capital's share

tau = g; % growth rate of money, inflation is 1+tau / 1+g

% Z has been normalized to 1.

delta = .08; % depreciation rate of capital

global Param

Param = [gama g beta tau alpha delta];

%%%%%%%%%%%%%%%%%%

OUTCOMES = []; % setting up storage matrix

for tK = [0:.05:.80];

    for tL = [0:.05:.80];

        EQout = EQ(tK,tL,gama,g,beta,tau,alpha,delta);
        OUTCOMES = [OUTCOMES; EQout']; % Eq outcomes for different taxes

    end;

end;


[Y,I] = max(OUTCOMES(:,9)) % gives the maximum Government Revenue and
% the row corresponding to that economy
disp('tK tL KL Lab Cons Inv LabT CapT LabT+CapT')

OUTCOMES(I,:)% equilibrium values for

%%%%%%%%%%%% Transformation to do the mesh figures %%%%%%%%%%%%

Labor=[];
Consumption=[];
Capital=[];
CapTax=[];
LabTax=[];
TotTax=[];
InstUtil=[];
```

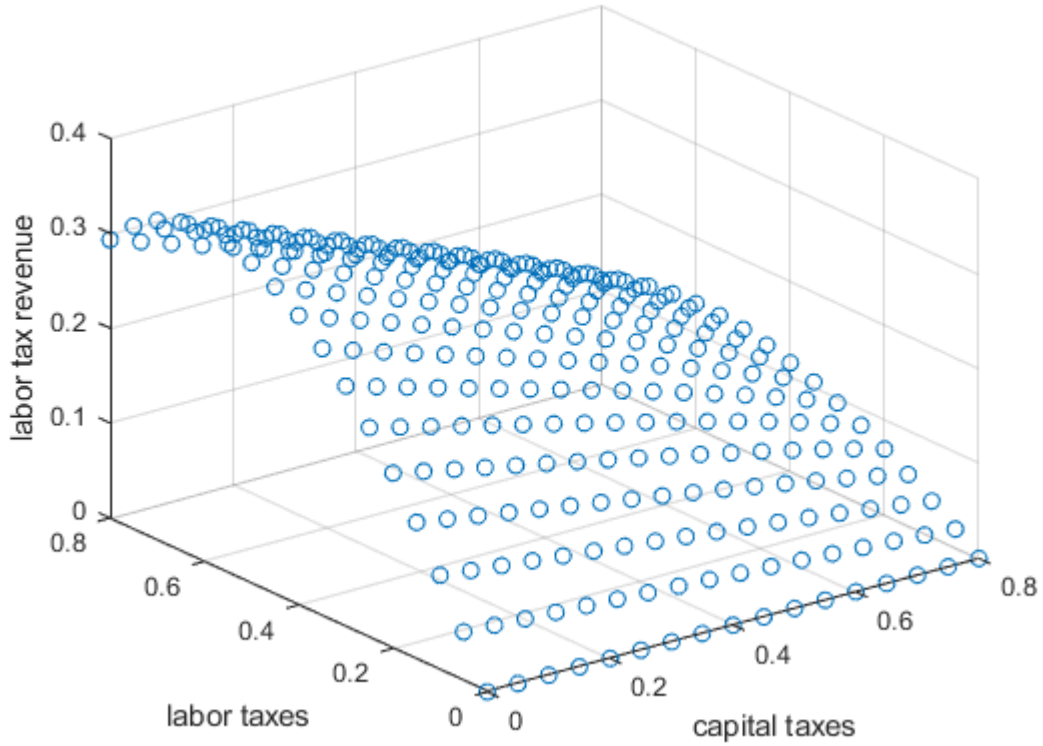
```
tK = [0:.05:.80];
tL = [0:.05:.80];

for i = 1:17

    for j = 1:17

        EQout = EQ(tK(i),tL(j),gama,g,beta,tau,alpha,delta);
        OUTCOMES = [OUTCOMES; EQout']; % Eq outcomes for different taxes
        Labor(i,j)=EQout(4);
        Consumption(i,j)=EQout(5);
        Capital(i,j)=EQout(3)*EQout(4);
        CapTax(i,j)=EQout(8);
        LabTax(i,j)=EQout(7);
        TotTax(i,j)=EQout(9);
        InstUtil(i,j)=log(EQout(5))-(EQout(4)^(1+gama))/(1+gama);

    end

end


%%%%%%%%%%%% Scatter Plots and Mesh Figures %%%%%%%%%%%%%%%

%%%%%%%%%%%% Laffer cost curves %%%%%%%%%%%%%%%%%%%%%%%%%

figure(1)
scatter3(OUTCOMES(:,1), OUTCOMES(:,2), OUTCOMES(:,7))
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('labor tax revenue')

figure(2)
mesh(tK,tL,LabTax')
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('labor tax revenue')

figure(3)
scatter3(OUTCOMES(:,1), OUTCOMES(:,2), OUTCOMES(:,8))
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('capital tax revenue')

figure(4)
mesh(tK,tL,CapTax')
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('capital tax revenue')

figure(5)
scatter3(OUTCOMES(:,1), OUTCOMES(:,2), OUTCOMES(:,9))
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('total tax revenue')

figure(6)
mesh(tK,tL,TotTax')
xlabel('capital taxes')
```

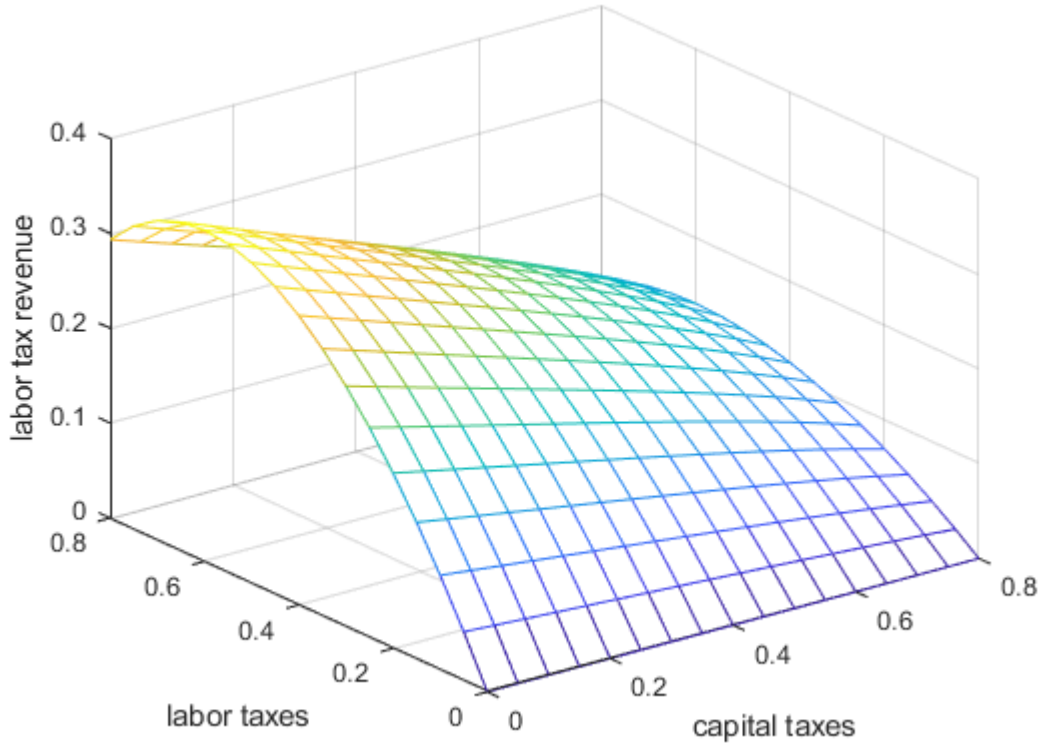
```
ylabel('labor taxes')
zlabel('total tax revenue')

%%%%%%%%%%%%% Mesh Figures %%%%%%%%%%%%%%%%%%
%%%%%%% Labor, Consumption and Capital %%%%%%%%


figure(7)
mesh(tK,tL,Labor')
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('Labor')

figure(8)
mesh(tK,tL,Consumption')
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('Consumption')

figure(9)
mesh(tK,tL,Capital')
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('Capital')

figure(10)
mesh(tK,tL,InstUtil')
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('Instant Utility')



%%%%%%%%%%%%% Efficient Taxation %%%%%%%%%%%%%%

% Here we fix G (Government Revenue from taxes) and then solve for the taxes that
% deliver this level while giving the highest consumption.
% Government consumption is zero (only have transfers)

EQout = EQ(.15,.15,gama,g,beta,tau,alpha,delta);

G = EQout(9);% total revenue from capital and labor taxes

Param = [Param G]; % increase the vector of parameters to 7 elements

CASE2 = [];% allocation memory
sol = .2; % initial value for the labor tax numerical optimization
options = optimoptions('fsolve','Display','none');

for tK = 0:0.05:0.75

    Param(8)=tK;% increase number of parameters to 8 elements

    sol = fsolve(@Rev,sol,options);% computes the tL for the exogenous tK and G

    tL = sol;

    EQout = EQ(tK,tL,gama,g,beta,tau,alpha,delta);
```

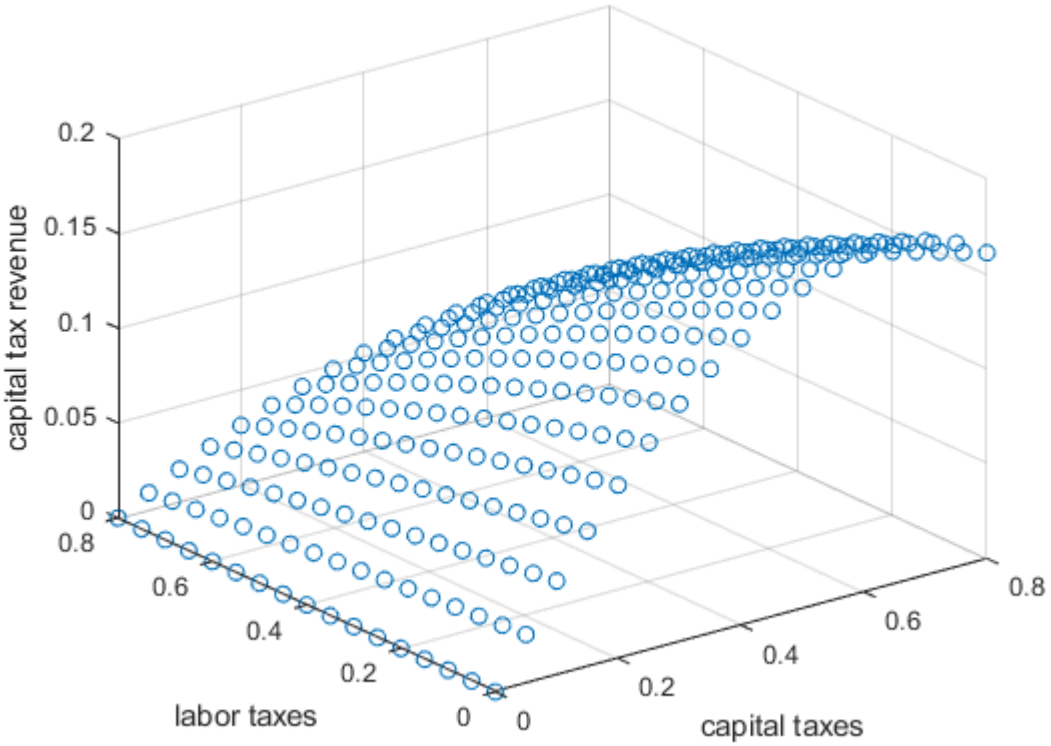
```
    CASE2 = [CASE2; EQout'];

end


figure(11)
scatter3(CASE2(:,1), CASE2(:,2), CASE2(:,5))
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('Consumption fixing Revenue')

figure(12)
scatter3(CASE2(:,1), CASE2(:,2), CASE2(:,4))
xlabel('capital taxes')
ylabel('labor taxes')
zlabel('Labor fixing Revenue')

%%%%%%%%%%%%%%% Adding in Waste %%%%%%%%%%%%%%%

disp('          Waste Special')
disp('_____________________________________')

disp('Here is the first case with no waste')

tK = 0.15; tL = 0.15;

Wout0 =  EQ(tK,tL,gama,g,beta,tau,alpha,delta);

Wout0 = [Wout0; 0];

disp(' ')

disp('Here is the second case with waste')
% Waste is 10 percent of total taxes without waste

WL = 0.1 * Wout0(9)/Wout0(4)*.99;  % this is ratio waste over labor
% adjusted downwards by 0.99 since L will be higher

KL = LabCap(tK,g,beta,alpha,delta)^(-1); % capital-to-labor ratio

C = KL^alpha - (g+delta)*KL - WL; % this is normalized consumption C/L from EQ 67.

I = (g+delta)*KL; % ditto for investment

    Factor = (beta/(1+tau))/C;

    Factor = Factor*(1-tL)*(1-alpha)*KL^alpha;

Lab = Factor^(1/(1+gama)); % this is the level of labor effort.

Cons = C*Lab; % level of consumption

Inv = I*Lab;  % level of output

Out =  Lab*KL^alpha; % this is the level of output

LabT = (1-alpha)*tL*Out; % labor tax revenue

CapT = alpha*tK*Out; % capital tax revenue
```

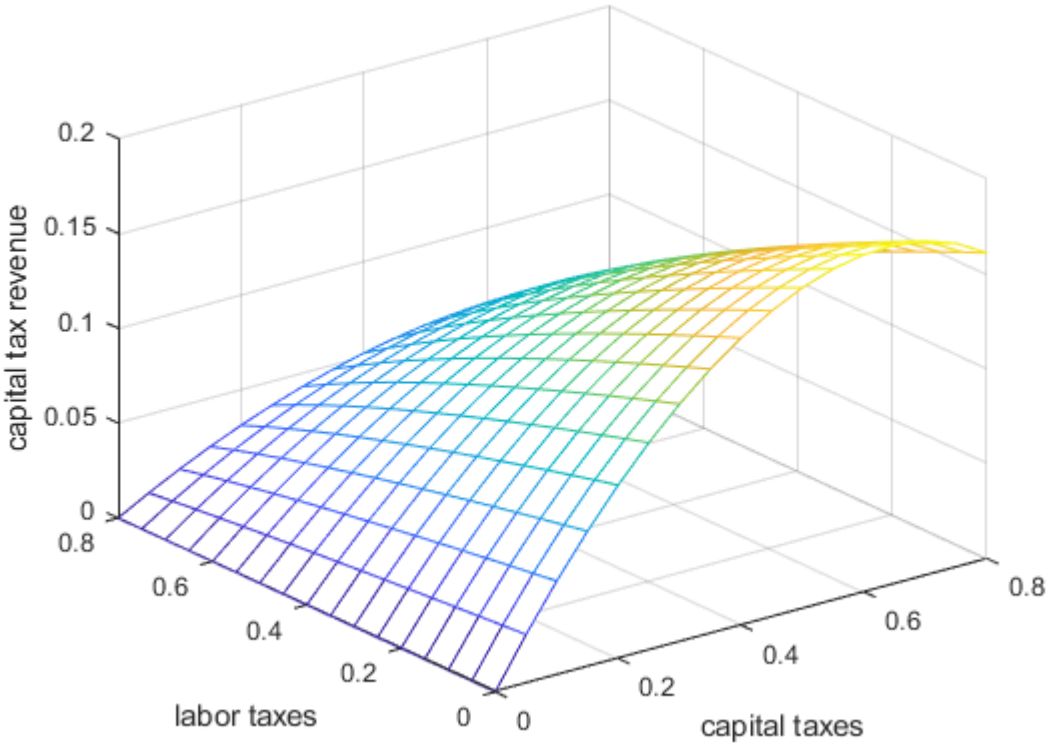
```
Waste = Out - Cons -Inv

Wout1 = [tK tL KL Lab Cons Inv LabT CapT LabT+CapT Waste]';

[Wout0 Wout1]

% with waste consumption is smaller and labor larger

end  % function close



%%%%%%%%%% Sub-Functions %%%%%%%%%%%%%%%%%%%

function LK = LabCap(tK,g,beta,alpha,delta)

LK = ( (1+g)/beta -1 +delta )/(alpha*(1-tK)); % this was fixed

LK = LK ^(1/(1-alpha)); % effective labor to capital ratio
                        % and labor to capital ratio given Z=1

end

function EQout = EQ(tK,tL,gama,g,beta,tau,alpha,delta)
% this function computes the equilibrium
KL = LabCap(tK,g,beta,alpha,delta)^(-1); % capital-to-labor ratio

C = KL^alpha - (g+delta)*KL; % this is normalized consumption C/L from EQ 67.

I = (g+delta)*KL; % ditto for investment

    Factor = (beta/(1+tau))/C;

    Factor = Factor*(1-tL)*(1-alpha)*KL^alpha;

Lab = Factor^(1/(1+gama)); % this is the level of labor effort.

Cons = C*Lab; % level of consumption

Inv = I*Lab;  % level of output

Out = Cons+Inv; % this is the level of output

LabT = (1-alpha)*tL*Out; % labor tax revenue

CapT = alpha*tK*Out; % capital tax revenue

EQout = [tK tL KL Lab Cons Inv LabT CapT LabT+CapT]';

end

function REVout = Rev(tL)

global Param   %Param = [gama g beta tau alpha delta]

gama = Param(1); g = Param(2); beta = Param(3); tau = Param(4);
alpha = Param(5); delta = Param(6); G = Param(7); tK = Param(8);
```

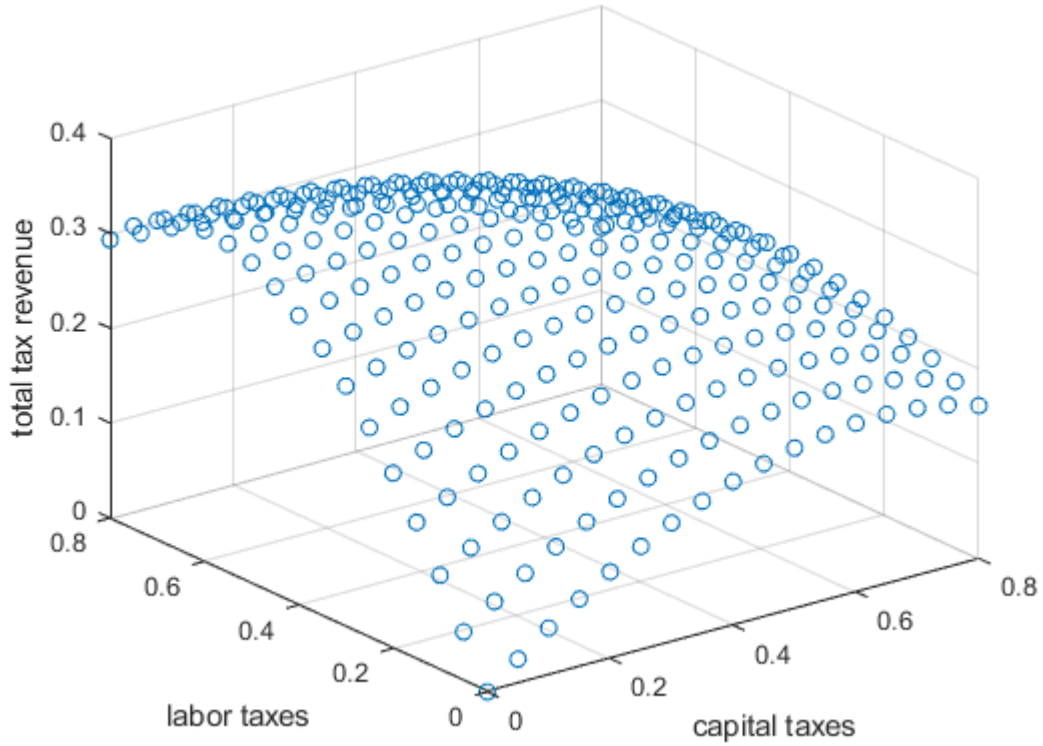
```
EQout = EQ(tK,tL,gama,g,beta,tau,alpha,delta);
%EQout = [tK tL KL Lab Cons Inv LabT CapT LabT+CapT]';

REVout = EQout(9) - G;

end
```

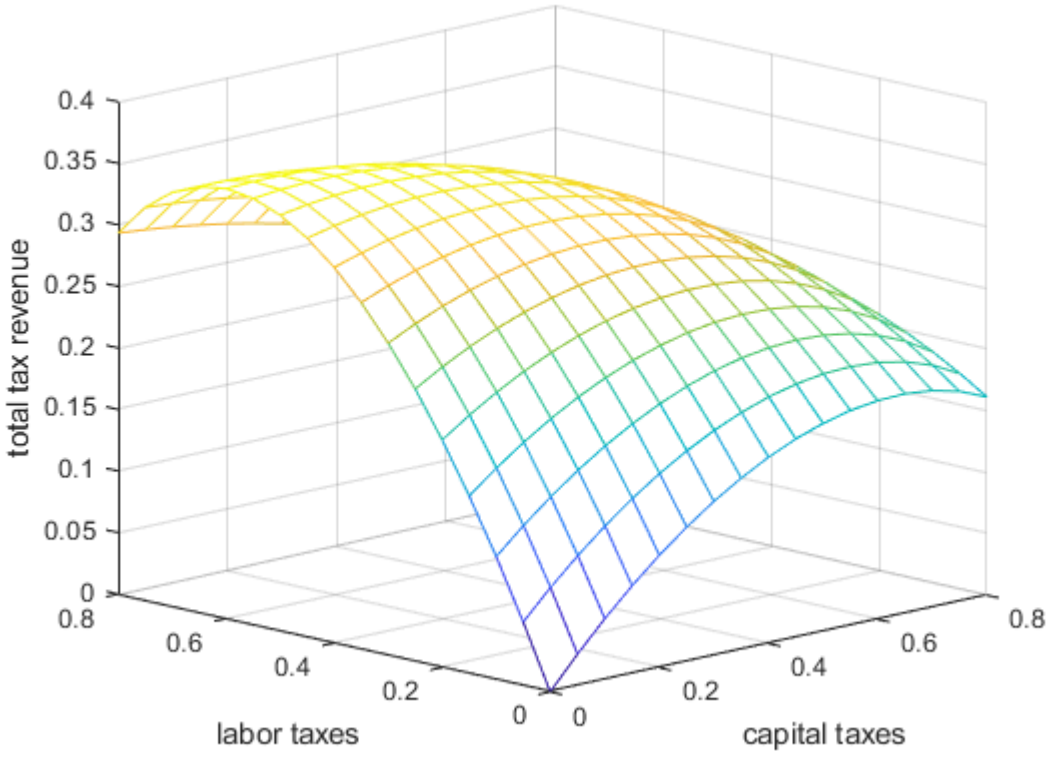

labor tax revenue
0.4
0.3
0.2
0.1
0
0.8
0.6
0.4
0.2
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes

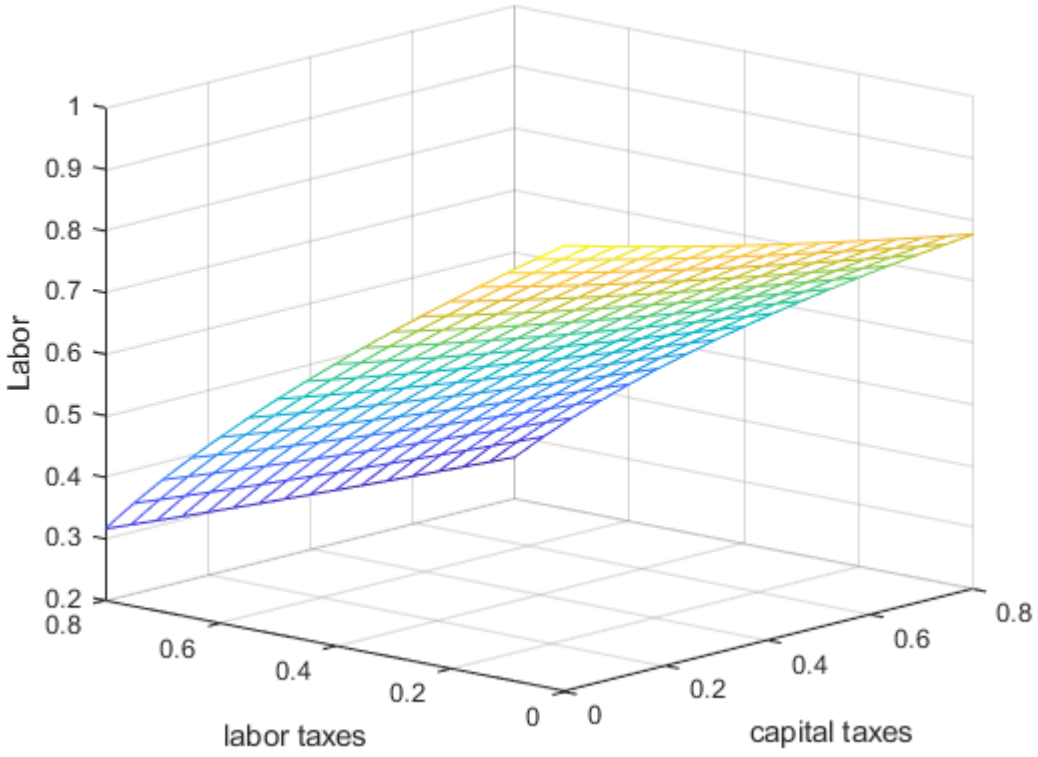

labor tax revenue
0.4
0.3
0.2
0.1
0
0.8
0.6
0.4
0.2
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes

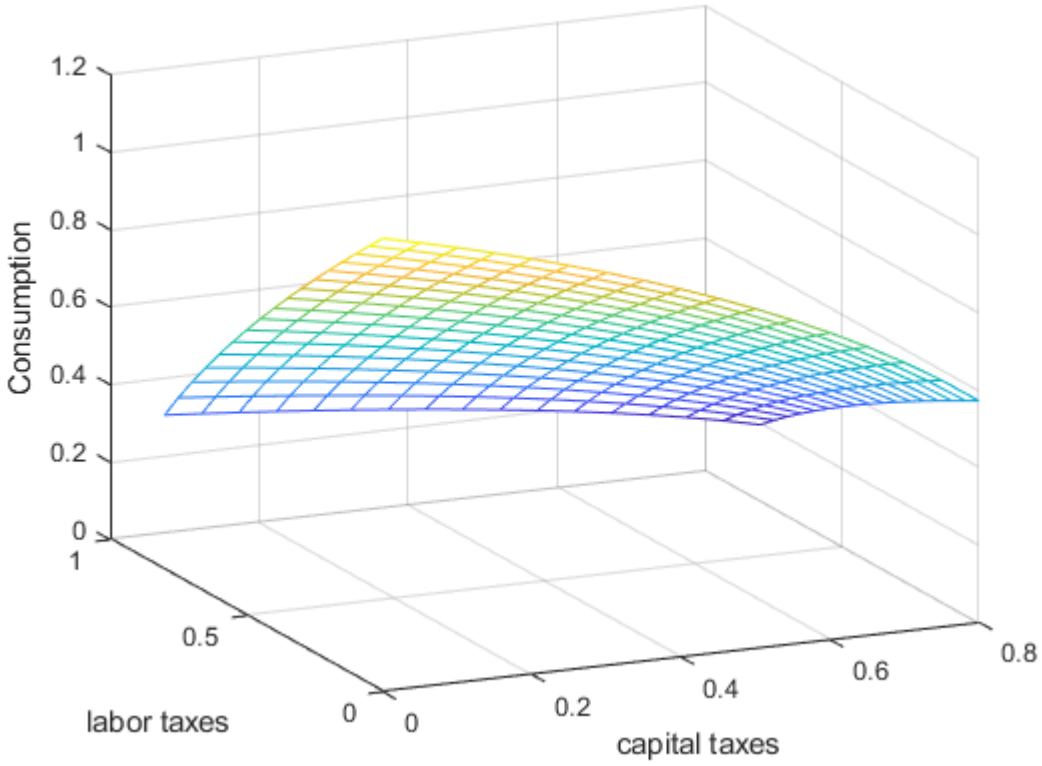

capital tax revenue
0.2
0.15
0.1
0.05
0
0.8
0.6
0.4
0.2
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes

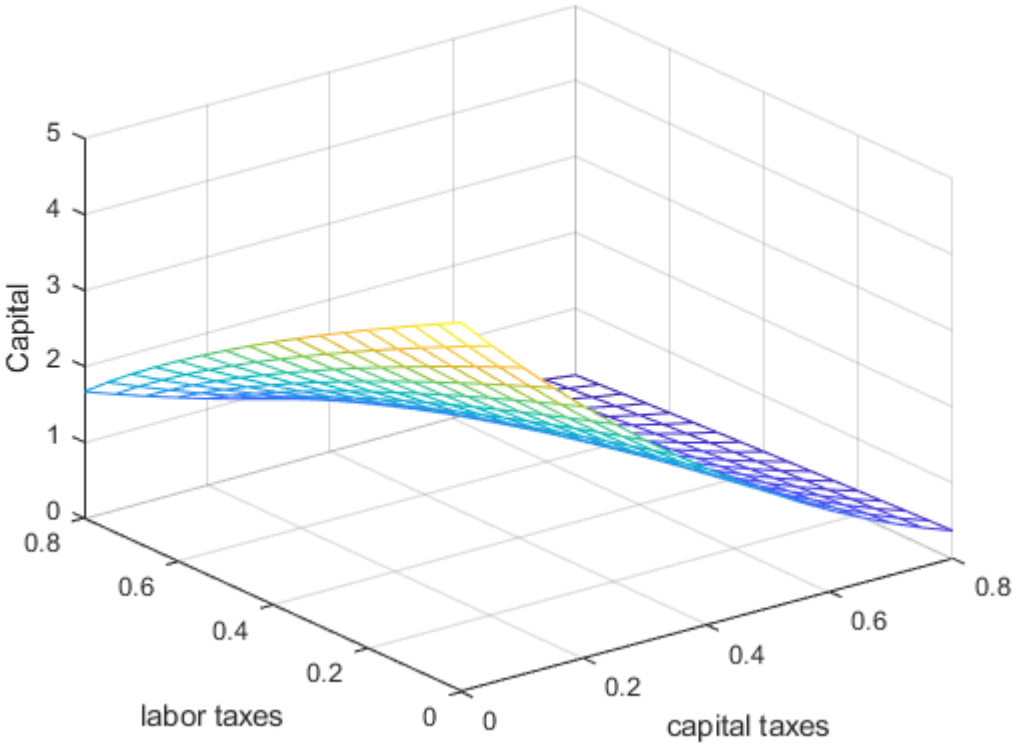

capital tax revenue
0.2
0.15
0.1
0.05
0
0.8
0.6
0.4
0.2
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes

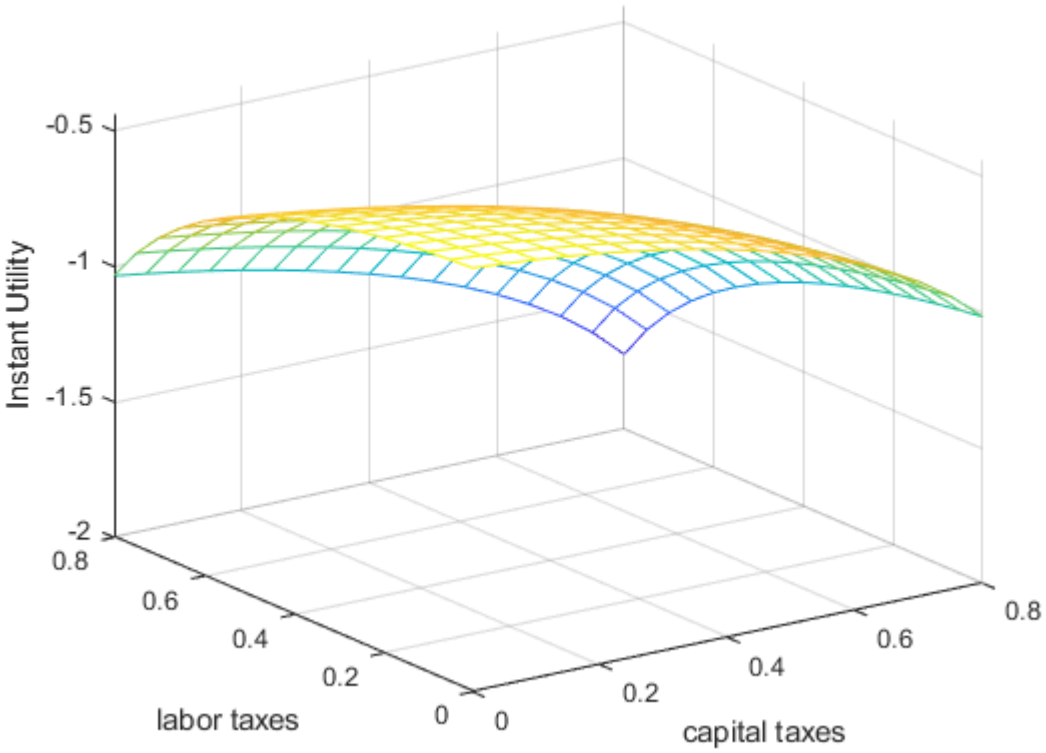

total tax revenue
0.4
0.3
0.2
0.1
0
0.8
0.6
0.4
0.2
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes

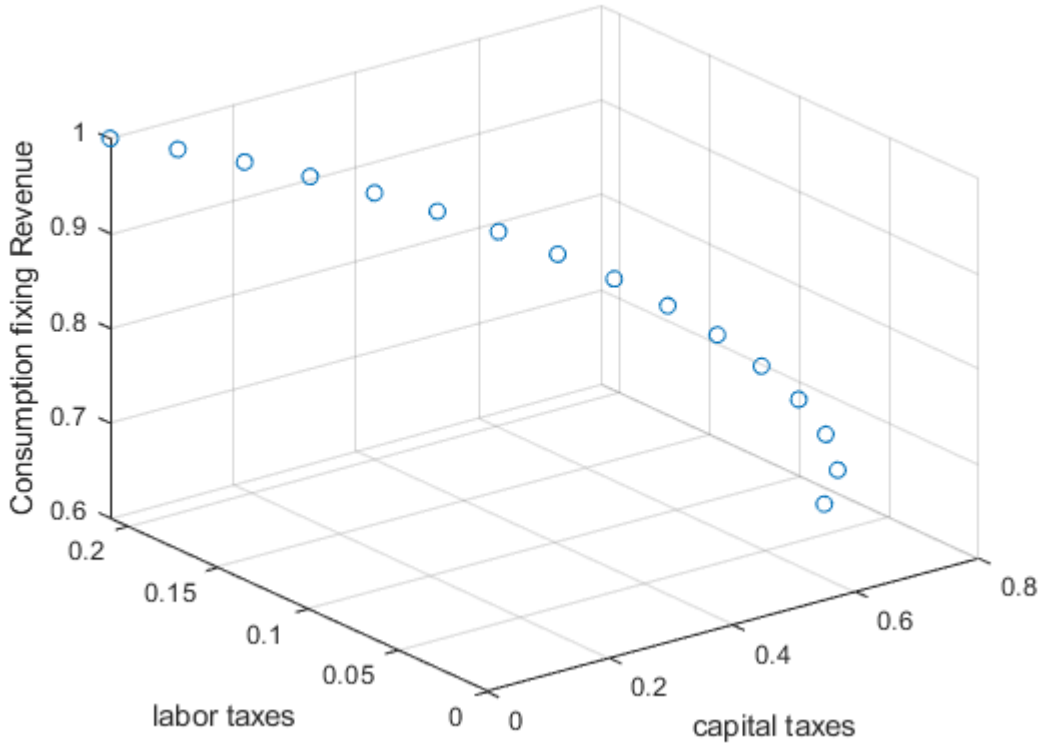

total tax revenue
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.8
0.6
0.4
0.2
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes

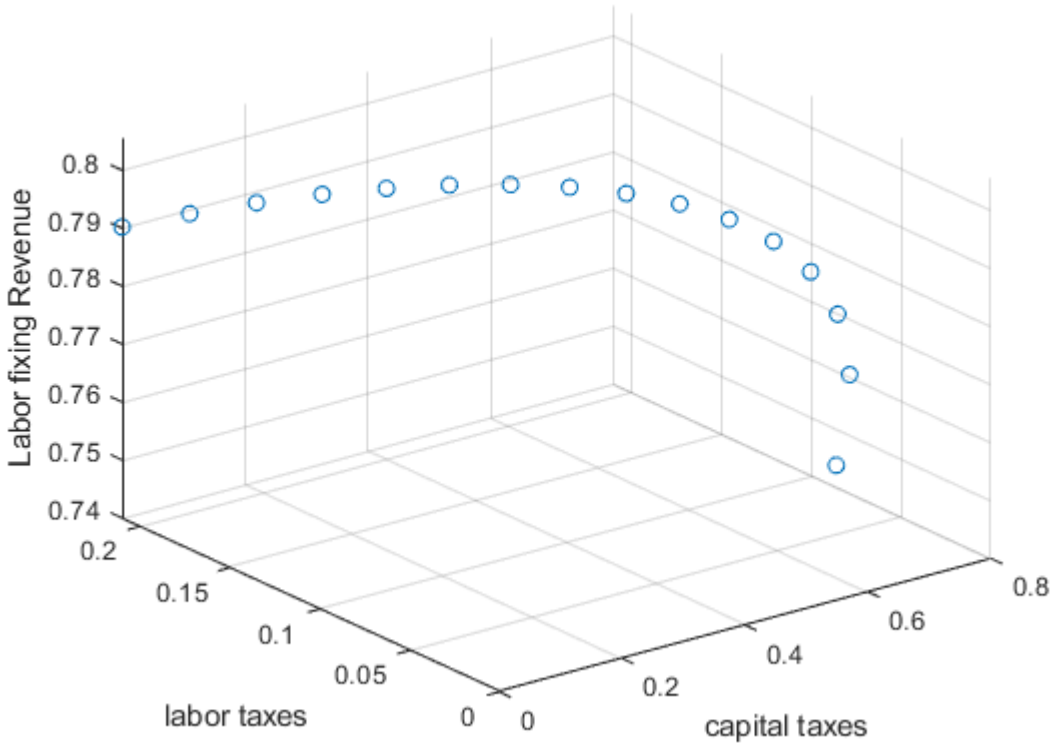

Labor
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.8
0.6
0.4
0.2
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes


Consumption
1.2
1
0.8
0.6
0.4
0.2
0
labor taxes
1
0.5
0
capital taxes
0
0.2
0.4
0.6
0.8


Capital
5
4
3
2
1
0
0.8
0.6
0.4
0.2
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes


-0.5
-1
-1.5
-2
Instant Utility
0.8
0.6
0.4
0.2
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes


Consumption fixing Revenue
1
0.9
0.8
0.7
0.6
0.2
0.15
0.1
0.05
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes


Labor fixing Revenue
0.8
0.79
0.78
0.77
0.76
0.75
0.74
0.2
0.15
0.1
0.05
0
labor taxes
0
0.2
0.4
0.6
0.8
capital taxes

```
>> Ch16a

Y =

    0.3502


I =

    47


ans =

    0.1000    0.6000    4.4917    0.4899    0.6102    0.1980    0.3233    0.0269↙
0.3502

          Waste Special
_____________________________________
Here is the first case with no waste

Here is the second case with waste

Waste =

    0.0193


ans =

    0.1500    0.1500
    0.1500    0.1500
    4.1226    4.1226
    0.8001    0.8106
    0.9860    0.9797
    0.2969    0.3007
    0.1283    0.1300
    0.0641    0.0650
    0.1924    0.1950
         0    0.0193

>>
```