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function CH6ans

% This function is designed to play around with simple AR1 process for g
% and tau and see what happens.

clc
clear all

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Part I: getting our shocks
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% x(t)=A*x(t-1) + B + C*epsilon(t)
% x(t)= [ tau(t), g(t) ]
% A = [ rho_tau,  0; 0, rho_g ]
% B = [B_tau, B_g ]
% C = [ delta_tau,  0; 0, delta_g ]

T = 100;  % length of time

TT = 10000; % number of random epsilon shocks we drew

EP = randn(TT,1); % randn generates values from a normal distribution with mean 0
%      and standard deviation 1

% Let's choose some basic moments for our model

mean_tau = .1; % so mean inflation is 10%

mean_g = .02; % so mean growth is 2%

rho_tau = 0.7;

rho_g = 0.95;

beta = 0.98; % 2 percent real interest rate

B_tau = mean_tau*(1 - rho_tau);

B_g = mean_g*(1 - rho_g);

C_tau = .007; % governs how volatile tau is

C_g = .007; % governs how volatile g is

vf = 1/ (1+.5);  % setting gamma = .5 so Frisch elasticity is 2

% We need to initialize our matrices of equilibrium variables
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% Generally good to use steady state values here

TAU = mean_tau;

G = mean_g;

Q = beta/(1+mean_tau);

L = (beta/(1+mean_tau))^vf;

P = 1;

M = 1;

Z = 1;

Y_level = Z(1)*L(1);

infl = (1+mean_tau)/(1+mean_g); %gross inflation rate

Y_gr = 1+mean_g; % gross output growth rate

for i=2:T

   ep_tau = randn; % drawing a standard normal with mean o and std 1

   tau = rho_tau*TAU(i-1)+B_tau+C_tau*ep_tau;

   TAU(i) = tau;

   ep_g = 0.5*randn; % generates values from a normal distribution with mean 0
%       and standard deviation .5

   g = rho_g*G(i-1)+B_g+C_g*ep_g;

   G(i) = g;

   L(i) = (beta/(1+tau))^vf;

   M(i) = M(i-1)*(1+tau);

   Z(i) = Z(i-1)*(1+g);

   Y_level(i) = Z(i)*L(i);

   P(i) = M(i-1)/Y_level(i);  % careful money at beginning of period here

   infl(i) = P(i)/P(i-1); % Gross growth rate of prices
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    Y_gr(i) = Y_level(i)/Y_level(i-1); % Gross growth rate of output

    newTau = rho_tau*tau+B_tau+C_tau*EP; % vector with dimension of TT reflecting distribution
of tau_{t+1}

    newTerm = beta./(1+newTau);

    Q(i) = mean(newTerm);


end

figure(1)
plot([1:T]',TAU','-b','LineWidth',3)
title('Money Growth Rates')
xlabel('Time')
ylabel('Growth Rates')

figure(2)
plot([1:T]',G','-b','LineWidth',3)
title('Productivity Growth Rates')
xlabel('Time')
ylabel('Growth Rates')

figure(3)
yyaxis left
plot([2:T]',P(2:T)','LineWidth',3)
yyaxis right
plot([2:T]', Y_level(2:T)','LineWidth',3)
xlabel('Time')
ylabel('Levels')
legend('Prices','Output')

figure(4)
yyaxis left
plot([2:T]',infl(2:T)','LineWidth',3)
yyaxis right
plot([2:T]',Y_gr(2:T)','LineWidth',3)
xlabel('Time')
ylabel('Growth Rates')
legend('Inflation','Output Growth')

figure(5)
plot([1:T]',Q','-b','LineWidth',3)
title('Interest Rates')
xlabel('Time')
ylabel('Rates')
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```
disp('Correlation between Money gr, Inflation, Y gr and Q')
corrcoef([1+TAU(2:T)' infl(2:T)' Y_gr(2:T)' Q(2:T)'])

% put everything here in gross growth terms so 1+tau
% dropped the first observation since not stochastic draw

disp('Correlation when we lag money growth one period')
corrcoef([1+TAU(1:T-1)' infl(2:T)' Y_gr(2:T)' Q(2:T)'])

% Note that the new money growth rate tau hits P_{t+1} through M so lag
% comes in too.


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Part 2: Correlations and Long-Run Growth rates
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%lrg_TAU = ((1+TAU(11:T))./(1+TAU(1:T-10))).^(1/10);

lrg_M = ((1+M(11:T))./(1+M(1:T-10))).^(1/10);

lrg_Y = (Y_level(11:T)./Y_level(1:T-10)).^(1/10);

lrg_P = (P(11:T)./P(1:T-10)).^(1/10);


disp('Correlation matrix for long-run growth money, growth output and inflation')

corrcoef([lrg_M' lrg_Y' lrg_P'])

% 10 year rolling windows


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Part 3: Simulation Panels
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

TT = 30; % Using TT now for the length of data in each country

for i = 1:T   % Using T for the number of countries 100 is pretty large

   % using p for panel. initializing matrix must do that for each year 1

   pTAU(1,i) = mean_tau;
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    pG(1,i) = mean_g;

    pLabor(1,i) = (beta/(1+mean_tau))^vf;

    pZ(1,i) = 1;

    pY(1,i) = pZ(1,i)*pLabor(1,i);

    Money(1,i) = 1;

    Prices(1,i) = Money(1,i)/pY(1,i);

    for j = 2:TT

        tau = rho_tau*pTAU(j-1,i)+B_tau+C_tau*randn;

        pTAU(j,i) = tau;

        pLabor(j,i) = (beta/(1+tau))^vf;

        g = rho_g*pG(j-1,i)+B_g+C_g*0.5*randn;

        pG(j,i) = g;

        pZ(j,i) = pZ(j-1,i)*(1+g);

        pY(j,i) = pZ(j,i)*pLabor(j,i);

        Money(j,i) = (1+tau)*Money(j-1,i);

        Prices(j,i) = Money(j-1,i)/pY(j,i);  % again money at beginning of period

    end

end

for i = 1:T

    lrg_TAU = ((1+pTAU(11:TT,i))./(1+pTAU(1:TT-10,i))).^(1/10);

    lrg_Money = ((1+Money(11:TT,i))./(1+Money(1:TT-10,i))).^(1/10);

    lrg_Y = (pY(11:TT,i)./pY(1:TT-10,i)).^(1/10);

    lrg_P = (Prices(11:TT,i)./Prices(1:TT-10,i)).^(1/10);

    A = corrcoef([lrg_Money lrg_P lrg_Y]);
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    PCORR_1(i) = A(1,2);

    PCORR_2(i) = A(1,3);

    PCORR_3(i) = A(2,3);

end



figure(6)
histogram(PCORR_1)
title('Histogram LR money growth vs. inflation')

figure(7)
histogram(PCORR_2)
title('Histogram LR money growth vs. output growth')

figure(8)
histogram(PCORR_3)
title('Histogram LR inflation vs. output growth')


end
```