```
clear
tic

%%%%%%%%%%%%%%%%%%%
%%% PARAMETERS %%%
%%%%%%%%%%%%%%%%%%%
beta = 0.96; %discount factor
gamma = 2; %inverse of intertemporal elasticity
y = [0.01;1]; %income
Z=[0.9; 1.1]; %TFP shoks
P_y=[0.8 0.2; 0.2 0.8];
P_Z=[0.9 0.1; 0.1 0.9];
bc = 0; %borrowing constraint
delta=1;
alpha=1/3;
N=300;
T=1000;
M=1000;

%%%%%%%%%%%
%%% SS %%%
%%%%%%%%%%%
P_Z_SS=P_Z^1000; %
Z_SS=P_Z_SS(1,:)*Z;
P_y_SS=P_y^1000; %
h_SS=P_y_SS(1,:)*y;
k_SS = h_SS*((1/beta-1+delta)/alpha/Z_SS)^(1/(alpha-1)); %capital in
↪ Ramsey SS

%%%%%%%%%%%%%
%%% GRID %%%
%%%%%%%%%%%%%
n_a=50;%n el on grid for assets
n_K=50;%n el on grid for capital
a_min = bc;
a_max = 10*k_SS;
K_min=0.8*k_SS;
K_max=2*k_SS;

g = (0:1/(n_a-1):1)';
a = a_min+(a_max-a_min)*g.^3; %grid of wealth
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gg=(0:1/(n_K-1):1)';
K = K_min+(K_max-K_min)*gg;

S = [kron(a,ones(4*n_K,1)) repmat(kron(y,ones(2*n_K,1)),n_a,1) repmat(kron(K,ones(2,1)), 2*n_a ,1) repmat(Z,n_a*2*n_K,1)]; %state space
n_s=size(S,1);% number of elements on grid
S_n=[repmat(kron([1;2],ones(2*n_K,1)),n_a,1) repmat([1;2],n_a*2*n_K,1)];

%%%%%%GUESS%%%%
b_ols=[0;1;0;1];
R_2=0;
tfp_n(1,1)=1;
emp_n(:,1)=randi(2,M,1);
cap_n(1,1)=n_K/2;
assets_n(:,1)=randi(n_a,M,1);
state=zeros(M,T);
while R_2<0.96
H=[exp(b_ols(1)) b_ols(2); exp(b_ols(3)) b_ols(4)];
K_f=H(S_n(:,2),1).*S(:,3).^H(S_n(:,2),2);
[~, ind_K]=min(abs(repmat(K_f,1,n_K)-repmat(K',n_s,1)),[],2);
J=[2*ind_K-1 2*ind_K 2*n_K+2*ind_K-1 2*n_K+2*ind_K];
P=zeros(n_s, 4*n_K);
for i=1:n_s
P(i,J(i,1:2))=P_y(S_n(i,1),1)*P_Z(S_n(i,2),:);
P(i,J(i,3:4))=P_y(S_n(i,1),2)*P_Z(S_n(i,2),:);
end

R=1-delta+alpha*S(:,4).*(h_SS./S(:,3)).^(alpha-1);
W=(1-alpha)*S(:,4).*(S(:,3)./h_SS).^alpha;


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%% SOLVING FOR VALUE FUNCTION %%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
c = repmat(R.*S(:,1)+W.*S(:,2),1,n_a)-repmat(a',n_s,1);
c = max(c,0); %consumption as function of a,a'
U = (c.^(1-gamma)-1)/(1-gamma); %utility on grid
V = zeros(n_s,1); %initial guess
for t=1:N
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V_old = V;
[V, I] = max(U+beta*P*reshape(V,4*n_K,n_a),[],2); %Bellman equation
error = max(abs((V-V_old)./V_old));
end
Savings = a(I);


%%%%%%Simulations%%%%%%%%
tfp_n(1,1)=1;
emp_n(1:M/2,1)=1;
emp_n(M/2+1:M,1)=2;
cap_n(1,1)=n_K/2;
assets_n(:,1)=n_a/2*ones(M,1);
state=zeros(M,T);
for t=1:T
state(:,t)=tfp_n(1,t)+2*(cap_n(1,t)-1)+2*n_K*(emp_n(:,t)-1)+4*n_K*(assets_n(:,t)-1); %current state of agents
assets_n(:,t+1)=I(state(:,t)); %evolutionof agents wealth
capital=mean(a(assets_n(:,t+1)));
[~, cap_n(1,t+1)]=min(abs(capital-K'));
x=rand(1,1); %evolution of tfp number
if x<P_Z(tfp_n(1,t),tfp_n(1,t));
tfp_n(1,t+1)=tfp_n(1,t);
else
tfp_n(1,t+1)=3-tfp_n(1,t);
end
x=rand(M,1); %evolution of h number
ind=find(P_y(emp_n(:,t),1)>x);
emp_n(:,t+1)=2;
emp_n(ind,t+1)=1;

end

%%%%%%%%%%%%%%%%%%%%
%%%OLS%%%
t=T/10;
b_old=b_ols;
cap=K(cap_n)'; %capital history
Y=log(cap(1,t+1:T+1))';
X(:,1)=2-tfp_n(1,t:T);
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```
X(:,2)=X(:,1).*log(cap(1,t:T))';
X(:,3)=tfp_n(1,t:T)-1;
X(:,4)=X(:,3).*log(cap(1,t:T))';
Y_hat=X*b_ols;
cc=cov(Y,Y_hat);
sst_Y=std(Y);
sst_Y_hat=std(Y_hat);
R_2=cc(1,2)/(sst_Y*sst_Y_hat)
b_ols=(X'*X)\(X'*Y)
b_ols=1/2*b_ols+0.5*b_old;
end
toc
```