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function [  ] = kaldor_phase_portrait(  )
%Written by Elmer G. Wiens June 2019
clear

syms y k

s = .2; d = .2; b = .5; i1 = 1; yd = 5; yk = 4; ti = 1.8; r = 1;
alpha = 8;ts = .6;

inv = r*tanh(b*(y - yk)) + ti - i1*k

sav = s * (y-yd)* k + ts

dep = d * k

dy = alpha*(inv - sav)

k1 = (r*tanh(b*(y - yk)) + ti - ts)/(i1 + s * (y-yd))

dk = inv - dep

k2 = (r*tanh(b*(y - yk)) +  ti) / (i1 +  d)

kdiff = k1 - k2

yt = double(solve(kdiff, 'y'))
kt1 = double(subs(k1, y, yt))
kt2 = double(subs(k2, y, yt))

yt = yt(1); kt1 = kt1(1)

J =[diff(dy, y), diff(dy, k); diff(dk, y), diff(dk, k)]

Jt = subs(J, y, yt)
Jt = double(subs(Jt, k, kt1))

p = double(trace(Jt))
q = double(det(Jt))
eggJt = eig(Jt)

Iy = diff(inv, y); Ik = diff(inv, k); Sy = diff(sav, y); Sk = diff(sav, k);

tIy = subs(Iy, y, yt); tIy = subs(tIy, k, kt1)
tIk = subs(Ik, y, yt); tIk = subs(tIk, k, kt1)
tSy = subs(Sy, y, yt); tSy = subs(tSy, k, kt1)
tSk = subs(Sk, y, yt); tSk = subs(tSk, k, kt1)

syms z
% z = alpha

tJ = [z*(tIy - tSy), z*(tIk - tSk); tIy, tIk - d]

p = trace(tJ)
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q = det(tJ)

figure(1);
hold on;

nxax = 0;pxax = 8; nyax = 0;pyax = 4 + 0.3;
axis([nxax pxax+1 nyax pyax])

plot(zeros(100),linspace(nyax,pyax), 'LineWidth',2)
plot(linspace(nxax,pxax+1),zeros(100), 'LineWidth',2)


title({'Kaldor Phase Portrait','dk/dt = 0: Blue,  dy/dt = 0: Red'},
'FontSize',15)
ylabel('k', 'FontSize',17)
xlabel('y', 'FontSize',17)

w = linspace(.1, pxax, 100);

for i=1:length(w)
    q1(i) = double(subs(k1, y, w(i)));
    q2(i) = double(subs(k2, y, w(i)));
end

plot(w,q1, 'r', 'LineWidth',3);
plot(w,q2, 'b', 'LineWidth',3);

line([0 4], [1.5 1.5], 'Color','green','LineWidth',2)
line([4 4], [0 1.5], 'Color','green','LineWidth',2)

line([3.25 4], [3 3], 'Color','black','LineWidth',2)
line([3.25 3.4], [3 3.05], 'Color','black','LineWidth',2)
line([3.25 3.4], [3 2.95], 'Color','black','LineWidth',2)

line([4 4], [3 2.5], 'Color','black','LineWidth',2)
line([4 3.9], [2.5 2.65], 'Color','black','LineWidth',2)
line([4 4.1], [2.5 2.65], 'Color','black','LineWidth',2)

line([0.2 0.95], [1.3 1.3], 'Color','black','LineWidth',2)
line([0.8 0.95], [1.35 1.3], 'Color','black','LineWidth',2)
line([0.8 0.95], [1.265 1.3], 'Color','black','LineWidth',2)

line([0.2 0.2], [1.3 0.8], 'Color','black','LineWidth',2)
line([0.1 0.2], [0.95 0.8], 'Color','black','LineWidth',2)
line([0.2 0.3], [0.8 0.95], 'Color','black','LineWidth',2)

line([5 5.75], [0.5 0.5], 'Color','black','LineWidth',2)
line([5.5 5.75], [0.55 0.5], 'Color','black','LineWidth',2)
line([5.5 5.75], [0.45 0.5], 'Color','black','LineWidth',2)

line([5 5], [0.5 1.0], 'Color','black','LineWidth',2)
line([4.9 5], [0.85 1.0], 'Color','black','LineWidth',2)
line([5.1 5], [0.85 1], 'Color','black','LineWidth',2)
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line([7.25 8], [1.7 1.7], 'Color','black','LineWidth',2)
line([7.25 7.4], [1.7 1.75], 'Color','black','LineWidth',2)
line([7.25 7.4], [1.7 1.65], 'Color','black','LineWidth',2)

line([8 8], [1.7 2.2], 'Color','black','LineWidth',2)
line([7.9 8], [2.05 2.2], 'Color','black','LineWidth',2)
line([8.1 8], [2.05 2.2], 'Color','black','LineWidth',2)
return
end
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