ECON 39: Undergraduate International Trade
Problem Set #5
Winter 2017, Professor Treb Allen
Due: Tuesday March 7 at the beginning of class

Preliminaries

This week, we are learning how to use our general equilibrium gravity trade model to analyze the welfare effects of trade policy in the real world. To do so, we are going to have to get our hands dirty with some actual data and some actual programming. The plan is to work through the majority of this problem set in class; however, you are ultimately responsible for turning in the solutions on the last day of class.

Questions

1. Install Matlab on your computer. To do so, go to: https://caligari.dartmouth.edu/downloads/matlab/

2. Download Econ39_Allen_PS5.m and Econ39_Allen_PS5.mat from the class website. Econ39_Allen_PS5.m is the computer program this problem set will rely upon and Econ39_Allen_PS5.mat is the trade data we will be using.

3. Open Econ39_Allen_PS5.m. Try to run it. You should get an error that says "Unexpected MATLAB operator." This is because I have replaced six key parts of the program with the symbols "???". Replace the "???" with the correct codes.

    - Please see the correct code (attached).

4. Explain in words how the algorithm on lines 35-41 works.

    - This is a "while loop" that continues as long as the difference between w_hat_0 and w_hat_1 ("diff") exceeds a small number ("tol"). We begin by guessing that w_hat_0 is one for all countries (i.e. wages do not change). Then lines 36 and 37 calculate what the equilibrium price index change and wage change in each country would be if all other country's wages did not change, giving us an updated guess of the wage change in each country ("w_hat_1"). Line 38 ensures that the normalization (that country 1's wage is equal to one) holds in our updated guess, and line 39 calculates the difference between our initial guess ("w_hat_0") and our updated guess ("w_hat_1"). Finally, line 40 updates our guess as a weighted average between our initial guess w_hat_0 and our new guess w_hat_1 (where "update" is the weight of the guess in the next iteration places on w_hat_1). The loop continues until our guess and updated guess converge to each other, at which point the equations will hold.

5. Calculate the welfare effects of a 40% increase in the cost of shipping a good from China to the U.S. and print out the scatter plot figure. Who is the biggest loser from the policy? Who is the biggest winner? What is the intuition?

    - See Figure 1. The biggest loser from this policy is China, as it finds it more costly to export its goods to the U.S.. (The U.S. is hurt too, as its consumers find goods from China more expensive). The biggest winner from this policy is Taiwan, who benefits from purchasing cheaper goods from China (since Chinese wages fall due to lower sales to the U.S.).

6. If the trade elasticity ε increased from 4 to 8, are the welfare effects larger or smaller? What is the intuition?

    - See Figure 2. If $\varepsilon = 8$, the welfare effects of the tariff are smaller, as trade flows respond more to the tariffs. One interpretation (from the Armington model) is that consumers now find goods more substitutable across countries, so the increase cost of goods from China does not affect welfare as much.

7. Suppose instead that the U.S. and Mexico engage in a trade war that makes it incredibly costly for either to trade with each other. Print out the picture of how this affects the welfare in all countries. Who is the biggest loser from the policy? Who is the biggest winner? What is the intuition? [Hint: Mexico is country 55 and the U.S. is country 89 in the data.]

   - See Figure 3. The biggest loser from the trade war is Mexico, with a welfare loss of over 3%. The U.S. loses as well, but to a much smaller extent; this is because the U.S. has many other important trading partners and the U.S. consumes more of its own production than Mexico does.

Figure 1: Change in welfare from a 40% tariff placed on China by the U.S. ($\varepsilon = 4$)

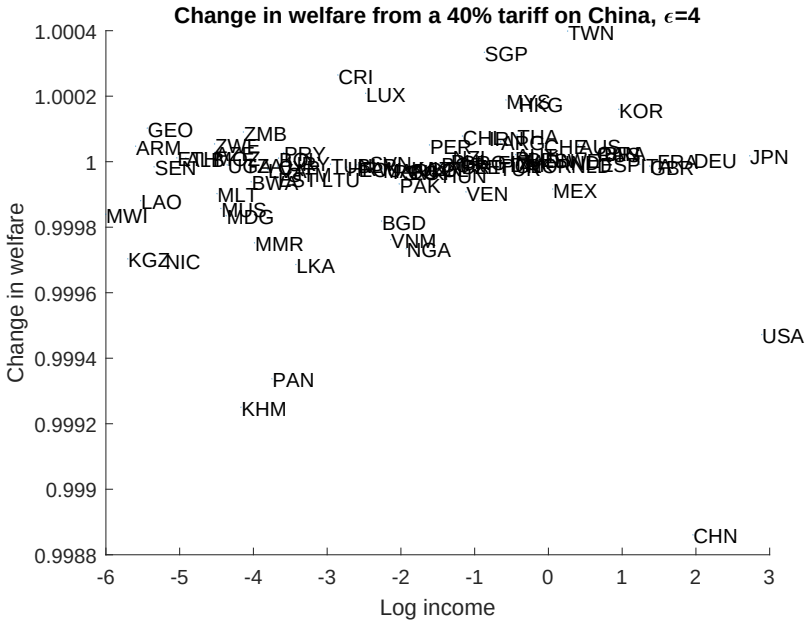

Figure 2: Change in welfare from a 40% tariff placed on China by the U.S. ($\varepsilon = 8$)

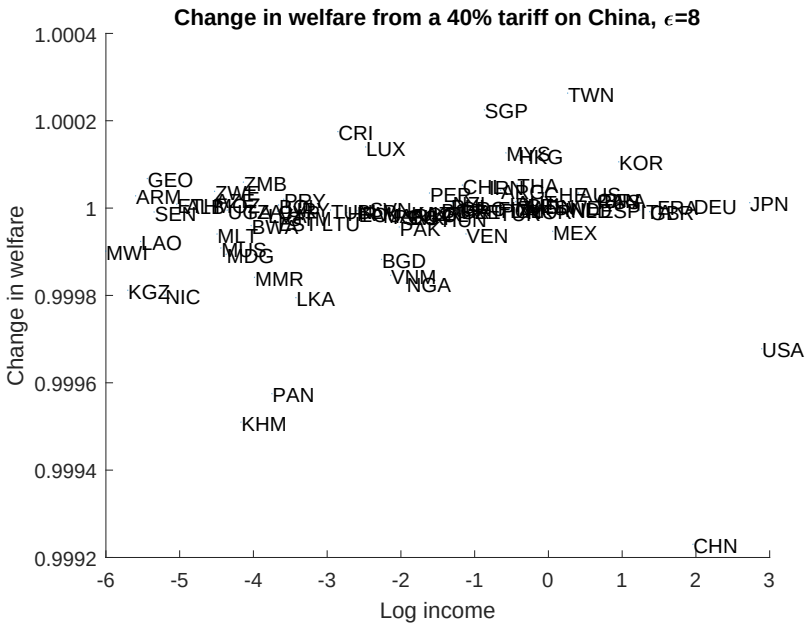

Figure 3: Change in welfare from a trade war between the U.S. and Mexico

```
% This m-file calculates the welfare effect of an arbitrary trade policy
% Econ 39 - Professor Treb Allen
% Winter 2017

clear % gets rid of all the data in memory
clc % gets rid of all previous commands on the screen
load Econ39_Allen_ps5.mat % loads the data

    % X is an NxN matrix of trade flows between the countries, with X(i,j)
    % being the trade from country i to country j

    % L is an Nx1 vector of populations between the countries (normalized
    % to have a mean of one)

    % N is the number of countries (N=94)

    % country is the list of the country names

% recovering income from the trade flow data
    Y = sum(X,2); % this is the income in each country

% here is our trade shock
    tau_hat = ones(N,N); % create an NxN matrix of ones
    tau_hat(17,89) = 1.4;
    % tau_hat(55,89) = 100; % trade costs from Mexico to U.S. to the U.S. increase by 10000%
    % tau_hat(89,55) = 100; % trade costs from U.S. to Mexico increase by 10000%

% here is our assumed trade elasticity
    epsilon = 8;

% we now calculuate the equilibrium change in wages in all locations

    w_hat_0 = ones(N,1); % this is our initial guess of the changes in wages
    diff = 1; % this is the variable that will check how close we are to the equilibrium
    tol = 0.0001; % this is the threshold at which we will say we are in an equilibrium
    update = 0.1;
```

```
    while diff>tol % continue to iterate until our diff < tol, at which point we will be in a solution
        P_hat = (sum((X'./(Y*ones(1,N))).*(tau_hat'.^-epsilon).*(ones(N,1)*(w_hat_0.^-epsilon)'),2)).^(-1/epsilon); %↙
equation for P_hat
        w_hat_1 = sum((X./(Y*ones(1,N))).*(tau_hat.^-epsilon).*((w_hat_0.^-epsilon)*ones(1,N)).*(ones(N,1)*((P_hat.↙
^epsilon).*w_hat_0)'),2); % the equation that must hold in equilibrium
        w_hat_1 = w_hat_1./w_hat_1(1); % we normalize the change in wages in country 1 to 1
        diff = sum(((w_hat_0 - w_hat_1).^2).^0.5) % diff measures how different our solution is from our initial↙
guess;
        w_hat_0 = (1-update)*w_hat_0 + update*w_hat_1; % updating our guess
    end

% here are the equilibrium values

    w_hat = w_hat_0; % equilibrium change in wages
    W_hat = w_hat ./ P_hat; % equilibrium change in welfare

% Plotting the change in welfare
    figure(1)
        clf % clears any previous figure
        scatter(log(Y),W_hat,0.01)
        title('Change in welfare from a 40% tariff on China, \epsilon=8')
        xlabel('Log income')
        ylabel('Change in welfare')
        text(log(Y),W_hat,country)
    print('Econ39_Allen_PS5_CHN_eps8.pdf','-dpdf')
```