ECON281A - Problem Set #3

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Question 1

CDP first replicate the procedure of ADH to idenfity the component of imports from China tht is driven by China. They estimate the regression:

$$\Delta M_{USA,j} = a_1 + a_2 \Delta M_{other,j} + u_j$$

where:

- j indexes 12 manufacturing sectors,
- $\Delta M_{USA,j}$ is the change in US imports from China in sector j,
- $\Delta M_{other,j}$ is the chnage in advanced economies' imports from China
- u_j is an unobserved error term.

To calibrate the China shock, CDP use $\Delta \hat{M_{USA,j}}$ predicted by the fitted regression above and back out the size of TFP changes for each manufacturing sector j:

$$A_{2007}^{CHINA,j} / A_{2000}^{CHINA,j}$$

such that the model-predicted imports match $\Delta \hat{M_{USA,j}}$.

In CDP's model, the counterfactuals are fed through the model using time-varying fundamentals denoted by Θ_t:

$$\Theta_t = (\{A_t^{nj}\}_{n=1,j=1}^{N,J}, \{\kappa_t^{nj,ij}\}_{n=1,i=1,j=1}^{N,N,J})$$

Hence, the alternative way to calibrate the China shock would be to back out the size of trade cost changes that match $\Delta \hat{M_{USA,j}}$:

$$\kappa_{2007}^{CHINA,j;USA,j} / \kappa_{2000}^{CHINA,j;USA,j}$$

Question 2

Definition: Given $(L_t, \Theta_t, \bar{\Theta})$, a **temporary equilibrium** is a vector of wages $w(L_t, \Theta_t, \bar{\Theta})$ that satisfies:

$$x_t^{nj} = B^{nj} \left((r_t^{nj})^{\xi^n} (w_t^{nj})^{1-\xi^n} \right)^{\gamma^{nj}} \prod_{k=1}^{J} (P_t^{nk})^{\gamma^{nj,nk}} \tag{1}$$

$$P_t^{nj} = \Gamma^{nj} \left(\sum_{i=1}^{N} (x_t^{ij} \kappa_t^{nj,ij})^{-\theta_j} (A_t^{ij})^{\theta_j \gamma_{ij}} \right)^{-\frac{1}{\theta_j}} \tag{2}$$

$$\pi_t^{nj,ij} = \frac{(x_t^{ij} \kappa_t^{nj,ij})^{-\theta_j} (A_t^{ij})^{\theta_j \gamma_{ij}}}{\sum_{m=1}^{N} (x_t^{mj} \kappa_t^{nj,mj})^{-\theta_j} (A_t^{mj})^{\theta_j \gamma_{mj}}} \tag{3}$$

$$X_t^{nj} = \sum_{k=1}^{J} \gamma^{nk,nj} \sum_{i=1}^{N} \pi_t^{ik,nk} X_t^{ik} + \alpha^j \left(\sum_{k=1}^{J} w_t^{nk} L_t^{nk} + \iota^n \chi_t \right) \tag{4}$$

$$w_t^{nj} L_t^{nj} = \gamma^{nj} (1 - \xi^n) \sum_{i=1}^{N} \pi_t^{ij,nj} X_t^{ij} \tag{5}$$

$$r_t^{nj} H^{nj} = \gamma^{nj} \xi^n \sum_{i=1}^{N} \pi_t^{ij,nj} X_t^{ij} \tag{6}$$

where $\chi_t = \sum_{i=1}^{N} \sum_{k=1}^{J} r_t^{ik} H^{ik}$ in (4).

Definition: Given $(L_t, \{\Theta_t\}_{t=0}^{\infty}, \bar{\Theta})$, a **sequential competitive equilibrium** is a sequence $\{L_t, \mu_t, V_T, w(L_t, \Theta_t, \bar{\Theta})_{t=0}^{\infty}\}$ that solves:

$$V_t^{nj} = U(C_t^{nj}) + \nu \log \left(\sum_{i=1}^{N} \sum_{k=0}^{J} \exp(\beta V_{t+1}^{ik} - \tau^{nj,ik})^{\frac{1}{\nu}} \right) \tag{7}$$

$$\mu_t^{nj,ik} = \frac{\exp(\beta V_{t+1}^{ik} - \tau^{nj,ik})^{\frac{1}{\nu}}}{\sum_{m=1}^{N} \sum_{h=0}^{J} \exp(\beta V_{t+1}^{mh} - \tau^{nj,mh})^{\frac{1}{\nu}}} \tag{8}$$

$$L_{t+1}^{nj} = \sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t^{ik,nj} L_t^{ik} \tag{9}$$

and the temporary equilibrium (1)-(6) at each t.

Question 2 (continued)

The system of equations for the numerical solution are:

For the **sequential competitive equilibrium**:

$$\mu_{t+1}^{nj,ik} = \frac{\mu_t^{nj,ik}(\dot{u}_{t+2}^{ik})^{\beta/\nu}}{\sum_{m=1}^{N}\sum_{h=0}^{J}\mu_t^{nj,mh}(\dot{u}_{t+2}^{mh})^{\beta/\nu}} \tag{10}$$

$$\dot{u}_{t+1}^{nj} = \dot{\omega}^{nj}(\dot{L}_{t+1}, \dot{\Theta}_{t+1})\left(\sum_{i=1}^{N}\sum_{k=0}^{J}\mu_t^{nj,ik}(\dot{u}_{t+2}^{ik})^{\beta/\nu}\right)^{\nu} \tag{11}$$

$$L_{t+1}^{nj} = \sum_{i=1}^{N}\sum_{k=0}^{J}\mu_t^{ik,nj}L_t^{ik} \tag{12}$$

For the **temporary equilibrium**:

$$\dot{x}_{t+1}^{nj} = (\dot{L}_{t+1}^{nj})^{\gamma^{nj}\xi^n}(\dot{w}_{t+1}^{nj})^{\gamma^{nj}}\prod_{k=1}^{J}(\dot{P}_t^{nk})^{\gamma^{nj,nk}} \tag{13}$$

$$\dot{P}_{t+1}^{nj} = \left(\sum_{i=1}^{N}\pi_t^{nj,ij}(\dot{x}_{t+1}^{ij}\dot{\kappa}_{t+1}^{nj,ij})^{-\theta_j}(\dot{A}_{t+1}^{ij})^{\theta_j\gamma_{ij}}\right)^{-\frac{1}{\theta_j}} \tag{14}$$

$$\pi_{t+1}^{nj,ij} = \pi_t^{nj,ij}\left(\frac{\dot{x}_{t+1}^{ij}\dot{\kappa}_{t+1}^{nj,ij}}{\dot{P}_{t+1}^{nj}}\right)(\dot{A}_{t+1}^{ij})^{\theta_j\gamma_{ij}} \tag{15}$$

$$X_{t+1}^{nj} = \sum_{k=1}^{J}\gamma^{nk,nj}\sum_{i=1}^{N}\pi_{t+1}^{ik,nk}X_{t+1}^{ik} + \alpha^j\left(\sum_{k=1}^{J}\dot{w}_{t+1}^{nk}\dot{L}_{t+1}^{nk}w_t^{nk}L_t^{nk} + \iota^n\chi_{t+1}\right) \tag{16}$$

$$\dot{w}_{t+1}^{nj}\dot{L}_{t+1}^{nj}w_t^{nj}L_t^{nj} = \gamma^{nj}(1-\xi^n)\sum_{i=1}^{N}\pi_{t+1}^{ij,nj}X_{t+1}^{ij} \tag{17}$$

where $\chi_{t+1} = \sum_{i=1}^{N}\sum_{k=1}^{J}\frac{\xi^n}{1-\xi^n}\dot{w}_{t+1}^{ik}\dot{L}_{t+1}^{ik}w_t^{ik}L_t^{ik}$ in (16)

Question 2 (continued)

We want to calibrate the following shock over 32 quarters between 1Q2000 and 4Q2007:

$$\frac{A_{2007}^{China,mfg}}{A_{2000}^{China,mfg}} = 44$$

Assume that $A_{2007}^{China,mfg} = 44$ and $A_{2000}^{China,mfg} = 1$ and interpolate between $t = 1$ and $t = 32$ to derive the growth rate $\dot{A}_{t+1} = \frac{A_{t+1}}{A_t} = 1.13$ (approximately 13% growth quarter-on-quarter for 31 quarters after quarter 1). Hence, consider a sequence of changes in fundamentals $\{\dot{\Theta}_t\}_{t=1}^{\infty} = \{\dot{A}_t, \dot{\kappa}_t\}_{t=1}^{\infty}$ and set $\dot{A}_t^{China,mfg} = 1.13$ for $t = 1, \ldots, 31$ and all other elements to 1.

Questions 3 and 4

See attached MATLAB code ("CDP_CODE.m"). I followed the code of the authors and calculated two versions of the baseline economy to perform the counterfactual analysis. I attempted to write my own code following the algorithm in Appendix D, but could not do the inversion for X_{t+1}^{nj} in Step 4c. My incomplete code is also attached ("CDP_INCOMPLETE.m").

Question 5

The results are summarized as follows:

Model	83%
Autor, Dorn & Hanson (2013)	5.0%
Adao, Arkolakis & Esposito (2019)	0.5%

Question 6

The alternative method to measure the impact of the China shock using the CDP method would be to consider a baseline economy with changing (rather than constant) fundamentals. To do so,

1. Calculate a baseline economy with additional data on actual changes in fundamentals over time that will comprise: (i) Gross migration flows between regions; (ii) Trade flows between regions; and (iii) Expenditures for each region.

2. Calculate the counterfactual economy where agents expected the the actual changes in fundamentals but the China shock **did not** happen, using the same calibration of the China shock as described above.