Replication File for the Quantification Results in "The Alibaba Effect: Spatial Consumption Inequality and Welfare Gains from E-Commerce" by Fan, Tang, Zhu and Zou

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1 Main programs

1. The Matlab program program1_calibration produces Table 6, Table 7 and Figure 1.
2. The Matlab program program2_validation produces the main data needed for Table 8. This program also prints the second row of Table 8. The STATA program Stata_program_validation produces Table 8, Figure D1 and Table D5.
3. The Matlab program program3_counterfactual produces Table 9, Figure 2, Figure 5 and Figure 6. It also produces the data for Table 10. The STATA program Stata_program_spatial_inequality produces Table 10,
4. The Matlab program program4_decomposition produces Figures 3 and 4.
5. Each of the matlab programs numbered 5a—5e produces a corresponding column for Table D6, Table D7 and Table D8.

2 User-define Matlab Functions used in the programs

- "Func_Solve_The_Model_v0:" main function for solving the model.
  - This main function takes three structures as inputs and returns a structure with market outcomes as output. The structure contain information on Parameters, TradeCosts and Options respectively. We update the Parameters, TradeCosts and Options structures during the calibration routines.

  - "Func_Solve_The_Model_Mute_v0:" performs the same task while displaying less output (used when matching city-specific nominal income with the data.).

- "Func_SolvingTwoEqm:" key function for the calibration routine. This function takes a vector and returns the value of the objective function.

- Func_Summarize_By_Groups: This function takes a variable vector and the population vector and returns the average by city size or market potential quintile

- Func_Summarize_By_Half: This function takes a variable vector and the population vector and returns the averages for observations above the median and below the median.

- "Func_v2struct:" collecting information to form structures and extracting information from structures.

3 Algorithm used in "Func_Solve_The_Model_v0:"

1. Guess P and Firm Mass.

2. Guess w, check labor clearing condition. Update w until labor market clears.

3. Check Free Entry Condition and Update P to P'. Stop when free entry condition is satisfied and $P = P'$

4. Compute model outcome of interest and collect them into a structure by calling the "Func_v2struct" function.

4 Key Quantities in "Func_Solve_The_Model_v0:".

1. Productivity Cutoff for setting up physically stores.

$$\phi^*_{ij} = \Big(\frac{\kappa^T \beta^T_j Y_j}{\sigma^T w_j f^P}\Big)^{\frac{1}{1-\sigma^T}} \frac{1}{P^T_j} \cdot w_i \Big[\Big(\sum_{m\in\{P,E\}} (\tau^m_{ij})^{-\theta^T}\Big)^{-\frac{1-\sigma^T}{\theta^T}} - (\tau^E_{ij})^{1-\sigma^T}\Big]^{\frac{1}{1-\sigma^T}}$$

This equation is reflected in the matlab code as the following.

$$\underbrace{\phi^*_{ij}}_{phi\_off\_temp} = \underbrace{\Big(\frac{\kappa^T}{\sigma^T}\Big)^{\frac{1}{1-\sigma^T}}}_{ConstantTerm} \underbrace{\Big(\frac{\beta^T_j Y_j}{w_j f^P}\Big)^{\frac{1}{1-\sigma^T}} \frac{1}{P^T_j}}_{DestinationTerm} \cdot w_i \underbrace{\Big[\Big(\sum_{m\in\{P,E\}} (\tau^m_{ij})^{-\theta^T}\Big)^{-\frac{1-\sigma^T}{\theta^T}} - (\tau^E_{ij})^{1-\sigma^T}\Big]^{\frac{1}{1-\sigma^T}}}_{DifferenceTerm}$$

2. Labor Clearing Conditions. $L_i = L^T_i + L^{NT}_i$

$$L^T_i = \underbrace{M^T_i \sum_{j=1}^{N} \Big(\int_{\underline{\phi}}^{\phi^*_{ij}} \frac{\sigma^T - 1}{\sigma^T} \frac{s^{ON}_{ij}(\phi)}{w_i} dF_i(\phi) + \int_{\phi^*_{ij}}^{\infty} \frac{\sigma^T - 1}{\sigma^T} \frac{s^{TC}_{ij}(\phi)}{w_i} dF_i(\phi)\Big)}_{\text{labor used as variable production cost}}$$

$$+ \underbrace{f^P \sum_{j=1}^{N} M^T_j \int_{\phi^*_{ji}}^{\infty} dF_i(\phi)}_{\text{labor used in setting up physical stores}} + \underbrace{M^T_i F_{Entry}}_{\text{labor used in firm entry}} .$$

where the revenue functions for Online-Only and Two-Channel firms are given by

$$s^{ON}_{ij}(\phi) = \frac{\beta^T_j Y_j \kappa^T w_i^{1-\sigma^T}}{(P^T_j)^{1-\sigma^T}} \big(\tau^E_{ij}\big)^{1-\sigma^T} \phi^{\sigma^T - 1},$$

and

$$s_{ij}^{TC}(\phi) = \frac{\beta_j^T Y_j \kappa^T w_i^{1-\sigma^T}}{(P_j^T)^{1-\sigma^T}} \Big(\sum_{m\in\{P,E\}} (\tau_{ij}^m)^{-\theta^T} \Big)^{-\frac{1-\sigma^T}{\theta^T}} \phi^{\sigma^T-1}.$$

To implement the labor demand equation in Matlab, we have

$$\begin{aligned} L_i^T =& \frac{\sigma^T-1}{\sigma^T}\kappa^T M_i^T w_i^{-\sigma^T} \underbrace{\sum_{j=1}^N \Big(\int_{\underline{\phi}}^{\phi_{ij}^*} (\tau_{ij}^E)^{1-\sigma^T} \phi^{\sigma^T-1} dF_i(\phi) + \int_{\phi_{ij}^*}^{\infty} \Big(\sum_{m\in\{P,E\}} (\tau_{ij}^m)^{-\theta^T} \Big)^{-\frac{1-\sigma^T}{\theta^T}} \phi^{\sigma^T-1} dF_i(\phi) \Big)}_{MatrixO} \cdot \underbrace{\frac{\beta_j^T Y_j}{(P_j^T)^{1-\sigma^T}}}_{DestinationTerm2} \\ &+ \underbrace{f^P \sum_{j=1}^N M_j^T \int_{\phi_{ji}^*}^{\infty} dF_i(\phi)}_{FixedCost.*(Prob-diag(ones(N,1)))'*FirmMass\_ini(:,2)} + \underbrace{M_i^T F_{Entry}}_{EntryCost*FirmMass(:,2)} . \end{aligned}$$

where $MatrixO$ is written as the following

$$\begin{aligned} MatrixO =& \sum_{j=1}^N \Big(\int_{\underline{\phi}}^{\phi_{ij}^*} (\tau_{ij}^E)^{1-\sigma^T} \phi^{\sigma^T-1} dF_i(\phi) + \int_{\phi_{ij}^*}^{\infty} \Big(\sum_{m\in\{P,E\}} (\tau_{ij}^m)^{-\theta^T} \Big)^{-\frac{1-\sigma^T}{\theta^T}} \phi^{\sigma^T-1} dF_i(\phi) \Big) \\ =& \frac{\alpha^T}{\sigma^T-\alpha^T-1} \sum_{j=1}^N \Big(\underbrace{(\tau_{ij}^E)^{1-\sigma^T} [\underline{\phi}^{\alpha^T} \phi_{ij}^{\sigma^T-\alpha^T-1} - \underline{\phi}^{\sigma^T-1}]}_{TempTermA} - \underbrace{\Big(\sum_{m\in\{P,E\}} (\tau_{ij}^m)^{-\theta^T} \Big)^{-\frac{1-\sigma^T}{\theta^T}} \underline{\phi}^{\alpha^T} \phi_{ij}^{\sigma^T-\alpha^T-1}}_{TempTermB} \Big) \end{aligned}$$

Total labor demand from the nontradeable sector in city i, L_i^{NT}, is

$$L_i^{NT} = \underbrace{M_i^{NT} \int_{\underline{\phi}}^{\infty} \frac{\sigma^{NT}-1}{\sigma^{NT}} \frac{s_i^{NT}(\phi)}{w_i} dF_i(\phi)}_{\text{labor used as variable production cost}} + \underbrace{M_i^{NT} F_{Entry}}_{\text{labor used in firm entry}}$$

where

$$s^{NT}(\phi) = \frac{\beta_i^{NT} Y_i \kappa^{NT} w_i^{1-\sigma^T}}{(P_i^{NT})^{1-\sigma^{NT}}} \phi^{\sigma^{NT}-1}.$$

Therefore, the labor demand function for Non-tradeable sector is implemented as

$$L_i^{NT} = \underbrace{\int_{\underline{\phi}}^{\infty} \frac{\sigma^{NT}-1}{\sigma^{NT}} \frac{\beta_i^{NT} \kappa^{NT}}{(P_i^{NT})^{1-\sigma^{NT}}} \phi^{\sigma^{NT}-1} dF_i(\phi) M_i^{NT}}_{LaborTerm1} w_i^{-\sigma^T} Y_i + \underbrace{F_{Entry} M_i^{NT}}$$

3. Expected Profit from Firm Entry

$$
\begin{aligned}
\underbrace{E(\pi^T)}_{pi(:,2)} &= \sum_{j=1}^{N} \Big[\int_{\underline{\phi}}^{\phi^*_{ij}} \pi^{ON}_{ij}(\phi) dF_i(\phi) + \int_{\phi^*_{ij}}^{\infty} (\pi^{TC}_{ij}(\phi) - f^P w_j) dF_i(\phi) \Big] \\
&= \sum_{j=1}^{N} \Big[\int_{\underline{\phi}}^{\phi^*_{ij}} \frac{1}{\sigma^T} s^{ON}_{ij}(\phi) dF_i(\phi) + \int_{\phi^*_{ij}}^{\infty} (\frac{1}{\sigma^T} s^{TC}_{ij}(\phi) - f^P w_j) dF_i(\phi) \Big] \\
&= \frac{\kappa^{NT}}{\sigma^{NT}} \underbrace{w_i^{1-\sigma^T}}_{OriginTerm2} \sum_{j=1}^{N} \underbrace{\Big(\int_{\underline{\phi}}^{\phi^*_{ij}} \big(\tau^E_{ij}\big)^{1-\sigma^T} \phi^{\sigma^T - 1} dF_i(\phi) + \int_{\phi^*_{ij}}^{\infty} \big(\sum_{m \in \{P,E\}} (\tau^m_{ij})^{-\theta^T} \big)^{-\frac{1-\sigma^T}{\theta^T}} \phi^{\sigma^T - 1} dF_i(\phi) \Big)}_{MatrixO} \\
&\quad \cdot \underbrace{\frac{\beta^T_j Y_j}{{P^T_j}^{1-\sigma^T}}}_{DestinationTerm2} \underbrace{- f^P \sum_{j=1}^{N} \int_{\phi^*_{ij}}^{\infty} dF_i(\phi) w_j}_{TotalFixedCost}
\end{aligned}
$$

and

$$
\begin{aligned}
\underbrace{E(\pi^{NT})}_{pi(:,1)} &= \int_{\underline{\phi}^{NT}}^{\infty} \pi_j^{NT}(\phi) dF_i(\phi) \\
&= \int_{\underline{\phi}^{NT}}^{\infty} \frac{1}{\sigma^{NT}} s_j^{NT}(\phi) dF_i(\phi) \\
&= \int_{\underline{\phi}^{NT}}^{\infty} \frac{1}{\sigma^{NT}} \frac{\beta_i^{NT} Y_i \kappa^{NT} w_i^{1-\sigma^T}}{(P_i^{NT})^{1-\sigma^{NT}}} \phi^{\sigma^{NT}-1} dF_i(\phi) \\
&= \underbrace{\frac{\kappa^{NT}}{\sigma^{NT}} \int_{\underline{\phi}^{NT}}^{\infty} \phi^{\sigma^{NT}-1} dF_i(\phi) \frac{w_i^{1-\sigma^T} \beta_i^{NT}}{(P_i^{NT})^{1-\sigma^{NT}}} Y_i}_{PiConstantNT}
\end{aligned}
$$

4. The price index for the tradeable sector in region j is

$$
\begin{aligned}
(P_j^T)^{1-\sigma^T} &= \int_{\Omega_j^T} (p_j(w))^{1-\sigma^T} dv \\
&= \sum_{i=1}^{N} M_i^T \Big[\int_{\underline{\phi}}^{\phi_{ij}^*} (p_{ij}^{ON}(\phi))^{1-\sigma^T} dF_i(\phi) + \int_{\phi_{ij}^*}^{\infty} (p_{ij}^{TC}(\phi))^{1-\sigma^T} dF_i(\phi) \Big].
\end{aligned}
$$

where

$$
p_{ij}^{TC}(\phi) = \frac{\kappa^{T\,\frac{1}{1-\sigma^T}} w_i}{\phi} \Big(\sum_{m \in \{P,E\}} (\tau_{ij}^m)^{-\theta^T} \Big)^{-\frac{1}{\theta^T}},
$$

and

$$
p_{ij}^{ON}(\phi) = \frac{\kappa^{T\,\frac{1}{1-\sigma^T}} w_i \tau_{ij}^E}{\phi}.
$$

This is implemented in the Matlab code as the following

$$
\begin{aligned}
(P_j^T)^{1-\sigma^T} &= \int_{\Omega_j^T} (p_j(w))^{1-\sigma^T} dw \\
&= \sum_{i=1}^{N} M_i^T \Big[\int_{\underline{\phi}}^{\phi_{ij}^*} \Big(\frac{\kappa^{T\frac{1}{1-\sigma^T}} w_i \tau_{ij}^E}{\phi}\Big)^{1-\sigma^T} dF_i(\phi) + \int_{\phi_{ij}^*}^{\infty} \Big(\frac{\kappa^{T\frac{1}{1-\sigma^T}} w_i}{\phi} \Big(\sum_{m\in\{P,E\}} (\tau_{ij}^m)^{-\theta^T} \Big)^{-\frac{1}{\theta^T}} \Big)^{1-\sigma^T} dF_i(\phi) \Big] \\
&= \kappa^T \sum_{i=1}^{N} \underbrace{\Big[{\tau_{ij}^E}^{1-\sigma^T} \int_{\underline{\phi}}^{\phi_{ij}^*} (\phi)^{\sigma^T-1} dF_i(\phi) + \Big(\sum_{m\in\{P,E\}} (\tau_{ij}^m)^{-\theta^T} \Big)^{-\frac{1-\sigma^T}{\theta^T}} \int_{\phi_{ij}^*}^{\infty} (\phi)^{\sigma^T-1} dF_i(\phi) \Big]}_{(MatrixO)'} \underbrace{M_i^T (w_i)^{1-\sigma^T}}_{OriginTerm}.
\end{aligned}
$$

Similarly, making use of $p_i^{NT}(\phi) = \frac{(\kappa^{NT})^{\frac{1}{1-\sigma^{NT}}} w_i}{\phi}$, the price index for the tradeable sector in region j is

$$
\begin{aligned}
(P_j^{NT})^{1-\sigma^{NT}} &= M_j^{NT} \int^{\infty} (p_j^{NT}(w))^{1-\sigma^{NT}} dw \\
&= \underbrace{-\kappa^{NT} \frac{\alpha^{NT}}{\sigma^{NT} - \alpha^{NT} - 1} \underline{\phi}^{\sigma^{NT}-1} M_j^{NT} w_i^{1-\sigma^{NT}}}_{P\_power\_ini(:,1)}.
\end{aligned}
$$