Bargaining and Welfare: A Dynamic Structural Analysis

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Presented by Yao Yao
Why important

- The cost or benefit of informal market institution?
- Bargaining: high transaction costs & reduce trade?
- Efficient means of bilateral price discrimination?
- Fixed Price: easy, clear?
- Inefficient?
- Which is better?
What the story is about

- Autorickshaw market in Jaipur, India
- 2008.1-2009.1 survey data about the offer, time duration and other characteristics
How the Story is Told

what we focus on

Entering buyers draw types
Matching occurs
Matched traders
Sellers’ types realized

Unmatched traders go to next period
Trade does not occur
Both go to next period
Seller goes to next period
Buyer exits

Discounting

Buyers decide whether to participate in market
Trade occurs

t

t+1
Difference in TRADE

- Fixed Price Mechanism

\[ \eta > v \quad \eta < v \]

\[ \eta < c \quad \eta > c \]

Trade fails

Trade succeed
Difference in TRADE

- Bargaining Mechanism

1. Seller

2. Buyer

- Accept:
  $\pi_{S_2} = 50 - c - k_S$
  $\pi_{B_2} = v - 50$

3. Seller

- Accept:
  $\pi_{S_3} = 30 - c - 2k_S$
  $\pi_{B_3} = v - 30 - k_B$

4. Buyer

- Accept:
  $\pi_{S_4} = 40 - c - 3k_S$
  $\pi_{B_4} = v - 40 - 2k_B$

...game continues...
Outline

Data
- survey

Parameters
- Player’s valuations
- Bargaining disutility

Welfare Comparison
- Fixed price VS
- Bargaining
Theoretical Model: Basic Setting

- Buyers: value $v$; outside option utility: $y$
- Sellers: cost $c$; outside option utility: $w$
- Matching probabilities: $\mu_s(S, B)$, $\mu_B(S, B)$
- Trade probability after matching: $p(c, v)$
- Searching cost: $\kappa$
- Bargaining disutility: $k$
- Discount factor: $\delta$
- Payment and other utility gained or lost from trade: $x_i(c, v)$
Theoretical Model

\[ W_B = \sum_{t=1}^{\infty} \delta^t W_B^t \]

\[ = \frac{B_0}{1 - \delta} (1 - F_B(v)) \mathbb{E}_{f_B(v)} [\mathbb{E}_c [U_B(c,v)] | v \geq v] \]

\[ W_B^t = B_0 (F_B(v) * y + (1 - F_B(v)) \mathbb{E}_{c,f_B(v)} [U_B(c,v) | v \geq v]) \]

\[ \mathbb{E}_c [U_B(c,v) | v] = -\kappa_B + \mu_B \mathbb{E}_c [u_B(c,v) | v] + (1 - \mu_B \mathbb{E}_c [p(c,v) | v]) \delta \mathbb{E}_c [U_B(c,v) | v] \]

\[ \mathbb{E}_c [U_B(c,v) | v] = \frac{-\kappa_B + \mu_B \mathbb{E}_c [u_B(c,v) | v]}{1 - \delta (1 - \mu_B \mathbb{E}_c [p(c,v) | v])} \]

\[ \mathbb{E}_c [u_B(c,v) | v] \equiv \mathbb{E}_c [v \cdot p(c,v) + x_B(c,v) | v] \]
Theoretical Model

- \( W_s = \mathbb{E}_{c,v} [U_s(c,v)] = w \)
  
  \( \mathbb{E}_v [u_S (c, v) | c] \equiv \mathbb{E}_v [ -cp (c, v) + x_S (c, v) | c] \)
  
  \( \mathbb{E}_{c,v} [U_S (c, v)] = -\kappa_S + \mu_S \mathbb{E}_{c,v} [u_S (c, v)] + \delta \mathbb{E}_{c,v} [U_S (c, v)] \)
  
  \( \mathbb{E}_{c,v} [U_S (c, v)] = \frac{1}{1 - \delta} (-\kappa_S + \mu_S \mathbb{E}_{c,v} [u_S (c, v)]) \)

- \( W = W_B + W_s \)

- The welfare is a function of \( p(c, v), x(c, v) \) and \( k \)

- The structural parameter: \( \{ f_B(v), g_S(c), \kappa_S, \kappa_B, \delta, B_0 \} \)
Weakness?

Rules out some trade probabilities!!!
Theoretical Model: Bargaining

\[ a_{it} \in A_i \left( x_{i(t-1)}, x_{ij(t-2)} \right) = \begin{cases} \chi & \text{exit} \\ \alpha & \text{accept player } - i \text{'s offer} \\ x_j \in X_i \left( x_{i(t-1)}, x_{i(t-2)} \right) & \text{counteroffer } x_j \end{cases} \]

\[ s_{St} = \left\{ x_{S(t-2)}, x_{B(t-1)}, h_S \left( v \mid \{ x_{\tau} \}_{\tau=1}^{t-1} \right), c \right\}, \text{ for } t \text{ odd} \]

\[ s_{Bt} = \left\{ x_{B(t-2)}, x_{S(t-1)}, h_B \left( c \mid \{ x_{\tau} \}_{\tau=1}^{t-1} \right), v \right\}, \text{ for } t \text{ even} \]

\[ \pi_S \left( a_{St} = \chi \mid s_{St} \right) = \delta \mathbb{E}_{c,v} \left[ U_S \left( c, v \right) \right] \]

\[ \pi_S \left( a_{St} = \alpha \mid s_{St} \right) = x_{B(t-1)} - c + \delta \mathbb{E}_{c,v} \left[ U_S \left( c, v \right) \right] \]

\[ \pi_S \left( a_{St} = x_j \mid s_{St} \right) = \Pr \left( a_{B(t+1)} = \chi \mid x_j, s_{St} \right) \delta \mathbb{E}_{c,v} \left[ U_S \left( c, v \right) \right] \]

\[ + \Pr \left( a_{B(t+1)} = \alpha \mid x_j, s_{St} \right) (x_j - c + \delta \mathbb{E}_{c,v} \left[ U_S \left( c, v \right) \right] ) - k_S \]

\[ \pi_B \left( a_{Bt} = \chi \mid s_{Bt} \right) = \delta \mathbb{E}_c \left[ U_B \left( c, v \right) \mid v \right] \]

\[ \pi_B \left( a_{Bt} = \alpha \mid s_{Bt} \right) = v - x_{S(t-1)} \]

\[ \pi_B \left( a_{Bt} = x_j \mid s_{Bt} \right) = \Pr \left( a_{S(t+1)} = \chi \mid x_j, s_{Bt} \right) \delta \mathbb{E}_c \left[ U_B \left( c, v \right) \mid v \right] \]

\[ + \Pr \left( a_{S(t+1)} = \alpha \mid x_j, s_{Bt} \right) (v - x_j) - k_B \]
Theoretical Model: Bargaining

\[ \Psi(s_{S(t+2)}|s_{St}, a_{it} = x_j) = \Pr(a_{B(t+1)} = x_{B(t+1)}|s_{St}, x_j) \]

\[ u_i(a|s_{it}) = \pi_i(a|s_{it}) + \int (V_{i}(s_{i(t+2)}) - k) d\Psi(s_{i(t+2)}|s_{it}, a) \]

where \[ V_{i}(s_{it}) = \max_{a \in A_{it}} \{u_i(a|s_{it})\} \]
Estimation

- Specifies extensive form and payoff functions of the bargaining game without solving for a specific equilibrium

Opponent’s action probabilities

Expected payoff of every action

Estimate the parameters
Estimation

\[ \Pr (a_{B(t+1)} = \chi | x_j, s_{St}) = \int \Pr (a_{B(t+1)} = \chi | s_{B(t+1)} (x_j)) h_S (v | \{ x_\tau \}_{\tau = 1}^t) \, dv \]
\[ = \Pr (a_{B(t+1)} = \chi | x_j, \{ x_\tau \}_{\tau = 1}^{t-1}) \]

\[ \Pr (a_{-i(t+1)} = a | s_{-i(t+1)} (x_j)) = \frac{\exp \left( \theta_a q \left( s_{-i(t+1)} (x_j) \right) \right)}{\sum_{a' \in A_{it}} \exp \left( \theta_{a'} q \left( s_{-i(t+1)} (x_j) \right) \right)} \]

\[ \tilde{V}_i (s_{iT}) = \int_{\varepsilon} \max \left\{ \tilde{\pi}_i (a_{iT} = \chi | s_{iT}, \varepsilon_T), \tilde{\pi}_i (a_{iT} = a | s_{iT}, \varepsilon_T) \right\} d\Gamma (\varepsilon) \]

\[ \mathcal{L}_i (\theta) = \prod_{n=1}^N \sum_{m=1}^M \omega (\theta_{im}) \prod_{t=1}^{T_{in}} \Pr (a_{itn} | s_{itn}; \theta_{im}) \]
Results and probable contradictions

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<thead>
<tr>
<th>Table 4: A: Estimated Driver’s Parameters - Log-normal Types:</th>
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<th>Table 5: A: Estimated Passengers’ Parameters - Log-normal Types</th>
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<td><strong>Mean</strong></td>
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<td>0.57</td>
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<td>(2.88E+06)</td>
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Welfare Comparison

- Optimal fixed price
- Pre-Paid Autorickshaw Stand

\[
\eta^* = \arg \max_{\eta} \mathbb{E}_{\hat{\theta}} \left[ \max \left\{ \hat{v} - \eta, V_B(t = 1; \hat{v}, k) \right\} \right]
\]
\[
\text{subject to } \mathbb{E}_c [\eta - c] = \mathbb{E}_{c,k} [V(t = 1; c, k)]
\]

- With “option” of fixed price, the welfare increase 28%
- However, still many (63%) prefer to maintain in bargaining market
Further extension

- Where may the contradictions in the data come from?
- Is there any flaw within the data the author collected?
- What’s the market like in China and other countries? What’s the difference?
- Is there anything we can do to solve similar problem in other market?