Bargaining and Welfare: A Dynamic Structural Analysis

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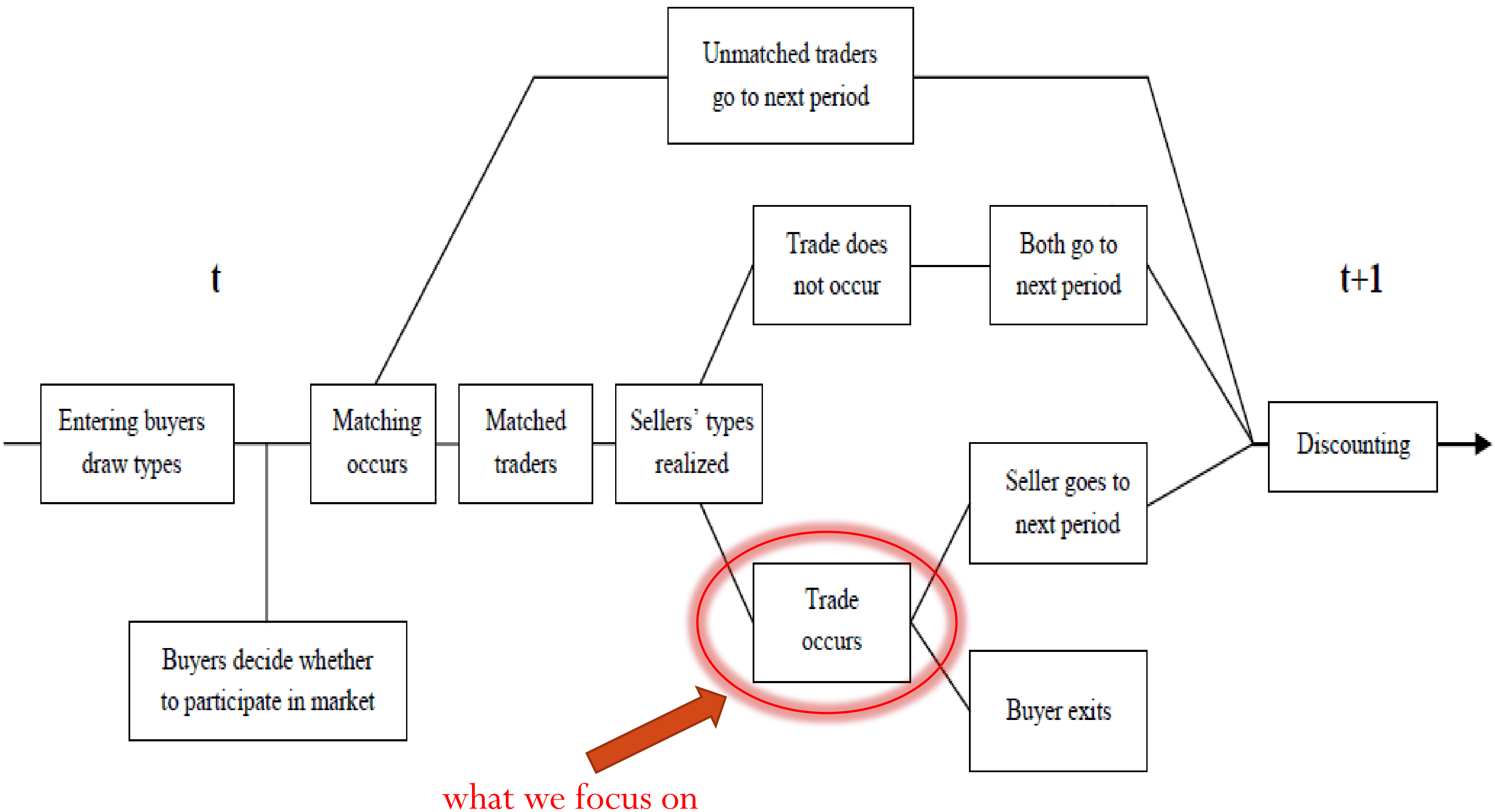
Why important

- 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



Difference in TRADE

- **Fixed Price Mechanism**
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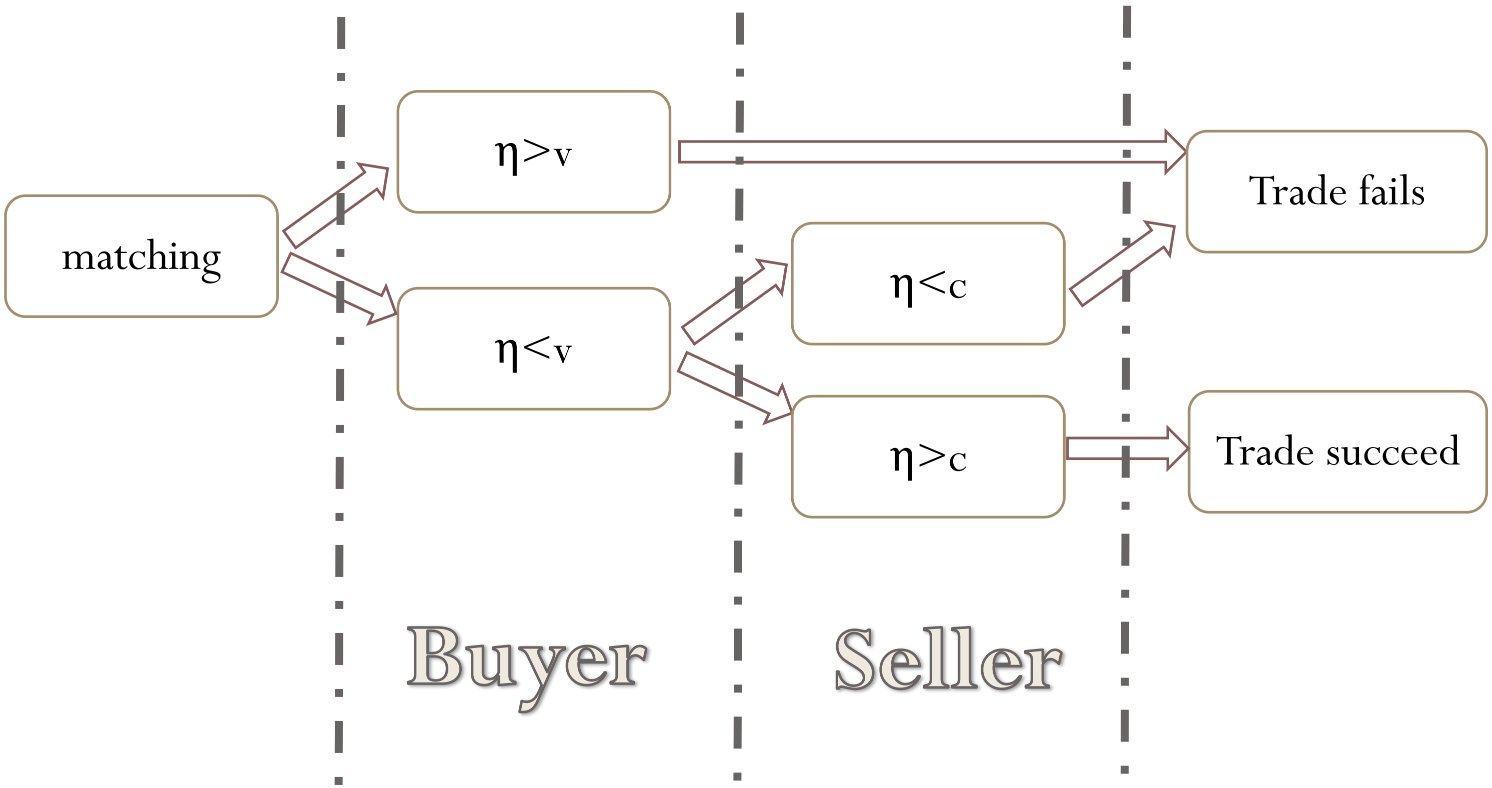
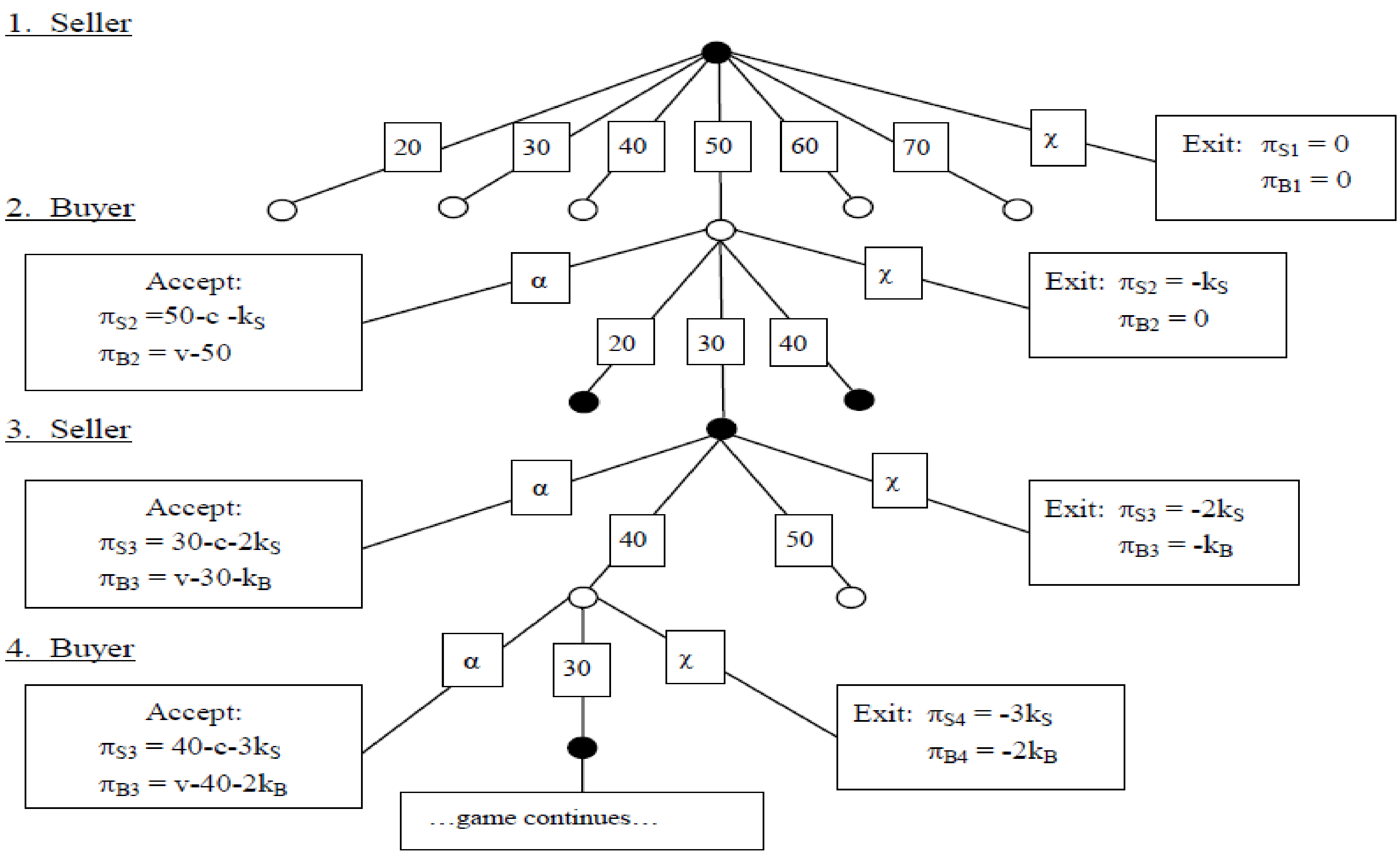


Difference in TRADE

- **Bargaining Mechanism**



Outline

Data

- survey

Parameters

- Player's valuations
- Bargaining disutility

Welfare Comparison

- Fixed price VS
- Bargainig

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: κ
- Bargaining disutility: k
- Discount factor: δ
- Payment and other utility gained or lost from trade: x_i(c,v)

Theoretical Model

- $$W_B = \sum_{t=1}^{\infty} \delta^t W_B^t$$
$$= \frac{B_0}{1-\delta} \left(1 - F_B\left(\underline{v}\right)\right) \mathbb{E}_{f_B(v)} \left[\mathbb{E}_c \left[U_B\left(c,v\right)\right] | v \geq \underline{v}\right]$$

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

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

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

$$\mathbb{E}_c \left[u_B\left(c,v\right) | v\right] \equiv \mathbb{E}_c \left[vp\left(c,v\right) + x_B\left(c,v\right) | v\right]$$

Theoretical Model

- $W_s = \mathbb{E}_{c,v}\left[U_S(c,v)\right] = w$

$$\mathbb{E}_v\left[u_S(c,v)\,|c\right] \equiv \mathbb{E}_v\left[-cp(c,v) + x_S(c,v)\,|c\right]$$

$$\mathbb{E}_{c,v}\left[U_S(c,v)\right] = -\kappa_S + \mu_S\mathbb{E}_{c,v}\left[u_S(c,v)\right] + \delta\mathbb{E}_{c,v}\left[U_S(c,v)\right]$$

$$\mathbb{E}_{c,v}\left[U_S(c,v)\right] = \frac{1}{1-\delta}\left(-\kappa_S + \mu_S\mathbb{E}_{c,v}\left[u_S(c,v)\right]\right)$$

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- $W = W_B + W_S$

- The welfare is a function of p(c,v), x (c,v) and k
- The structural parameter: $\{f_B(v), g_S(c), \kappa_S, \kappa_B, \delta, B_0\}$

Theoretical Model: Fixed price

$$x_S(c,v) = -x_B(c,v) = \begin{cases} \eta & \text{if } c \le \eta \le v \\ 0 & \text{otherwise} \end{cases}$$

$$p(c,v) = \begin{cases} 1 & \text{if } c \le \eta \le v \\ 0 & \text{otherwise} \end{cases}$$

- Weakness?
- Rules out some trade probabilities!!!

Theoretical Model: Bargaining

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

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

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

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

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

$$\begin{aligned} \pi_S\left(a_{St} = x_j | s_{St}\right) &= \Pr\left(a_{B(t+1)} = \chi | x_j, s_{St}\right) \delta \mathbb{E}_{c,v}\left[U_S\left(c, v\right)\right] \\ &+ \Pr\left(a_{B(t+1)} = \alpha | x_j, s_{St}\right)\left(x_j - c + \delta \mathbb{E}_{c,v}\left[U_S\left(c, v\right)\right]\right) - k_S \end{aligned}$$

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

$$\pi_B\left(a_{Bt} = \alpha | s_{Bt}\right) = v - x_{S(t-1)}$$

$$\begin{aligned} \pi_B\left(a_{Bt} = x_j | s_{Bt}\right) &= \Pr\left(a_{S(t+1)} = \chi | x_j, s_{Bt}\right) \delta \mathbb{E}_c\left[U_B\left(c, v\right) | v\right] \\ &+ \Pr\left(a_{S(t+1)} = \alpha | x_j, s_{Bt}\right)\left(v - x_j\right) - k_B \end{aligned}$$

Theoretical Model: Bargaining

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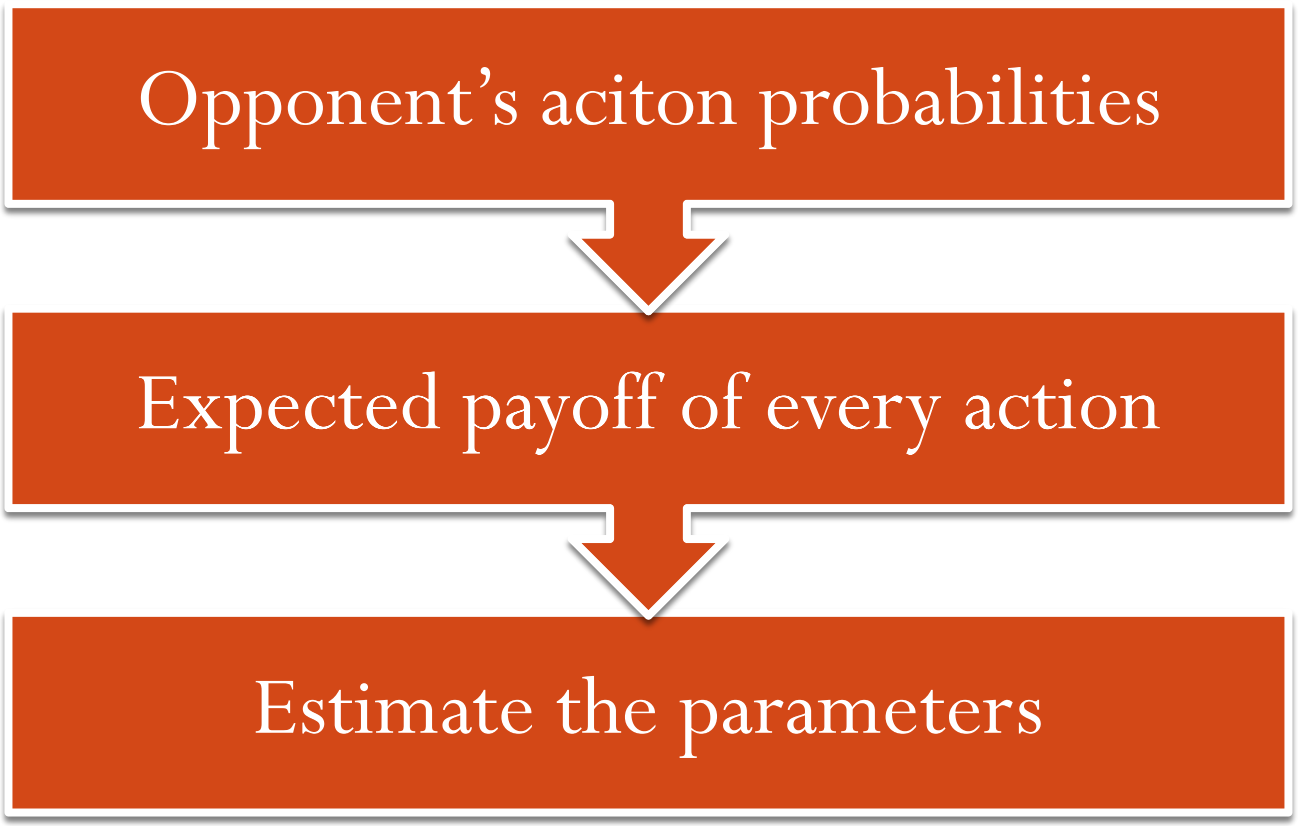
$$\Psi\left(s_{S(t+2)} \middle| s_{St}, a_{it} = x_j\right) = \Pr\left(a_{B(t+1)} = x_{B(t+1)} \middle| s_{St}, x_j\right)$$

$$u_i\left(a|s_{it}\right) = \pi_i\left(a|s_{it}\right) + \int \left(V_i\left(s_{i(t+2)}\right) - k\right) d\Psi\left(s_{i(t+2)} \middle| s_{it}, a\right)$$

- where $V_i\left(s_{it}\right) = \max_{a \in A_{it}} \left\{u_i\left(a|s_{it}\right)\right\}$

Estimation

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



Estimation

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

$$= \Pr\left(a_{B(t+1)} = \chi | x_j, \left\{x_\tau\right\}_{\tau=1}^{t-1}\right)$$

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

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

$$\mathcal{L}_i\left(\theta\right) = \prod_{n=1}^{N} \sum_{m=1}^{M} \omega\left(\theta_{im}\right) \prod_{t=1}^{T_{in}} \Pr\left(a_{itn} | s_{itn}; \theta_{im}\right)$$

Results and probable contradictions

Table 4: A: Estimated Driver's Parameters - Log-normal Types:

	Costs Mean	Costs Std. Deviation	Correlation with bargaining disutility
2 km	41.86	0.25	-0.01
	(5.48)	(6.90)	(0.16)
3 km	42.18	3.03	-0.12
	(2.80)	(13.20)	(0.15)
4 km	46.14	4.09	-0.15
	(2.98)	(1.96)	(0.11)
5 km	66.14	13.85	-0.37
	(4.17)	(1.83)	(0.09)
6 km	56.49	2.11	-0.06
	(3.18)	(2.37)	(0.10)
7 km	49.99	6.71	-0.23
	(5.43)	(6.11)	(0.13)
8 km	56.08	10.80	-0.34
	(4.24)	(11.86)	(0.15)

B: Drivers' Bargaining Disutility

Mean	Std. Deviation
0.31	0.11
(0.17)	(0.19)

Table 5: A: Estimated Passengers' Parameters - Log-normal Types

	Costs Mean	Costs Std. Deviation	Correlation with bargaining disutility
2 km	31.38	18.05	0.00
	(12.31)	(8.72)	(0.21)
3 km	25.61	9.31	0.00
	(8.64)	(3.95)	(0.22)
4 km	46.14	12.20	0.00
	(4.57)	(4.57)	(0.13)
5 km	49.30	6.81	0.00
	(4.79)	(3.84)	(0.10)
6 km	49.86	6.10	0.00
	(1.74)	(1.44)	(0.07)
7 km	56.17	12.76	0.00
	(5.98)	(6.99)	(0.10)
8 km	87.88	37.96	0.00
	(19.84)	(21.66)	(0.25)

B: Passengers' Bargaining Disutility

Mean	Std. Deviation
0.57	2688.75
(2.88E+06)	(2.70E+21)

Welfare Comparison

- Optimal fixed price
- Pre-Paid Autorickshaw Stand

$$\eta^* = \text{argmax}_\eta \mathbb{E}_{\hat{v}} \left[max \left\{ \hat{v} - \eta,\ V_B \left(t = 1; \hat{v}, k \right) \right\} \right]$$

$$\text{subject to } \mathbb{E}_c \left[\eta - c \right] = \mathbb{E}_{c,k} \left[V \left(t = 1; c, k \right) \right]$$

- 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?