Matching Mismatch-Sensitive Players in Ride Sharing

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Characterizing players spatial preference in Ride Sharing (RS)

Using circular city model to describe players' preferences using, the central angle between players' destinations, a dimensional variable. *Reflecting the pickiness riders and drivers demonstrated when selecting their carpooling partners.*
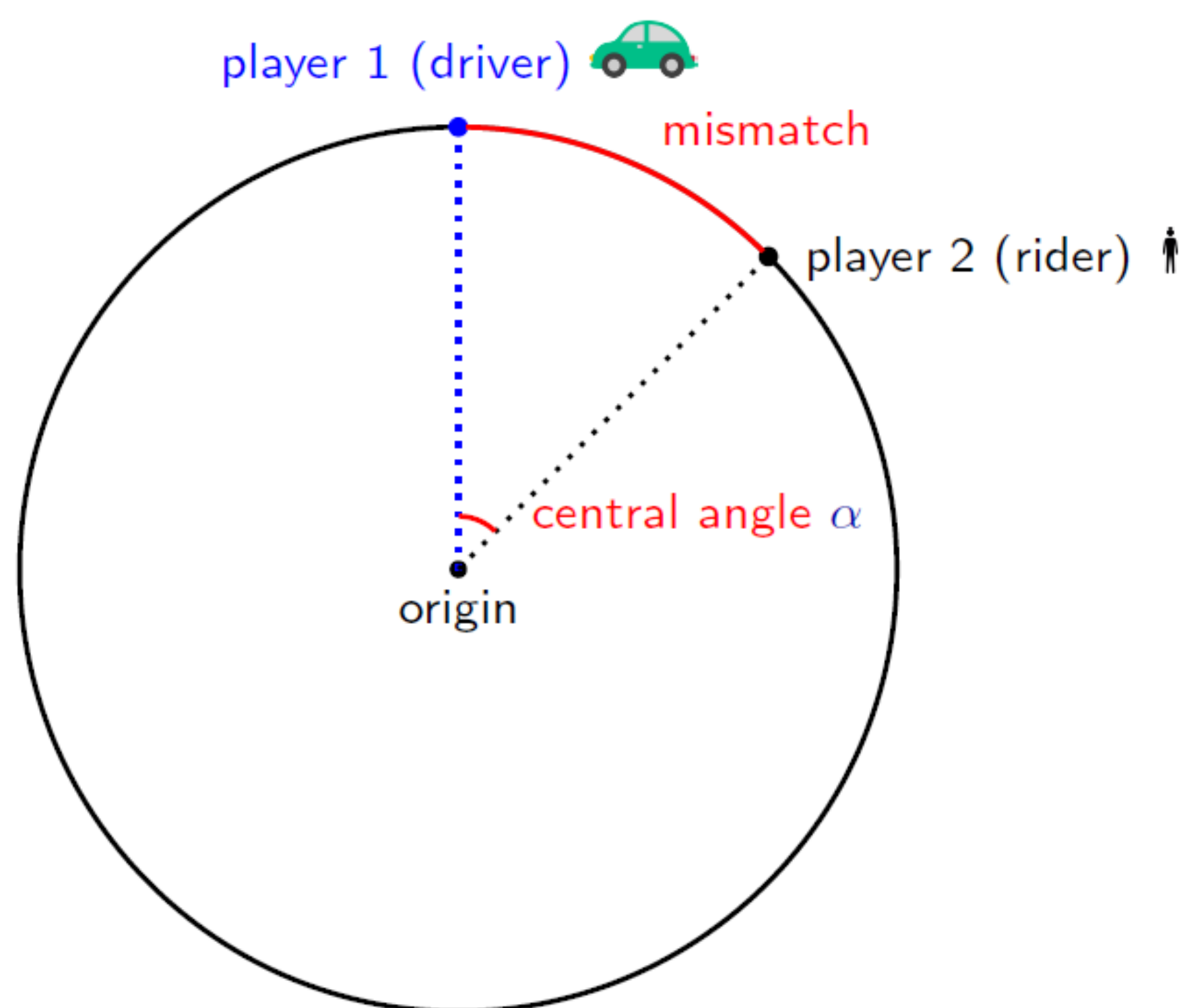

Figure 1. Mismatch between players in a circular city.

Modeling matching system using a Birth-Death process

Using two *M/M/Inf queueing* systems to approximate the matching process:

$$Y(0) \succeq_1 X(\epsilon\rho) \succeq_1 Y(\epsilon\rho). \qquad \mathbb{E}h_\epsilon(Y(\epsilon\rho), \epsilon\rho) \leq \mathbb{E}h_\epsilon(X(\epsilon\rho), \epsilon\rho) \leq \mathbb{E}h_\epsilon(Y(0), \epsilon\rho).$$

Stochastic dominance and *Taylor Expansions* give us a simple approximation on the *optimal matching threshold*:

$$\hat{\rho}_\epsilon = 1 - \frac{\lambda_S}{2\gamma}\epsilon. \qquad \lim_{\epsilon \to 0} \frac{1}{\epsilon}\left(\frac{U(\epsilon\rho^*) - U(\epsilon\hat{\rho}_\epsilon)}{U(\epsilon\rho^*)}\right) \leq \frac{\lambda_S}{\gamma}.$$

Dealing with Heterogeneity among players

Using the pricing rule and players' average statistics from DIDI*, we conduct a numerical study on a circular city with 24km radius when facing heterogeneity among riders (different outside options). We find riders underlying arrival rate has significant impact on the matching mechanism.
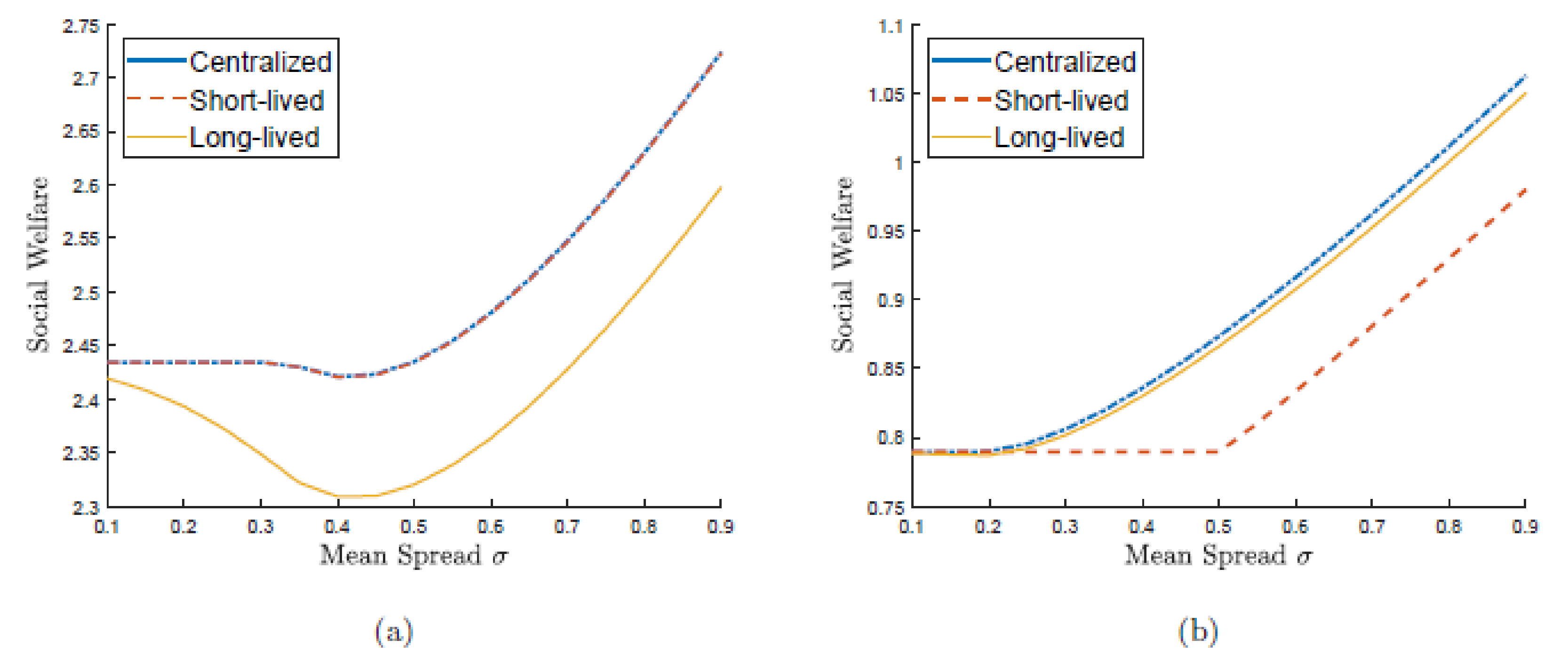

Figure 2. Social welfare comparison under different matching mechanism (a) riders' arrival rate = 5, (b) riders' arrival rate = 30

Comparing different matching mechanism

Letting *long-lived players* choose their matching partner leads to better social welfare when the market of short-lived players is thick, and the level of heterogeneity is significant. Otherwise, letting *short-lived players* choose matching partners is better.

Related Research

Chen, M., Sun, P., and Wan, Z., *Matching Supply and Demand with Mismatch Sensitive Players*

Chen, M., and Hu, M., *Courier Dispatch in On-Demand Delivery Platforms*

Liu, X., Yang, C., and Wan, Z., *The Efficiency of A Dynamic Decentralized Two-sided Matching Market*