# Congestion Effect for Taxi Market and Mechanism Design

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This work
1. Model congestion effect for Taxi Market
2. Proper Price Mechanism

Congestion district
high demand: $D_1$
low profit: $p_1$

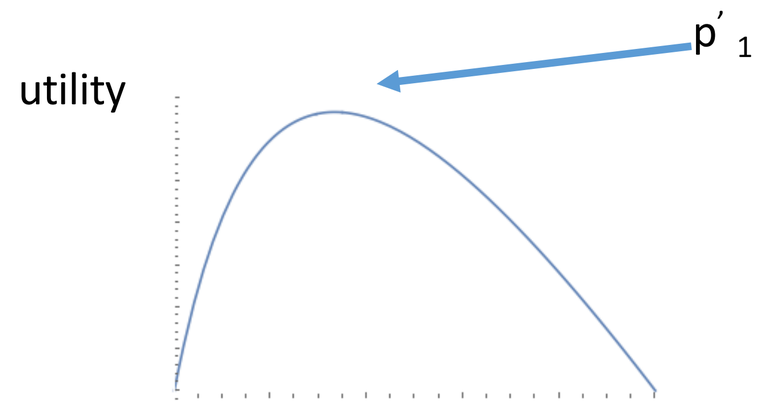
$D_1 > D_2$

Clear district
low demand $D_2$
high profit $p_2$

$p_1 < p_2$

Supply: S


Comment:
- Market 2 would always have privilege over market 1
- In first case, maximum social welfare is achieved in equilibrium.
- In the second case, consumer's utility is maximized, social state is much better than original one.




Platform model $u = -\gamma R_{empty} + Cost_{com}$

**Theorem 2** *Platform can increase its revenue as well as social welfare by compensating for marginal consuming cost if*

$$\frac{dS_1}{dp_1'} > \frac{S_1}{\gamma}$$

*Notice that compensating for marginal consuming cost would be seen as increasing* $\alpha$.

**Proposition 1.** *Without government regulation and special price mechanism, obey ordinary market price would be dominant strategy for consumer.*

$$S_1 = \max\{S - \frac{p_2}{p_1} D_2,\ 0\}$$
$$S_2 = \min\{\frac{p_2}{p_1} D_2,\ 0\}$$


Consumer model: $\mathrm{u} = -p - \alpha T$
Social welfare = $U_{taxi} + U_{consumer} - \beta R_{empty}$

**Proposition 2.** *Maximum social welfare could be achieved when*

$$p_1' - \varepsilon = p_2' = p^*$$

*However, at the same time, consumer's utility may not reach its climax, thus they do not have the incentive to pay for* $p^*$ .

*Small congestion effect for different equilibrium price.*


**Theorem 3** *With taxi platform, congestion due to different price can be eliminate by indirect revealing method.*

Free market with Taxi platform.

**Theorem 1**. *With taxi platform, there exists unique Nash equilibrium, more specifically*

*if* $\frac{(\sqrt{\alpha D_1 D_2 p_2} + p_2 D_2)}{S} > p_2$

$$p_1' = p_2' = \frac{\alpha D_1 D_2}{S - D_2}$$

*else*

$$p_1' = \frac{(\sqrt{\alpha D_1 D_2 p_2} + p_2 D_2)}{S},\ p_2' = p_2$$


Further Study:
- Non linear dependence on T ? May require dynamic pricing
- Multi-level congestion? Existence NE?
- More taxi flush into congestion road make things worse? May need new characterization of social welfare