Platform Pricing for Ride-Sharing*

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Abstract

Ride services create value by efficiently matching buyers and sellers. We develop a model to study the platform economics of these services, and optimal pricing strategies. The structure of wait time externalities means that any feasible platform must employ a mix of efficient (Pigovian) and monopoly pricing. Price competition between drivers or platforms leads to prices that are inefficiently low. Monopoly platforms enjoy scale economies. As a market expands, the platform can use capacity more efficiently, so efficient growth involves adding riders faster than drivers. We also characterize optimal dynamic pricing policies, showing that these depend crucially on whether or not demand surges are anticipated, and efficient prices for ride pooling.

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Ride services such as Uber, Didi Kuadi, Ola and Lyft create value by efficiently matching buyers and sellers. Doing this requires technology (mobile communication, mapping, logistics optimization) and economics. Ride services must solve a classic platform problem: using prices to balance demand and supply while respecting the trade-offs involved in limiting wait times for riders and idle time for drivers. These trade-offs depend on the size and geography of different markets, the amount of variation in demand, the availability of flexible supply, and the nature of competition.

We develop a model to study these platform economics, and use the model to characterize optimal platform pricing behavior. The model is quite simple. We start with equations that characterize the demand for rides, the supply of drivers, and steady-state idling and wait times. Individual demand and supply decisions depend not just on ride prices, but on aggregate demand and supply, because the latter determine wait times for riders and idle time for drivers. As a result, optimal pricing uses Pigovian taxes and subsidies to manage the resulting externalities. This point is familiar from the work of Armstrong (2006), Rochet and Tirole (2003, 2006), Weyl (2010) and others. What is interesting about the ride market is its specific structure, which leads to some intuitive observations, and a few that may be surprising.

Our first observation is that a feasible platform, that is a platform that doesn’t lose money, must use a mix of Pigovian and monopoly pricing to maximize efficiency. This follows from the structure of wait time externalities. A platform that sets an efficient Pigovian tax on riders and pays an efficient Pigovian subsidy to drivers, must pay out more than it receives. This leads to a related observation about the effects of competition. With perfectly competitive ride pricing, whether it results from competition between drivers or between rival platforms, prices and driver availability will be inefficiently low relative the best break-even outcome.

We then consider the role of scale economies. Ride platforms have an intrinsic scale economy: all else equal, doubling the number of riders and drivers reduces wait times. Using this observation, we consider the optimal pricing behavior of a platform as its potential market expands. Optimal management of market growth involves increasing demand at a faster rate than supply, relying on improved capacity
utilization as the market scales.

Next we turn to dynamic “surge” pricing, in particular how prices should respond to variation in demand. The answer depends crucially on the supply response. With inelastic supply, as may be expected when demand shocks are unforeseen, prices should increase to manage wait time. With elastic supply, as may be expected when demand shocks are foreseen, the efficient ride price decreases, and the platform uses high volume to limit wait times. We also consider the case where drivers commit to drive for entire days or weeks, and characterize how the platform optimally commits to a demand-varying pricing schedule.

The last section of the paper consider ride pooling and derives formulas for the optimal sharing and individual ride prices. We show that it is optimal to set low prices for pooled rides, both because they economize on driver time, and because of an externality in the pool market: the time savings are larger when there are more pool riders.


Relationship to other platform settings...