

Congestion and Incentives in the Age of Driverless Cars

Federico Boffa, Fedele, and Alberto Iozzi

The development of autonomous vehicles (AVs), that is, vehicles driven by a software that does not require human intervention, will have a significant, and as of now underappreciated, impact on the structure of the mobility market.

The development of AVs will spur the provision of mobility services through fleets of AVs; this mode of transport will likely gain prominence over private vehicles, at least in urban contexts. Fleets will become comparatively cheaper than private vehicles due to savings in the drivers' labor costs and to a utilization rate that is higher than that of private vehicles. This trend is already underway, with the emergence of robotaxis, i.e., taxis operated by ride service companies through AVs. Waymo, an Alphabet subsidiary and one of the leading companies in the development of self-driving technology, has partnered with Lyft and is currently offering robotaxi services in selected locations in the United States. General Motors' subsidiary Cruise is also expected to roll out its robotaxi fleet soon, and Tesla has recently announced that it will soon stop selling the cars it manufactures to private owners, and use them for its own—comparatively more profitable—robotaxi fleet instead.

Consumers' investment in private cars is thus bound to shrink. As a result, urban transport will likely be centralized and managed by a handful of companies that will provide the transport service.

Such centralization will have dramatic consequences on how congestion will be dealt with. Congestion in the mobility industry not only derives from the inadequacy of transport infrastructures relative to demand, but is also the result of a standard externality. In the current decentralized setting, with drivers making traveling decisions independently from one another, drivers do not factor in their choices the external effect in terms of congestion they impose on fellow travelers. The paper studies how the transition to a centralized mobility market, organized around companies that manage their own fleets, affects congestion, and as a result, welfare, in the different stages of the transition process. The researchers then analyze the taxation schemes that allow restoration of first best during this transition.

Boffa, Fedele, and Iozzi We consider a stylized framework with travelers using AVs to travel over a road network, segmented into two separate parallel lanes, both congested. They are *ex ante* identical, but *ex post* they can differ in the amount of congestion. Agents are assumed to be heterogeneous as to the utility they derive from the trip and to the disutility they suffer from the congestion. Consistent with evidence pointing to a positive relation between income and the value of time, the researchers assume that the larger the utility from the trip, the larger the cost of congestion. They look at the equilibrium assignment of consumers to one of the two lanes or to not traveling in the current decentralized situation, and in the transition toward centralized traffic.

The researcher first show that welfare maximization requires differentiating the congestion level in the two lanes, reflecting the heterogeneity in travelers' value of time. Agents with low disutility of congestion should travel in a slow lane, while those with a high disutility of congestion should travel in a fast lane. Furthermore, a commuter in the first best travels as long as her benefit from traveling exceeds the increase in aggregate congestion costs she imposes on fellow commuters. Thus, if the congestion cost is sufficiently large, efficiency requires preventing some low-value agents from traveling.

The researchers then move to the analysis of both a setting with no road taxes, to reflect their limited application and the popular opposition to them, as well as a setting with road taxes. They find that, without road taxes, the emergence of a small company supplying a small fraction of the travelers (while the others remain atomistic) increases (decreases) welfare if and only if the congestion problem was (was not) sufficiently severe in the first place. With road taxes, they find that, while congestion charges are optimal when all travelers are atomistic, the structure of the taxes differs markedly with a company that supplies a mass of customers. Restoring first best, in this case, may require subsidizing the company — something likely to be politically difficult.