Macro Economic Impact of Autonomous Vehicles

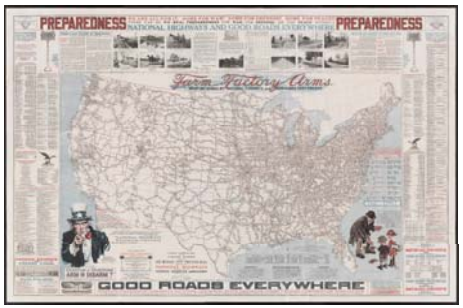
Richard Mudge, Ph.D.
Compass Transportation and Technology Inc.
dick@compasstranstech.com
(301) 529-3834

Background

Most speculation on the economic impacts of autonomous vehicles takes a bottoms up approach. This can be misleading when considering change that affects an entire national network. A short list of past network-scale investments in the United States includes:

- The inland waterway system in the early 19th century (in addition to the Erie Canal this includes opening the Ohio and Mississippi Rivers)
- Transcontinental railroads
- Early auto roads ("Get the farmer out of the mud")
- The Interstate ("No traffic lights from coast to coast")
- The internet
- Wireless telecommunications.

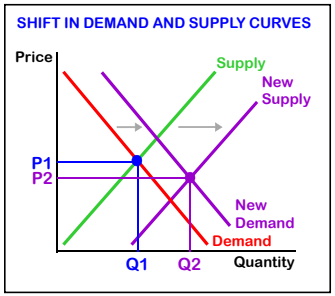
Each of these reflected their times and involved a different mix of public and private roles and different financing mechanisms. Autonomous vehicles continues continue this trend with a focus on state-of-the-art technology, private investment, and market forces.



Characteristics of Network-Scale Change

The economic (and social) impacts of network-scale investments differ from traditional transportation or technology investments. In sum, they:

- Are national in scale
- Generate non-linear impacts
- Improve access to
  - labor/jobs
  - Markets
  - intermediate goods
  - raw materials.
- Stimulate positive shifts in the supply and demand curves These shifts reflect a new economy and are generated by:
  - Economies of scale
  - New markets
  - New products/services.



Past examples: Professor Ishaq Nadiri's (NYU) classic study of the Interstate Highway System found annual rates of return of 50-60 percent over two decades; economic gains for almost **every industry (mining as an exception – and services gained more than manufacturing); and this network accounted for more than 50 percent of total US economic productivity. In contrast, using linear assumptions, a classic benefit-cost analysis was only able to justify one third of the Interstate System.**

Possible Implications

Improved accessibility has a broad positive impact on the nation's economy. The value of these productivity gains could exceed those generated by the Interstate Highway System and should be larger than the benefits from safety gains alone.

While it is difficult to forecast the specific beneficiaries of this change, past history and recent analysis show the impacts will be very large. For example, a ten percent increase in accessibility can generate an additional 2.4 percent increase in output. This is a small number, but multiplied times a very large number – US GDP is about $17 trillion. It also reflects a linear change and not a network scale change such as generated by autonomous vehicles.

The scale of these changes has implications for international competitiveness.

Regulations Safety benefits dominate the debate over the value of autonomous vehicles including the nature of regulations. A macro/network view implies that these benefits under estimate the overall value of full deployment. This has implications for any benefit-cost analysis of potential regulations and can show tangible economic and financial benefits for society. A broader understanding of the full value of autonomous vehicles should encourage regulatory agencies to support rapid deployment of these vehicles.

Change in business and individual location Reduced congestion will permit individuals to travel longer distances in the same amount of time. This may make it possible for people to decide to live in less expensive (and probably larger) homes on the fringe of urban areas and still have access to a larger pool of potential jobs than at present.

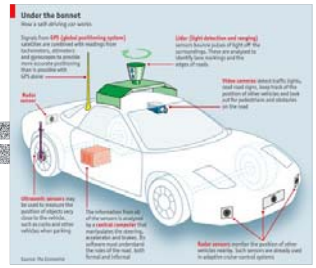
At the same time, autonomous vehicles will make it possible for people to live without owning a car and should make it possible to reuse parking spaces for more productive uses. This may encourage urban lifestyles.

Outreach Important to let the public know that there is more to autonomous vehicles than simply saving lives and helping people with mobility problems. These benefits are important, but autonomous vehicles will provide a broad set of benefits that will offset the losses that some industries will experience.

How Will This Happen?

Autonomous vehicles will create a de facto increase in the capacity of the nation's transportation system:

- Greatly reduce and perhaps eliminate traffic incidents – these account for 25 percent of traffic congestion.
- Enable reduced vehicle headways, resulting in an effective increase in roadway capacity. There is controversy over the magnitude of this impact, with some simulations showing a four-fold increase. Google says they believe a doubling is possible. Some analysis (PATH) shows short-term negative impacts on congestion.
- These gains will take time for the vehicle fleet to turn over and could be quite large if vehicle designs change significantly. This has important side effects:
  - Significant environmental benefits due to smoother flow of vehicles
  - Significant drop in energy use
  - Significant decline in the level of funds requested by state and federal DOTs



Questions

More analysis is needed regarding the impact of autonomous vehicles on roadway capacity.

- What are realistic numbers for expressways, major arterials and the roadway network as a whole?
- How do these estimates change based on market penetration? How important is the "soft spot" when market penetration is low?
- How do these numbers change based on types of autonomous vehicles?
- What is the likely pace of market penetration? How will this vary by type of autonomous vehicles? How much of the economic benefits will be lost if level 4 (SAE level 5) vehicles never play a dominant role? What is the impact if capacity gains are found only on expressways, with limited change for arterials?
- Will VMT increase or decrease? This may be less of an issue since new VMT is likely to be "better" than old VMT due to reduced energy use, less environmental impacts per VMT and fewer accidents.