

# Osher Lifelong Learning Institute, Summer 2022

## Contemporary Economic Policy

Rochester Institute of Technology  
July-Aug, 2022

Jon Haveman, Ph.D.  
National Economic Education Delegation



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## Course Outline

### • Contemporary Economic Policy

- Week 1 (7/11): Economic Update (Jon Haveman, NEED)
- Week 2 (7/18): Economic Inequality (Christopher Herrington VCU)
- Week 3 (7/25): Trade and Globalization (Alan Deardorff, University of Michigan)
- ~~Week 4 (8/1): *The Black-White Wealth Gap (Mike Shor, UConn)*~~
- Week 5 (8/8): Economic Mobility (Jon Haveman, NEED)
- **Week 6 (8/15): Climate Change Economics (Jon Haveman, NEED)**
- Week 7 (8/22): Autonomous Vehicles (Jon Haveman, NEED)
- Week 8 (8/29): The Black-White Wealth Gap (Mike Shor, Uconn)



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## Submitting Questions

- **Please submit questions of clarification in the chat.**
  - I will try to handle them as they come up.
- **We will do a verbal Q&A once the material has been presented.**
- **OLLI allowing, we can stay beyond the end of class to have further discussion.**
- **Slides will be available from the NEED website tomorrow ([https://needelegation.org/delivered\\_presentations.php](https://needelegation.org/delivered_presentations.php))**



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*OLLI – Rochester Institute of Technology*

## Driving Change – Autonomous Vehicles' Big Impact

National Economic Education Delegation  
Jon Haveman, Ph.D.

*August 22, 2022*



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## Credits and Disclaimer

- **This slide deck was authored by:**
  - Jon Haveman, NEED
- **This slide deck was reviewed by:**
  - Ronald Fisher, Michigan State University
  - William F. Fox, University of Tennessee, Knoxville
- **Disclaimer**
  - NEED presentations are designed to be nonpartisan.
  - It is, however, inevitable that the presenter will be asked for and will provide their own views.
  - Such views are those of the presenter and not necessarily those of the National Economic Education Delegation (NEED).



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## Outline

- **Where does the AV path lead?**
- **Transition**
- **Policy/Planning Issues**
- **Major Economic/Development Changes**
- **Environmental Implications**



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# Autonomous Taxonomy

## SAE AUTONOMY LEVELS

**HUMAN**

**LEVEL 0**  
Human driver is in complete control. Maybe the car shifts its own gears, if you, you know, have fun.

**LEVEL 1**  
Driver must be ready to take over at any time. Features like adaptive cruise control, parking assist with automatic steering, lane keeping assist, in any combination.

**LEVEL 2**  
Automated system is doing most of the driving, including steering, braking, and accelerating, but human must be alert and ready to take over at any time.

**LEVEL 3**  
In specific situations and environments, like highway driving, the car is in complete control. Human driver can read or text or whatever if they want.

**LEVEL 4**  
The car can drive itself independently in most environments, with some exceptions for weather or unusual environments. Human may still need to take over at times.

**LEVEL 5**  
All robot, all the time. Humans just along for the ride and, ideally, to tell the car where to go. No restrictions where the car can drive.

**ROBOT**

**WAYMO**

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**JALOPNIK**

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# Growth Path

## The self-driving vehicle revolution

An illustration of potential growth

**Era 1:** Fully autonomous vehicles (AVs) being developed for consumers

**Era 2:** Consumers begin to adopt AVs

**Era 3:** AVs become the primary means of transport

McKinsey & Company

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## McKinsey isn't Always Spot On

- "In 1980, McKinsey & Company was commissioned by AT&T to forecast cell phone penetration in the U.S. by 2000.

- The consultant's prediction, 900,000 subscribers,
- was less than 1% of the actual figure, 109 Million."

• Professor Angel Lozano, 2014



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## Three Important Questions:

1. When will Transportation as a Service (TaaS) be available?
2. How quick will the transition be?
3. What will the future look like?



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# WHEN?

## What do the headlines say?



NVIDIA to introduce level-4 enabling system by 2018



First autonomous Toyota to be available in 2020



Volkswagen

Volkswagen expects first self driving cars on the market by 2019



Audi

Audi to introduce a self-driving car by 2020



TESLA MOTORS

Elon Musk now expects first fully autonomous Tesla by 2019, approved by 2021



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# 40+ Corporations Working On Autonomous Vehicles



TOYOTA



WAYMO



HONDA



Audi



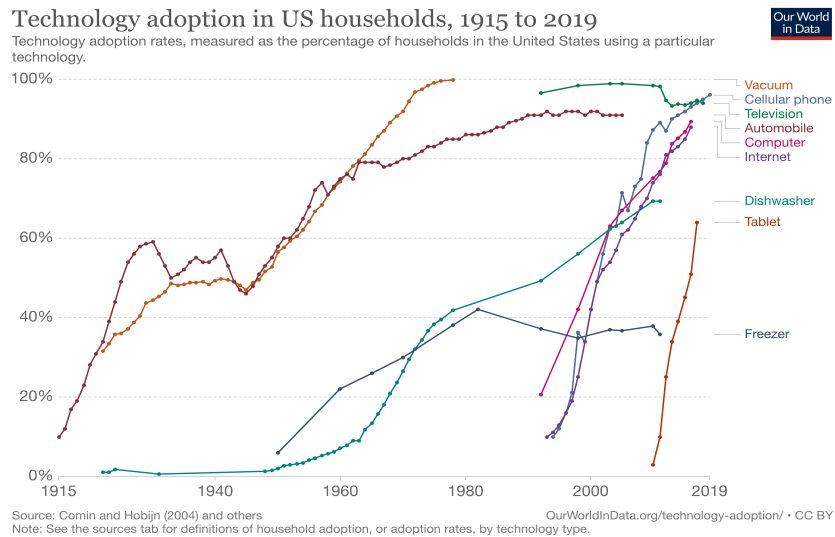
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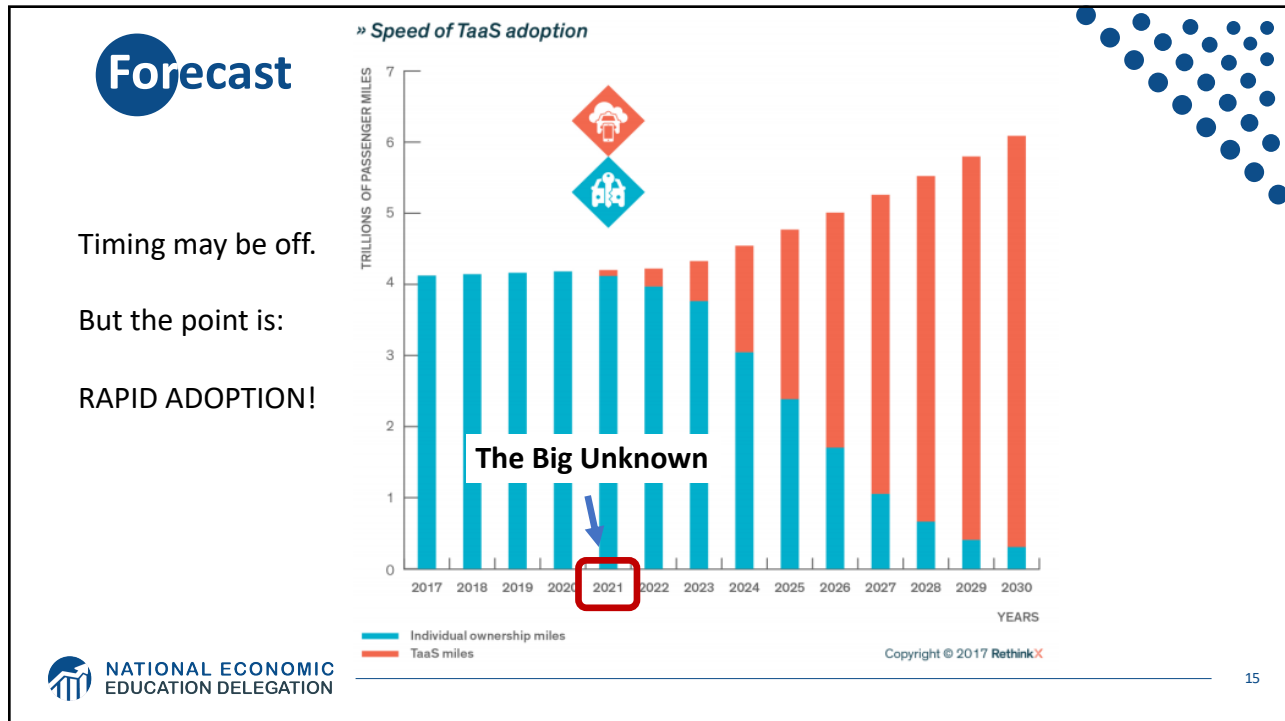
# WHEN? What is possible?

- By 2025 (?)
- Potentially 95% of VMT by 2035.
- Last 5% is going to be very difficult to achieve.
- Is this possible?
  - Horses to cars: 10 years – early 1900s
  - But adoption of EVs is so slow!
  - Adoption of AVs will be rapid.



# Rate of Technology Adoption – Faster!





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**Waymo's self-driving cars are now available on Lyft's app in Phoenix**

**Hyundai plans to launch a free robot taxi service in California**

**Singapore's self-driving cars can now be hailed with a smartphone**

*NuTonomy joins forces with 'the Uber of Southeast Asia'*


**Cruise to offer free robo-taxi rides in S.F. for the public — without backup drivers**

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## Waymo is in New York!



Waymo

New York City

Waymo driving territory

Image courtesy of Waymo

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## Trucking – Highly Fertile Ground

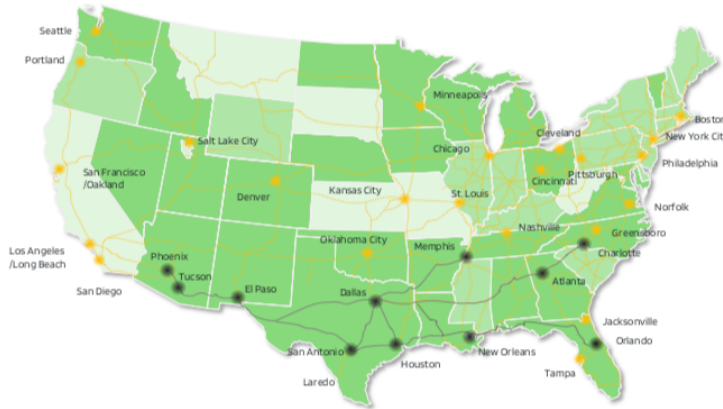
- **Long haul trucking the first place we are seeing it adopted.**
  - Reduces costs associated with drivers.
  - End run around limits on hours of driving.
- **Where does it stand?**
  - Lots of trials underway.
  - TuSimple – actively building a long-haul network.
  - Waymo – focused more on last mile/local delivery.

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# TuSimple Current and Future Routes (Level 4)



**44** states  
allow autonomous semi-truck testing

**26** states  
allow autonomous semi-truck commercial deployment

**50** states  
cohesive AV operations framework laid out in US DOT 4.0 AV Regulations

### AFN Network Expansion Plans<sup>®</sup>

- Current Routes
- Future Expansion Plans

### Regulatory Landscape

- L4 Autonomous Commercial Operations
- L4 Autonomous Testing
- In Progress



# Actively Pursuing Autonomous Local Delivery

- Dominos
- Walmart
- Amazon
- CVS Pharmacy
- Stop and Shop
- Postmates
- Kroger



# What will the future look like?



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This:



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**But, will it be:**



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**Hell**

- **Primarily individual private car ownership**
  - Much as today.
- **Internal combustion engines**
- **Why Hell?**
  - Dramatically increased VMT and pollution.
  - Potentially increased congestion
  - Parking.



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## Two Adults and a Child: Morning Miles

**And this is just the morning.....**

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## Heaven

- **Vehicle ownership will be very limited**
  - Private ownership for those with specialized vehicle needs.
  - Fleet ownership will serve everybody else.
- **Engines: electric**
- **Insurance: product liability**
- **Not clear when we will get there, but this is the likely model.**
  - 2030 for widespread adoption in many regions.

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## Why is this Heaven?

- **Not only autonomous, but:**
  - Shared
  - Connected
  - Green
- **Far fewer cars in existence.**
  - Better resource utilization.
- **VMT could go up or down, but more productive than in Hell.**
- **Congestion effects – unclear, but likely reduced.**
  - Right-sized vehicles, platooning, sharing, V2V communication
- **Minimal need for parking.**



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## Transition

- **Short term: Tesla model of highway autonomy**
  - Level 2, adaptive cruise control.
- **Medium term:**
  - short period of personal vehicle ownership with level 3 capability.
  - introduction of independent private fleets – Uber, Lyft, Google, nuTonomy, etc., with level 4/5 capability.
- **Long term:**
  - Personal vehicle ownership is largely a thing of the past.



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## Economics Drives Transition: Private

- **Adoption dividend for private individuals**

- Eliminate car ownership
  - o Ave annual cost of owning a car: \$9,666 (2021)
  - o Cost per mile will fall: \$0.64 to \$0.19
- Repurpose your garage
  - o \$50,000 from transition to bedroom

*Average Costs Per Mile*

Miles per Year	10k	15k	20k
Average Cost	82¢	64¢	55¢

- **Time recovery**

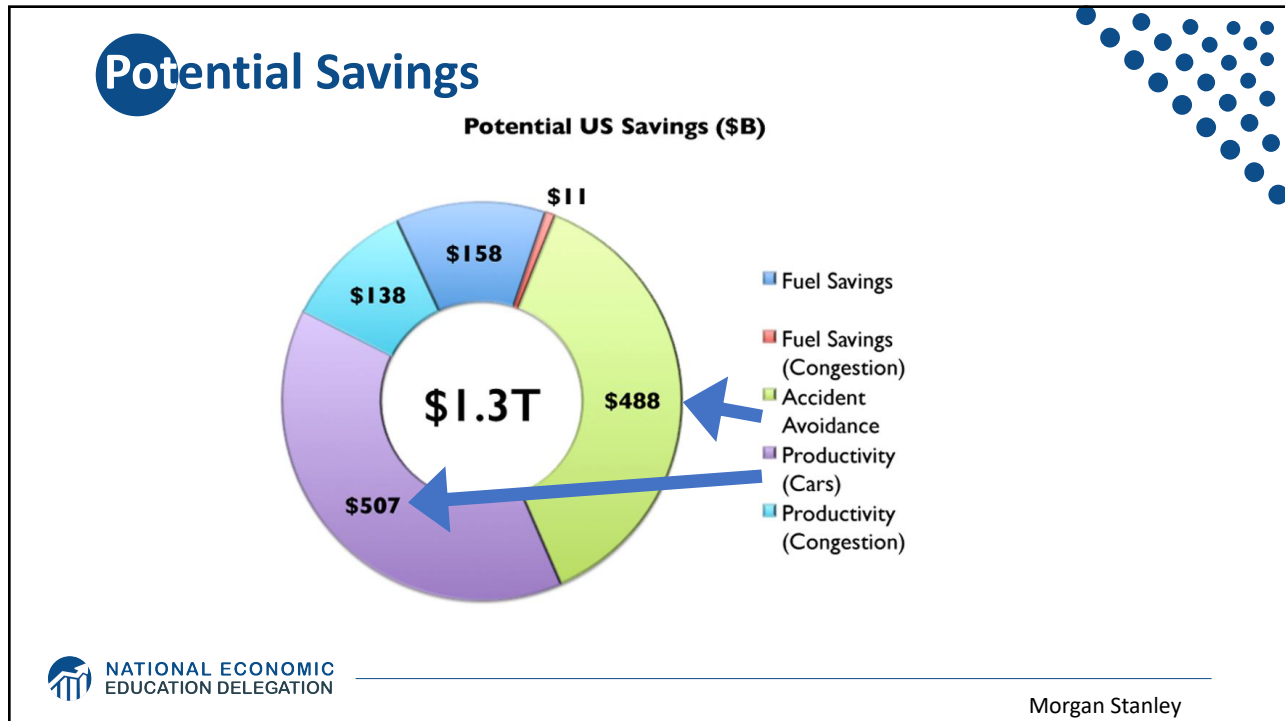
- 50% of the San Francisco Bay area workforce has a commute in excess of 30 minutes.

## Economics Drives Transition: Public

- **Economic and social costs associated with human drivers are enormous:**

- ACCIDENTS:
  - o Drive 25% of congestion.
  - o Result in 40,000 deaths.
  - o And 2 million injuries.
  - o 90+% caused by human error.
- Increased productivity from not driving.
- Costs of human drivers estimated at up to \$1.3 TRillion each year





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## Public Policy/Planning Issues

- Government buy-in:**
  - Essential – gov’t must encourage progress
  - Difficult – because of displacement issue
- Important transitional issues:**
  - What infrastructure should be developed?
  - What to do about public transportation?
  - What to do with all of the parking spaces?

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 Morgan Stanley

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## Responding to the coming changes:



- **Transportation organizations must develop a forecast for adoption in their specific geography**
  - San Francisco – faster than Chicago
  - Chicago – faster than Fresno
  - Fresno - faster than Kansas
- **How does this affect the ROR calculation on projects?**
  - Highway expansion? Public Transportation?

## Encourage Change

- **Mobility and equity considerations.**
  - Elderly/disabled/impoveryished
- **Safety:** only way to reduce traffic fatalities is by coordinated effort.
- **Productivity:** reduced congestion.
- **Environment:** speed transition to electric vehicles.

These are all societal benefits that come about too slowly  
if the private market is left to itself.

# Mobility and Equity

- **Mobility**

- Handicapped
- Elderly
- Lower income

- **Equity**

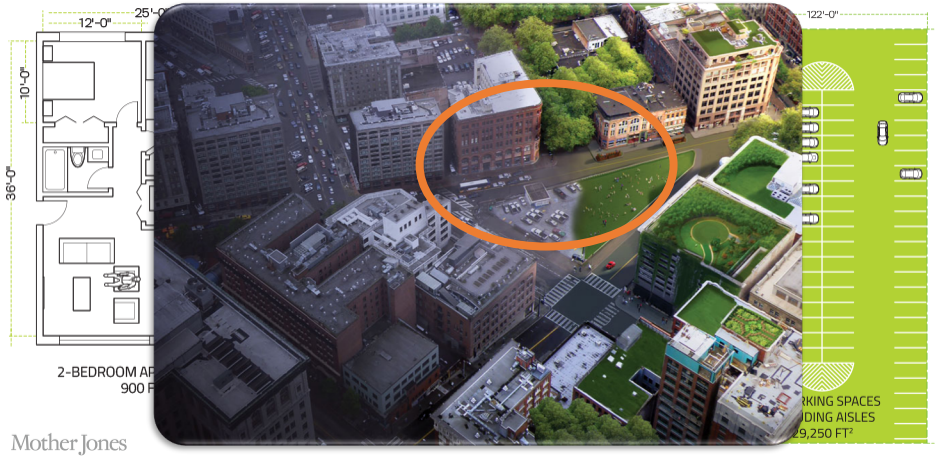
- Public Transportation often does not work well for low-income workers/residential workers
  - o Does not go from residential to residential, but from residential to commercial



# Safety and Productivity



# Environment



# Environmental Implications Depends: Heaven or Hell

- **Improved resource utilization**
- **More efficient travel**
  - Right sized vehicles
  - Optimized routes
  - Reduced congestion
  - No searching for parking
- **Increased VMT**
- **Cleaner technologies**
  - Electric
  - Lighter vehicles
- **Energy use of onboard electronics**
  - Weight and functional
- **Increased urban sprawl**

Bottom line: push governments at all levels to embrace and to implement policies deterring private vehicle ownership and zero passenger miles



## Incentives Through Policy and Planning

- **Allow vehicles equipped with ACC into HOV lanes**
  - Eventual conversion of HOV lanes to ACC/AV lanes
- **Allow ACC equipped vehicles to travel faster in HOV lanes**
- **Subsidize ACC upgrades**
  - Arguably more concrete benefits than electric vehicles
- **Sticks: higher costs of vehicle ownership**
  - Registration fees, VMT taxes, etc.



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Note: ACC = Adaptive Cruise Control

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## Interim Summary

- **Transition is coming very quickly!**
  - Most reports are extremely conservative.
  - Apply generally, but faster in many regions.
- **Very important to start incorporating AVs into planning now.**
  - To realize the benefits of AVS.
  - Sacrifice expansion for maintenance.



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## What Changes Will This Bring?

- Disposable income
- Government finances
- Transportation
- Infrastructure
- Public transportation
- Employment
- Housing
- Parking

Potentially dramatic improvements in infrastructure planning and maintenance -  
Data sharing and integration



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## Disposable Income



- Costs \$9,666 to own a car.
- Will cost \$3,000 to use TaaS.
- Net increase in disposable income of > \$6,000.
- Spread across all households: more than \$1 trillion in new spending in the economy.
- Major boost to economic activity.  
- CREATING JOBS!



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## Government Finances



- **Government finances thrown for a loop:**

- Revenues up and down:
  - o Parking revenue, tickets, traffic violation revenues
  - o More commercial, retail and residential space
- Less spending on road development
- More (maybe less) spent on road maintenance
  - o Fewer road miles
  - o but perhaps more VMT

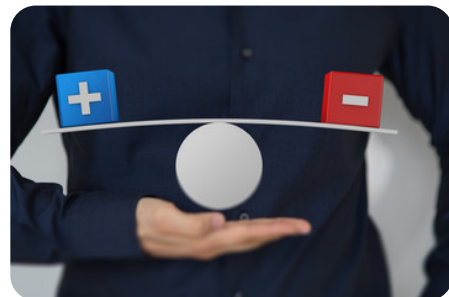
## Transportation

- **Demand for transportation will likely increase significantly: price falls, demand rises**

- Commutes may increase in distance, but not necessarily in duration
- Zero passenger trips will arise
  - o Deliveries

- **At the same time, demand for roadway lane-miles will likely decrease**

- AVs make significantly more efficient use of space
- Front to back and side to side



## Infrastructure

- **Focus of transportation infrastructure:**

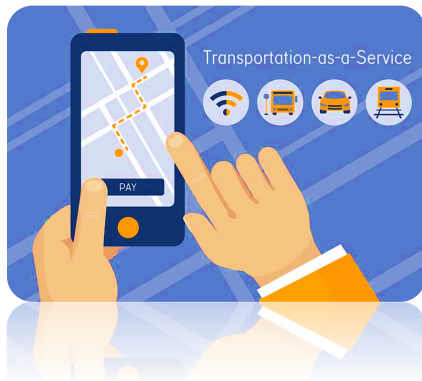
- Currently on expansion
- Will turn toward:
  - Maintenance
    - TaaS providers push for fewer potholes?
  - Adding technology
    - Stop lights will be digital as well as visual
- Some will disappear: Signs!



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## Public Transportation



- **Ambiguous implications for public transportation**
- **Demand may:**
  - Shrink because of low cost of TaaS
  - Grow because last mile problem is solved
- **Extensions may be added through contract with TaaS company**



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## Cautionary Tale From Long Ago

- **Automobiles impact on rail:**

“The increasing dominance of cars was also felt by railway companies, which by June 1894 had to start making **pricing concessions** for transporting goods, even including free transport.”



- Samuel I. Schwartz, No One at the Wheel, 2018

## Employment

- **Massive job displacement/relocation (Millions!):**

- Drivers of all varieties: truck, taxi, delivery...
- Car production jobs, car parts production jobs
- Gas station, vehicle repair, and body shop
- Police and fire
- Health care workers
- And so on...



## Employment (con't)



- **What jobs will be created?**
  - IT jobs
  - Retail/Production jobs
  - ??
- **Always easier to identify things that will go away than to identify what will pop up in its place.**
- **Regardless of where they are created, training programs will be crucial to the transition.**



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## Housing



- **Housing is suddenly easier to build**
  - Issue of traffic congestion is significantly reduced.
  - Space for new housing is available where parking lots used to be.
- **Existing houses can now accommodate more people: garage to bedroom conversions.**



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## Parking

- **Greatly reduced demand for parking lots.**
- **Service providers will own parking lots in strategic places.**
  - Where the cost of land is low.
- **Street parking will largely be a thing of the past.**
  - More green space in cities.
- **Shopping mall parking will be converted to:**
  - More shopping mall? Housing?
- **Apartment complexes will convert parking.**



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## Freeing Up Urban Space from Parking

- **Los Angeles: 14% of incorporated land area**
  - 200 Square miles
- **San Francisco: 275,450 on-street parking spaces**
  - Enough to parallel-park a line of cars 900 miles.
    - o California's entire coastline is 840-miles.
  - Enough parking to fill parking lots that would cover the **Presidio, Golden Gate Park, and Lake Merced.**
- **Nationwide: (estimate) 500 million spaces**
  - That's larger than Delaware and Rhode Island combined.
  - Could be as many as 2 billion (add in Connecticut and Vermont).



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## Potential Problems and Concerns

- **Expansion of the electric grid to provide sufficient capacity.**
- **Mining for rare earth minerals for batteries.**
- **Hacking of autonomous vehicles for nefarious purposes.**
- **Competition in service provision in some markets.**
- **And many more...**



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## Summary of Change

- **Massive employment upheaval.**
- **Local government finances will look very different.**
- **Housing will be easier to build and more plentiful.**
- **Parking conversions will be commonplace.**
- **Demand for transportation infrastructure will likely decline.**
  - Transportation infrastructure technology will be a booming business.
- **Demand for public transportation may well decline.**
- **Coming likely sooner rather than later!**



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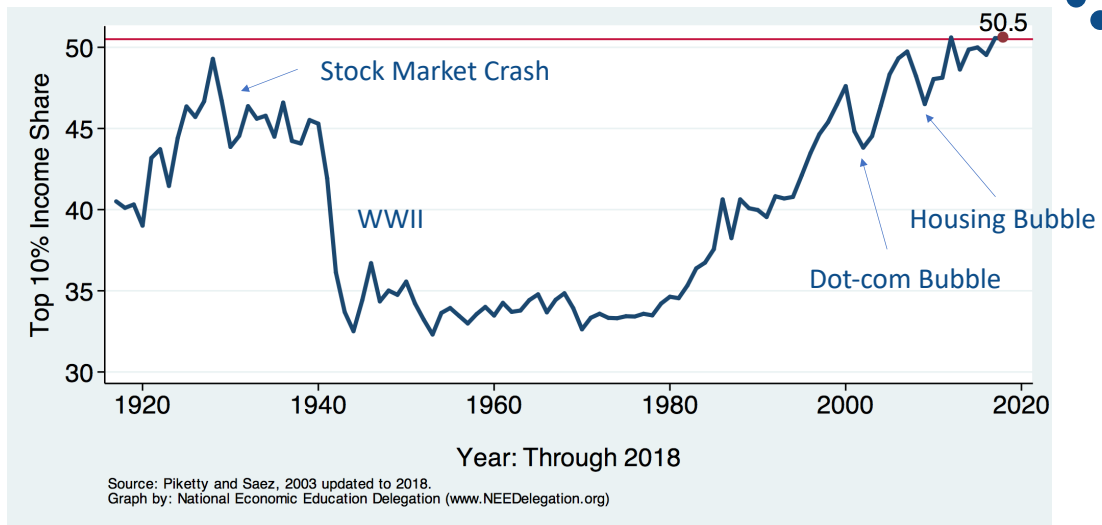


# US Economic Update



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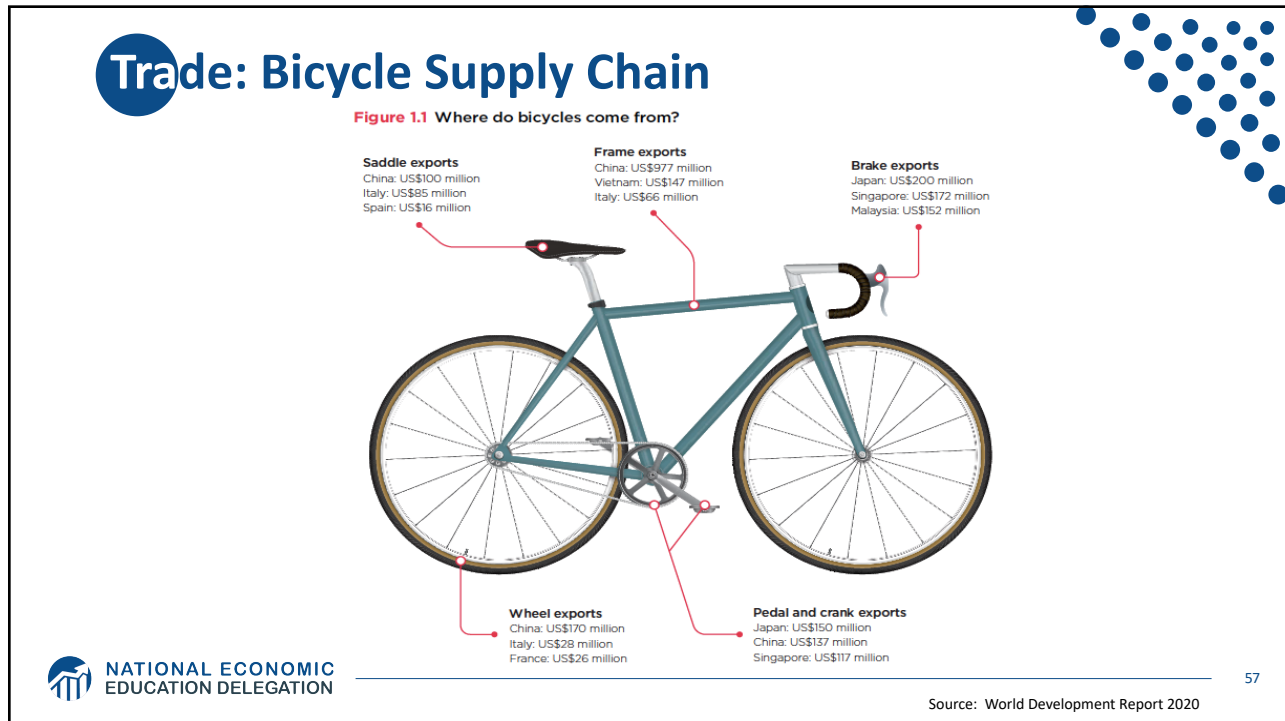
## Income Inequality: Share of Top 10%



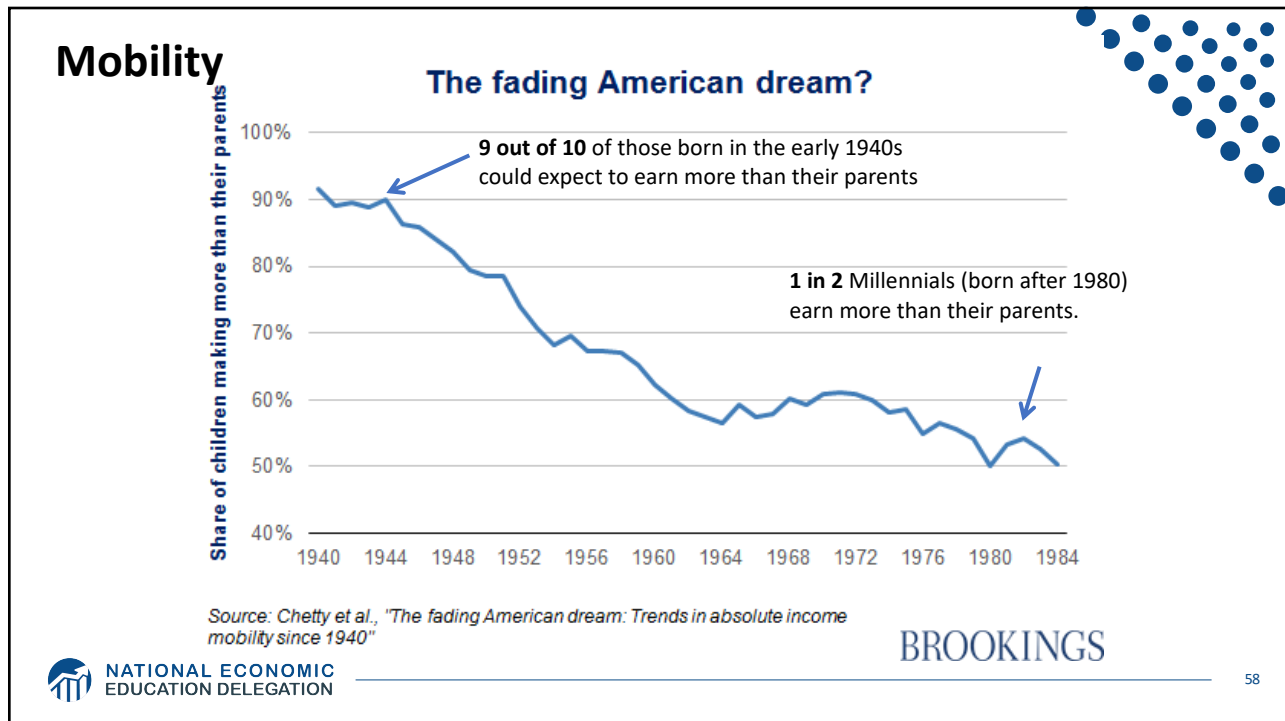
Source: Piketty and Saez, 2003 updated to 2018.  
Graph by: National Economic Education Delegation ([www.NEEDelegation.org](http://www.NEEDelegation.org))

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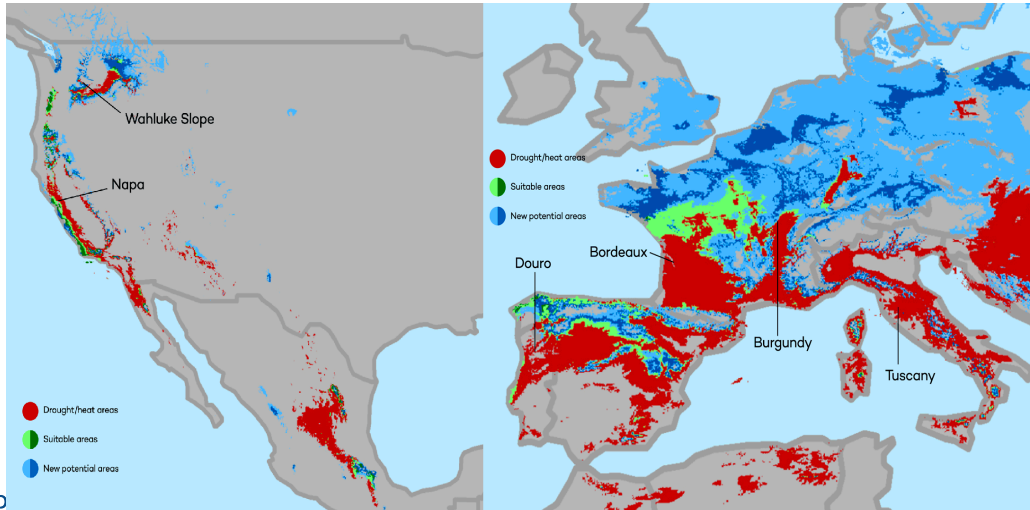
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# Climate Change Economics

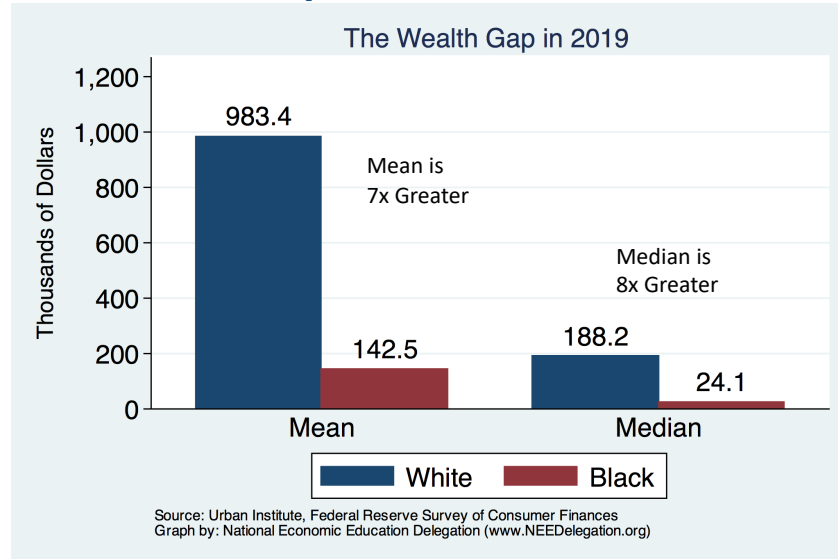
The changing map of the world's wine-growing regions.



# Autonomous Vehicles



## The B-W Wealth Gap: Mike Shor



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## Available NEED Topics Include:

- Healthcare Economics
- US Economy
- Climate Change
- Economic Inequality
- Economic Mobility
- Trade and Globalization
- Minimum Wages
- Immigration Economics
- Housing Policy
- Federal Budgets
- Federal Debt
- Black-White Wealth Gap
- Autonomous Vehicles
- Healthcare Economics

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**Thank you!**

## Any Questions?

[www.NEEDelegation.org](http://www.NEEDelegation.org)

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