



Osher Lifelong Learning Institute, Winter 2022
Contemporary Economic Policy

Clemson University
February-March, 2022

National Economic Education Delegation

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Available NEED Topics Include:

- Coronavirus 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
- US Social Policy

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Course Outline

- **Contemporary Economic Policy**

- Week 1 (2/28): US Economy & Coronavirus Economics
- Week 2 (3/7): Economic Inequality (Brian Peterson, Central College)
- Week 3 (3/14): Cryptocurrencies (Geoffrey Woglom, Amherst College)
- **Week 4 (3/21): Autonomous Vehicles (Jon Haveman, NEED)**



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Submitting Questions

- **Please submit questions in the chat.**
 - I will try to handle them as they come up, but may take them in a bunch as time permits.
- **We will do a verbal Q&A once the material has been presented.**
 - And the questions in the chat have been addressed.
- **OLLI allowing, we can stay beyond the end of class to have further discussion.**



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Driving Change – Autonomous Vehicles’ Big Impact

National Economic Education Delegation

Jon Haveman, Ph.D.

March 21, 2022



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Credits and Disclaimer

- **This slide deck was authored by:**
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- **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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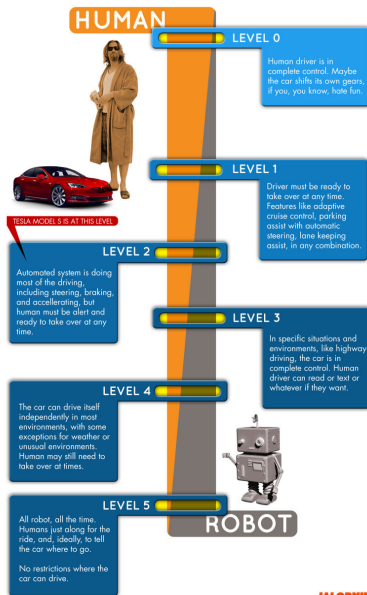
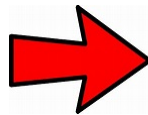
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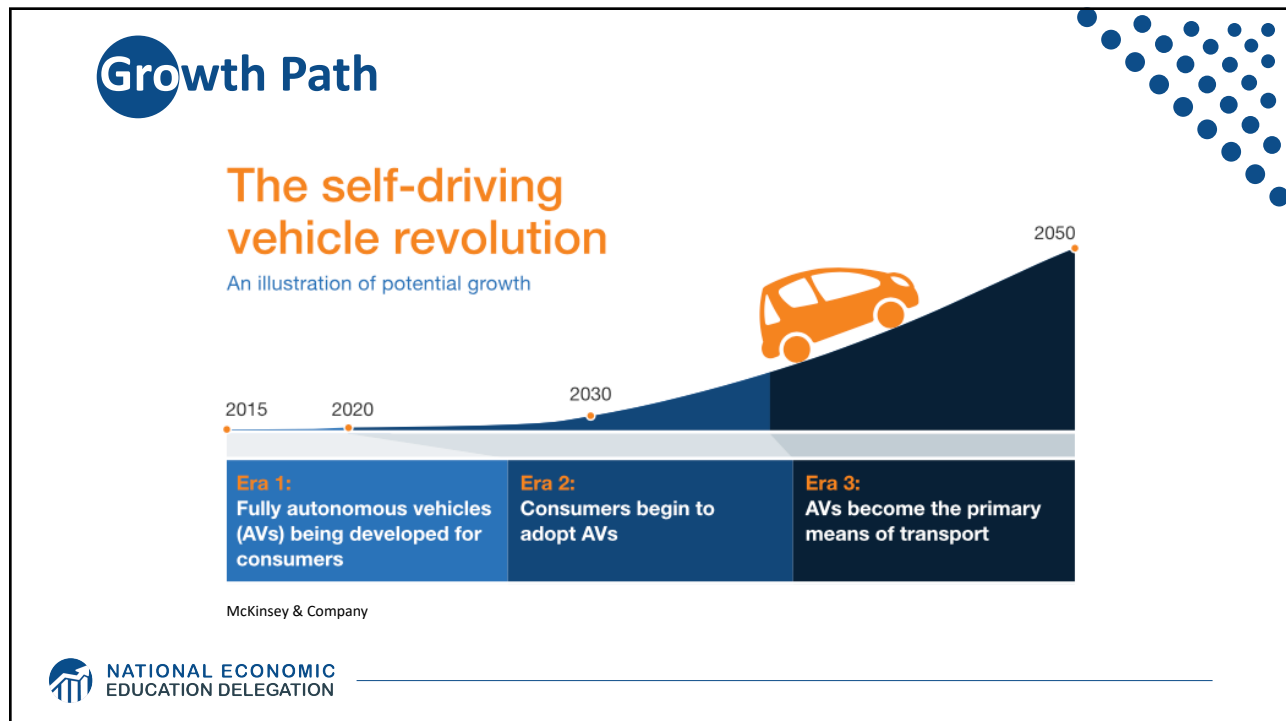
Outline

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

Autonomous Taxonomy

SAE AUTONOMY LEVELS






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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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Two Important Questions:

1. When will Transportation as a Service (TaaS) be available?
2. How quick will the transition be?

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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



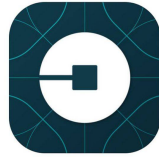
TESLA MOTORS

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

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Wildly Optimistic, But...

40+ Corporations Working On Autonomous Vehicles



WAYMO



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WHEN?

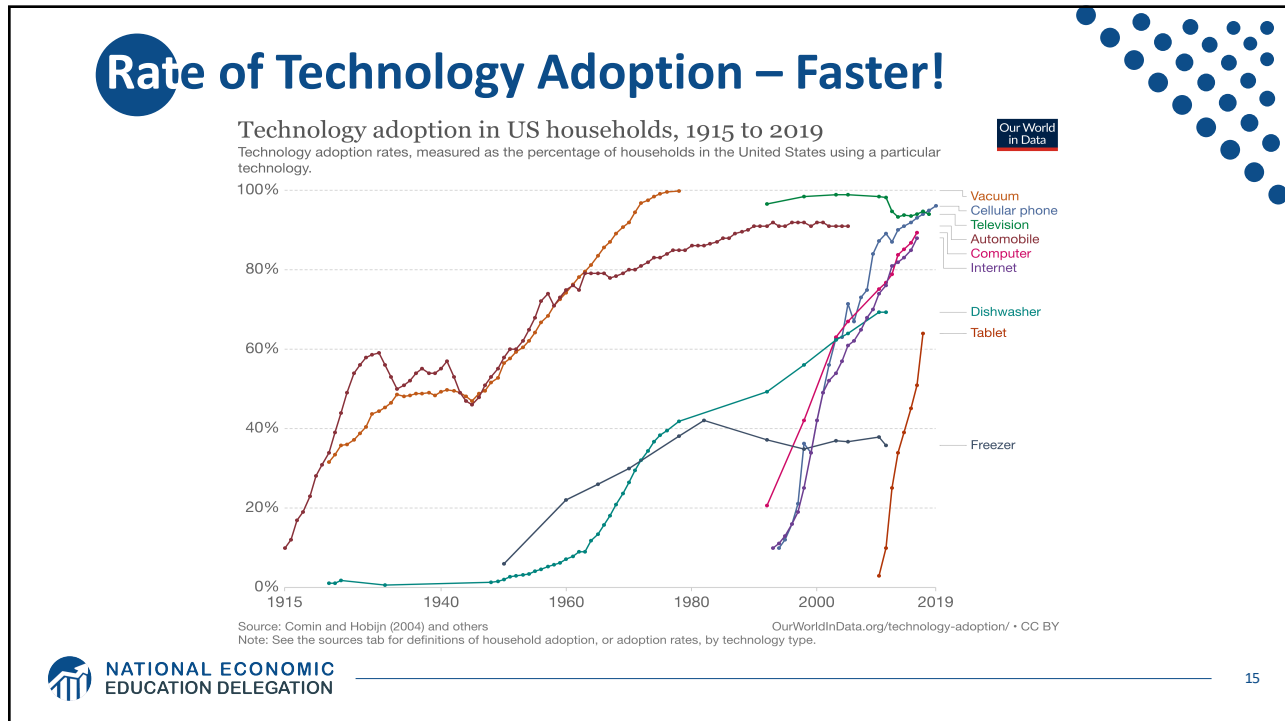
What is possible?

- 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.

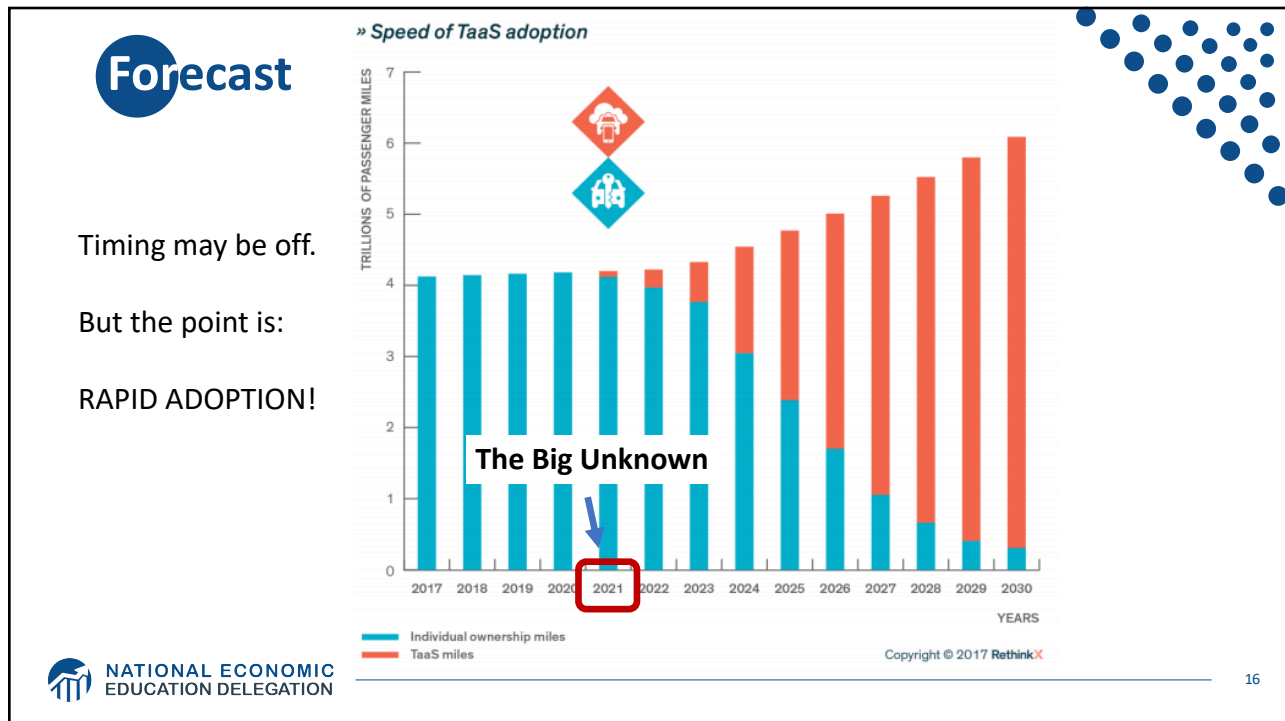


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Waymo's self-driving cars are now available on Lyft's app in Phoenix

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



Waymo is in New York!



New York City



Waymo driving territory

Image courtesy of Waymo



Trucking – Highly Fertile Ground

- **Long haul trucking is likely the first place we will see 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)



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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: \$9,561
 - 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 Bay Area workforce has a commute in excess of 30 minutes



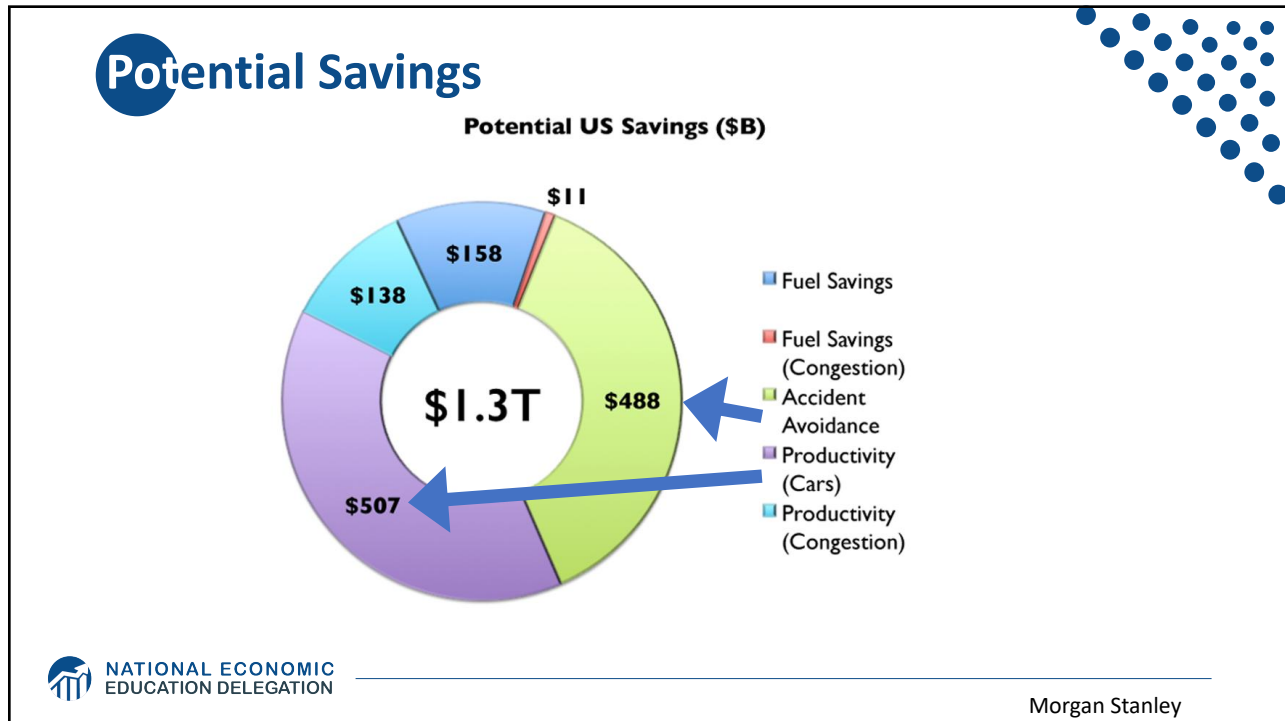
Source: NEED Calculations and AAA Driving Cost Fact Sheet, 2020

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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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/impooverished
- **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**

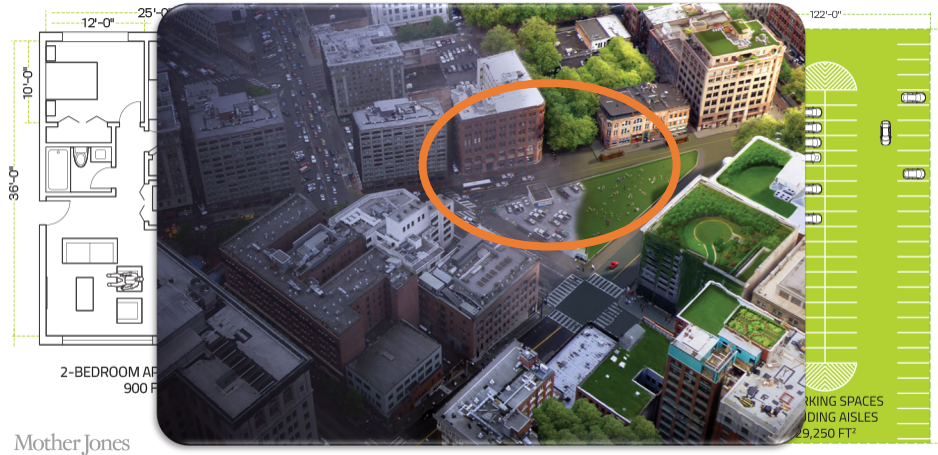
- Public Transportation often does not work well for low-income workers/residential workers
 - o Does not go from residential to residential, but from residential to commercial



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 \$9,282 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

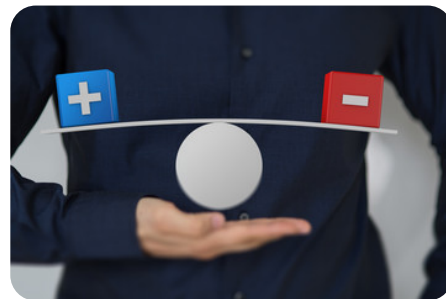
Transportation

- **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:**

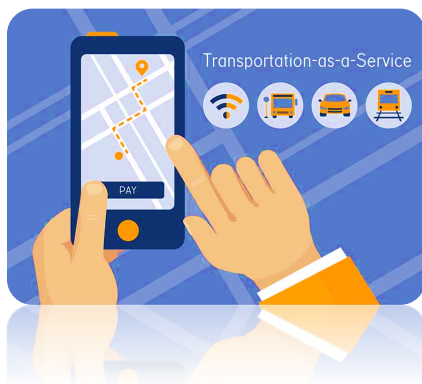
- Currently on expansion
- Will turn toward:
 - o Maintenance
 - Signage and striping has to be robust
 - TaaS providers push for fewer potholes?
 - o Adding technology
 - Stop lights will be digital as well as visual
- Some will disappear: Signs!



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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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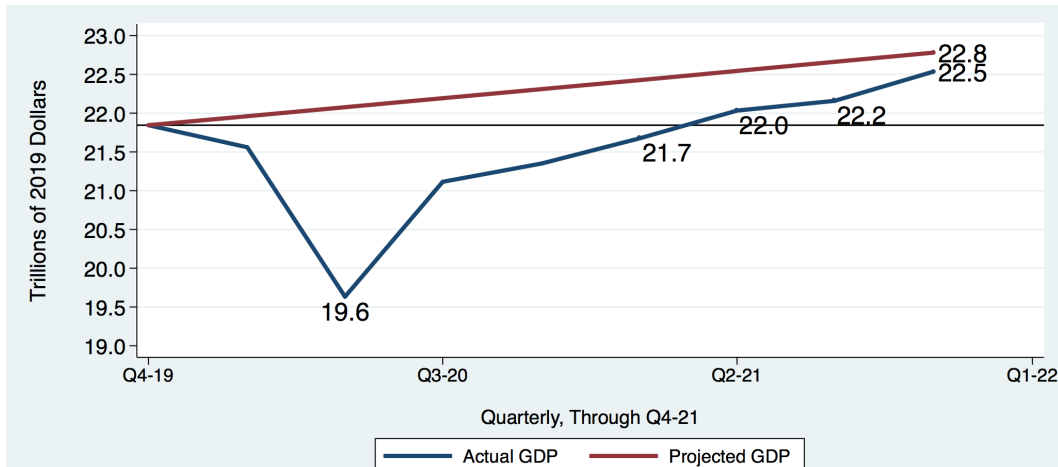
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Summary of Change

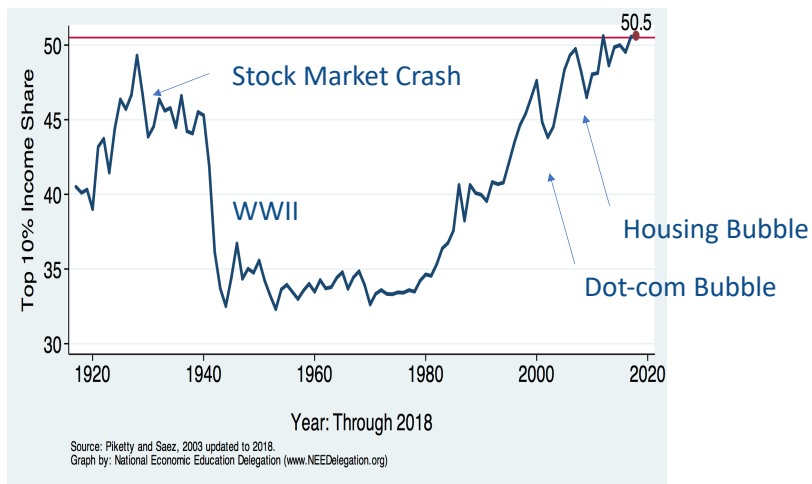
- Massive employment upheaval.
- Local government finances will look very different.
- Housing will be easier to build and more plentiful.
- Parking conversions will be commonplace.
- Demand for transportation infrastructure will likely decline.
 - Transportation infrastructure technology will be a booming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

US Economy: Simone Wegge



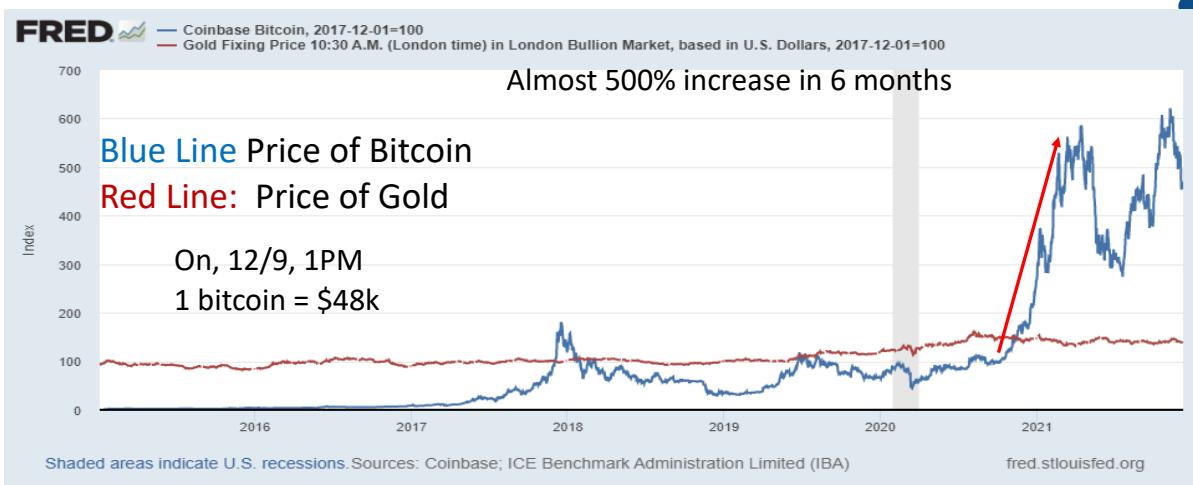
Source: Bureau of Economic Analysis. Projected GDP is a continuation of the 2011-2019 trend.
 Graph by: National Economic Education Delegation (www.NEEDelegation.org)

Inequality: Brian Peterson



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Bitcoins: Geoffrey Woglom



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Autonomous Vehicles: Me!



Thank you!

Any Questions?

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