Osher Lifelong Learning Institute, Fall 2022

Contemporary Economic Policy

Duke University
September-October, 2022

National Economic Education Delegation

1

Available NEED Topics Include:

- Healthcare Economics
- Climate Change
- Economic Inequality
- Economic Mobility
- US Social Policy
- Trade and Globalization
- Minimum Wage
- The U.S. Economy
- Immigration Economics
- Housing Policy
- Federal Budgets
- Federal Debt
- Black-White Wealth Gap
- Autonomous Vehicles

2

Course Outline

- **Contemporary Economic Policy**
  - Week 1 (9/19): US Economy (Geoffrey Woglom, Amherst College)
  - Week 2 (10/3): Trade and Globalization (Alan Deardorff, Univ. of Michigan)
  - Week 3 (10/10): Economics of Immigration (Roger White, Whittier College)
  - **Week 4 (10/17): Autonomous Vehicles (Jon Haveman, NEED)**
  - Week 5 (10/24): Trade Deficit and Exchange Rates (Alan Deardorff)
  - Week 6 (10/31): Cryptocurrencies (Geoffrey Woglom, Amherst College)

3

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.**
- **Slides will be available from the NEED website tomorrow (https://needelegation.org/delivered_presentations.php)**

4

OLLI – Duke University

Driving Change – Autonomous Vehicles' Big Impact

National Economic Education Delegation

Jon Haveman, Ph.D.

October 17, 2022

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5

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.
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  - Such views are those of the presenter and not necessarily those of the National Economic Education Delegation (NEED).

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6

Outline

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

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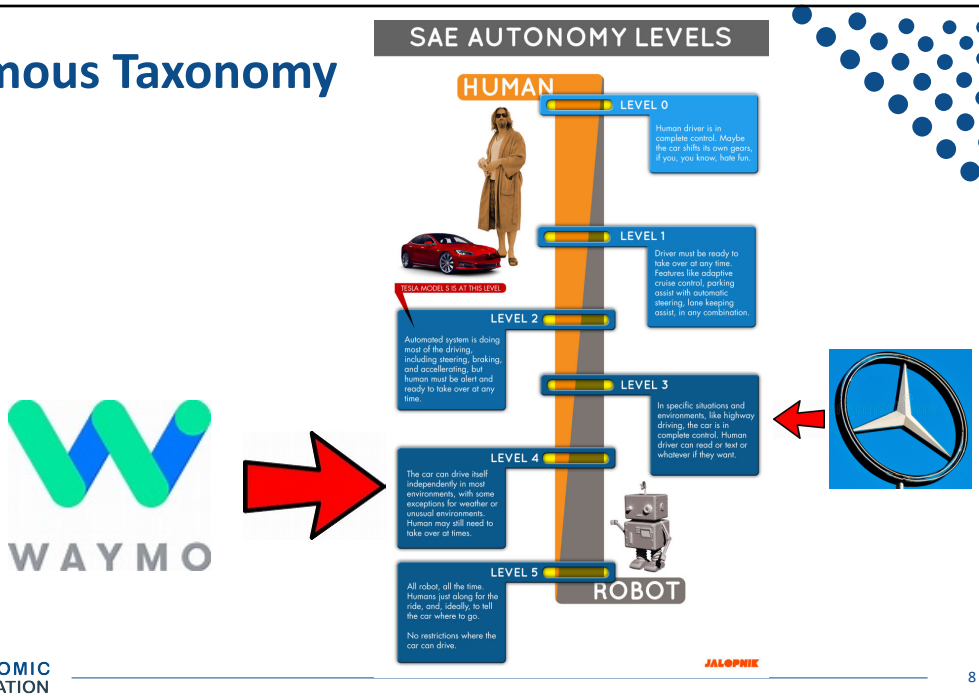
7

Autonomous Taxonomy



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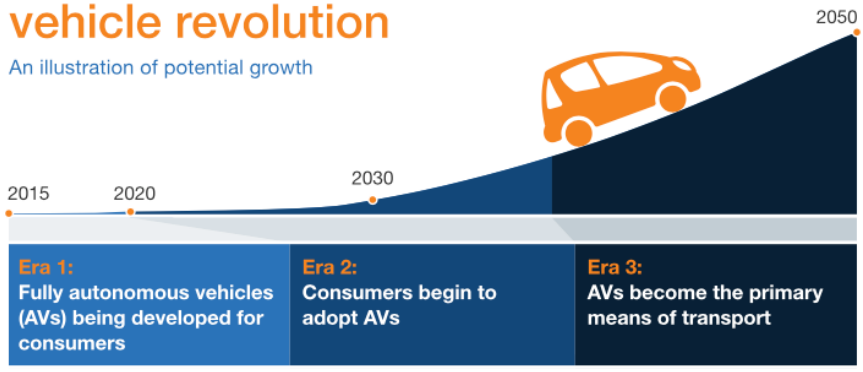
8

8

Growth Path

The self-driving vehicle revolution

An illustration of potential growth



McKinsey & Company

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9

WHEN?

What do the headlines say?

NVIDIA to introduce level-4 enabling system by 2018

Audi to introduce a self-driving car by 2020

Volkswagen expects first self driving cars on the market by 2019

First autonomous Toyota to be available in 2020

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

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10

40+ Corporations Working On Autonomous Vehicles



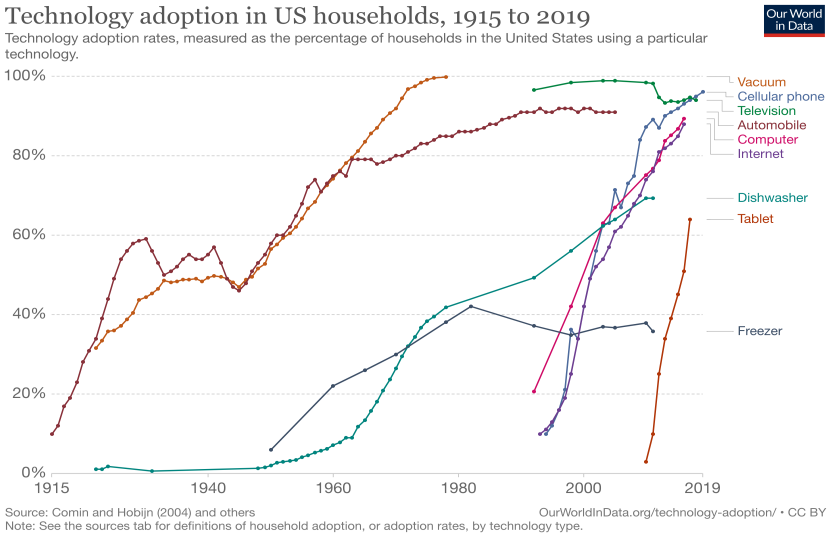
11

WHEN?
What is possible?

- **By 2025 (?)**
- **Potentially 95% of VMT by 2035.**
  - Last 5% may 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.

12

Rate of Technology Adoption – Faster!



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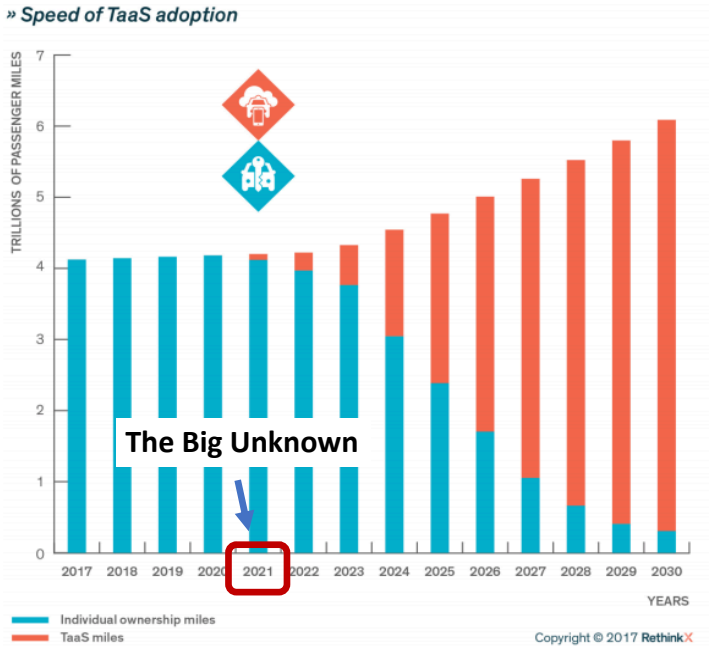
13

Forecast

Timing may be off.

But the point is:

RAPID ADOPTION!



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

Lyft and Motional's all-electric robotaxi service is now live in Las Vegas

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

NuTonomy joins forces with 'the Uber of Southeast Asia'

Cruise is now charging for rides in its driverless vehicles in San Francisco

15

Waymo is in New York!

WAYMO

New York City

Image courtesy of Waymo

16

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.

17

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

18

Actively Pursuing Autonomous Local Delivery

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

19

What will the future look like?

20

This:

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21

But, will it be:

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22

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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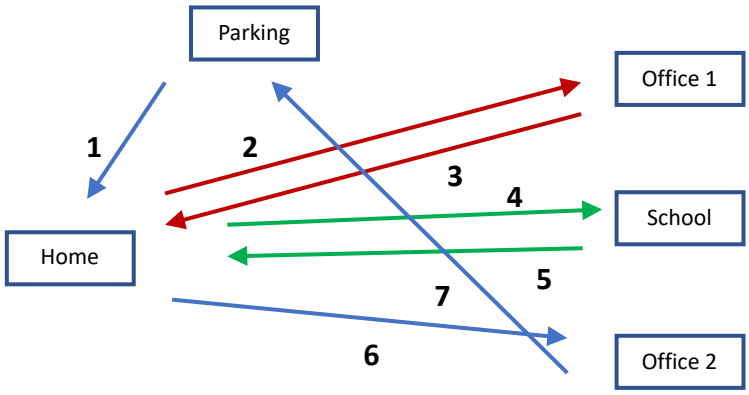
Two Adults and a Child: Morning Miles



And this is just the morning…..

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24

24

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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Economics Drives Transition: Private

- **Adoption dividend for private individuals**
  - Eliminate car ownership
    - Ave annual cost of owning a car: $9,666 (2021)
    - Cost per mile will fall: $0.64 to $0.19
  - Repurpose your garage
    - $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 Bay Area workforce has a commute in excess of 30 minutes.

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Economics Drives Transition: Public

- **Economic and social costs associated with human drivers are enormous:**
  - ACCIDENTS:
    - Drive 25% of congestion.
    - Result in 40,000 deaths.
    - And 2 million injuries.
    - 90+% caused by human error.
  - Increased productivity from not driving.
  - Costs of human drivers estimated at up to $1.3 **TR**illion each year

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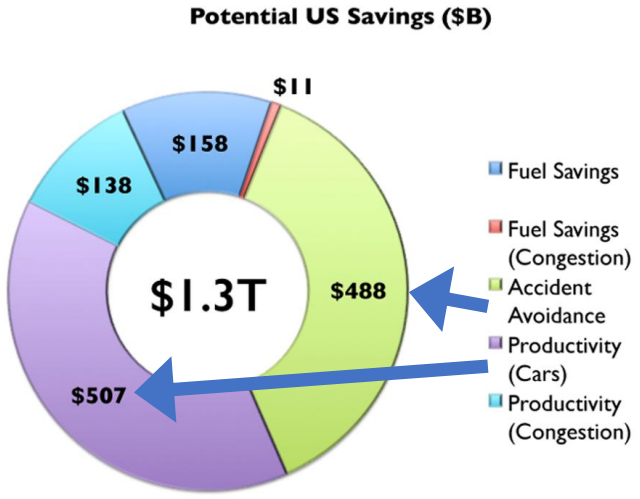
28

Potential Savings



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Morgan Stanley

29

Encourage Change

- **Mobility and equity considerations**
  - Elderly/disabled/impoverished
- **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.

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Mobility and Equity

- **Mobility**
  - Handicapped
  - Elderly
  - Lower income
- **Equity**
  - Public Transportation often does not work well for low-income workers/residential workers
    - Does not go from residential to residential, but from residential to commercial

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31

Safety and Productivity

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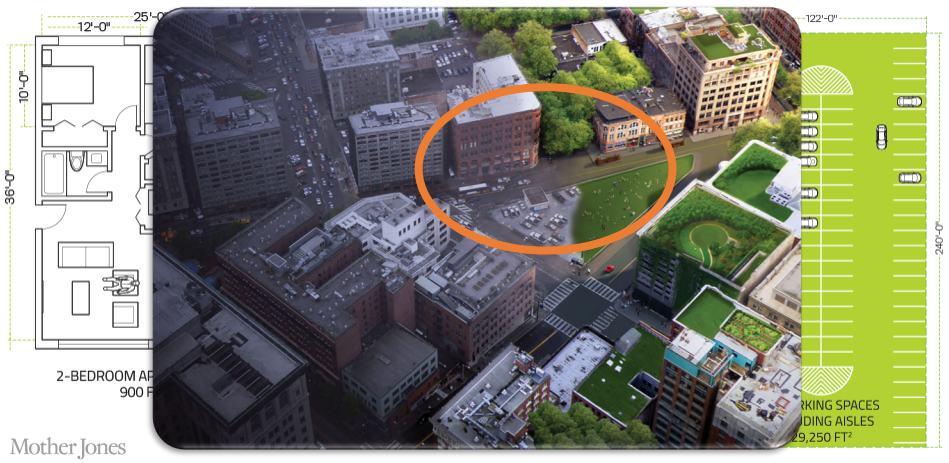
32

Environment



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33

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

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34

What Changes Will This Bring?

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

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

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35

Disposable Income

- Costs $9,561 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:
    - Parking revenue, tickets, traffic violation revenues
    - More commercial, retail and residential space
  - Less spending on road development
  - More (maybe less) spent on road maintenance
    - Fewer road miles
    - but perhaps more VMT

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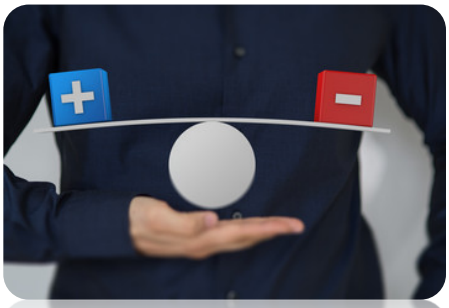
Transportation

- **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
    - 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



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38

Infrastructure

- **Focus of transportation infrastructure:**
  - Currently on expansion
  - Will turn toward:
    - Maintenance
      - Signage and striping has to be robust
      - 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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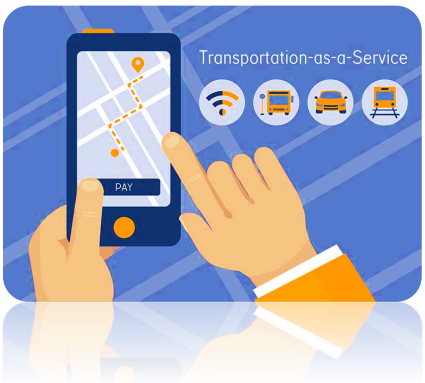
39

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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40

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

41

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…

42

Parking

- **Greatly reduced demand for parking lots.**
- **Service providers will own parking lots in strategic places.**
- **Street parking will largely be a thing of the past.**
  - More green space in cities
- **Shopping mall and apartment parking?**
  - Converted to housing?

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43

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 60 miles longer than California's entire 840-mile coastline
- **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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44

44

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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45

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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46

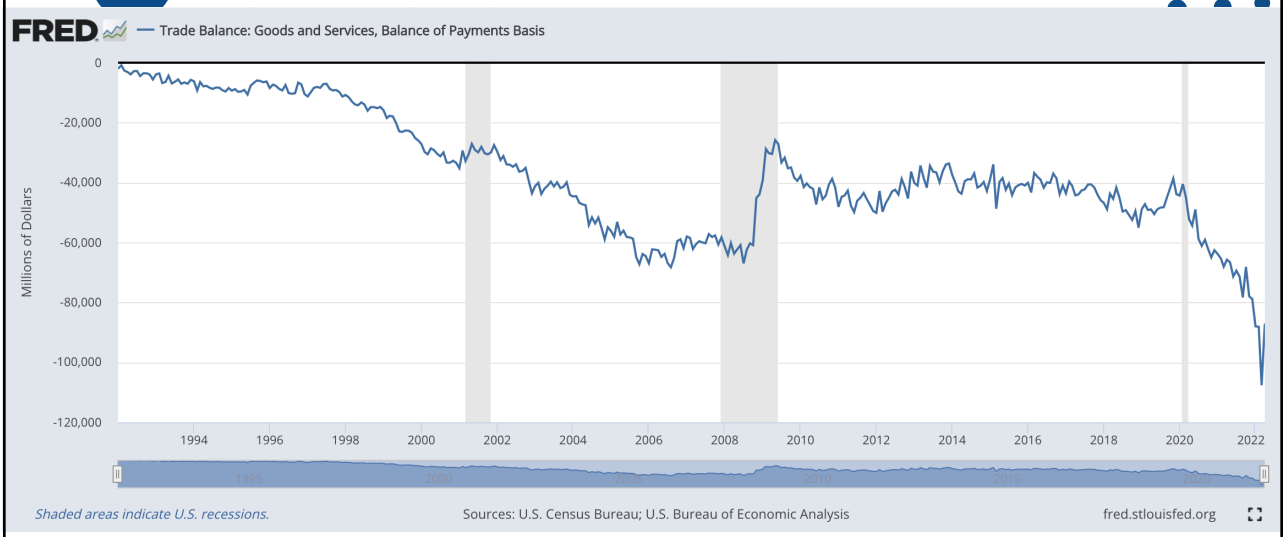
46

Investment Opportunities

- Parking lots/garages
- Transportation technology
- Certain residential properties
- Apartment complexes
- Infrastructure technology

47

Trade Deficits: Alan Deardorff



48

Thank you!

Any Questions?

www.NEEDelegation.org
Jon D. Haveman
Jon@NEEDelegation.org

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49