Infrastructure Economics

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Who Are We?

- **Honorary Board: 54 members**
  - 2 Fed Chairs: Janet Yellen, Ben Bernanke
  - 6 Chairs Council of Economic Advisers
    - ○ Furman (D), Rosen (R), Bernanke (R), Yellen (D), Tyson (D), Goolsbee (D)
  - 3 Nobel Prize Winners
    - ○ Akerlof, Smith, Maskin
- **Delegates: 600+ members**
  - At all levels of academia and some in government service
  - All have a Ph.D. in economics
  - Crowdsource slide decks
  - Give presentations
- **Global Partners: 45 Ph.D. Economists**
  - Aid in slide deck development

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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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Available NEED Topics Include:

- **Coronavirus Economics**
- **Climate Change**
- **Economic Inequality**
- **Economic Mobility**
- **US Social Policy**
- **Trade and Globalization**
- **Minimum Wages**

- **The U.S. Economy**
- **Immigration Economics**
- **Housing Policy**
- **Federal Budgets**
- **Federal Debt**
- **Black-White Wealth Gap**
- **Autonomous Vehicles**

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Outline

- **What do we mean by infrastructure?**
- **Current state of infrastructure in the US**
- **Infrastructure in economic models**
- **Why should we invest in infrastructure?**

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What is a Useful Definition of Infrastructure?

- *Infra-* means "below;"
  - So the infrastructure is the "underlying structure" of a country and its economy.
- Miriam-Webster definition of Infrastructure:
  - the system of public works of a country, state, or region
    - o *also* **:** the resources (such as personnel, buildings, or equipment) required for an activity
  - the underlying foundation or basic framework (as of a system or organization)
  - the permanent installations required for military purposes

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Different Kinds of Infrastructure (& Examples)

- **Provide basic services.**
  - Electricity, water, broadband (?).
- **Improve the performance of the economy.**
  - Roads, bridges, airports, seaports…..
  - General R&D?
  - Education
- **Make people's lives better.**
  - Roads, bridges, airports…
  - Protection from natural disaster
  - Child care, education.

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Infrastructure – Is it:

- **Traditional:**
  - Roads, bridges, tunnels, airports, seaports, dams, water, electrical, and telephone systems?
- **Additional:**
  - Broadband
- **What about:**
  - R&D? Human capital? Institutions?

- **What definition of "infrastructure" is the most useful today?**

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One Taxonomy:

- **Tangible**
  - Traffic systems: roads, railways, bridges, and other transportation
  - Utilities and disposal: energy, water, communication networks
- **Intangible**
  - Human capital: education, research facilities
  - Health care and social systems
- **Institutional**
  - Legal system
  - Economic system
  - Social system
  - Culture and traditions (?)

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Categories of Tangible Infrastructure

- **Transportation**
  - Highways, roads, bridges
  - Mass transit
  - Airports, seaports
- **Water**
  - Supply
  - Distribution
- **Waste management**
  - Trash, recycling, and wastewater

- **Energy**
  - Generation
  - Transmission
- **Communications**
  - Telephone
  - Internet

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Current State of Infrastructure in the US

2021 Infrastructure Grades

✈ AVIATION	↑ D+		🛳 PORTS	↑ B-	
🌉 BRIDGES	↓ C		🚂 RAIL	B	
🏭 DAMS	D		🏢 ROADS	D	
🥤 DRINKING WATER	↑ C-		🏫 SCHOOLS	D+	
💡 ENERGY	↑ C-		🗑 SOLID WASTE	C+	
🗄 HAZARDOUS WASTE	D+		🏢 STORM WATER	D	
🌊 INLAND WATERWAYS	↑ D+		🚌 TRANSIT	D-	
▦ LEVEES	D		💧 WASTEWATER	D+	
🌲 PARKS AND RECREATION	D+				

America's Cumulative Infrastructure Grade

C-

A	EXCEPTIONAL
B	GOOD
C	MEDIOCRE
D	POOR
F	FAILING

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Source: https://www.infrastructurereportcard.org/

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Current Infrastructure Package

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What is in it?

• Transportation

Roads, bridges, major projects	$110 Billion
Passenger and freight rail	$66 Billion
Public transit	$39 Billion
Airports	$25 Billion
Port infrastructure	$17 Billion
Transportation safety programs	$11 Billion
Electric vehicles	$7.5 Billion
Zero and low-emission buses and ferries	$7.5 Billion
Revitalization of communities	$1 Billion

• Other

Broadband	$65 Billion
Power infrastructure	$73 Billion
Clean drinking water	$55 Billion
Resilience and waste water storage	$50 Billion
Removal of pollution from water and soil	$21 Billion

Just $550 million new.

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What is missing?

- **Strategic thinking:**
  - Long term thinking, planning, prioritizing.
- **Meaningful climate resilience planning.**
- **Education & R&D.**
- **Expanding/insuring water supplies.**
- **Hazardous waste.**
- **A meaningful magnitude of spending?**

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Funding – According to the White House

- **Unspent emergency relief funds**
- **Targeted corporate user fees.**
- **Strengthening tax enforcement – crypto currencies.**
- **Revenue generated from higher economic growth.**

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Infrastructure Benefits

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Infrastructure in economic models

- **Vast macroeconomic literature on relation between infrastructure and economic growth**

- **Wide variation in the magnitude of economic effects of infrastructure spending on growth or productivity**

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Why Should we Invest in Infrastructure?

- **Vital ingredient to economic growth**
  - Facilitates economies of scale, raises productivity
    A 10% rise in infrastructure assets directly increases Real GDP per capita by 0.7 – 1%.

    o Assuming increases in spending translate 1-1 to the stock of assets:
      - **~$50 billion** will raise GDP per capita in the US by **~$300** -**$450**.

    o Productivity growth raises standards of living

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Why Should we Invest in Infrastructure?

- **Vital ingredient to economic growth**
  - Reduces trade costs by improving access to markets.
    - o Port capacity improvement
    - o Reducing traffic congestion
  - Reduces effective distances, facilitates trade and agglomeration.
  - Advances public health by providing clean water and effective sewage systems.

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Case for Spending More on Infrastructure Maintenance

- **Rundown infrastructure increases costs**
  - Longer travel time → higher costs for businesses
  - Wear on cars → more spending on car repairs → faster car depreciation
  - Vehicle deterioration → Additional fuel consumption

  *"The average motorist in the U.S. is losing $523 annually -- **$112 billion nationally** -- in additional vehicle operating costs as a result of driving on roads in need of repair."*
                                               -- November 2016 Urban roads TRIP report

- **Deferred maintenance is a debt burden on the future generations.**

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Public or Private Infrastructure Investment?

- **Nonrival consumption**
- **Non-excludable use**

➔ Social benefits might exceed expected financial return.

➔ Private sector likely to underprovide key types of infrastructure.

➔ Economic case for public provision of infrastructure assets.

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Public or Private Infrastructure Investment?

- **A few arguments for public provision:**
    - Provision of public infrastructure increases productivity of private infrastructure
        - o Incentivizes private capital investment,
        - o Increases labor productivity,
        - o Indirectly increases employment and wages.

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Public or Private Infrastructure Investment?

- **A few more arguments for public provision:**
  - Provides short-term stimulus to the economy by creating jobs
  - Promotes trade and commerce
  - Promotes equity
    - o Pays prevailing wages
    - o More demographically inclusive
    - o Encompasses all congressional districts
  - Promotes public health and well-being
  - Improves public safety
  - Affects not just the present but also future generations.

- **Some of these are more debatable than others.**

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Empirical Evidence on Effect of Gov't Investment

- **In studies from 80s, early 90s:**
  - A 1% increase in the stock of public capital raised GDP by 0.39%

- **In more recent studies**
  - by only 0.08% in the short run, 0.12% long run

- **In terms of multiplier, most short-term estimates are less than 1**
  - Due to negative effects of tax/interest rate increases on private C and I

- **Longer term multiplier**
  - OECD panel data – 1.6
  - US interstate highway system – 1.8

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Empirical Evidence on Effect of Gov't Investment

- **Estimates from the 2009 American Recovery and Reinvestment Act**
    - Each $100,000 spent led to 0.8 job-years created
    - Highway construction employment unaffected in 2009-10
        - ○ fell sharply afterwards
    - Significant "crowd-in" of state and local highway spending
        - ○ For each $1 of federal grant and additional $2.30 in state spending

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Infrastructure Investment in the US

- **Transportation, drinking water, and wastewater infrastructure**
    - mainly funded by the public sector
- **Publicly owned transportation infrastructure**
    - Highways
    - Mass transit
    - Aviation
    - Water transportation
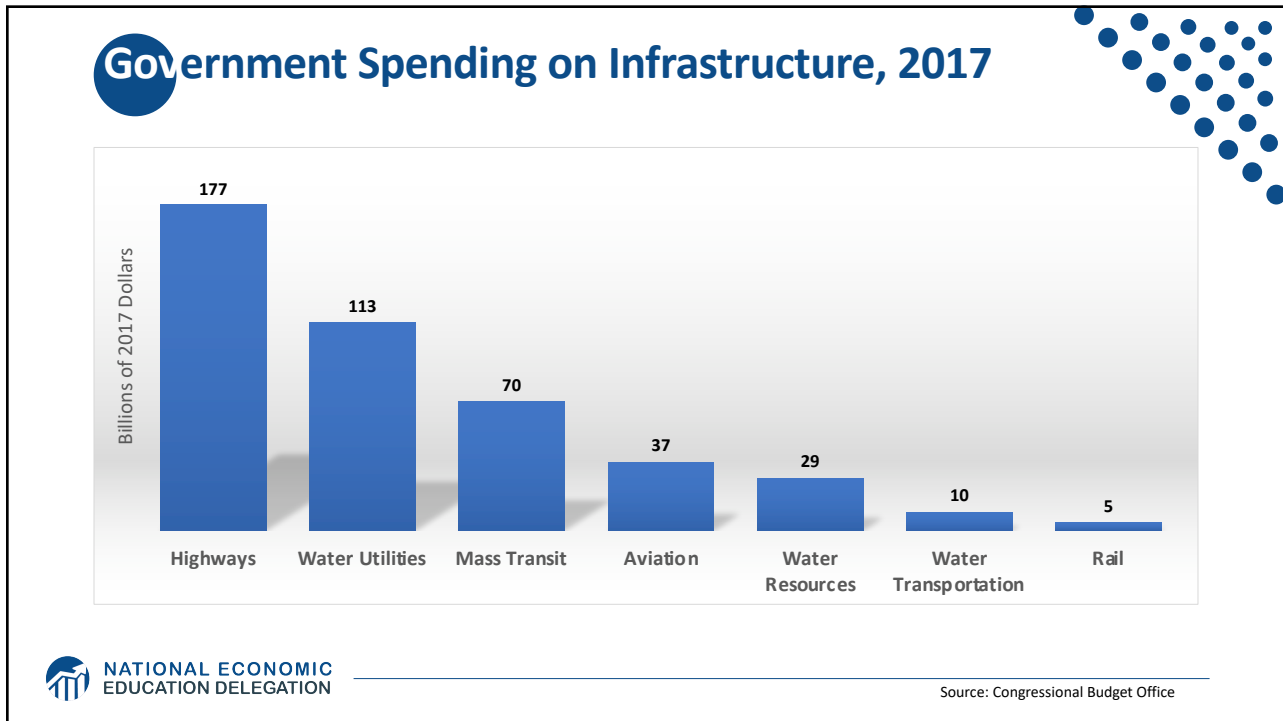   - Rail
- **Publicly owned water infrastructure**
    - Water utilities
    - Water resources
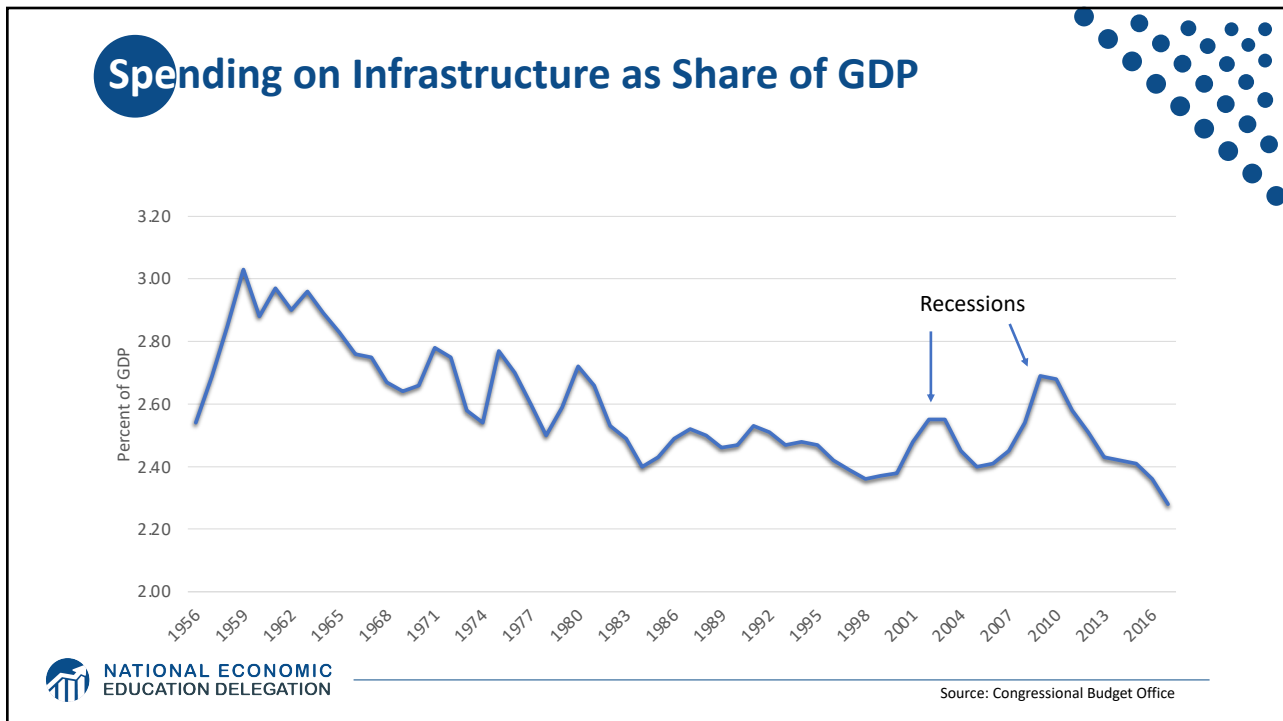- **In 2017, Federal, State and Local governments spent**
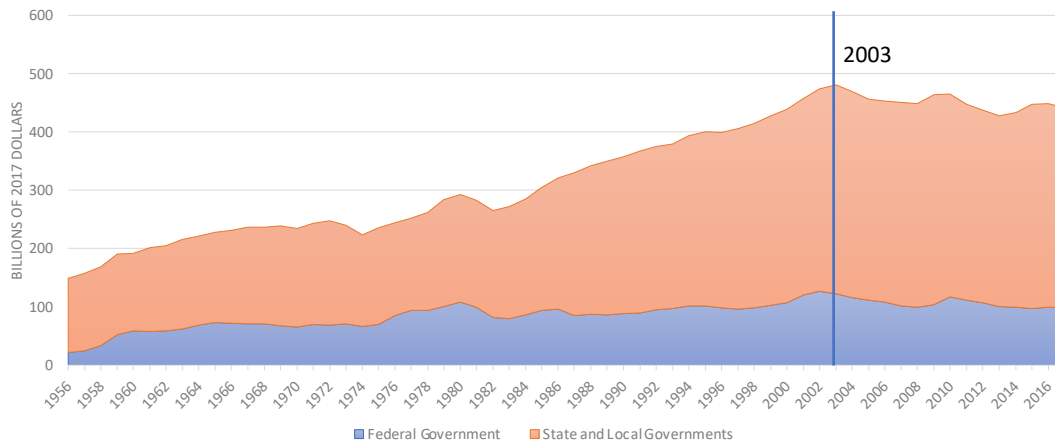   - $441 billion on infrastructure
    - 2.3% of gross domestic product

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Government Spending on Infrastructure, 2017

Source: Congressional Budget Office

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Spending on Infrastructure as Share of GDP

Source: Congressional Budget Office

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Infrastructure Spending by Levels of Government

2003

Source: Congressional Budget Office

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Another Aspect of Infrastructure – Broadband

• Talk of a digital divide ubiquitous.
  - Especially in light of the current pandemic.

• 21 million+ Americans lack meaningful access to the internet.
  - Meaningful access: 25 Mbps download and 3 Mbps upload
  - 14.5 million have no access at all.

• Lack of access more common among the less educated, low income, living in rural or suburban areas.

• 9 million+ school children lacked internet access for online schoolwork.

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Broadband Access

- Modern-day equivalent of the interstate highway system

- Lack of access not just a rural problem
    - In 2016, 57% of households in Detroit, MI;
    - 49% in Memphis, TN and
    - 48% in Cleveland, OH without fixed broadband

- Digital redlining within cities.

- Where available, service is often limited to a single service provider – natural monopolies
    - Due to high up-front fixed costs of laying fiber optic lines

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Enormous Economic Benefits to Access

- **Individual benefits:**
    - Better health and life outcomes.
        o Access to health and education online.
        o Job search and development of digital skills.
    - Higher property values.
    - Increased population and job growth.
        o Higher rates of business formation.

- **Broader economic benefits:**
    - World Bank
        o 10% increase in access yields a 1.2% jump in real incomes.
    - Indiana
        o ROI = 300-400%.

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Brookings; The Benefits and Costs of Broadband Expansion, Aug 18, 2021

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Pace of Investment

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Too Much, Too Soon? Too Little, Too Late?

- **Is the current infrastructure package appropriate?**
- **The United States has enormous needs.**
  - Basic infrastructure – bridges, roads, etc.
  - Other:
    - General R&D: 2% of GDP in the 1950s, currently 0.75%.
- **Is now the time to borrow extensively?**
  - Have just borrowed > $4 Trillion.
  - Interest rates are very low.
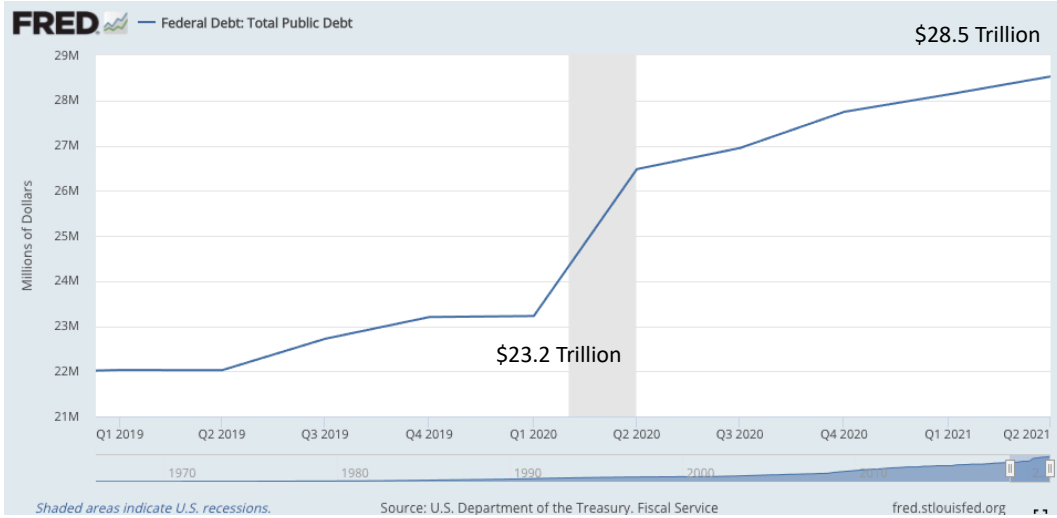- **Given the state of our infrastructure, the ROR can be very high.**

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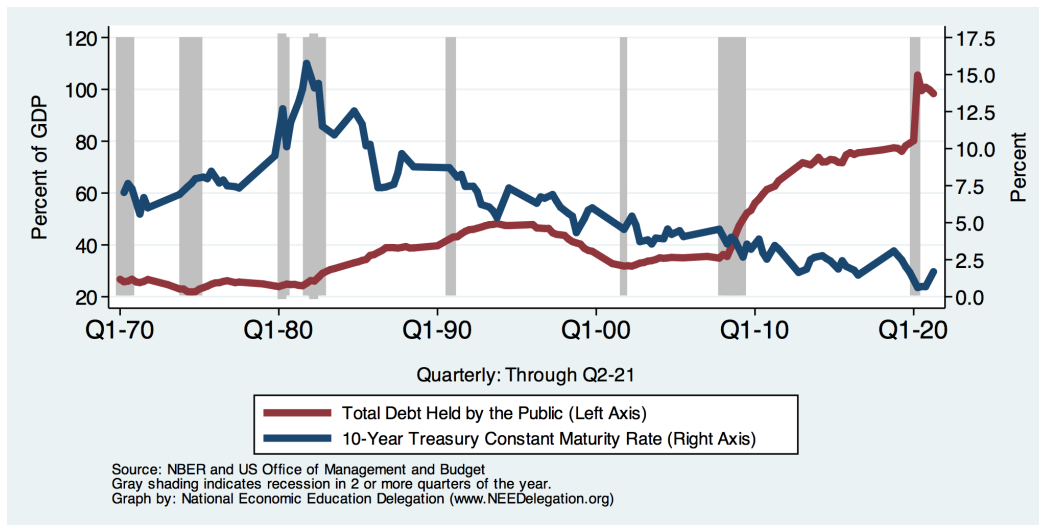EDUCATION DELEGATION

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COVID Borrowing

FRED — Federal Debt: Total Public Debt

$28.5 Trillion

$23.2 Trillion

Shaded areas indicate U.S. recessions. Source: U.S. Department of the Treasury. Fiscal Service fred.stlouisfed.org

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Rising Debt and Low Interest Rates

Quarterly: Through Q2-21

- Total Debt Held by the Public (Left Axis)
- 10-Year Treasury Constant Maturity Rate (Right Axis)

Source: NBER and US Office of Management and Budget
Gray shading indicates recession in 2 or more quarters of the year.
Graph by: National Economic Education Delegation (www.NEEDelegation.org)

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Debt Outlook is Troublesome

Federal Debt Held by the Public, 1900 to 2050

Percentage of Gross Domestic Product

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Summary

- **Infrastructure investment is important.**
- **Current state of US infrastructure – leaves a lot to be desired.**
- **Public infrastructure investment can play a vital role in long run growth.**
  - Improve mobility
  - Raise private capital productivity
  - Improve health
- **May not be ideal as short-term stimulus.**
- **Arguments for and against going big.**
  - ROR arguments likely carry the day in today's interest rate environment.
  - Risk is always the impact on the debt.

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Food for Thought:

- **Why do we categorize some government *investment* as infrastructure?**
  - To make spending on it politically palatable?
    - Gives the impression that it is particularly beneficial.
  - Is there a useful categorization of infrastructure?
    - If so, to what end…

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$3.5 Trillion Infrastructure Bill?

- **Climate Change**
- **Health care**
- **Child care**
- **Family leave**
- **Public education expansion**

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Thank you!

Any Questions?

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Current State of Transportation Infrastructure

- **Roads**
  - Over 4 million miles of roads.
  - In 2018: 3.3 trillion VMT (Vehicle Miles Traveled).
  - 40%+ of America's urban interstates are congested.
  - In 2017, 8.8 billion hours of traffic delay.
    - ○ Costing the country $166 billion in wasted time and fuel.

"The average auto commuter spends 54 hours in congestion and wastes 21 gallons of fuel due to congestion at a cost of $1,080 in wasted time and fuel."
-- 2019 Urban Mobility Report, Texas A&M Transportation Institute

  - 42,060 motor vehicle fatalities in 2020 (8% increase over 2019).

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Current State of Transportation Infrastructure

- **Mass Transit**
  - ~2,500 separate transit agencies.
  - Transit ridership: peaked at 10.7 billion in 2014.
  - 50% of passenger trips by bus.
    - 10% of fleets NOT in "state of good repair".
  - 33+% by heavy rail (subway/metro)
    - 3% of fleets NOT in "state of good repair".

  - Transit's physical infrastructure fairs considerably worse (% NOT in "state of good repair"):
    - 15% of facilities (e.g., maintenance facilities),
    - 17% of systems (e.g., power, signal, communications, fare collecting)
    - 35% of guideway elements (e.g., tracks), and
    - 37% of stations.

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Current State of Transportation Infrastructure

- **Aviation**
  - In 2018, 10 million+ commercial flights
    - Flying ~3 million passengers daily
  - National Plan of Integrated Airport Systems (NPIAS)
    - identifies over 3,300 airports in the U.S. aviation network
  - Contributed 5.1% to US GDP
    - Generated 10.6 million jobs
  - In 2017, 80% of flights were on-time. Delays were caused by
    - late-arriving aircrafts (6.8%),
    - air carriers (5%),
    - weather (3.1%), and
    - diverted flights (0.2%).

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Current State of Transportation Infrastructure

- **Ports**
  - 99% of US overseas trade pass through ports
  - Los Angeles and Long Beach – busiest ports in the US
    - Top 10 U.S. ports account for 3/4th of U.S. trade
  - Congestion decreased port productivity by over 25% over the past decade
  - Port infrastructure upgrades needed to accommodate new, larger ships with deeper navigation channels
- **Waterways**
  - More than 600 million tons of cargo
    - 14% of annual domestic freight
  - Beyond their 50-year design life
  - 50% vessels experience delays due to maintenance shut downs

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Current State of Water Infrastructure

- **Drinking Water**
  - 150,000+ public drinking water systems
  - 1 billion+ glasses of drinking water consumed daily
    - 80% from surface waters such as rivers, lakes, oceans, reservoirs
    - 20% from groundwater aquifers
  - Delivered via 1 million miles of pipes
    - Majority laid in mid-20th century and are aging
    - estimated 240,000 water main breaks occur each year
    - 6 billion gallons of treated drinking water lost daily due to leaking pipes
      - could support 15 million households

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Current State of Water Infrastructure

- **Wastewater**
  - 14,748 wastewater treatment plants
    - ○ 1.3 million miles of public and private lateral sewers
  - Used by 76% of Americans
    - ○ Likely to serve 56 million more people by 2032
  - Structural failure, blockages, and overflows cause at least 23,000 to 75,000 sanitary sewer overflow events each year

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Current State of Water Infrastructure

- **Dams**
  - There are over 90,000 dams in the US providing:
    - ○ drinking water,
    - ○ irrigation,
    - ○ hydropower,
    - ○ flood control, and
    - ○ recreation
  - Average age – 56 years
  - By 2025, 7 out of every 10 dams will be over 50 years old
  - In 2015, there were 15,500 high-hazard potential dams
    - ○ up 52% since 2005

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Current State of Water Infrastructure

- **Levees**
    - A network of 30,000 miles of levees
    - Levees in the U.S. Army Corps of Engineers Levee Safety Program protect
        - over 300 colleges and universities,
        - 30 professional sports venues,
        - 100 breweries, and
        - an estimated $1.3 trillion in property
    - Built in the mid-20th century with an average age of 50 years, aging fast
    - Levees are crucial with majority of the U.S. population living within 50 miles of a coast

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Infrastructure Spending by Category

2003

BILLIONS OF 2017 DOLLARS

■ Capital ■ Operation and Maintenance

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Source: Congressional Budget Office

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