THE ECONOMICS OF ELECTRIC VEHICLES

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Transportation is a major/growing source of GHGs (~20%)
Electrification vision
We drive mostly gasoline-powered cars (US & worldwide)
~60% of electricity comes from fossil fuels (high GHG)

Electricity production by source, World

Source: Our World in Data based on BP Statistical Review of World Energy & Ember (2021)
Note: ‘Other renewables’ includes biomass, waste, geothermal and wave and tidal energy.
Today

- Private economics of EVs
- (Potential) externalities
  - Unpriced global & local pollution
  - Non-appropriable learning by doing
  - Network effects (charging infrastructure)
- Concluding remarks

*Informs desired incentives and optimal policy*
Private savings varies substantially by location

- 2019 Nissan Leaf vs Nissan Versa
EVs are not “zero-emissions vehicles”

- 2021: Midwest grid 70% fossil fuel generation (30% coal)
- US coal production increased ~10% YoY in 2021Q4

Source: Holland, Mansur, Muller & Yates 2016
Cost savings positively correlated with environmental benefits

- But environmental benefits are negative in most states

Panel (a): Ford Focus Electric vs Ford Focus ICE
Indirect Network Externalities

- If external (likely, to some extent), justifies either
  - Subsidize EV purchases
  - Subsidize EV charging infrastructure
Indirect Network Externalities

- Multiple equilibria?
  - Low EV / low charging infrastructure
  - High EV / high charging infrastructure

- Market failure exists if
  - Hurdle prohibits achieving “high” equilibrium AND if welfare in “high” equilibrium exceeds welfare in “low” equilibrium

- Little empirical evidence to inform relative welfare levels
  - “High” equilibrium: higher environmental benefits, also higher costs
EV Purchase Subsidies

There are many.

• $7,500 federal subsidy (up to $1.5B per manufacturer)
  • Proposals to renew/replenish

• Many state subsidies
  • E.g. CA: CVRP offers $1,000 - $7,000 per EV
  • Additional low-income subsidies up to $9,500 per EV

• Subsidies at this level far exceed environmental benefits (which, again, are negative in many cases)
Subsidizing EVs produces unintended consequences

• Puts more cars on the road
• Fails to reduce driving in gasoline cars
• Promotes driving EVs in areas with coal electricity
  • Driving EVs is typically cheaper per mile in those locations
• If successful, drives down the price of oil
  • Changes incentives in rest of world
EV Charging Infrastructure Subsidies

- Again, in the billions of dollars
- Potentially important for stimulating demand for EVs in MUDs
  - Is this desirable?

A few questions/concerns:
- If EV purchase subsidies are optimal (or excessive), can infrastructure subsidies be justified on network externality grounds?
  - Are there other market failures?
  - Standardization?
- Often directed towards government-determined locations
  - Would the market allocate these more efficiently?
- Sunk costs
Is it more cost-effective to subsidize infrastructure than EVs?

• Extremely challenging to identify empirically

• Best-in-class papers
  • Springel (2021): uses EV incentives as IV for charging station density
  • Li, Tong, Xing & Zhou (2017): use grocery stores and supermarkets as IV
  • Li (WP): uses state-level & ARRA federal subsidies as IVs

• Exclusion assumptions are strong (and untestable)

• Recommendation: deploy infrastructure subsidies in a manner that allows credible ex-post evaluation
Learning by Doing

Key questions

- Does meaningful learning occur in EV (and related) markets?
- Is this learning appropriable by firms?
- Very little evidence in general; no evidence in EV market
Remarks (1): Are EVs and ICEs substitutes?

(+ ) Adjust for away-from-home charging

(+ ) Adjust for fuel efficiency

eVMT = 6,700 miles/BEV/yr

vs

10,000 miles/gas car/yr

Source: Burlig, Bushnell, Rapson & Wolfram (2021)
Remarks (1a): Tesla vs range effects

Source: Burlig, Bushnell, Rapson & Wolfram (2021)
Remarks (2): Norway

- 84.2% EV market share in April 2022

**Figure 1.2. New passenger cars registered in Norway**

2006-2018

- No EV subsidies (aside from HOV lane access, toll exemptions, etc)
- Massive taxes on gasoline cars ($72k/car in 2018\(^1\))
- 98% renewable electricity (hydro → replicable?)

Source: Data obtained for this report from Norwegian Road Federation.

\(^1\) Eskeland & Yan 2021
Concluding remarks

- **Aspiration**: complete transformation of the transportation economy
  - Replace $800 billion/year in liquid fuel expenditures with electricity (currently a $400 billion/year industry)
- **Abatement benefits** likely to be lower than expected, at least in the short run
- **Optimal policies** will vary over time and space
- There are several important, unanswered questions
- **Benefits** to remaining open-minded about alternative abatement pathways
Comments welcome:

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