# Discussion of ”Financing the Global Shift to Electric Mobility”

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# How do we finance the green transition?

- Green technologies tend to face higher cost of credit. Lanteri and Rampini (2023)
  - Most studies take demand as passive.
  - Credit moves demand only through firm's marginal costs.
- However, we know credit is crucial for consumption of durables.
  - Durables: houses, cars, etc...
  - If credit is also costlier for green durables, effect is amplified.
  - Firm invest less in green tech and consumers buy less.
- Then, need to understand "green" spreads in durables.

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**This paper:** what is the spread and what drives it?

# Data

**Car data:** standardized loan-level data for car loans.

- Observe loan amount, interest rate, maturity, and LTV.
- Observe make and manufacturer, and borrower characteristics.
- Matched with residual value data.

**Patent data:** all US patents.

- Used to compute intensity of innovation.
- Focus on patents on clean auto technology.
- Yields a time series of clean energy intensity.

# Empirical strategy

$$Y_{it} = \alpha_{\text{make-model}} + \alpha_{\text{region},t} + \alpha_{\text{lender}} + \alpha_{\text{deal}} + \beta \text{Hybrid}_i + \delta X_{it} + \varepsilon_{it}$$

- Use cross-sectional variation within a maker-model.
- Fully absorb lender and region variation.
- Also include interaction of Hybrid with patent intensity.

# Result 1: EV are charged a higher interest rate

Panel C. within make-model×geography×year×lender comparison

| | (1) interest rate | (2) LTV | (3) maturity |
|---|---|---|---|
| Hybrid | 0.239*** | −4.616*** | −2.223*** |
| | (0.06) | (1.02) | (0.46) |
| deal FE | Y | Y | Y |
| make-model × nuts3 × lender × year FE | Y | Y | Y |
| borrower controls | Y | Y | Y |
| Observations | 7,471,046 | 7,028,766 | 7,471,057 |
| R-sq | 0.783 | 0.430 | 0.443 |

- LTV is lower $\implies$ larger downpayment.
- Maturity is lower $\implies$ monthly payment is larger.

# Result 2: lender's estimation of residual value is lower for EVs

| | (1) RV/price | (2) RV adjustment ever | (3) RV adj. down ever | (4) RV adj. down never |
|---|---|---|---|---|
| Hybrid | −0.048*** | 0.025*** | 0.023*** | 0.002 |
| | (0.006) | (0.006) | (0.005) | (0.002) |
| lender FE | Y | Y | Y | Y |
| deal FE | Y | Y | Y | Y |
| model-make FE | Y | Y | Y | Y |
| nuts3 × year FE | Y | Y | Y | Y |
| borrower controls | Y | Y | Y | Y |
| loan controls | Y | Y | Y | Y |
| mean outcome var. | 0.403 | 0.125 | 0.114 | 0.011 |
| Observations | 1,261,987 | 1,370,360 | 1,370,360 | 1,370,360 |
| R-sq | 0.357 | 0.293 | 0.284 | 0.070 |

- Revisions of residual value are also more common.
- But only for downwards revisions.

# Result 3: variation in interest rates comes from intensity of clean patenting

Panel A. intensity of clean patenting - ADHMV2016

| | interest rate | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Hybrid | 0.101 | 0.038 | 0.039 | 0.002 |
| | (0.10) | (0.10) | (0.08) | (0.10) |
| Hybrid × number of clean patents ADHMV2016 (log) | 0.162*** | 0.134*** | | |
| | (0.03) | (0.03) | | |
| Hybrid × share of clean patents ADHMV2016 | | | 0.169*** | 0.136*** |
| | | | (0.02) | (0.02) |
| baseline FE, borrower & loan controls | Y | Y | Y | Y |
| Hybrid × incentive controls | N | Y | N | Y |
| Hybrid × socioeconomic controls | N | Y | N | Y |
| Hybrid × competition controls | N | Y | N | Y |
| Observations | 2,816,501 | 2,816,501 | 2,816,501 | 2,816,501 |
| R-sq | 0.805 | 0.805 | 0.805 | 0.805 |

- Hybrid dummy is no longer significant.
- Number of clean patents varies across *t*.

# Identification

$$Y_{it} = \alpha_{\text{region,make-model,lender},t} + \alpha_{\text{deal}} + \beta \text{Hybrid}_i + \delta X_{it} + \varepsilon_{it}$$

- FE implies they compare Porsche Cayenne with Porsche Cayenne hybrid.
  - Not Porsche 911 with Toyota Prius.
- Consumers should be very similar.

1. Are hybrids the same as EVs?
   - Most hybrids are built for tax reasons.
   - Is the collateral channel weaker?

# How do car loans work in Europe?

Most common contract is a PCP or financial lease.

- Buyer pays a deposit.
- Terminal value: big chunk of loan paid at end $\implies$ deferred loan + lease.
- Monthly payment depends on principal of loan minus terminal value.
- Repayment of loan can be in cash or by returning the car.

Lender bears all the **recovery risk**.

- If $P > TV$, buyer pays in cash $\implies$ lender has a **short call option**.
- If $P < TV$, buyer returns car $\implies$ lender has a **short put option**.
- Lender really dislikes volatility.

Aside: is the financing for EVs identical to financing of other cars?

# What can the lender do?

1. Reduce principal of loan $\implies$ decrease LTV.
2. Increase monthly payments $\implies$ increase interest rate.
3. Reduce volatility $\implies$ decrease T.

However, the borrower needs to accept.

- If borrower is financially constrained, crucial to keep monthly payments down.
- If not, present value of payments matter.

# What are the payoffs to the borrower?

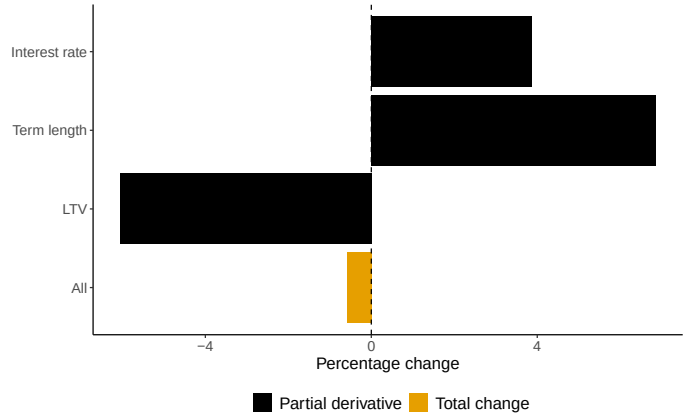
$$-\sum_{t=1}^{T}\frac{M}{(1+i)^T}+\frac{1}{(1+i)^{T-1}}\left(\underbrace{\max\{P_{T+1}^{\text{resale}}-\bar{TV},0\}}_{\text{long call}}+\underbrace{\max\{\bar{TV}-P_{T+1}^{\text{resale}},0\}}_{\text{long put}}\right)$$

and if we ignore the option value (financially constrained borrowers),

$$M=\underbrace{\text{LTV}\times P}_{\text{loan value}}\times\frac{i(1+i)^T}{(1+i)^T-1}$$

and so I can use the empirical estimates to predict the effect on $M$.

# Monthly payments seem to vary little




- Price of EVs is also declining $\implies$ Euro amount of downpayment $\downarrow$.
- Results are consistent with a desire to make monthly payments stable.

# Depreciation or collateral value?

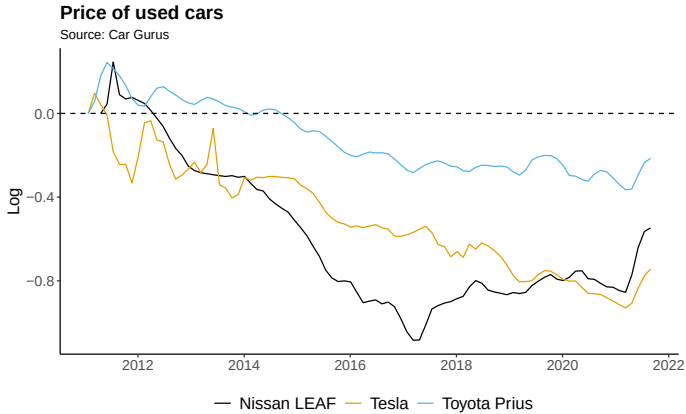
**Result:** credit is more expensive for EV & driven by lower resale price.

- But it could be driven by a faster physical depreciation of EV.
- For example, old batteries depreciated fast.
- In turn, fast depreciation creates incentives for more innovation.

One possible way to check this is to use data on component warranties.

- For each car, look at warranties.
- Compute average warranty length.
- Sort cars according to this variable.

# Price of used EVs have been declining




- Vintage risk or quantity effect?

# How is the spread moving over time?

Measure of patent intensity is not vehicle-specific.

- Captures only time-series variation.
- Is it the patenting activity or the fluctuations in price of used cars?
- Both could capture the same thing - low recovery price.
- But quantity of used cars is also moving.

My suggestion: allow the `Hybrid` coefficient to vary over time.

- Then, compare with time series of prices.

# Conclusion

**This is a great paper!**

- Focus should be on how the financing of consumption also matters!
  - This goes beyond green vs. brown technologies.
- EVs are a great example - large vintage risk.
- Data + empirics are amazing!
- I would change very little.