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- A very insightful analysis of the **various effects of data on markups**
  - Data has an ambiguous effect on product (and firm and industry) markups.
  - Data has a compositional effect on markups.

- Some **critical assumptions** (and some not so critical ones) that make the setup work
  - Firms are **risk-averse** and goods are **bundles of characteristics**.
  - Data provides **information about attribute demand**.
  - Demand is linear, firms compete in quantities, characteristics are fixed, investment occurs before data and uncertainty are realized, and there is no entry or exit.

Main Driving Forces

- Producing large quantities is **risky**. Risk aversion dampens the response to information.
  - ▶ Data reduces this risk, increases output, and increases sensitivity to demand information.
  - ▶ Producing larger quantities **lowers markups** (risk premium channel).

- Data provides better information about attribute demand.
  - ▶ Firms produce more of the goods with high demand and less of the goods with low demand.
  - ▶ Data has a **compositional** effect on production which drives the divergence in markups.

- Investment increases production which is **risky**.
  - ▶ Data reduces this risk and thus increases investment.
  - ▶ Investment lowers costs and thus **increases markups** (investment channel).
  - ▶ Larger firms can charge higher markups (e.g., superstar firms).

- Producing larger quantities generates more data.
  - ▶ Firms **reduce markups** to increase production to generate more data.

Data and Information

- **Are data and information the same thing?**
  - In this model, they are the same thing.
  - To be even more specific, data is the same thing as signals about demand for attributes and thus more informed firm production (or pricing) decisions.
  - But is this really what we worry about in the context of data and market power?
  - In this model, data has the same effect no matter whether it's Amazon, Walmart, OpenAI, Boeing or Tecnoglass that uses data.

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- Greatest concerns with respect to data are usually about digital platforms.
  - No special role for customer data or privacy concerns in this model
  - Exploitation of consumers?
  - Are there non-market effects of market power?

Firm Objective Function

- Model departs from the **standard objective function** in industrial organization, finance, and macro:

$$U_i = \mathrm{E}[\pi_i|\mathcal{I}_i] - \frac{\rho_i}{2}\mathrm{Var}[\pi_i|\mathcal{I}_i] - g(\chi_c, \tilde{c}_i)$$

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- Departure is perfectly fine in my opinion.
  - ▶ Many other papers also depart from standard firm objective functions (Azar and Vives, 2020; Antón et al., 2023; Ericson, 2024) and it has a long intellectual history (Drèze, 1974; Grossman and Hart, 1979; Rotemberg, 1984) in economics.
  - ▶ A bit more justification than just a reference to Eckbo (2008) would be great.

- One micro-foundation could be risk-averse managers that make the firm behave this way.
  - ▶ That's a completely standard assumption in the contract theory literature.
  - ▶ Even with (linear) incentive contracts the manager would still be exposed to risk and one would obtain just a slightly modified version of this setup.

Data and Welfare

- Data has **positive welfare effects** when it is symmetric.
  - ▶ Data increases output and lowers costs, a double benefit for welfare.
  - ▶ But this is somewhat hard-wired given the setup.
  - ▶ Is there also an allocational effect of better data? Can you decompose it?

- Data increases investment which appears to be unambiguously good.
  - ▶ With a change in setup would it be possible that more data leads to **excess investment**?
  - ▶ But isn't there also evidence of a secular decline in investment despite the rise in data?

- "Data **amplifies** market power" …
  - ▶ … but, strictly speaking, that's because without data, firms **already** produce low q.
  - ▶ Also, with much data welfare is high so the welfare loss of market power is less important.

- Data **asymmetry** has welfare costs.
  - ▶ Data differences can lead to large differences in firm size—a source of PPDSSF?
  - ▶ Demirer et al. (2024) documents regulation creating data-intensity differences across firms.
  - ▶ More discussion in the main paper of the results of Appendix C.2 would be great.

Data for Data on Markups

- Paper provides new insights (weapons?) for the "Markup Wars"
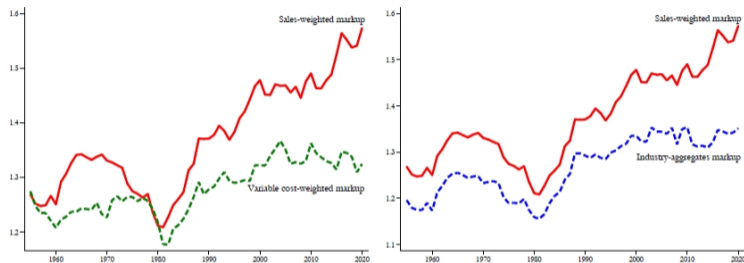
(a) Sales-weighted markups, M^s, (solid line) vs. cost-weighted markups, M^c, (dashed line)

(b) Sales-weighted markups, M^s, (solid line) vs. industry-aggregates markups, M^{ind}, (dashed line)

- Suggestive evidence that divergence in markups may be caused by increased data use
    - Are there good measures of data usage? Has it increased and, if so, uniformly?
    - Papers on IT implementation (Bloom and Van Reenen, 2007; Bloom et al., 2012) with time-series and cross-sectional variation may provide some insights.
    - Demirer et al. (2024) analyzes data storage decisions for US and European firms.

Minor Comments

- Literature on **Cournot games with demand uncertainty**
  - A few seminal references include Ponssard (1979), Vives (1984), Gal-Or (1985, 1986).

- Attributes and **differentiated products**
  - I really like the attributes setup, but is it necessary?
  - Would the same results hold for goods that are differentiated substitutes and where signals are more correlated for less differentiated substitutes?
  - Or is that exactly the same as the present setup? If so it would be worth mentioning that this is just a micro-foundation for this more standard IO setup.

- Do **entry and exit** amplify the effects of data?
  - Entrants have much worse information than incumbents so data could be a barrier to entry ...
  - ... which in turn would increase markups.
  - Dominance of a data-rich firm may also cause the exit of other firms.

Conclusion

- **Creative and insightful paper**
  - A new channel that influences markups …
  - … with so many interesting avenues for extensions!

- I encourage **everybody** with an interest in market power to read it.

Thank You!

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