A Growth Model of the Data Economy

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This Paper

Broad agenda about the role of data in macroeconomics

- What is the importance of data in the production function
  - How does it affect aggregate output?
  - What are the characteristics of a "market" for data
  - What makes data special? Is it different from R&D?

Some Predictions

- Data alone does not sustain long run growth
- In the model data shows complementarity features
- Increasing returns to scale account for specialization: firms as a data vendors

This Discussion

- Highlight some of the key assumptions to model data
  - How does data get into production functions
- Link to standard growth models
  - What would it take to get data fueled growth?
  - Does data foster learning by doing?

Plan

1. Framework: Data as a Firm Input

2. Data and Classical Growth Models

Key Modelling Choices

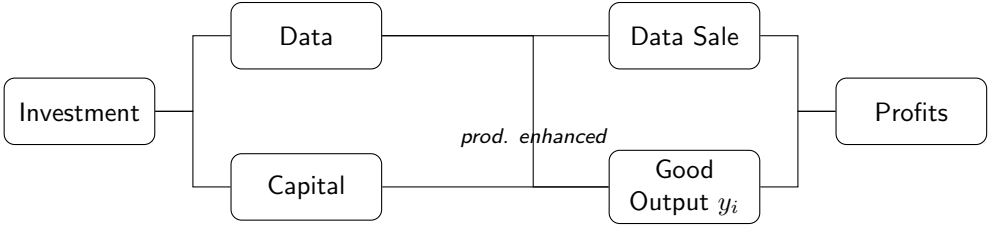
Standard Production Function

- DRS Technology: $y_i = A_i k_i^{\alpha}$
  - From early growth literature: g = savings rate$ptmAK^{\alpha-1}$
  - Cannot sustain long term growth without endogenous change in productivity A
- Data: a candidate to endogenous growth
  - Firms accumulate data from operations: $n_i = z_i k_i^{\alpha}$
  - Data enters productivity $A_i = \bar{A} - f(n_{i,t}, n_{i,t-1}, \dots)$

Data is Special

- Non-rival: data can be sold without incurring losses to other firms
- Interesting results on firm accumulation path

An Overview of the Firm Problem



Modelling Data

Data Accumulation

- Data are a byproduct of production: no agency in data production
- Inside data accumulation is passive
- Outside data acquisition in competitive markets
  - data can be sold / bought on markets at price π
  - non-rival good (Romer): data is replicable

What is Data Good for?

- Potential productivity $\bar{A}$
  - Information friction about production process introduce a gap
  - $A_i = \bar{A} - d(\theta + \epsilon_{a,i}, a_i)$
  - Learning about a persistent moving target $\theta + \epsilon_{a,i}$
  - Datas are signals about production processes θ
- Interesting results on firm accumulation path

Main Results

No long run growth

- DRS in aggregate productivity ($\alpha < 1$)
- Upper bound on $\bar{A}$
- Standard result on impossibility of long run growth ... endogenous growth runs out of steam

Data Feedback

- Data accumulation tied to output or size of a firm
  - $\uparrow k_i \Rightarrow \uparrow n_i \Rightarrow \uparrow A_i \Rightarrow \uparrow k_i$
  - Small firms have low n_i, low productivity, no incentives to invest and grow

Specialization

- Large firms generate lots of data:
  - sell it or keep it and produce high quality goods
  - data salesman (google/fb) or data hoarder (uber)

Plan

Growth Models: Romer (1986)

- Firms produce $y_j = \bar{A} k_j^{\alpha}$
  - Agg. productivity depends on agg. capital stock: $\bar{A} = A_0 \int k_i^{\eta} di$
  - Introduces externality in capital accumulation
- Here set up differs from Romer (1986):
  - $y_j = \bar{A} (1 - f(n_j)) k_j^{\alpha}$
  - $f(\cdot) > 0$, does not allow for endogenous growth in $\bar{A}$
- Can we have endogenous growth with? Why is $\bar{A}$ bounded?

Growth Models: second generation, Romer (1987, 1990)

Expanding Varieties

- Expanding variety: $Y = L^{1-\alpha} \int_0^M x_i^\alpha di$
- Final output: $Y = M^{1-\alpha} \cdot \left(L^{1-\alpha} X^\alpha\right)$: with $X = \int x_i di$
- GDP growth: $g = d \log M_t / dt$

What is data good for

- Inferring product demand: restricts growth. There is only so much we want to consume in frictionless world
- Create new product: see AI generated content (GPT-3), Netflix shows etc...
- How is data different from R&D?

Other Comments

What is $\bar{\mathbf{A}}$?

- If it is the short-run productivity
  - Data is mostly about demand estimation
- If $\bar{A}$ is some sort of theoretical limit (e.g. speed of light)
  - then model feels less restrictive about creating growth
  - But it is also hard to map to actual data

On the empirical side

- Show some evidence of main mechanism ... data traps
- Data hoarding when data is very specific (is that really the case for uber?)

Final Thoughts

Very interesting Paper!

Take away

- Data drives dynamics over lifecycle over the firm
- Important input into production function

Great Paper!