The Effect of Software Adoption on Skill Demand and Inequality

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*The views expressed herein do not necessarily represent the position of the Federal Reserve Bank of Philadelphia, the Federal Reserve System, or the Federal Reserve Board of Governors.

What the Paper Does

- Relates firms' adoption of software to mentions of analytic and social tasks in their job ads.
  - Even studies point to pre-trends → Utilizes methodology of Freyaldenhoven et al. (2020) to identify causal impact of software on analytic and social skill requirements.
    - Basic idea: Latent trends in a firm's skill demands are inferred from time-paths of non-adopting occupations.
  - Also estimates impact of software adoption on number of vacancies in adopting and other occupations.
  - Develops and estimates a model of software adoption.
    - Jobs' skill requirements and output increase after software adoption.

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What the Paper Finds

- Task mentions increase by 1 p.p. in the two years after software adoption
  - 20 percent increase in number of ads in the adopting occupation; 5 percent increase in number of ads in other occupations.
- Decrease in software prices leads to increasing within-occupation inequality.
  - Most of the effects occur because of increasing skill requirements and not the direct productivity impacts of software.

Aims for this discussion

1. Place the paper in the existing and contemporaneous literature

2. Main contribution of the paper: Careful estimation of task impacts of software.

3. One suggestion simplify the theoretical portion of the paper.

4. Two comments about calibrating the model.

The paper contributes to a vibrant literature on technology adoption, job tasks, and the skill premium

- Hirvonen, Stenhammar, Tuhkuri: “New Evidence on the Effect of Technology on Employment and Skill Demand”
  - Firm subsidies to adopt new technology in Finland
  - New technology adoption → increase in labor demand; no change in skill composition

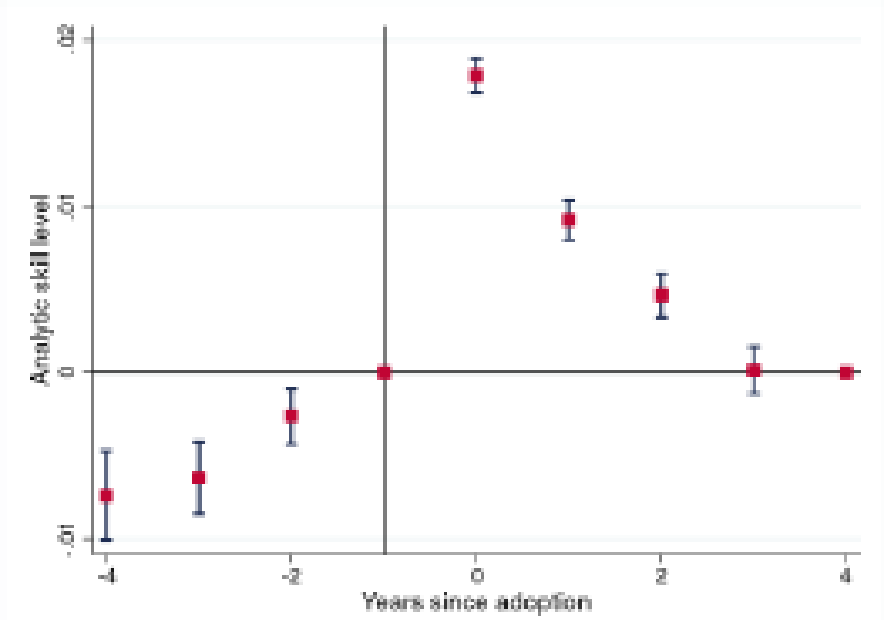
- Bessen, Denk, Meng: “The Remainder Effect: How Automation Complements Labor Quality”
  - Looks at firms’ job ads after hiring software developers.
  - Increase in the number of skills requested and pay offered in job ads.

Main contribution: Careful estimation of task impacts of software adoption

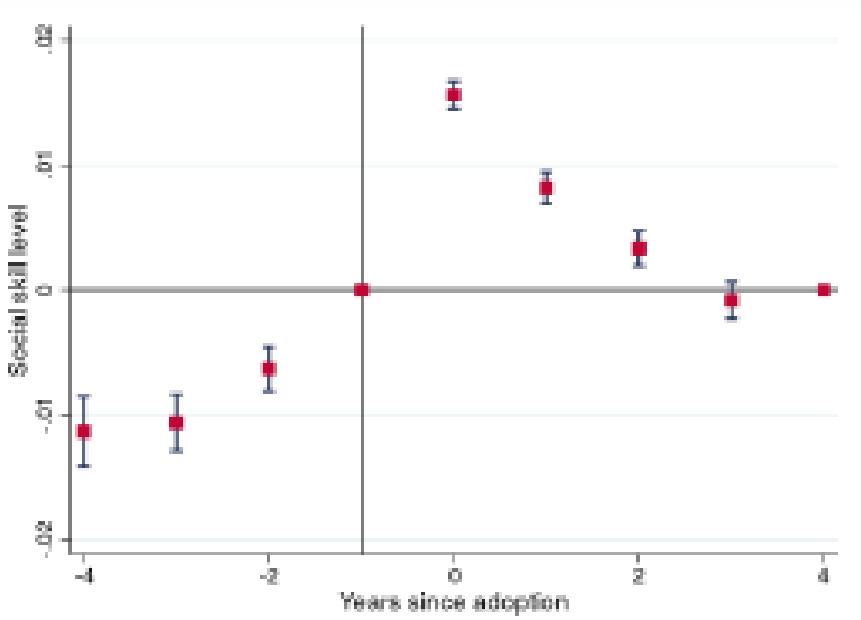
$$y_{oft} = \sum \beta_\tau D^\tau_{fot} + \mu_{fo} + \upsilon_t + u_{fot}$$

Figure 1: Event study estimates: impact of software adoption on skill requirements

(a) Analytic skill requirements



(b) Social skill requirements



Notes: TWFE estimates of the evolution of skill requirements 5 years before and after a software adoption event. Skill requirements at year -1 are normalized to 0.

Main contribution: Careful estimation of task impacts of software adoption

$$y_{oft} = \beta_1 I_{fot}^{adopted} + \mu_{fo} + \upsilon_t + \beta_2 \theta_{fot} + \varepsilon_{fot}$$

$$= \beta_1 I_{fot}^{adopted} + \mu_{fo} + \upsilon_t + \left(\frac{\beta_2}{\psi}\right)\left(\bar{y}_{ft} - \eta_{fot}\right) + \varepsilon_{fot}$$

Instrument $\bar{y}_{ft}$ using lead of software adoption in occupation o.

Idea: Future software adoption in o is correlated with θ_{fot} but does not impact demand for skills other than in o.

Alternate specifications?

- Apply above equation to estimate longer-run impact of software on tasks.
  - Currently look at only data up to two years after adoption.
- Include μ_{ft} and or μ_{ot} as additional fixed effects with OLS specification.

One Suggestion to Simplify the Model

- Paper has a clean way of thinking about how skill requirements change with the introduction of software: y_j takes one of two values—software is present or not.
- Extensive margin of software adoption precludes considering more than a handful of occupations
  - For each combination of *J* occupations, need to solve for variable profits if software is adopted or not $\rightarrow 2^J$ variable profit functions to consider.
- In the model, first piece of software increases skill requirements, additional ones do not; not quite so in the event-study regressions.
- Counterfactual considers an economy-wide decline in software prices; is it super important to consider firms' extensive margin decisions?
- Suggestion: Allow skill-levels to enter production function
  - Possible starting point: $t_j = \left[\left(L_j\right)^{(\sigma-1)/\sigma} + \left(S_j \prod y_{ij}\right)^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)}$

Two Comments about the Calibration

1. Calibration compares skill level gains in first two years, but event-study graphs suggest these gains die about after two years.
2. Might be interesting to add (a) non-employment or (b) occupations where software is not important to get a fuller picture of inequality.