Technological Progress and Worker Productivity at Different Ages

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Seventh Annual Conference of Retirement Research Consortium
August 11, 2005

Long Run Perspective

- Technological progress increases the "effectiveness" of labor hours, enabling wages to rise

- This paper asks:

  (i) When technological progress enhances worker productivity, does it do so for workers of all ages — or mainly for young workers?

  (ii) In general, as the work force "ages" — due to declining fertility and mortality — what is in store for average worker productivity?

Earnings

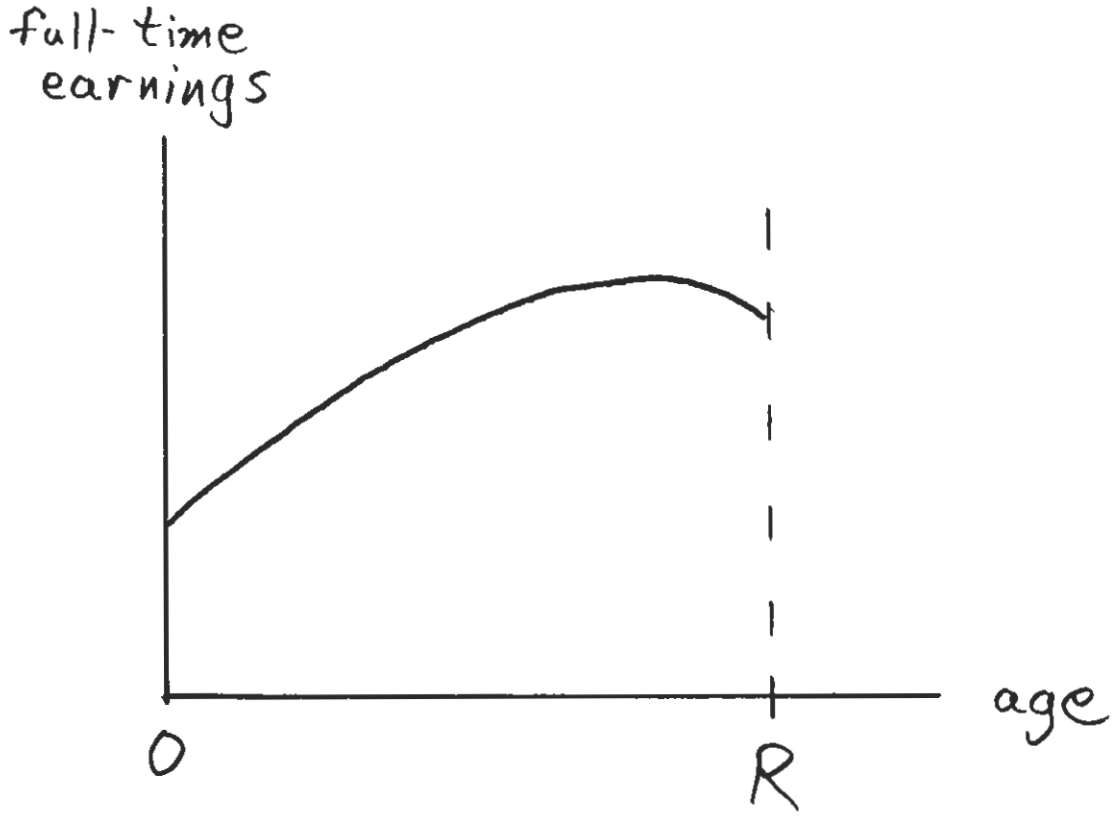
ln(full-time earnings time t, experience x)

= productivity independent of technological progress
[i.e., human capital from experience; health]

+ productivity augmentation from technological progress

+ idiosyncratic error

Productivity Independent of Technological Progress



Productivity Augmentation from Technological Progress

Let α_t be a measure of the level of technology at time t

Then for a worker of experience x and time t, productivity augmentation from technological progress is

- α_{t-x} if augmentation is vintage "specific"
- α_t if augmentation is completely "non-specific"

A general specification is

$$\alpha_{t-x} + \sum_{u=1}^{x} \theta_u \cdot [\alpha_{t-x+u} - \alpha_{t-x+u-1}]$$

with

- $\theta_u = 0$ all $u \geq 1$ in "specific" case
- $\theta_u = 1$ all $u \geq 1$ in "non-specific" case
- $\theta_u \in (0, 1)$ and $\theta_u \geq \theta_{u+1}$ for cases in between

Issues at Stake

- Do current workers of all ages — or only young workers and future generations — benefit from current technological progress?

- How will "aging" of the work force affect productivity?

    - Quotation from Borsch-Supan [2004] about productivity independent of technological progress

    - Quotation from Nyce and Schieber [2005] about productivity augmentation from technological progress

- What specification of the life–cycle model of household behavior (e.g., Modigliani [1986]) should we employ?

Empirical Analysis

I. Basic regression equation:

$$\begin{aligned}
&\ln(\text{full-time earn}_{iext}) \\
&= \gamma_0^e + \gamma_1^e \cdot x + \gamma_2^e \cdot \frac{x^2}{10} + \gamma_3^e \cdot \frac{x^3}{100} + \gamma^4 \cdot \frac{x^4}{1000} \\
&+ \alpha_{t-x} + \sum_{u=1}^{x} \theta_u \cdot [\alpha_{t-x+u} - \alpha_{t-x+u-1}] \\
&+ \text{error}
\end{aligned}$$

with

$$\theta_u \equiv [1 - \frac{u}{50}]^B \,, \quad B \geq 0$$

Empirical Analysis (cont.)

Cases:

- $B = \infty$ implies vintage "specific" case
- $B = 0$ implies completely "non-specific" case
- $B \in (0, \infty)$ for cases between the polar extremes

Empirical Analysis (cont.)

Reminiscent of earnings dynamics literature

- Deriving aggregation rule
- This paper's novelty is its detailed treatment of augmentation from technological progress

Empirical Analysis (cont.)

II. Data

- Full-time workers; white males; 25-55 or 25-60; high school, some college, and college/more
- PUMS: 1950, 60, 70, 80, 90, 2000 [1,200,000 observations]
- CPS: 1967, 68,...,2000 [620,000 observations]
- Correct to total compensation

Empirical Analysis (cont.)

III. Possible outcomes

- $B = \infty$: young might as well learn newest techniques; for older workers, marginal gain from replacing existing techniques may not render changeover worthwhile

- $B = 0$: specialization within large companies may reduce the burden of learning about new technologies

Empirical Analysis (cont.)

IV. Table 1

- Add second equation:
  - Letting q_t be BLS output per hour,

$$\ln(q_t) = \bar{\alpha} + \alpha_t + \text{error}_t \tag{2}$$

  - Reasoning: direct identification of alphas better than latent–variable treatment
- Results for columns 1-2 [aggregate education categories]:
  - Technological progress anemic post 1970
  - B roughly .33 — quite small (e.g., $\theta_{20} = .84$, $\theta_{30} = .74$, $\theta_{40} = .59$)
- Results columns 3-4 [separate gammas]: *some college* implies 5 percent gain every experience; *college* implies 30 percent gain
- Results columns 5-6 [separate B's]: B= .07 to .45; largest most education

Empirical Analysis (cont.)

V. Table 2 [equation (1) alone; separate education groups]

- All experience profiles for productivity independent of technological change peak age 50 and beyond

- B's are small as before; evidently, pattern with respect to education is fragile

- All education groups do well prior 1970; only college group shows technological progress after 1980 [recall Bound and Johnson 1992]

Conclusions (to date)

- Augmentation of labor productivity from technological progress appears non-specific

- "Aging" may actually boost average productivity of the labor force

    - Productivity independent of technological progress appears to peak quite late in people's careers [though sample here restricted to full-time workers]

    - Productivity augmentation from technological progress appears to persist until late in people's careers

- Need formulations of the life–cycle model of household behavior that include aggregative risk

- Continue to desire more data for early years

- "Skill–bias" of technological progress since 1980 puzzling