Skills, Tasks and Technologies: Implications for Employment and Earnings, Acemoglu, Autor 2010

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Data Source	-
Data Time	-
Country	general theoretical model
Focus	task based framework proposition to extend the cannonical model

1 Introduction

canonical model:
two-skill groups performing two distinct and imperfectly substitutable occupations
Technology is assumed to take a factor-augmenting form; Changes in this factor-augmenting technology then capture skill biased technical change

modern labor markets and recent empirical trends necessitates a richer framework.

two shortcomings of the canonical model

- does not include a meaningful role for tasks; imposes a one-to-one mapping between skills and tasks.
  we suggest following Autor, Levy and Murnane (2003)
- it treats technology as exogenous and assumes that technical change is, by its nature, skill biased
  but extent of skill bias of technical change has varied over time and across countries
  Acemoglu (1998, 2002a) suggested that the endogenous response of technology to labor market conditions

we show that:

- low skill workers experienced significant real earnings declines
- non-monotone changes in earnings levels across the earnings distribution
- non-monotone shifts in the composition of employment
- polarization of employment reflect also a change in the allocation of skill groups across occupations

- technological developments and recent trends in oshoring and outsourcing appear to have directly replaced workers in certain occupations and tasks

we propose a task based framework
three types of skillslow, medium and high
Workers have dierent comparative advantages
similar to Ricardian trade models. Given the prices of (the services of) dierent tasks and the wages for dierent types of skills in the market, firms (equivalently, workers) choose the optimal allocation of skills to tasks
Importantly, the model allows for new technologies that may directly replace workers in certain tasks
The canonical model is in fact a special case of this more general task-based model,
richer implications because of the endogenously changing allocation of skills to tasks.

2 3 The Cannonical Model

high skill worker ratio determined by relative supply and relative demand for skills
relative demand for skills increases over time due to skill biased technology (increased demand / complementarity)
=¿ Tinbergens famous race between technology and supply of skills

2.1 3.1

model:
high / low skill workers
competitive labor markets
constant elasticity of substitution aggregate production function

elasticity of substitution between high and low skill determines how changes in relative supply affect skill premia

Total supply of Low and High skill labor in the economy
$L = \int_{i \in L} l_i \mathrm{d}i$ and $H = \int_{i \in H} h_i \mathrm{d}i$

Production function for aggregate economy

$$Y = [(A_L L)^{\frac{\sigma-1}{\sigma}} + (A_H H)^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}$$

A_L / A_H factor-augmenting technology terms
high/low skill workers are gross substitutes for $\sigma > 1$
$\sigma = 1$ cobb-douglas production function
$\sigma \to 0$ leontief production function
$\sigma \to \infty$ perfect substitutes

Technologies are factor augmenting $\to$ no explicitly skill replacing technologies

due to competitive labor market:

$$\omega_L = \frac{\partial Y}{\partial L} = A_L^{\frac{\sigma-1}{\sigma}} [A_L^{\frac{\sigma-1}{\sigma}} + A_H^{\frac{\sigma-1}{\sigma}} (H/L)^{\frac{\sigma-1}{\sigma}}]^{\frac{1}{\sigma-1}}$$

higher fraction of H/L leads to a low-skill wage increase
factor augmenting technical change (higher A_L/A_H) leads to a low-skill wage increase

skill premium

$$\omega = \frac{\omega_H}{\omega_L} = (\frac{A_H}{A_L})^{\frac{\sigma-1}{\sigma}} (\frac{H}{L})^{\frac{-1}{\sigma}}$$

. 2 Forces in Tinbergen's race:

- relative high-skill biased technology
  $\frac{\partial ln\omega}{\partial ln(A_H/A_L)} = \frac{\sigma-1}{\sigma}$
  changes in technology increasing the demand of skills
  $\sigma > 1$ relative improvements in high skill augmenting technology will increase skill premium

- relative supply of high skill labor
  $\frac{\partial ln\omega}{\partial lnH/L} = -\frac{1}{\sigma} < 0$
  for given skill bias of technology, an increase in relative supply of skills reduces the skill premium with an elasticity of $1/\sigma$
  This means if A_L/A_H stayed roughly the same a high increase in the relative skill supply should have lowered the wage premium significantly which was not the case in the recent decades

In studies with college/non-college workers o is estimated between 1.4 and 2

2.2 3.2

assuming log lin increase in demand for skills coming from technology:
$ln(\frac{A_{H,t}}{A_{L,t}}) = \gamma_0 + \gamma_1 t$ will lead to $ln\omega_t = \frac{\sigma-1}{\sigma}\gamma_0 + \frac{\sigma-1}{\sigma}\gamma_1 t - \frac{1}{\sigma}ln(\frac{H_t}{L_t})$
technological development takes place at a constant rate while supply of skills may vary
when H/L grows slower than the rate of skill biased technical change, (o-1)y1, the skill premium will increase

2.3 6 conclusions

task-based framework a unique final good is produced combining services of a continuum of tasks.

$$Y = exp[\int_0^1 lny(i)\mathrm{d}i]$$

productivity of tasks:

$$y(i) = A_L\alpha_L(i)l(i) + A_M\alpha_M(i)m(i) + A_H\alpha_H(i)h(i) + A_K\alpha_K(i)k(i)$$

worker has one of three types of skills: low, medium and high
pattern of comparative advantage
equilibrium allocation of skills to tasks is determined by two thresholds, I_L and I_H, such that all tasks below the lower threshold (I_L) are performed by low skill workers, all tasks above the higher threshold (I_H) are performed by high skill workers
no arbitrage conditions:

$$\frac{A_M\alpha_M(I_H)M}{I_H - I_L} = \frac{A_H\alpha_H(I_H)H}{1 - I_H}$$
$$\frac{A_L\alpha_L(I_L)L}{I_L} = \frac{A_M\alpha_M(I_L)M}{I_H - I_L}$$

despite the endogenous allocation of skills to tasks, the model is tractable, and that relative wages among skill groups depend only on relative supplies and the equilibrium threshold tasks
technical change favoring one type of worker can reduce the real wages of another group
framework enables us to model the introduction of new technologies that directly substitute for tasks previously performed by workers of various skill levels