

Summary: Artificial Intelligence, Automation and Work*

Yun-Ting, Yeh

March 11, 2020

0 Abstract

We summarize a framework for the study of the implications of automation and AI on the demand for labor, wages, and employment.

.....

1 Overview

1.1 A False Dichotomy

- (Alarmist) Oncoming advances in AI and robotics will spell the end of work by humans.
- (Optimist) Since technological breakthroughs increased labor demand and wages in the past, this time will be the same.

1.2 Task-Based Approach

- What is automation?
 - Automation is conceptualized as replacing labor in tasks that it used to perform (due to lower costs or higher productivity).
- What effects does this type of replacement have?
 - It directly causes a drop in labor demand and labor shares: *Displacement Effect*.
 - However, in the history, there were several periods where automation was accompanied by the expansion of labor demand.
 - It is due to some countervailing forces including (1) *Productivity Effect*, (2) *Capital Accumulation*, and (3) *Deepening of Automation*.

*Acemoglu, Daron, and Pascual Restrepo. 2018. “Artificial Intelligence, Automation and Work.” NBER Working Paper No. 24196, January.

- Toward a balanced growth path
 - These countervailing forces alone are insufficient since they do not prevent labor shares from dropping.
 - However, there was no secular downward trend in labor shares in the history.
 - *Creation of New Tasks* in which labor has a comparative advantage relative to machines results in *Reinstatement Effect*.

1.3 Constraints and Inefficiency

- The adjustment process is slow and painful.
- The productivity growth is missing.

2 Task-Based Approach and Displacement

2.1 Tasks

- Production in most industries requires the simultaneous completion of a range of tasks. Some are produced by labor while some are produced by machines.
- Automation: an expansion in the set of tasks that can be produced with capital.

2.2 Displacement Effect

- Replacement reduces labor demand and equilibrium wage rates. With an elastic labor supply, it leads to lower employment.
- However, it does not exist in most of other approaches in macroeconomics and labor economics, say, factor-augmenting technological changes:
 - an increase in α_L or α_K in aggregate production $F(\alpha_L L, \alpha_K K)$.
 - labor demand and wages always increase (see Acemoglu and Restrepo, 2016).

2.3 Model Setup

- Acemoglu and Restrepo (2016):

$$\ln Y = \int_{N-1}^N \ln y(x) dx,$$

where x : a unit of measure of tasks $x \in [N - 1, N]$, Y : aggregate output, and $y(x)$: the output of task x .

$$y(x) = \begin{cases} \gamma_L(x)l(x) + \gamma_M(x)m(x) & \text{if } x \in [0, I] \\ \gamma_L(x)l(x) & \text{if } x \in (I, N], \end{cases}$$

where $l(x)$: task produced by labor, $m(x)$: task produced by machines, $\gamma_L(x)$: productivity of labor, $\gamma_M(x)$: productivity of machines, I : frontier of automation possibilities, and N : total number of tasks.

- Types of technological changes
 1. Labor-augmenting technological advances: $\gamma_L(x) \uparrow$
 2. Automation (at the extensive margin): $I \uparrow$
 3. Deepening of automation (at the intensive margin): $\gamma_M(x)$ for $x < I$
 4. Creation of new tasks: $N \uparrow$
- Please refer to the paper for equilibrium and the abovementioned effects and refer to the appendix for formal derivation.

3 Countervailing Effects

3.1 Three Countervailing Forces

1. *Productivity Effect*

- cost of producing automated tasks $\downarrow \Rightarrow$ the economy expands \Rightarrow labor demand in non-automated tasks \uparrow
- Expansion occurs in
 - (a) the same sectors which are undergoing automation: ATMs
 - (b) different sectors: spinning and weaving
- Real threat: “so-so” automation technologies rather than “brilliant” technologies.

2. *Capital Accumulation*

- automation \uparrow (intensive in capital) \Rightarrow capital demand $\uparrow \Rightarrow$ labor demand \uparrow

3. *Deepening of Automation*

- only productivity effect but no displacement \Rightarrow labor demand \uparrow

3.2 New Tasks

Creation of new tasks always increases labor demand, equilibrium wages, and labor shares.

1. By displacing workers, automation creates a greater pool of labor to be employed in new tasks.
2. AI itself serves as a platform to create new tasks:
 - trainers, explainers, sustainers
 - application to other industries such as education and health care

4 Constraints and Inefficiency

The adjustment process is slow and painful: reallocating workers to new tasks is hard due to (1) time-consuming search and (2) labor market imperfections (cf. studies on the adjustment of local US labor markets to negative demand shocks).

- Example: the “Engel’s pause” during British Industrial Revolution.
- While technological advances and productivity growth were ongoing, wages stagnated, poverty expanded, living conditions worsened, and labor shares fell for 80 years.

4.1 Mismatch

- When the education sector does not keep up with the demand for new skills required by new tasks,
 - inequality \uparrow
 - lack of complementary skills \Rightarrow productivity of new technologies \downarrow

4.2 Missing Productivity and Excessive Automation

- Faster automation than socially desirable is caused by
 - tax treatment in favor of capital
 - labor market imperfections: equilibrium wages are above social opportunity cost of labor
- Technological improvements are redirected away from productivity-enhancing activities which lead to the creation of new tasks or deepening automation.

5 Future Directions

The development of AI should not be taken for granted. It is crucial to find a way to create broadly shared gains from these new technologies.

1. The imbalance in the distribution of automation gains might slow down the creation of new tasks.
2. Apart from lack of skills, acquiring wrong skills is also an issue. More empirical work is needed to see what types of skills will complement new technologies.
3. An understanding of impacts of government policies and labor market institutions on the speed or the types of automation is critical.