The Romer Model: Policy Implications

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Econ520

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Topics

We discussion policy implications of the Romer model:

1. Do policies affect long-run growth?
   No - but why not?
2. How much growth is sustainable in the long run?
   Not much.
3. Does growth cost jobs?
   No.

Do Policies Affect Long-run Growth?

Policies have level effects

What are the effects of government policies?

We may expect policies to affect saving (s_K), R&D (s_A), or population growth (n).

Consider the case of $\phi < 1$, where growth is

$$g(A) = \frac{\lambda\ n}{1-\phi} \tag{1}$$

Main result: Policies that affect only saving or investment in R&D (s_A) do not affect long-run growth.

Note: For policies that do not affect R&D the model behaves exactly like the Solow model.

R&D Subsidies

Consider a permanent increase in s_A.

We must consider two equations:

$$g(A) = B \ (s_A L)^{\lambda} \ A^{\phi - 1} \tag{2}$$

$$\dot{K} = s_K \ Y - d \ K \tag{3}$$

Note: Behavior of A is independent of K and Y.

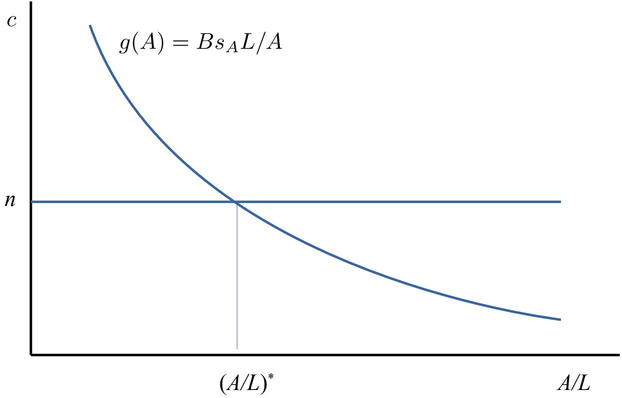
Simplify by assuming $\lambda = 1$ and $\phi = 0$ so that

$$g(A) = B \ s_A \ L \ / \ A \tag{4}$$

Balanced growth rate:

$$g(A) = n$$

R&D Subsidies



R&D Subsidies

On a **BGP**, (4) determines A/L:

$$g(A) = n = Bs_A L/A \tag{5}$$

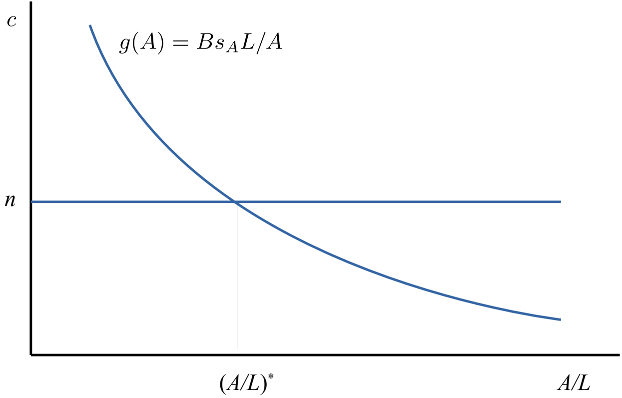
implies

$$(A/L)^* = \frac{B\ s_A}{n} \tag{6}$$

Transition:

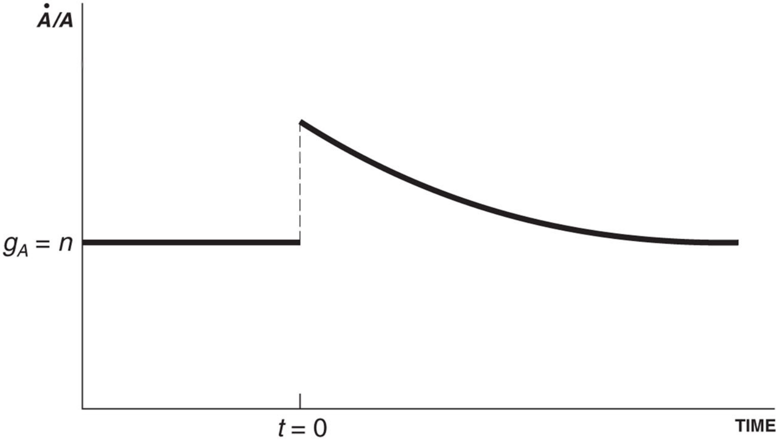
- As long as L/A is above BGP, $g(A) > n$ is above BGP.
- Therefore, $g(A)$ declines over time until it reaches n.
- The BGP is stable.

Transition path after an increase in s_A



Time path of the growth rate of ideas

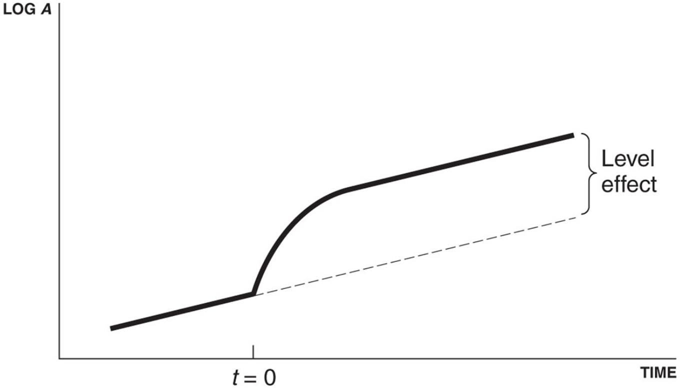
FIGURE 5.2 $\dot{A}/A$ OVER TIME



A period of faster innovation builds up more ideas.

Time path of A

FIGURE 5.3 **THE LEVEL OF TECHNOLOGY OVER TIME**



Eventually growth levels off, but the higher level of A remains forever.

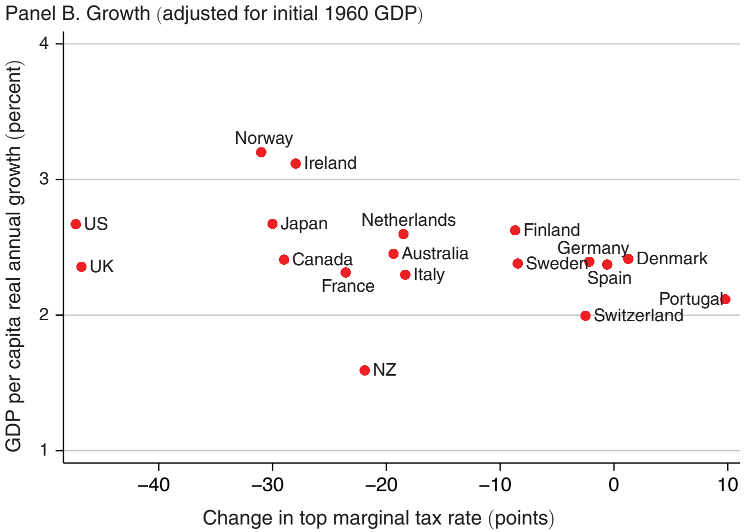
Policy implications

- Patent protection, R&D subsidies, and other policies affect s_A.
- These policies can raise the growth rate of output, although not in the long run.
- Policies do affect long-run levels of Y/L.

How could the hypothesis that taxes do not change long-run growth be tested?

- it's surprisingly tricky...
- regress growth rates on tax rates?

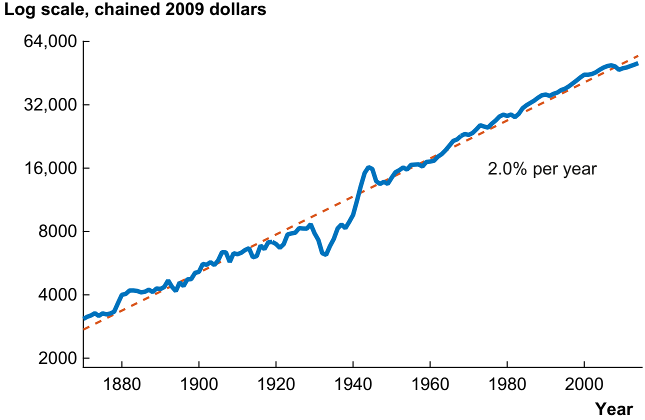
Empirical evidence



Source: Piketty et al. (2014)

Is Growth Sustainable?

Outlook for U.S. growth



U.S. growth has been constant for a long time.
But are we on a balanced growth path?

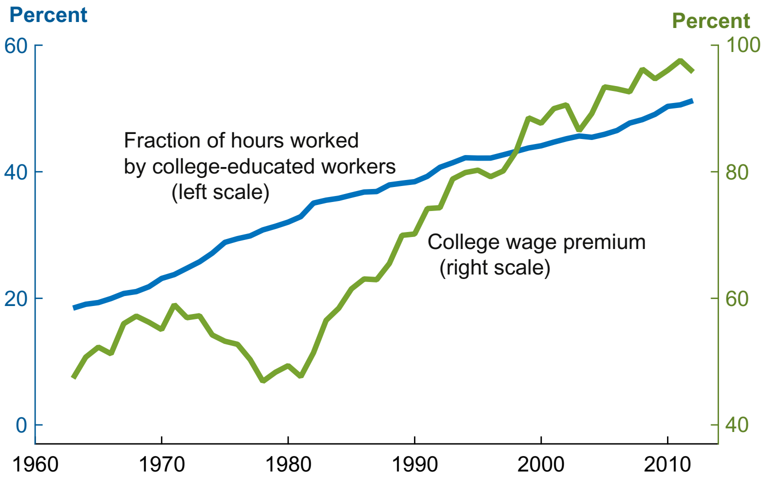
Source: Jones (2016)

Will growth level off?

The basic idea of Jones (2002):

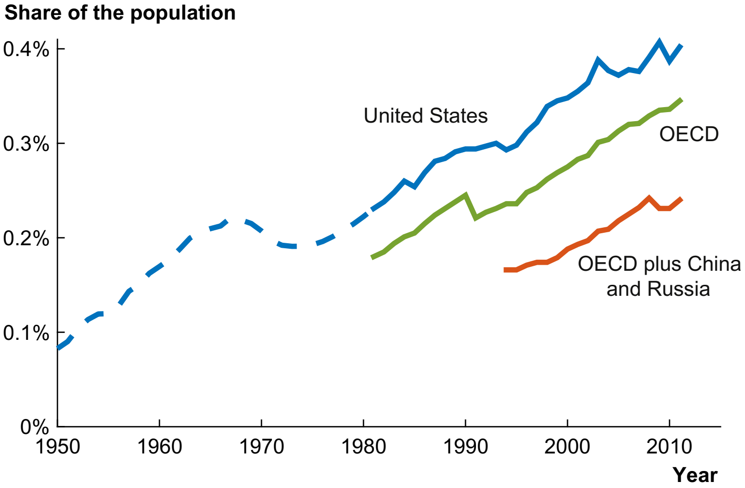
- Over the past 100 years, inputs that improve productivity have been rising: years of schooling; R&D spending / output.
- Eventually, these must level off.
- Then output growth must slow down.
- By how much?

Growing human capital



Source: Jones (2016)

Growing R&D employment



Source: Jones (2016)

What happens when these inputs stop growing?

A Model

Extend the Romer model to incorporate:

1. Human capital in the production of output.
2. Human capital in R&D.

Output production:

$$Y_t = A_t^{\sigma} K_t^{\alpha} \left(h_t L_{Yt}\right)^{1-\alpha} \tag{7}$$

Then

$$y_t = \underbrace{A_t^{\sigma/(1-\alpha)} \left(K_t/Y_t\right)^{\alpha/(1-\alpha)}}_{\text{Solow}} \underbrace{h_t}_{\text{education}} l_{Yt} \tag{8}$$

where $y_t = Y_t/L_t$ and $l_Y = L_Y/L$ is the fraction of workers in this sector.

Derivation I

This derivation is just in case you want to know...

$$Y = A^{\sigma} K^{\alpha} (hl_y L)^{1-\alpha} \tag{9}$$

$$= A^{\sigma} \left(\frac{K}{L}\right)^{\alpha} (hl_y)^{1-\alpha} L \tag{10}$$

$$Y/L = A^{\sigma} \left(\frac{K}{hl_y L}\right)^{\alpha} hl_y \tag{11}$$

$$Y/K = A^{\sigma} \left(\frac{K}{hl_y L}\right)^{\alpha-1} \tag{12}$$

$$\left(\frac{K}{hl_y L}\right)^{\alpha} = (K/Y)^{\frac{\alpha}{1-\alpha}} A^{\frac{\sigma\alpha}{1-\alpha}} \tag{13}$$

Derivation II

Substitute this back into (11) and note that

$$A^{\sigma} A^{\sigma\alpha/(1-\alpha)} = A^{\sigma/(1-\alpha)} \tag{14}$$

because $1 + \frac{\alpha}{1-\alpha} = \frac{1}{1-\alpha}$. Then we get (8).

Output growth

What does

$$y_t = (K_t/Y_t)^{\alpha/(1-\alpha)} l_{Yt} h_t A_t^{\sigma/(1-\alpha)} \tag{15}$$

imply for growth of output per worker?

Along the transition:

$$g(y) = \underbrace{\frac{\alpha}{1-\alpha} g(k/y) + g(l_Y)}_{\text{empirically about 0}} + \underbrace{g(h)}_{>0} + \underbrace{\frac{\sigma}{1-\alpha} g(A)}_{>0} \tag{16}$$

We expect $g(A)$ above balanced growth

- because R&D inputs are rising over time

Balanced growth

Balanced growth rate:

$$g(y) = g(A) \tag{17}$$

Why?

- K/Y and l_y must be constant over time (they are bounded)
- Assume long-run $g(h) = 0$ because schooling levels off (strong assumption).
- Normalize $\sigma = 1 - \alpha$. (why can I do this?)

We expect a growth slowdown:

- $g(A)$ will slow down when R&D inputs stop growing.
- h will stop growing as education levels off.

BGP output growth

How much growth is sustainable according to the model?

The balanced growth rate is the same as in the baseline model:

$$g(y) = g(A) = \underbrace{\frac{\lambda}{1-\phi}}_{\gamma} n \tag{18}$$

Key point

Transitional growth has several sources:

- $g(h)$,
- growth of A in excess of balanced growth γn, and
- balanced A growth of γn.

Only the γn part is sustainable!

Derivation: Balanced growth rate

$$\dot{A}_t = B\left(l_{At} h_t L_t\right)^{\lambda} A_t^{\phi} \tag{19}$$

so that

$$g\left(A\right) = \frac{\left(h_t l_{At} L_t\right)^{\lambda}}{A_t^{1-\phi}} \tag{20}$$

Balanced growth with $g\left(h\right) = g\left(l_A\right) = 0$:

$$g\left(A\right) = \frac{\lambda}{1-\phi} n \tag{21}$$

(just like in our textbook model)

We observe: $g\left(y\right) = 2\%$ per year

Balanced growth: γn where $n = 1.2\%$ per year.

So the value of γ determines the slowdown.

How big is γ?

Key idea (roughly):

$$g(A) = \frac{(h_t l_{At} L_t)^{\lambda}}{A_t^{1-\phi}} \tag{22}$$

- We observe $g(A), h$, and $L_{A,t} = l_{A,t} L_t$.
- If $g(A)$ was constant over time (roughly true), the we can estimate $\gamma = \lambda / (1 - \phi)$.

Result: $\gamma \approx 1/3$.

Key implication

Only 1/3 of past TFP growth is sustainable once transitory increases of h and l_A comes to an end.

Growth accounting implications

Post-war average growth $g(y) = 0.02$

$n = 0.012$

Balanced growth = $\gamma n = (1/3) \times 1.2\% = 0.4\%$

Transition dynamics

We can simulate the model path to find out how rapidly growth slows down.

Result: Growth slows by half (relative to γn) every 40 years.

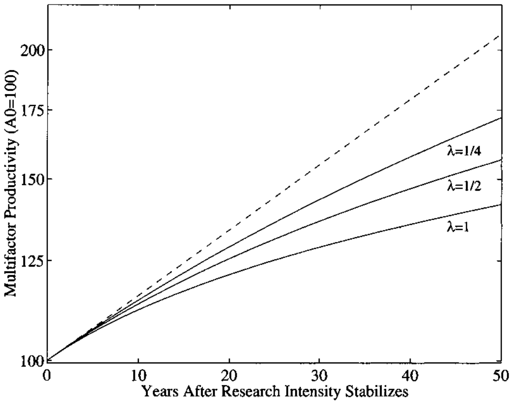


FIGURE 5. THE TRANSITION OF MULTIFACTOR PRODUCTIVITY TO STEADY STATE

Discussion

How seriously should we take this analysis?

What Does the Model Contribute?

1. It can make an intuitive argument precise.
   The idea: long-run growth should be lower than past growth because R&D input growth must slow down
2. It can give an idea of magnitudes.
   The model is very simple. Assumptions have weak empirical support.
   Read as: "This could be a big deal."

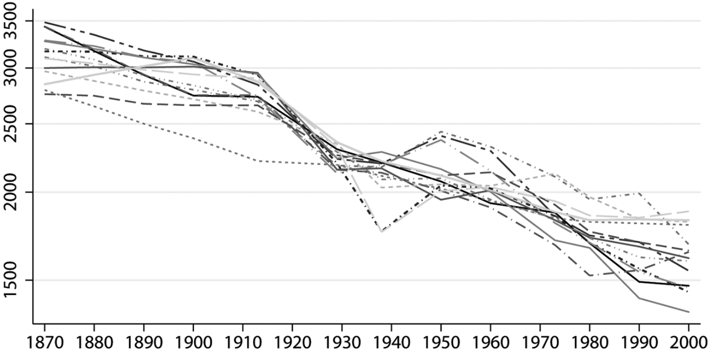
Does Growth Cost Jobs?

Does Growth Cost Jobs?

How do we think about this question?

Why do people think growth might cost jobs?

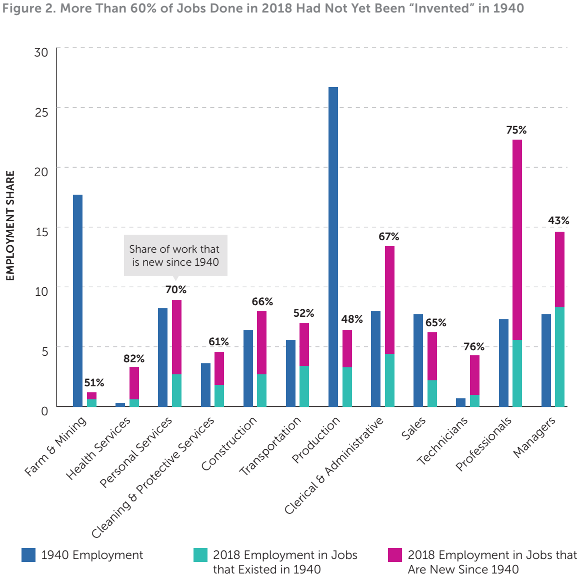
Falling hours worked



Source: Boppart and Krusell (2019). See also the VoxEU summary.

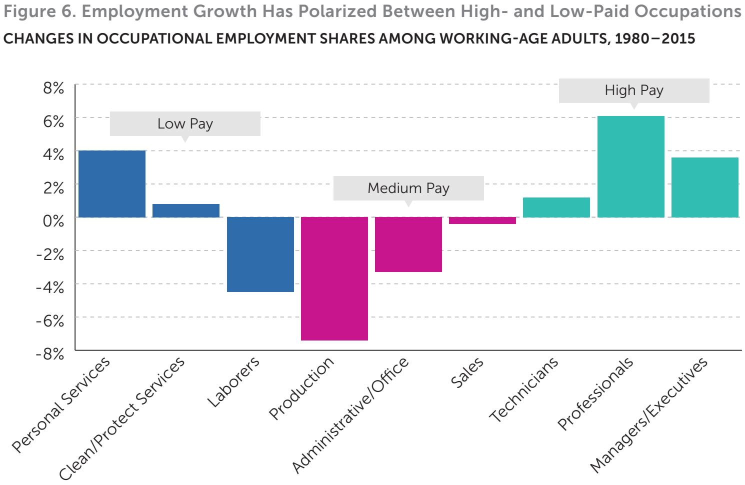
Is this evidence of job loss?

Technologies create new jobs



Source: Autor (2020)

Middle income jobs are automated



Source: Autor (2020)

Does growth cost jobs?

What is the overall answer?

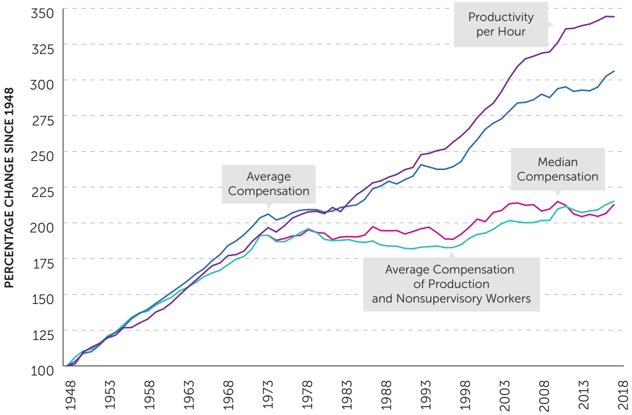
- We do not see large numbers of working age persons unable to find jobs.
- But we see displacement of middle skill jobs.

Future automation could render many workers obsolete.

Autor (2020): "No economic law dictates that the creation of new work must equal or exceed the elimination of old work. Still, history shows that they tend to evolve together."

Labor income lags output growth

Figure 4. Productivity and Compensation Growth in the United States, 1948–2016



Source: Autor (2020)

But the reason for the falling labor share may not be technology.

Reading

- Jones (2013b), ch. 5.
- The section on the outlook for US growth is based on Jones (2002).

Optional:

- Romer (2011), ch. 3.1-3.4
- Jones (2013a), ch. 6
- Jones (2005) talks in some detail about the economics of ideas.

References I

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