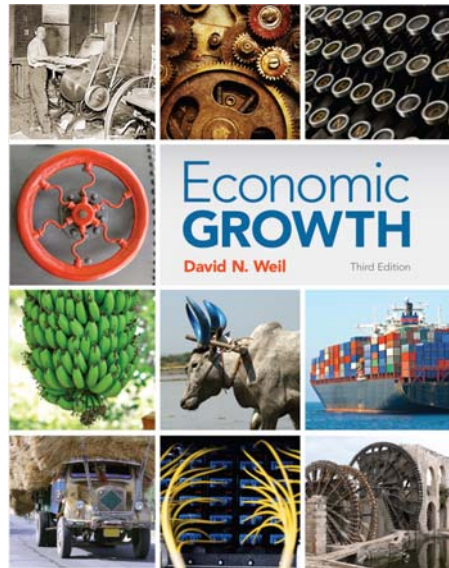


Chapter 7

MEASURING PRODUCTIVITY



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Groups and Themes for presentations

- | | |
|--|---------------------------|
| 1. Alessandro, Enrico, Elena, Hamza | 1. Labour Mkt and Skills |
| 2. Nauhaila, Nada, Nesrine, Hiba | 2. Business Environment |
| 3. Arrate, Irate, Tommaso, Khalid, Valentina | 3. Technological Progress |
| 4. Ghita, Simran, Anna, Karolina K., Azza | 4. Public Administration |
| 5. Karolina D, Katharina, Fatma, Paula | 5. Green Economy |
| 6. Tomas, Ammar, Lisa, Gabriele | 6. Education |

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Calendar: 9-10-11 December

1. Labour Mkt and Skills, 9 Dec h. 10
2. Business Environment, 9 Dec h 11
3. Technological Progress, 10 Dec h 10
4. Public Administration 10 Dec h 11
5. Green Economy 11 Dec h 10
6. Education 11 Dec h 11

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Productivity measurement

Productivity is how efficient we use the factors of production. In the Solow model: A

- Knowledge
- Production organisation
- Effort

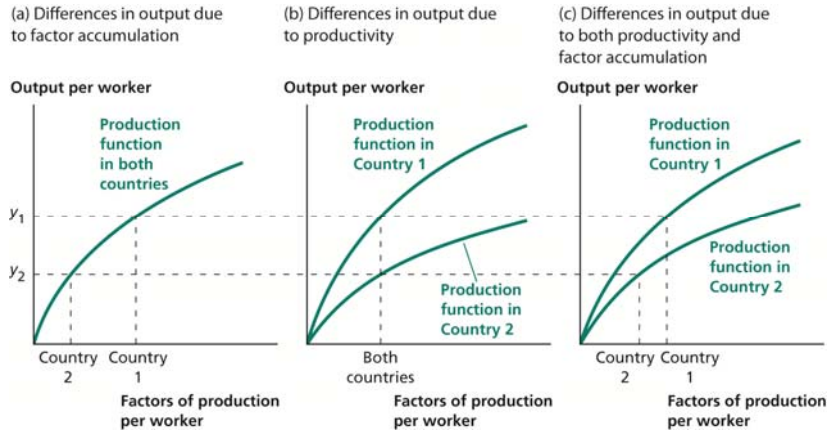
Over the long run, productivity growth is considered the major factor behind income growth.

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Possible Sources of Differences in Output per Worker



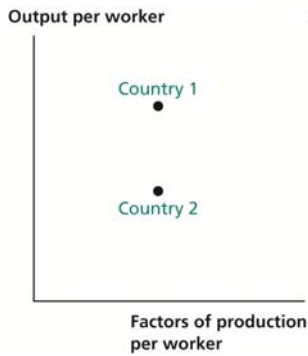
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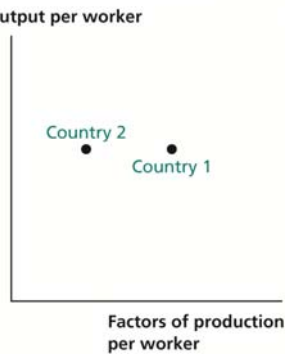
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Inferring Productivity from Data on Output and Factor Accumulation

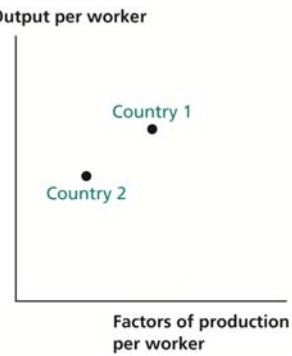
(a) The countries have equal factor accumulation, but Country 1 has higher output.



(b) The countries have equal output, but Country 1 has higher factor accumulation.



(c) Country 1 has higher output and higher factor accumulation.



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Productivity accounting

Ratio of output =

Ratio of productivity * Ratio of factors of production

Ratio of productivity =

Ratio of income / Ratio of factors of production

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An example

	Output per Worker, y	Physical Capital per Worker, k	Human Capital per Worker, h
Country 1	24	27	8
Country 2	1	1	1

Given $\alpha = 1/3$, we get

$$\frac{A_1}{A_2} = \frac{y_1 k_2^\alpha h_2^{1-\alpha}}{y_2 k_1^\alpha h_1^{1-\alpha}} = \frac{24 \cdot 1^{1/3} \cdot 1^{2/3}}{1 \cdot 27^{1/3} \cdot 8^{2/3}} = 2.$$

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Cross-country evidence

Country	Output per Worker, y	Physical Capital per Worker, k	Human Capital per Worker, h	Factors of Production, $A^{1/2}$	Productivity, A
United States	1.00	1.00	1.00	1.00	1.00
Norway	1.12	1.32	0.98	1.08	1.04
United Kingdom	0.82	0.68	0.97	0.80	1.03
Canada	0.89	0.81	0.96	0.91	0.89
Japan	0.73	1.16	0.98	1.04	0.70
South Korea	0.62	0.92	0.98	0.95	0.64
Turkey	0.37	0.28	0.78	0.55	0.68
Mexico	0.35	0.33	0.84	0.61	0.58
Brazil	0.20	0.19	0.78	0.48	0.42
India	0.16	0.089	0.66	0.34	0.31
Kenya	0.032	0.022	0.73	0.23	0.14
Mali	0.018	0.029	0.57	0.21	0.087

Source: Output per worker: Deaton, Summers, and Aten (2011); physical capital: author's calculations; human capital: Deaton and Lee (2010). The data surveyed here and in Section 7.3 is organized according to the 90 countries for which consistent data are available for 1973 and 2009.

Enormous differences in the A 's.

Where do A differences come from? From many factors but also from measurement errors?

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Problems with measuring capital and implications

Waste of investment

Quality of investment

There are estimate according to which the actual level of the capital stock is in between 60% to 75% of the official statistics...

Especially in developing countries

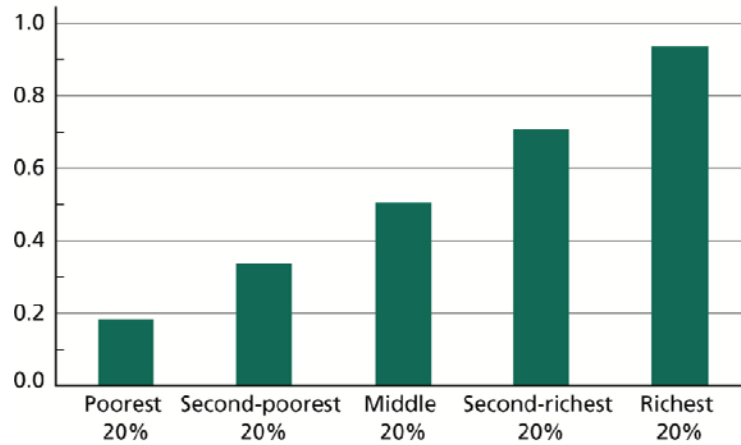
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Productivity or factor accumulation?

Factors of production per worker relative to U.S.



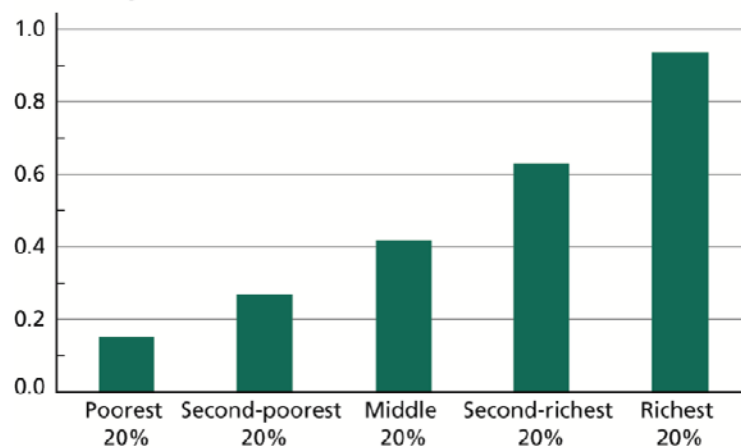
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Productivity or factor accumulation?

Productivity relative to U.S.



Both - surprisingly similar plots.

Factors accumulation is relatively more important for poorest countries.

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Other measurement issues

Productivity A is the residual, after having removed h and k . Maybe we are capturing differences in

- the quality of capital.
- unobserved worker differences.
- other factors of production.

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Growth accounting

The previous decomposition was in levels.

Here, ask the question: is growth coming from factor accumulation or productivity?

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Growth accounting

Output = productivity * factors of production

Output growth rate =
Productivity growth rate + growth rate of factors of production

The growth rate of factors of production has to be weighted with respect to their share on output

Productivity growth rate =
Output growth rate – growth rate of factors of production

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Growth accounting

Production function again

$$y = Ak^\alpha h^{1-\alpha}$$

Growth rates:

$$\hat{y} = \hat{A} + \alpha \hat{k} + (1 - \alpha) \hat{h} \quad \Leftrightarrow$$

$$\hat{A} = \hat{y} - \alpha \hat{k} - (1 - \alpha) \hat{h}$$

Productivity growth = output growth - growth in inputs.

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Example

	Output per Worker, y	Physical Capital per Worker, k	Human Capital per Worker, h
Erewhon in 1875	1	20	5
Erewhon in 2010	4	40	10
Annual Growth Rate	4%	2%	2%

Set $\alpha = 1/3$. Then

$$\begin{aligned}\hat{A} &= \hat{y} - \alpha \hat{k} - (1 - \alpha) \hat{h} \\ &= 0.04 - \frac{1}{3} 0.02 - \frac{2}{3} 0.02 = 0.02\end{aligned}$$

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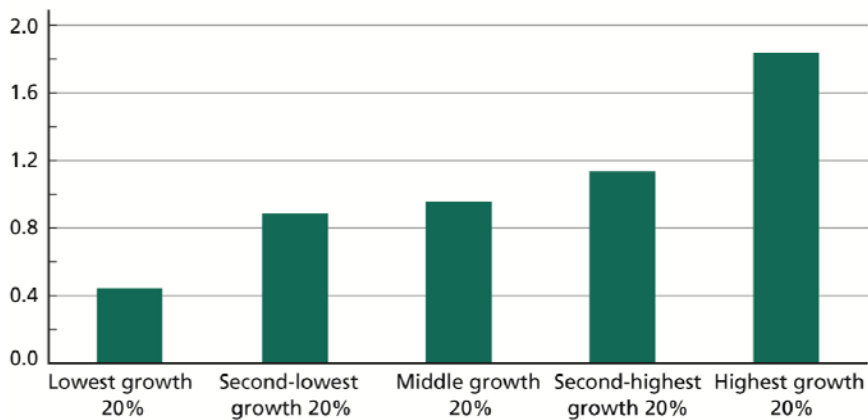
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Historical data

Following countries over time, does factor accumulation (FA) or productivity (A) explain growth?

Growth rate of factors of production (% per year)



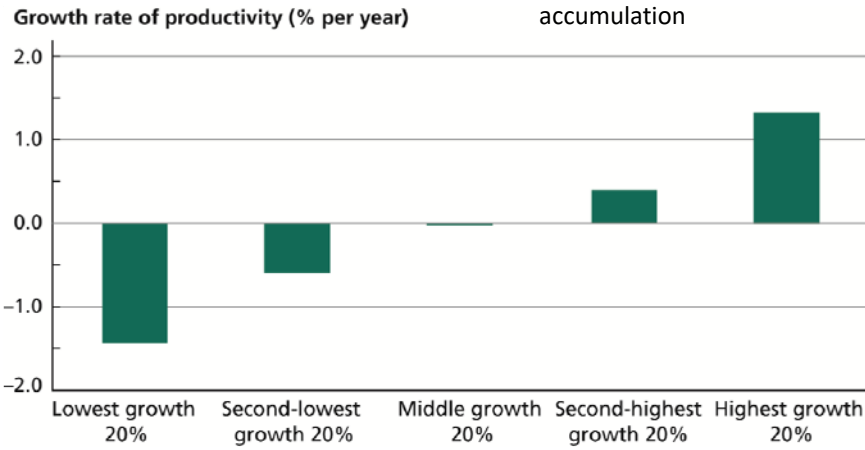
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Historical data

65% of variation in growth rates is due to productivity only
35% is due to factor accumulation



Appears that \hat{A} is more important - more variation in \hat{A} than $\hat{F}A$

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Let's have a look at real data

Oecd stats

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