Chapter 7

MEASURING PRODUCTIVITY

Economic
GROWTH
David N. Weil   Third Edition

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Learning assessment procedures

- The evaluation will take place through a written exam and two assessments during the course (33.3% each). Students will have to prepare a written report and to present a specific case-study to the class. Students that will write the report and present a study to the class can choose to answer just one out of three questions at the final exam. [30 minutes per question].
- The written exam consists of three open questions (closed books) on the topics taught in the course. Students that will not present the report and study to the class will be required to write the entire exam (3 questions instead of 1).

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Learning assessment procedures

- The written exam includes open question on a general topic analysed during the course, such as: human capital, technological change, geography…

- The report refers to a short document about of a country/region for a potential customer/employer, be it a public institutions or a private company

- Presentations with slides of about 15 minutes for each student on an issue chosen by students (and approved by the Professor) on European issues/policies

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Syllabus for written exam

Economic Growth, D. Weil

PART I: OVERVIEW
Chapter 1: The Facts to be Explained
Chapter 2: A Framework for Analysis
PART II: FACTOR ACCUMULATION
Chapter 3: Physical Capital
Chapter 4: Population and Economic Growth
Chapter 6: Human Capital

PART III: PRODUCTIVITY
- Chapter 7: Measuring Productivity
- Chapter 8: The Role of Technology in Growth

PART IV: FUNDAMENTALS
- Chapter 12: Government
- Chapter 14: Culture
- Chapter 15: Geography, Climate, and Natural Resources

PART V: CONCLUSION
- Chapter 17: What We Have Learned and Where We are Headed

In italics only reading. No appendices

Country report

3/5 pages, cover included, if any
One page devoted to a statistical overview of the socio-economic background

Eligible countries
- EU28
- Enlargement candidates
  » Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Iceland, Kosovo*,, Montenegro, Serbia, Turkey
- European Neighbouring countries
  » Algeria, Armenia, Azerbaijan, Belarus, Egypt, Georgia, Israel, Jordan, Lebanon, Libya, Moldova, Morocco, Palestine, Syria, Tunisia, Ukraine

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EUROPEAN NEIGHBOURHOOD POLICY

EU cooperation with its nei...

Cases

- Report on a EU contry for an extra EU multinationals

- Report on a candidate country for a government body of a EU country

- Report on a EN country for an ONG based in EU

- Report on either a candidate or a EN country for EU institutions (a DG for example)

- Others?

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Report delivery

- Report: pdf file via mail to stefanousai@unica.it

- File name: surname_name.pdf

- Mail subject: country report

- Mail text: specification of the case (see above)

- deadline: end of January?

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Report: examples

- Example 1

- Example 2

- Example 3

- Examcple 4

Presentations

- Groups, 3/4 people

- Mixed group
  - 5 groups of 4 students + 1 group of 5 students

- Theme: European issue/policy (your/our choice)

- 45/60 minutes

- Group and Individual assessment

- December/January?

Themes for presentations

1. **Malek, Khaoula, Peppe, Fabrizio, Misha**
   Green economy

2. **Lina, Maha, Monica, Yana, Julia**
   Trade policies

3. **Marta, Inaki, Arka, Marco, Mia**

4. **Joanna,Joanna, Natalia, Patrik, Ivan**
   Education

5. **Giulio, Matthew, Annike, Itziar, Timon**

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Calendar

1. **Malek, Khaoula, Peppe, Fabrizio, Misha**
   3 dec
2. **Lina, Maha, Monica, Yana, Julia**
   4 dec
3. **Marta, Inaki, Arka, Marco, Mia**
   5 dec
4. **Joanna,Joanna, Natalia, Patrik, Ivan**
   10 dec
1. **Giulio, Matthew, Annike, Itziar, Timon**
   11 dec

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The European Semester

The European Semester provides a framework for the coordination of economic policies across the European Union. It allows EU countries to discuss their economic and budget plans and monitor progress at specific times throughout the year.

The framework

The European Semester: why and how
Macroeconomic imbalance procedure
Stability and Growth Pact
The EU's economic governance explained

European Semester timeline

Setting the priorities
The analysis phase
National Reform Programmes and Stability/Convergence Programmes
EU country-specific recommendations
Putting recommendations into practice
Timeline: visual presentation
The autumn package explained

Thematic factsheets

Business environment
Financial stability
Green economy
Public administration
Labour markets and skills
Social protection and cohesion
Fiscal stability

Presentations: standard outline

- Introduction: motivations, aims and summary

- Main analytical background and framework

- Main empirical scenario

- Focus

- Conclusions

Presentations: examples

- Example 1

- Example 2

Productivity measurement

Productivity is how efficient we use the factors of production.

In the Solow model: A

- Knowledge

- Production organisation

- Effort

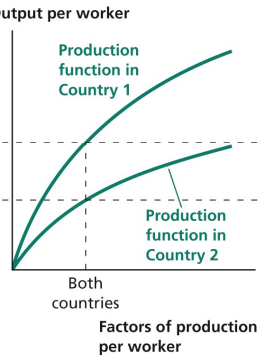Over the long run, productivity growth is considered the major factor behind income growth.

Possible Sources of Differences in Output per Worker

(a) Differences in output due to factor accumulation

Output per worker

Production function in both countries

y_1

y_2

Country 2   Country 1

Factors of production per worker
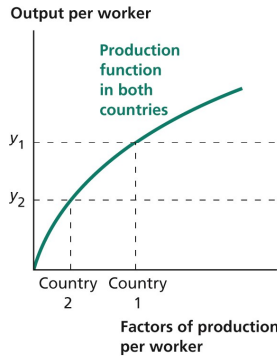
(b) Differences in output due to productivity

Output per worker

Production function in Country 1

Production function in Country 2

Both countries

Factors of production per worker

(c) Differences in output due to both productivity and factor accumulation
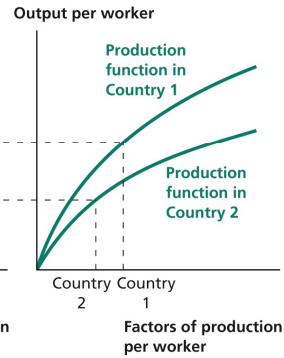
Output per worker

Production function in Country 1

Production function in Country 2

Country 2 Country 1

Factors of production per worker

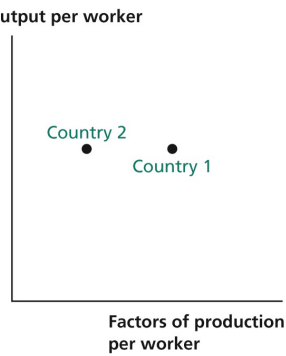ALWAYS LEARNING   PEARSON

Inferring Productivity from Data on Output and Factor Accumulation

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

Output per worker

Country 1

Country 2

Factors of production per worker
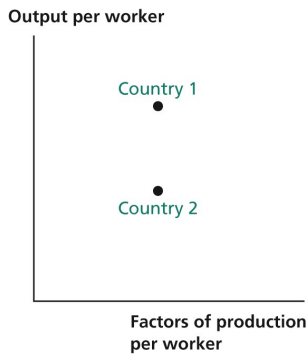
(b) The countries have equal output, but Country 1 has higher factor accumulation.

Output per worker

Country 2

Country 1

Factors of production per worker

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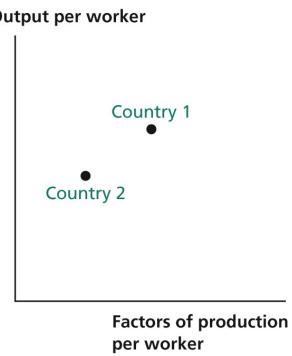
Output per worker

Country 1

Country 2

Factors of production per worker

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Productivity accounting

Can we identify the 3rd case?
Consider 2 countries with production function

$$Y_i = A_i K_i^\alpha (h_i L_i)^{1-\alpha} \quad \Leftarrow \Rightarrow$$

$$y_i = A_i k_i^\alpha h_i^{1-\alpha}$$

Then

$$\frac{y_i}{y_j} = \frac{A_i k_i^\alpha h_i^{1-\alpha}}{A_j k_j^\alpha h_j^{1-\alpha}} \quad \Leftarrow \Rightarrow$$

$$\frac{A_i}{A_j} = \frac{y_i \, k_j^\alpha h_j^{1-\alpha}}{y_j \, k_i^\alpha h_i^{1-\alpha}}$$

Yes. Intuition: Given same α, we adjust GDP/capita ratio with factor accumulation ratio to infer A ratio.

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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

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

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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, $k^{1/3}h^{2/3}$	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	0.87	0.80	1.03
Canada	0.80	0.81	0.96	0.91	0.88
Japan	0.73	1.16	0.98	1.04	0.70
South Korea	0.62	0.92	0.98	0.96	0.64
Turkey	0.37	0.28	0.78	0.55	0.68
Mexico	0.35	0.33	0.84	0.61	0.56
Brazil	0.20	0.19	0.78	0.48	0.42
India	0.10	0.089	0.66	0.34	0.31
Kenya	0.032	0.022	0.73	0.23	0.14
Malawi	0.018	0.029	0.57	0.21	0.087

Sources: Output per worker: Heston, Summers, and Aten (2011); physical capital: author's calculations; human capital: Barro and Lee (2010). The data set used here and in Section 7.3 is composed of data for 90 countries for which consistent data are available for 1975 and 2009.

Enormous differences in the A's.

Where do A differences come from? Measurement issues?

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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…
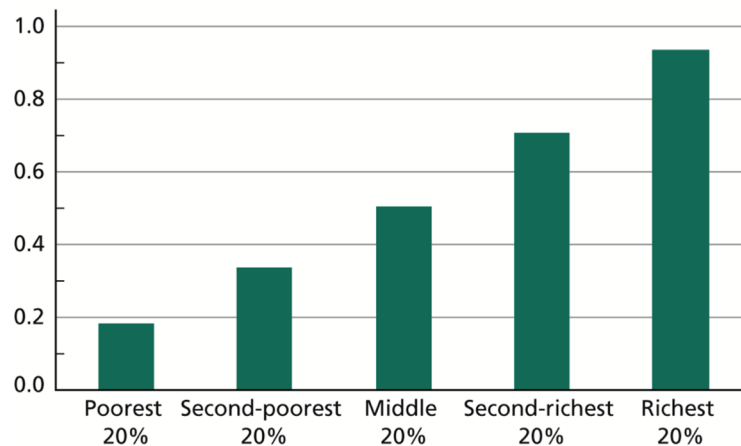
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Productivity or factor accumulation?

Factors of production per worker relative to U.S.

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Productivity or factor accumulation?

Productivity relative to U.S.
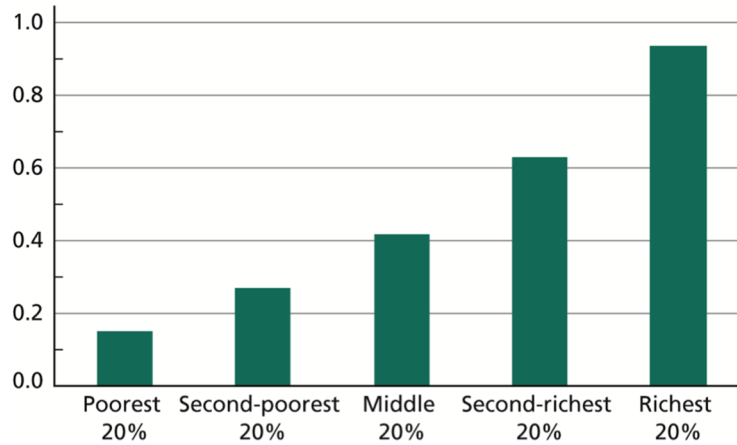
Both - surprisingly similar plots.

Factors accumulation is relatively more important for poorest countries.

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.

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 productions 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:

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

Productivity growth = output growth - growth in inputs.

Example

	Output per Worker, y	Physical Capital per Worker, k	Human Capital per Worker, h
Erewhon in 1975	1	20	5
Erewhon in 2010	4	40	10
Annual Growth Rate	4%	2%	2%

Set $\alpha = 1/3$. Then

$$\hat{A} = \hat{y} - \alpha\hat{k} - (1-\alpha)\hat{h}$$
$$= 0.04 - \frac{1}{3}0.02 - \frac{2}{3}\,0.02 = 0.02$$
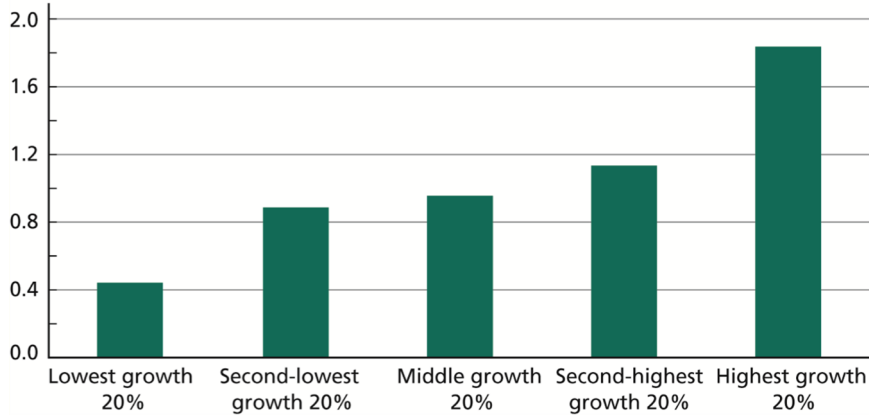
Historical data

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

Growth rate of factors of production (% per year)
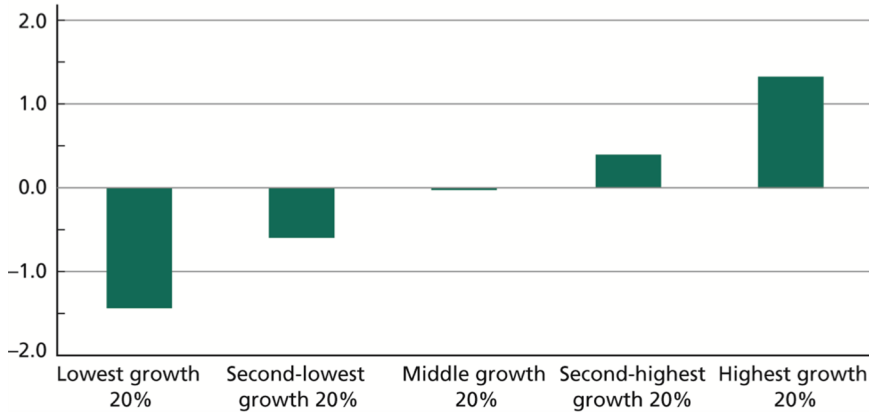

Historical data

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

Growth rate of productivity (% per year)

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