Measuring Productivity

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"Productivity isn't everything but in the long run it is almost everything"

Paul Krugman *The Age of Diminishing Expectations*

1. Why is productivity important?

- Basis for improvements in real incomes and economic well-being:

- Monetary policy (inflationary pressures)

- Fiscal policy (financing of health, education, welfare)

- Slow productivity growth = conflicting demands for distribution of income more likely

2. Concepts: labour productivity

- Every measure of productivity is a ratio between output and input(s)

- Simplest and most frequently-encountered measure: labour productivity:

$$\text{Labour productivity (LP)} = \frac{Q}{L}$$

- Indicates how efficiently labour is used in production

- Not necessarily an indicator of effort per worker

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Table of productivity measures

Type of output measure:	Type of input measure			
	Labour	Capital	Capital & labour	Capital, labour & intermediate inputs (energy, materials, services)
Gross output	Labour productivity (based on gross output)	Capital productivity (based on gross output)	Capital - labour MFP (based on gross output)	KLEMS multi-factor productivity
Value-added	Labour productivity (based on value-added)	Capital productivity (based on value-added)	Capital – labour MFP (based on value-added)	-
	Single factor productivity measures		Multi-factor productivity (MFP) measures	

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2. Concepts: multi-factor productivity

- Ratio of output and combined capital and labour input

$$\text{Multi} - \text{factor productivity (MFP)} = \frac{Q}{F(L, K)}$$

- Indicates how efficiently combined labour and capital are used in production

- When measured as rate of change:

Cost share of labour

Cost share of capital

$$\ln\left(\frac{Q^t}{Q^{t-1}}\right) = s_L \ln\left(\frac{L^t}{L^{t-1}}\right) + s_K \ln\left(\frac{K^t}{K^{t-1}}\right) + \ln\left(\frac{A^t}{A^{t-1}}\right)$$

% change in output

% change in labour input

% change in capital input

% change in MFP

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MFP and labour productivity

- Useful tool – decomposition of labour productivity

$$\ln\left(\frac{Q^t}{Q^{t-1}}\right) - \ln\left(\frac{L^t}{L^{t-1}}\right) = (1 - s_L)\left(\ln\left(\frac{K^t}{K^{t-1}}\right) - \ln\left(\frac{L^t}{L^{t-1}}\right)\right) + \ln\left(\frac{A^t}{A^{t-1}}\right)$$

% change labour productivity

Effect of capital intensity

Effect of MFP

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MFP and labour productivity
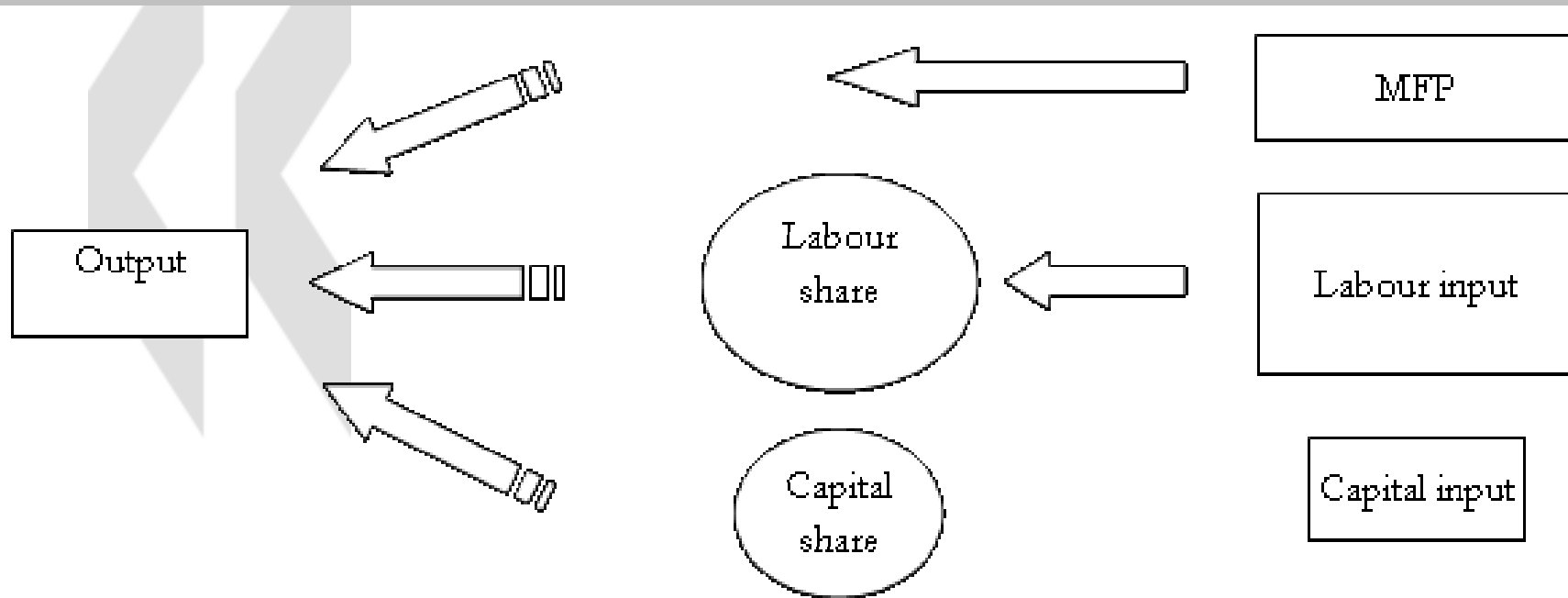
- Decomposition of labour productivity important:

  - Is labour productivity driven by investment in 'traditional' capital (--> rise in capital intensity)?

  - Is labour productivity driven by investment in 'intangible' capital, i.e., innovation, organisational change, R&D (--> change in MFP)

- Example: Canada

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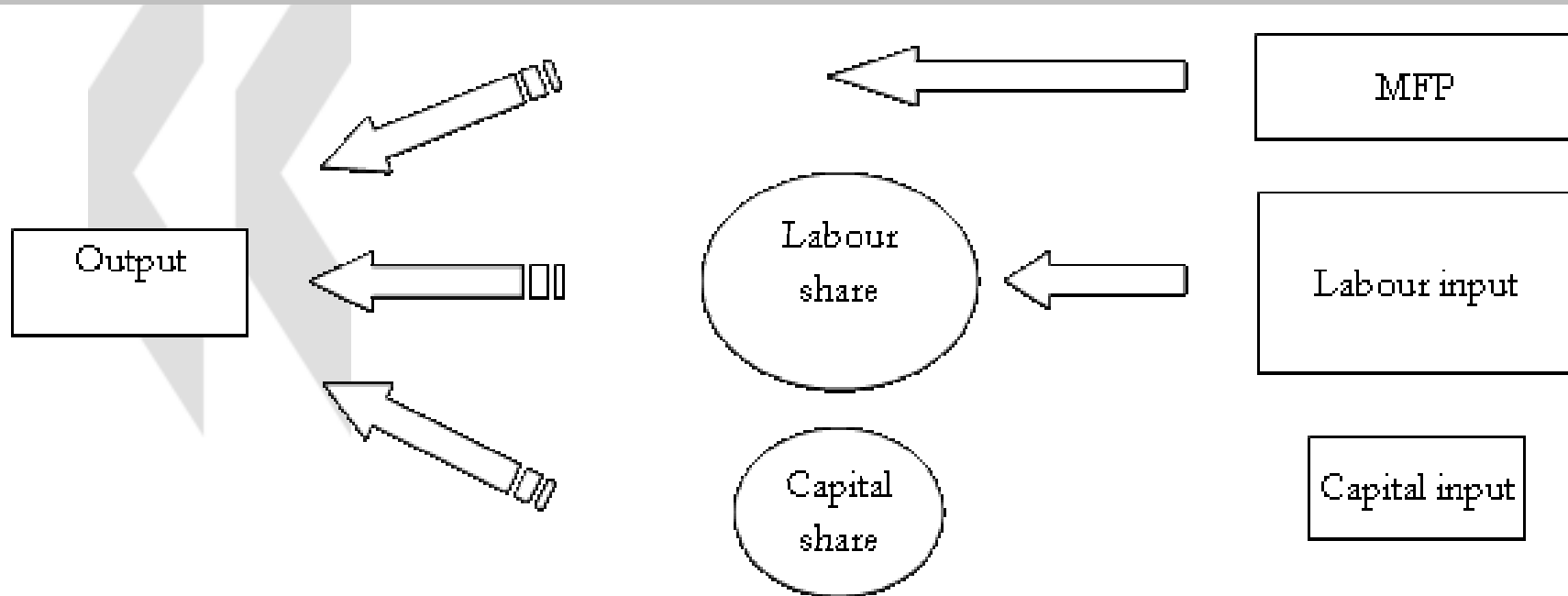
Decomposition of labour productivity, Canada
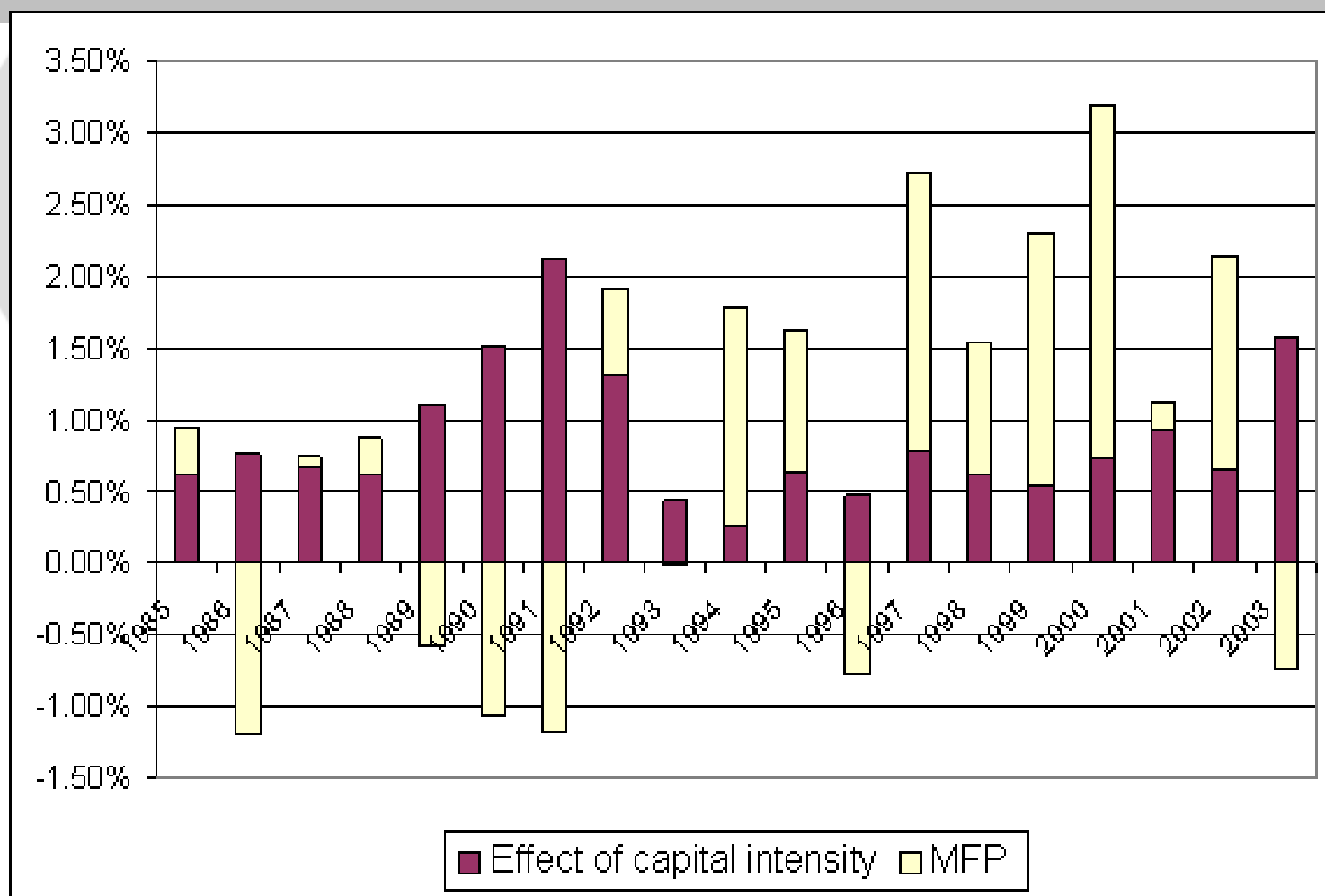
MFP – framework

MFP framework: measurement issues

Output

Labour share

Capital share

MFP

Labour input

Capital input

Tricky areas:
-Implicit pricing
-Non-market services
-Quality change

Measuring output: 3 tricky areas

1) Output measures for industries where there is implicit pricing so that even *nominal* output measures are debated:

- Banking (FISIM, how to deal with new financial instruments and risk?)

- Insurance (how to deal with catastrophes?)

➔ OECD Taskforce recommends to measure insurance output as premiums minus *expected* claims, not actual claims

➔ Otherwise sharp drop in output when there is a catastrophe

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# Measuring output: 3 tricky areas

2) Output measures for industries where technology moves fast and where rapid quality change makes price measurement difficult

- Example ICT: computer production, communication services

3) Output measures for industries with non-market producers

- Traditionally from input side

- But increasingly demand for output-based measures ➔ *Atkinson Report UK*

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Measuring output: 3 tricky areas

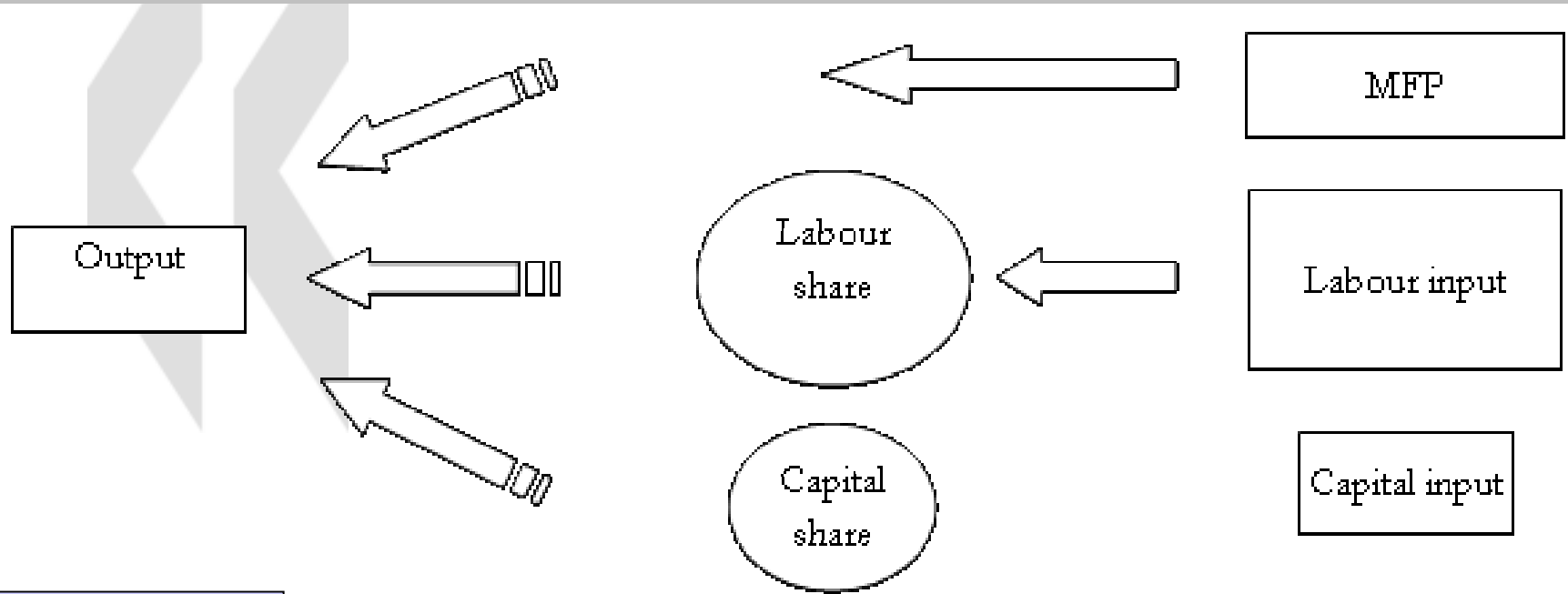**Chart 5. Real value added per employed person in the health and social work industry**

Indices, 1982=100
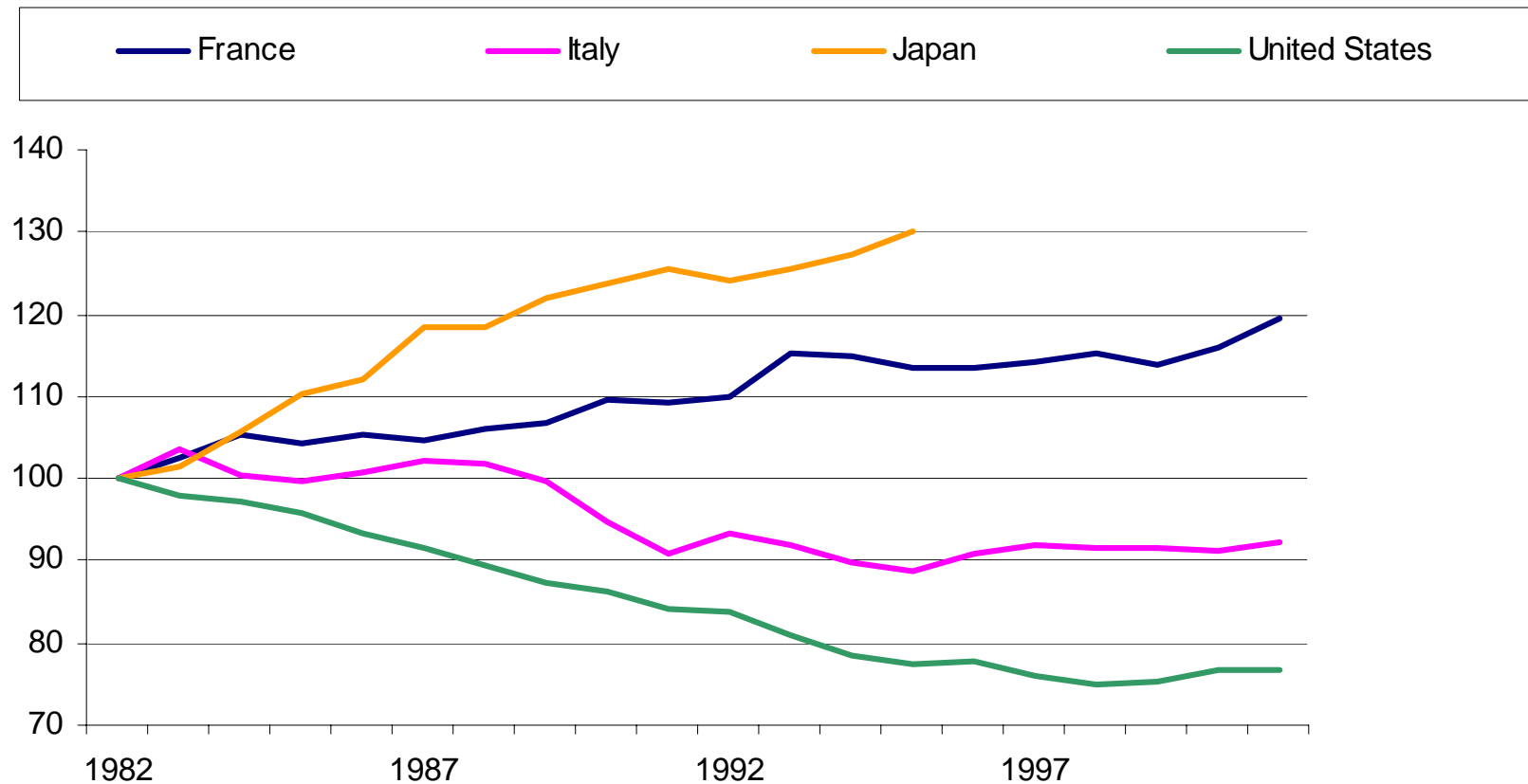
Source: OECD.

Multi-factor productivity framework: measurement issues

MFP

Output

Labour share

Labour input

Capital share

Capital input

Comparability of GDP growth rates:

-Non-market services
-High-tech industries

Measuring user costs

Splitting mixed income

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Multi-factor productivity framework: measurement issues

MFP

Output

Labour share

Labour input

Capital share

Capital input

Comparability of GDP growth rates:

-Non-market services
-High-tech industries

-Measuring user costs

-Splitting mixed income

-Hours actually worked

-Hours worked by occupation/skill

-Capital measures by industry

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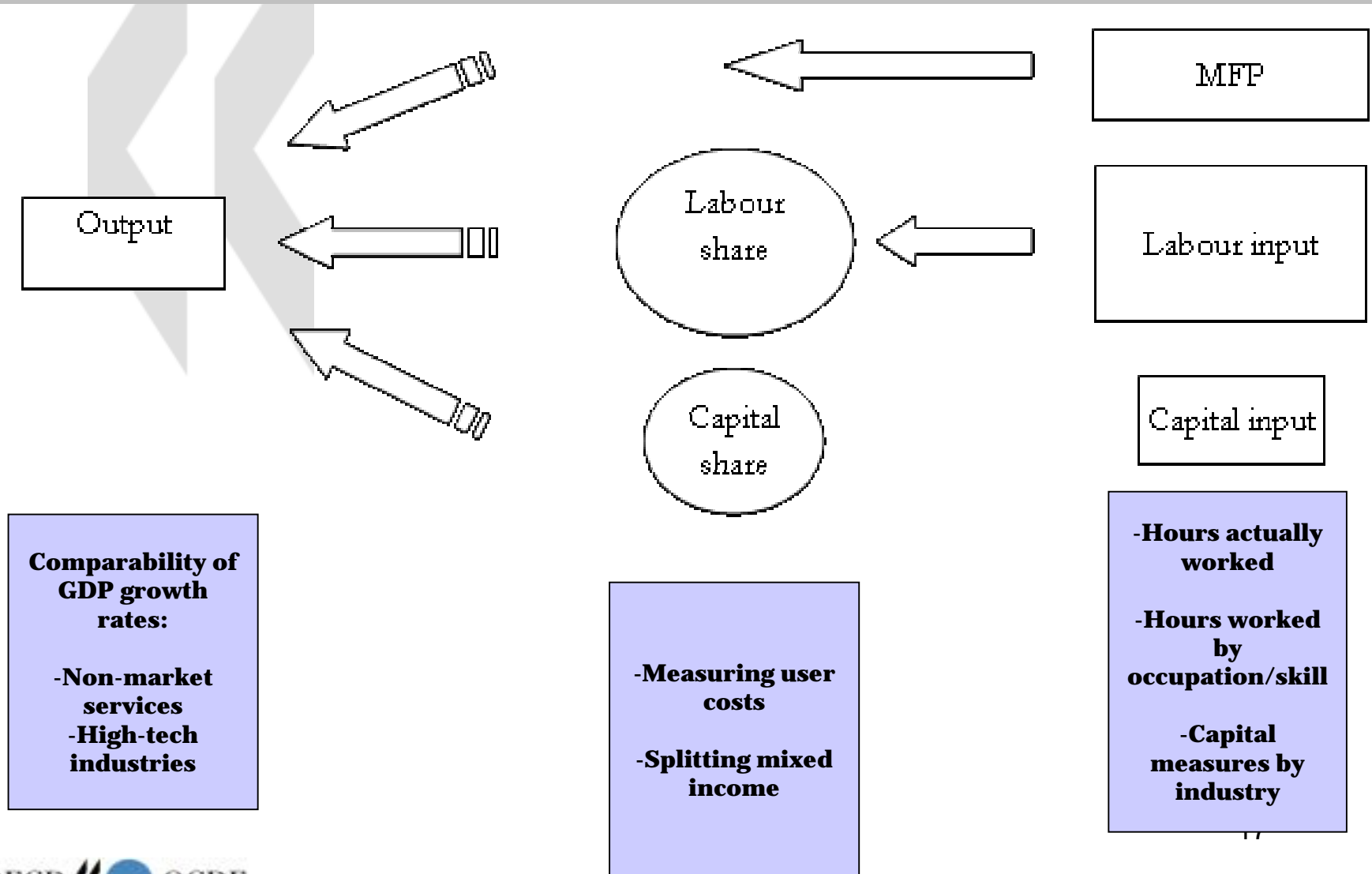
4. Measuring labour input

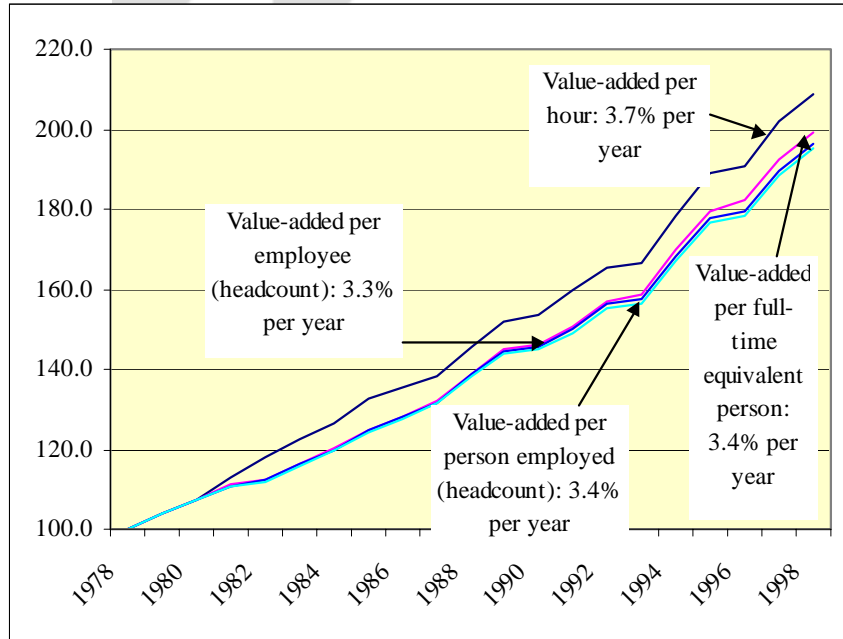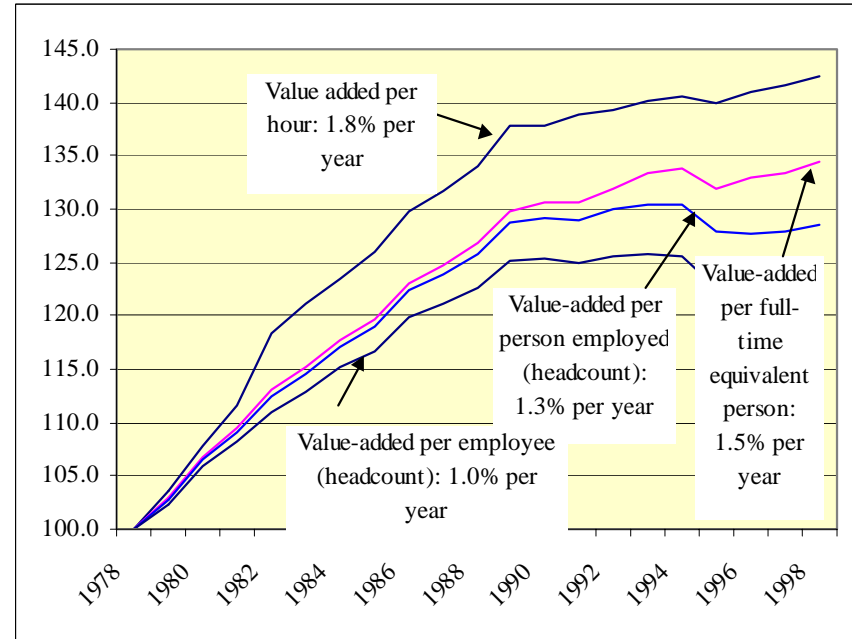- Ideal measure: total number of hours worked, broken down by type of labour input

- Number of persons employed or number of jobs can generate biased measures of productivity if hours per person change or if there are multiple job holdings

- Total hours should comprise the hours of employees, the hours of self-employed and the hours of unpaid workers (e.g. family members in agriculture)

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Example: impact of different measures of labour input on labour productivity, France

Industry (mining, manufacturing and construction)

Market services

Value-added per hour: 3.7% per year

Value-added per employee (headcount): 3.3% per year

Value-added per person employed (headcount): 3.4% per year

Value-added per full-time equivalent person: 3.4% per year

Value added per hour: 1.8% per year

Value-added per person employed (headcount): 1.3% per year

Value-added per employee (headcount): 1.0% per year

Value-added per full-time equivalent person: 1.5% per year

*Output is measured as a quantity index of value-added.

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Labour input: statistical issues

1) Two main statistical sources for hours worked:

- Labour force surveys (LFS)

- Establishment or firm-based surveys (ES)

- Results are not normally consistent

➔ Important role for national accountants:

Bring together these sources and provide labour input measures by industry (and sector) that are consistent with output measures

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2) Splitting mixed income:

- Important for productivity measurement: how big is labour income?

- To date: crude approximations are made

➔ National accounts could help by putting forward higher quality estimates

3) Information on composition of hours worked and relative remuneration:

- What is skill composition of hours?

- What is the wage difference between skill levels?

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5. Measuring capital input

- Conceptually correct measure: capital services (Theory see Griliches, Jorgenson, Diewert)

- Capital services = flow of productive services that capital delivers in production

- Measurement assumption: capital services = fixed proportion of productive capital stock

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Productive capital stock of a particular asset type

$$K_t = I_t + h_1 I_{t-1} + h_2 I_{t-2} + ... + h_T I_{t-T}$$

Past investment

Efficiency and retirement parameter

Capital services of a particular asset type

Growth of capital services of a particular asset type =

Growth of productive stock of this asset type

$$\ln\left(\frac{S_t}{S_{t-1}}\right) = \ln\left(\frac{K_t}{K_{t-1}}\right) \quad \text{because} \quad S_t = \lambda K_t$$

Normally assumed as constant

Price of capital service = user costs

How much would the owner of a capital good charge in a competitive market to rent the capital good out for one period (Diewert 1974)?

$$u_t = (r_t + \delta_t - i_t)p_t$$

Rate of asset price change

Rental price or user cost

Required rate or return

Rate of depreciation

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Price and quantity of capital services

Value of capital services for asset i $= u_t^i S_t^i$

User costs and the rate of capital service for each asset type are brought together to form an index of overall capital input = the rate of change of total capital services

$$\ln\left(\frac{K^t}{K^{t-1}}\right) = \sum_i w_i^t \ln\left(\frac{K_i^t}{K_i^{t-1}}\right)$$

Average share of each asset in total value of capital services

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Capital services and net capital stock, Australia
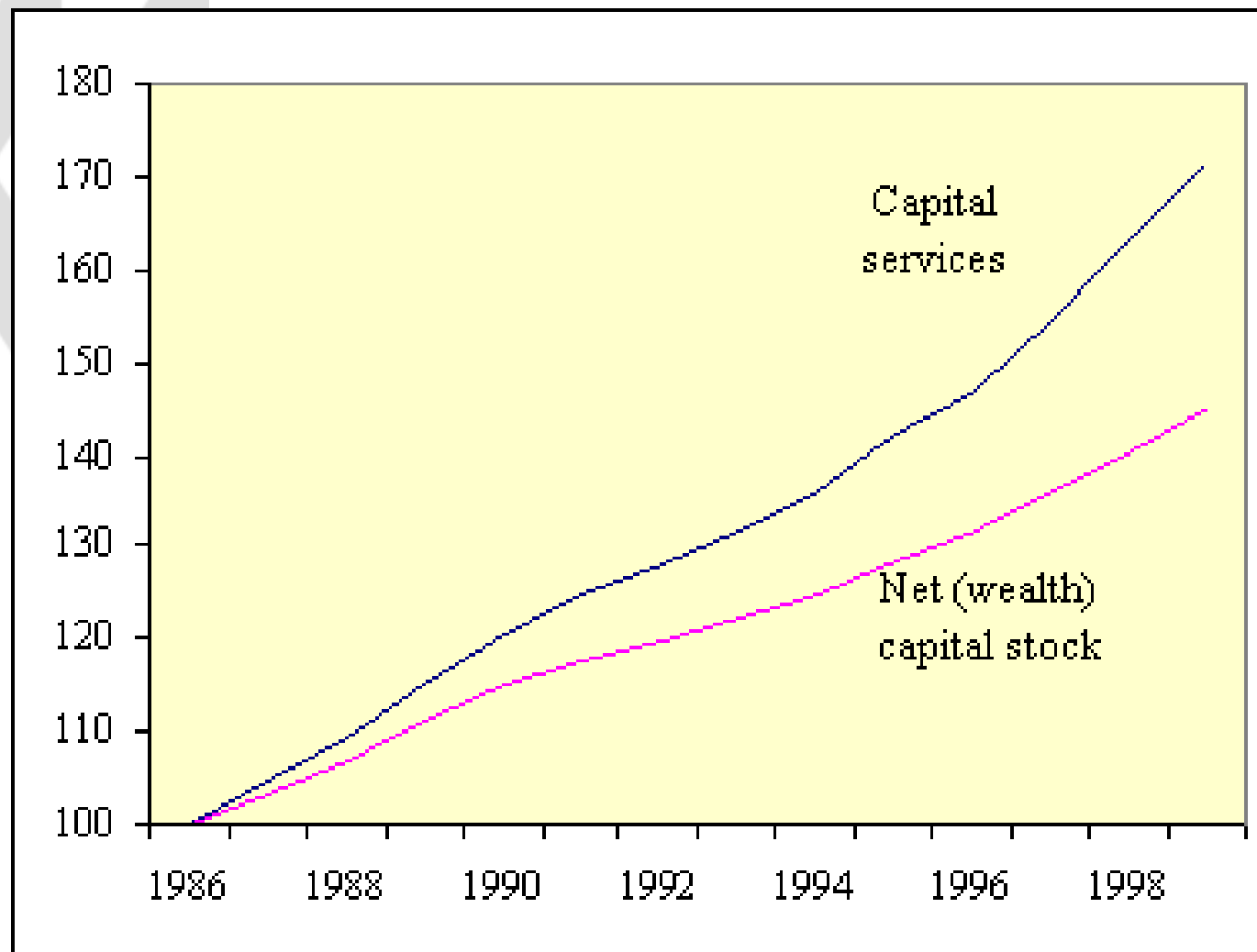
Capital services and national accounts

Capital services are different from net and gross capital stock

But different does not mean unrelated

Desirable: consistent entity of

- Net capital stock and balance sheets

- Productive stock and capital services

- Consumption of fixed capital (=depreciation)

This is one important topic of SNA revision, discussed next week in Canberra by Canberra II Group

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Capital services and national accounts

Some measurement issues:

- •Availability and quality of investment series

- •Breakdown by type of asset important

- •Scope of assets

- •Investment deflators

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6. OECD Productivity database

•Since March 2004, OECD productivity data available on the internet:

•Productivity:Statistics Portal

•For total economy:

   •Growth of GDP, hours worked and capital services

   •Labour productivity growth

   •MFP growth

   •Labour productivity levels

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Average rates of MFP growth
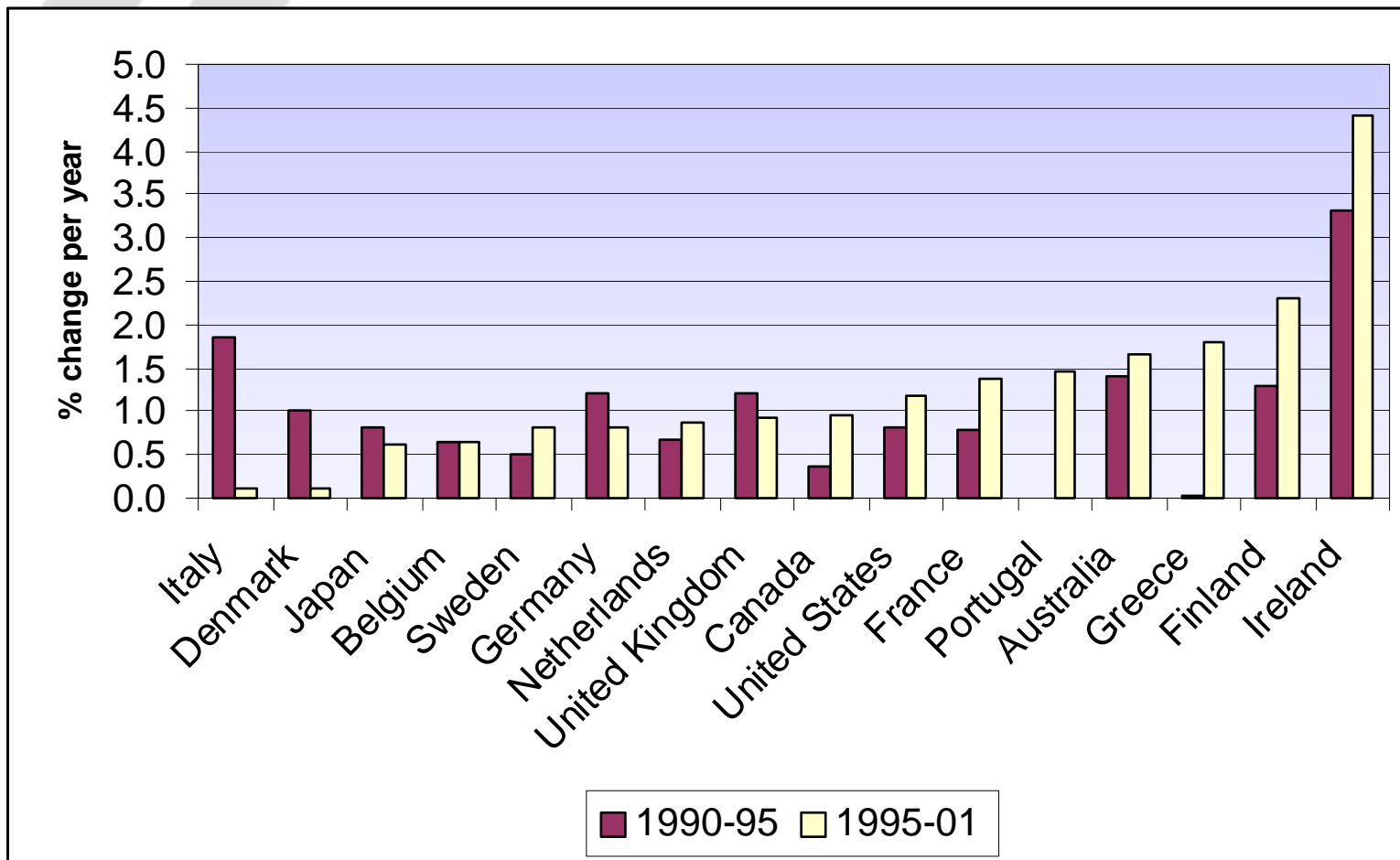
7. OECD Factbook

• Since last week: OECD Factbook

• **Online version** is freely available at
http://new.SourceOECD.org/factbook and enables the
downloading of the data underlying the tables and
graphs

• First compilation of economic, social and
environment indicators across OECD countries

• Chapter on macro-economic indicators includes
productivity comparisons, in particular MFP growth
rates

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8. Conclusions

• Productivity is a key indicator for analysis of economic growth --> significant demand from policy makers

• Simple ratio but sometimes difficult to measure

• Desirable: close integration of productivity measures and their ingredients with the national accounts

• Release of 'official' productivity statistics by statistical agencies

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Thank you for your attention!

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