# *Productivity measurement in France and Italy*

Rossella Bardazzi
University of Florence, Italy

XVII Inforum Conference, Jurmala

7-12 September 2009

# Outline

- The new EU KLEMS database to measure productivity growth: main features
- Double deflation in EU KLEMS
- Productivity measures in France and Italy with EU KLEMS data
- The alternative IO method proposed by Almon
- Results and comparisons

# EU KLEMS Database

- This database is part of a research project financed by the European Commission to analyse productivity in the European Union at the industry level.
- The EU KLEMS growth accounts include measures of economic growth, productivity, employment, capital and technological change at the industry level for 25 EU member states, the US and Japan, and cover the period 1970-2005 (latest release March 2008).

# EU KLEMS Database
# Data sources

- The EU KLEMs database has largely been constructed on the basis of data from national statistical institutes  involved as consortium partners of the research project.
- The database is publicly available on http://www.euklems.net along with reports about the methodology used and national sources.

# EU KLEMS Database
# Main features

- “A crucial element in KLEMS database is the consistency of inputs and outputs within and across industries. Therefore, the main building block of a KLEMS account is a series of input-output tables in which inter-industry flows are recorded in a consistent way.”
- The variables covered can be split into 3 main groups:
  - labour productivity variables
  - growth accounting variables
  - additional variables

# Labour productivity variables (statistical module)

| | |
|---|---|
| ***Values*** | |
| *GO* | Gross output at current basic prices (in millions of local currency) |
| *II* | Intermediate inputs at current purchasers' prices (in millions of local currency) |
| *IIE* | Intermediate energy inputs at current purchasers' prices (in millions of local currency) |
| *IIM* | Intermediate material inputs at current purchasers' prices (in millions of local currency) |
| *IIS* | Intermediate service inputs at current purchasers' prices (in millions of local currency) |
| *VA* | Gross value added at current basic prices (in millions of local currency) |
| *LAB* | Labour compensation (in millions of local currency) |
| *CAP* | Capital compensation (in millions of local currency) |
| *CAPIT* | ICT capital compensation (in millions of local currency) |
| | |
| ***Volumes*** | |
| *GO_QI* | Gross output, volume indices, 1995 = 100 |
| *II_QI* | Intermediate inputs, volume indices, 1995 = 100 |
| *IIE_QI* | Intermediate energy inputs, volume indices, 1995 = 100 |
| *IIM_QI* | Intermediate material inputs, volume indices, 1995 = 100 |
| *IIS_QI* | Intermediate service inputs, volume indices, 1995 = 100 |
| *VA_QI* | Gross value added, volume indices, 1995 = 100 |
| *LAB_QI* | Labour services, volume indices, 1995 = 100 |
| *CAP_QI* | Capital services, volume indices, 1995 = 100 |
| *CAPIT_QI* | ICT capital services, volume indices, 1995 = 100 |
| *LP_I* | Gross value added per hour worked, volume indices, 1995=100 |
| *CAPIT_QPH* | ICT capital stock per hour worked, 1995 reference |
| *CAPNIT_QPH* | Non-ICT capital stock per hour worked, 1995 reference |

# Growth accounting variables (analytical module)

| | |
|---|---|
| *LAB* | Labour compensation (in millions of local currency) |
| *CAP* | Capital compensation (in millions of local currency) |
| *LAB_QI* | Labour services, volume indices, 1995 = 100 |
| *CAP_QI* | Capital services, volume indices, 1995 = 100 |
| | |
| *VA_Q* | Growth rate of value added volume (% per year) |
| *VAConL* | Contribution of labour services to value added growth (percentage points) |
| *VAConH* | Contribution of hours worked to value added growth (percentage points) |
| *VAConLC* | Contribution of labour composition change to value added growth (percentage points) |
| *VAConKIT* | Contribution of ICT capital services to output growth (percentage points) |
| *VAConKNIT* | Contribution of non-ICT capital services to output growth (percentage points) |
| *VAConTFP* | Contribution of TFP to value added growth (percentage points) |
| *TFPva_I* | TFP (value added based) growth, 1995=100 |
| | |
| *GO_Q* | Growth rate of gross output volume (% per year) |
| *GOConII* | Contribution of intermediate inputs to output growth (percentage points) |
| *GOConIIM* | Contribution of intermediate energy inputs to output growth (percentage points) |
| *GOConIIE* | Contribution of intermediate material inputs to output growth (percentage points) |
| *GOConIIS* | Contribution of intermediate services inputs to output growth (percentage points) |
| *GOConL* | Contribution of labour services to output growth (percentage points) |
| *GOConK* | Contribution of capital services to output growth (percentage points) |
| *GOConTFP* | Contribution of TFP to output growth (percentage points) |
| *TFPgo_I* | TFP (gross output based) growth, 1995=100 |

# Growth accounting variables (analytical module)

These variables are of analytical nature and cannot be derived from published NA without additional assumptions. A major advantage of growth accounting methodology is that it is rooted in neo-classical production theory. The construction of these series needs additional assumptions such as:

- competitive factors markets
- full input utilization
- Constant returns to scale

Moreover to compute the decomposition of value added growth another assumption is needed:

*value added functions for each industry must exist which means that the industry-level production function is value-added separable (intermediate inputs are separable from primary inputs, so that intermediate input's prices would not matter).*

This assumption is necessary not only for variables of the second module but also for price and volume indices of value added measuring something meaningful (these variables are included in the basic "statistical" group).

# EU KLEMS database: diffusion and applications

- Many WP on the project website
- Coverage on newspapers: The Economist, 17-5-07
- Economic Systems Research (3), 2007; IIOA WP 09-005
- Latest issue of *Économie et Statistique* (INSEE)
- Bank of Italy*, Report on trends in the Italian productive system*, 2008
- Van Ark, O'Mahony, Timmer (2008), "The productivity gap between Europe and the US: Trends and causes", *Journal of Economic Perspectives,* (1), vol.22.
- O'Mahony, Timmer (2009), "Output, Input and Productivity Measures at the Industry Level: the EU KLEMS Database", *The Economic Journal*, June.

# EU KLEMS Database: an application for Italy and France

- French and Italian data have been used to measure labour productivity at the industry level
- Main findings: real value added included in the database (reported as computed with double deflation) is different from the 'home-cooked' results obtained by applying double deflation to the original disaggregated data of the same dataset.

   The procedure to compute the volume of VA included in the dataset is unknown.

# If double deflation is applied negative values of real value added appear:

| ITALY | | | FRANCE | | |
|---|---|---|---|---|---|
| Total cell no. | 3816 | | Total cell no. | 3816 | |
| - of which NOT empty | 1404 | | - of which NOT empty | 3188 | |
| | | | | | |
| No. cells with real VA<0 | 5 | | No. cells with real VA<0 | 153 | |
| as % of total | 0.4% | | as % of total | 4.5% | |
| | | | | | |
| max Val | 1290 | *nace 24 "chemicals" in '74* | max Val | 49463 | *nace 90 "sewage" in '85* |
| | | | | | |
| Δ = 0 | 20 | | Δ = 0 | 96 | |
| 0 < Δ < 10 | 1324 | | 0 < Δ < 10 | 2216 | |
| 10 < Δ < 50 | 40 | | 10 < Δ < 50 | 409 | |
| 50 < Δ < 100 | 5 | | 50 < Δ < 100 | 131 | |
| 100 < Δ < 1000 | 14 | | 100 < Δ < 1000 | 308 | |
| 1000 < Δ | 1 | | 1000 < Δ | 28 | |
| | 1404 | | 0 | 3188 | |
| | | | | | |

# Which industries show the highest differences?

- Industries for which changes in prices of intermediate inputs were very different from changes in output deflators (for instance for France: *rubber and plastics; office, accounting and computing machinery; electronic valves and tubes*. For both countries: *coke, refined petroleum and nuclear fuel; electricity, gas and water supply*)
- Industries for which intermediate consumption is a large share of production (mostly same as above)

  [Meade, 2007]

# Labour productivity in EU KLEMS

However,  a series of value added in volume is included in the dataset and used with total hours worked to compute the productivity of labour at the industry level.

These data have been used to make comparisons with results we have obtained applying the IO procedure proposed by Clopper Almon at the conference in Cyprus.

# The input-output alternative

- The procedure is described by Almon (2009). The aim is to measure how many primary inputs are required by the *whole economy* to produce a product for final demand.

The vector of real inputs per unit of final demand produced in year t is defined as

$$x_t = v_t'(I - A_t)^{-1}$$

where

- $A_t$ is the input-output coefficient matrix of year t,
- $v_t$ is the vector of real input per unit of output in year t

The $x_t$ vector is converted to a constant unit, multiplying it element-by-element by the price index vector $p_t$ :

$$z_t = x_t * p_t$$

This vector represents the primary inputs directly and indirectly required to produce a (constant-sized) unit of final output.

If we consider labour input, the reciprocal of $zl_t$ vector may be considered as a labour productivity index for the economy in producing various products.

- This procedure has been applied to France and Italy over the period 1995-2005 for which SUTs for both countries where available. A common classification of 20 industries has been created to compare national results, the same classification has been used to aggregate EU KLEMS data as well.

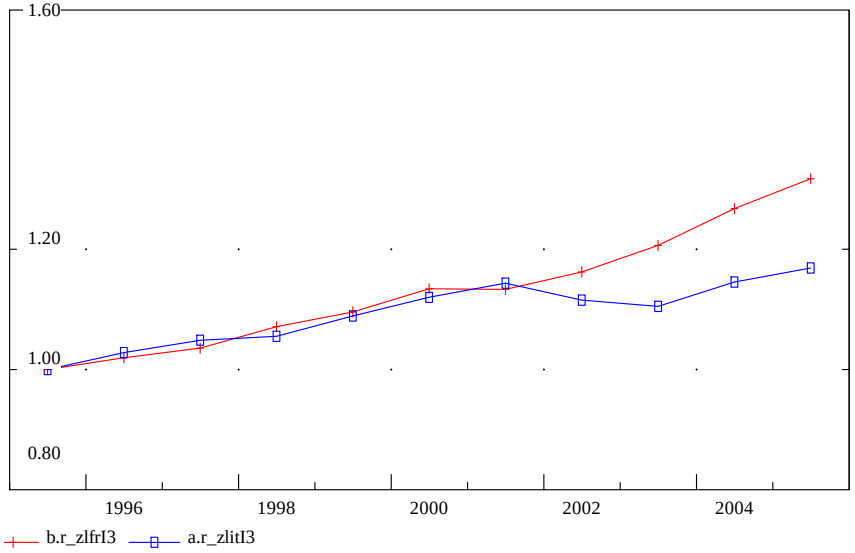
# Labour productivity in France and Italy: selected results

- In all graphs the red line marked by + signs is France, while the blue line marked by squares is Italy. Values have been normalized to be 1 in 1995.
- In most industries labour productivity growth is higher for France than for Italy:  Italian labour productivity stagnation  (or decrease for some industries) is well known, due to a growth of input demand notwithstanding the sluggish production.

# Higher EU KLEMS productivity growth for (French) industries with large shares of intermediates

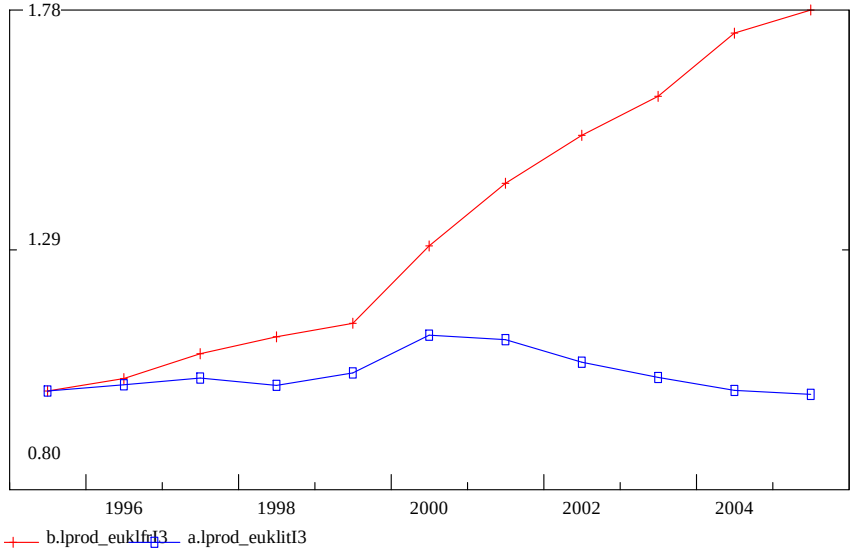
RECIPROCAL OF LABOUR REQUIREMENTS (1995=1)

Textiles, Wearing apparel



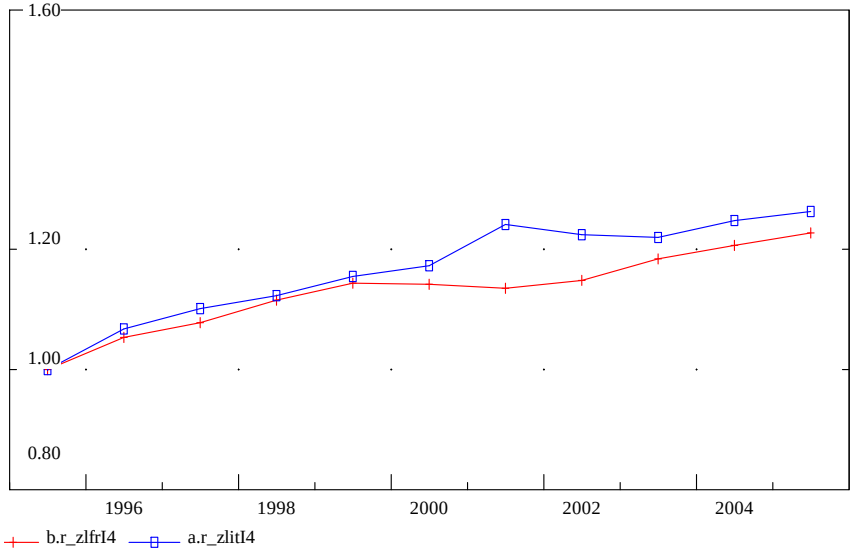

LABOUR PRODUCTIVITY (EUKLEMS) 1995=1

Textiles, Wearing apparel



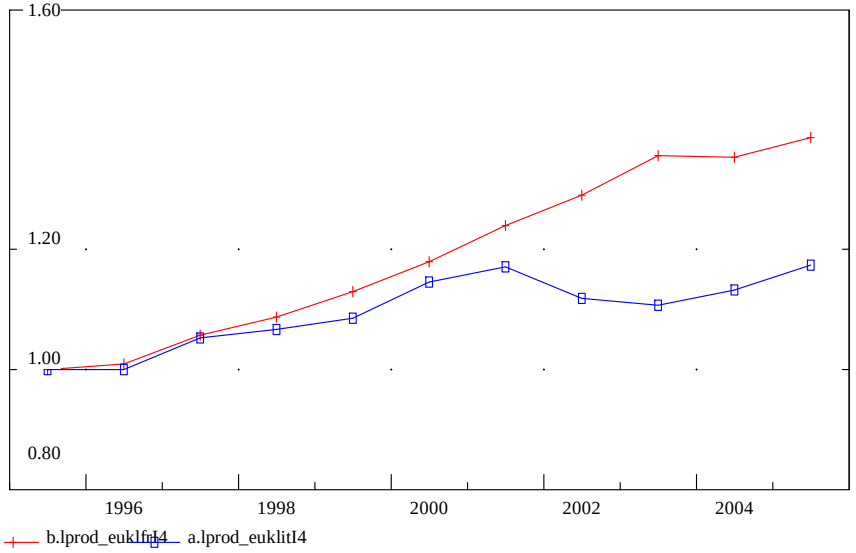
## RECIPROCAL OF LABOUR REQUIREMENTS (1995=1)

Wood, Paper, Printed matter, Recorded media



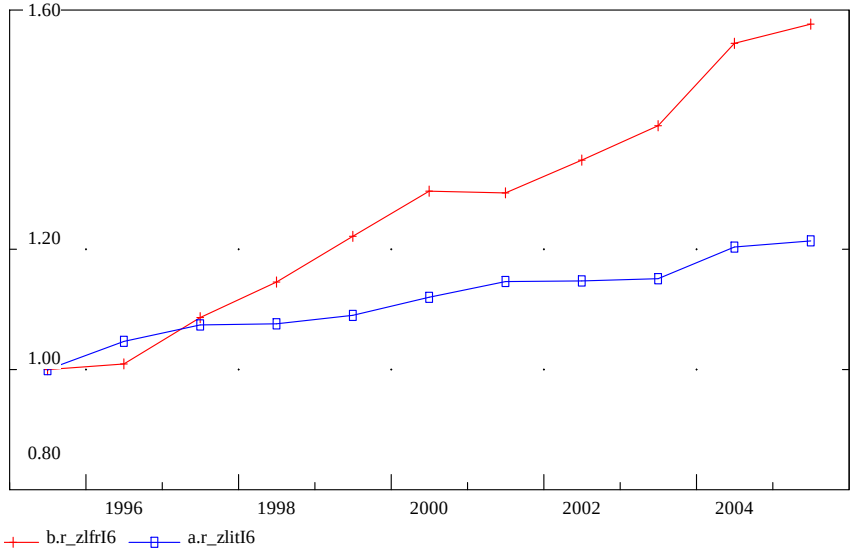

## LABOUR PRODUCTIVITY (EUKLEMS) 1995=1

Wood, Paper, Printed matter, Recorded media



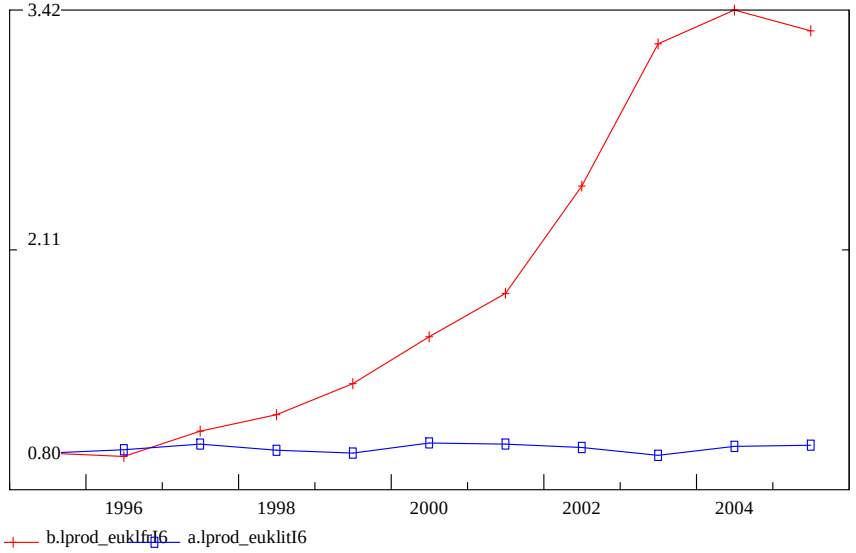
## RECIPROCAL OF LABOUR REQUIREMENTS (1995=1)

Electric and electronic equipment



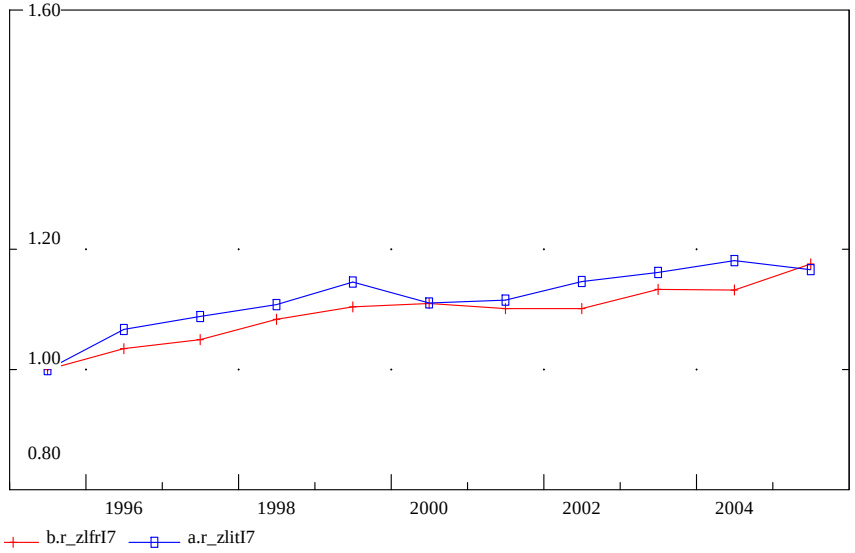

## LABOUR PRODUCTIVITY (EUKLEMS) 1995=1

Electric and electronic equipment



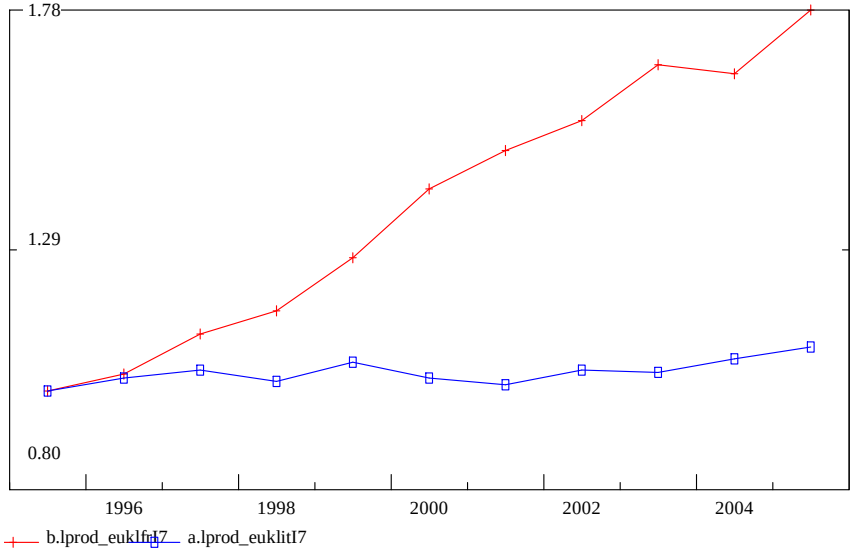
## RECIPROCAL OF LABOUR REQUIREMENTS (1995=1)

Chemicals, Rubber, Plastic



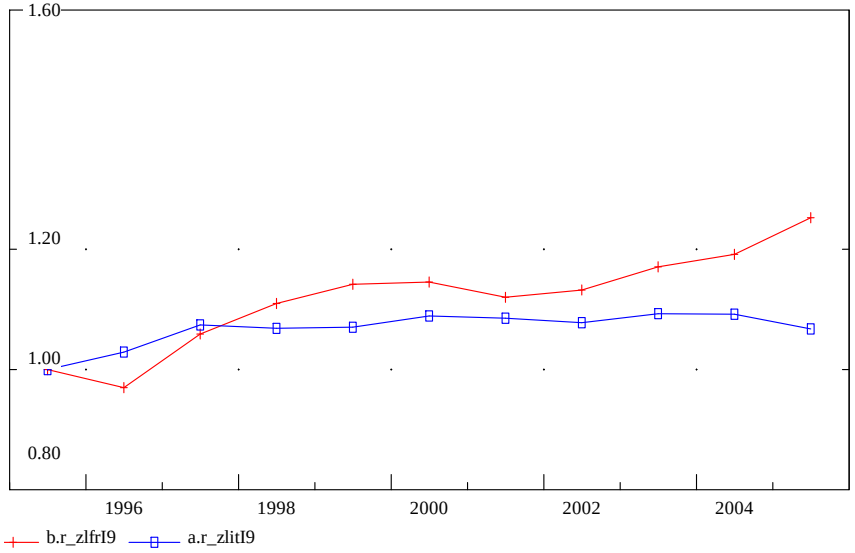

## LABOUR PRODUCTIVITY (EUKLEMS) 1995=1

Chemicals, Rubber, Plastic



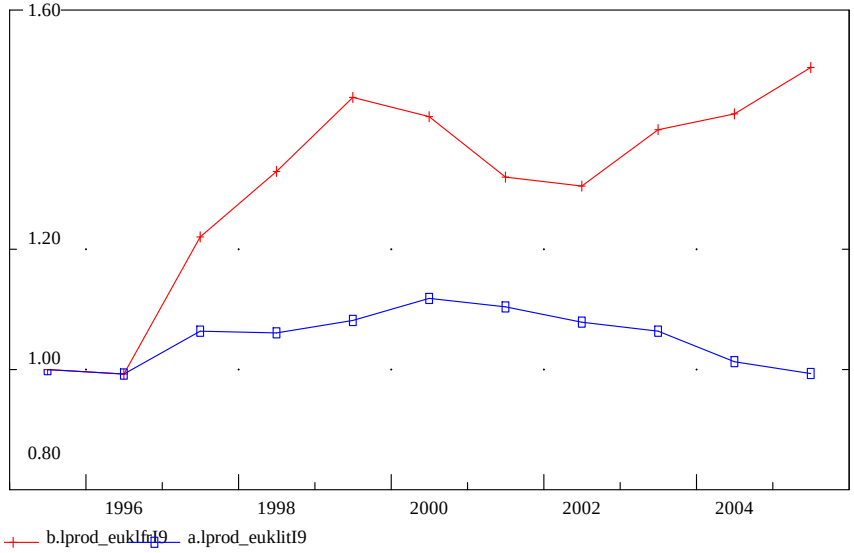
## RECIPROCAL OF LABOUR REQUIREMENTS (1995=1)

Motor vehicles



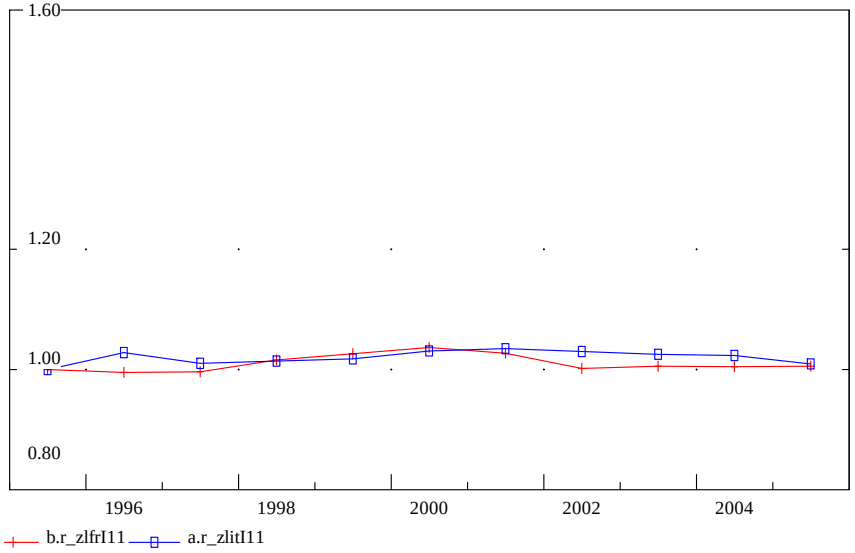

## LABOUR PRODUCTIVITY (EUKLEMS) 1995=1

Motor vehicles



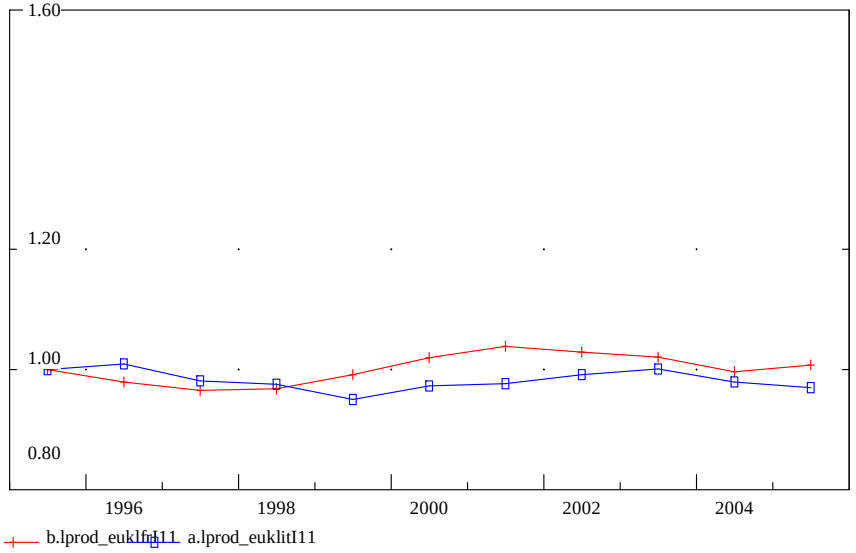
## RECIPROCAL OF LABOUR REQUIREMENTS (1995=1)

Construction




## LABOUR PRODUCTIVITY (EUKLEMS) 1995=1

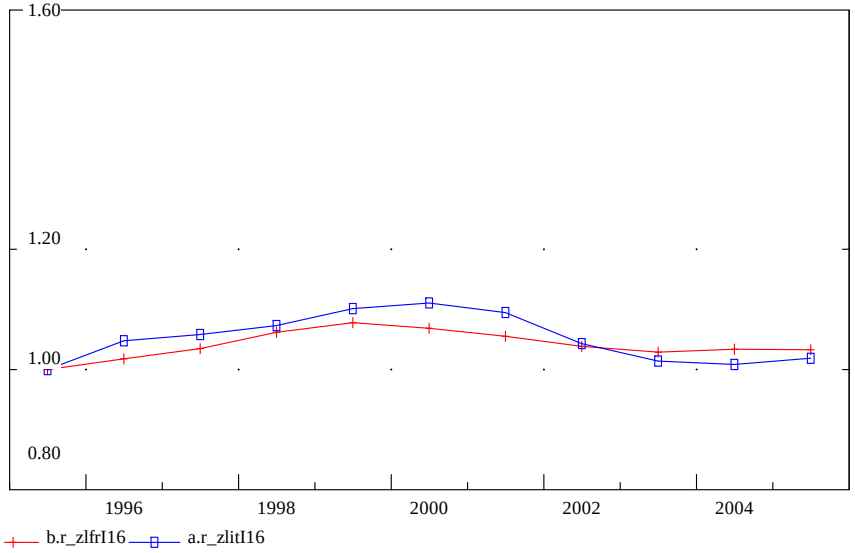
Construction



# Small differences for most services

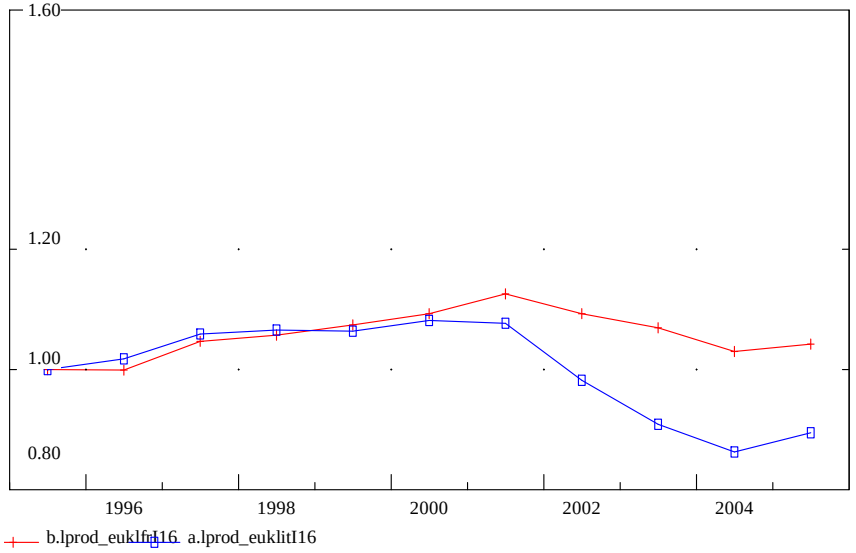
RECIPROCAL OF LABOUR REQUIREMENTS (1995=1)

Hotels and restaurants




LABOUR PRODUCTIVITY (EUKLEMS) 1995=1

Hotels and restaurants



# Conclusions

- Some further inquires about the content of EU KLEMS dataset are necessary: this will be a much used source of information for productivity analysis and it's essential to be aware of the methodology used to produce the 'basic variables' included in this dataset.

- Our disaggregated results show that the computation of input requirements for a certain product at the economy level perhaps avoid the distortions produced by using variables (such as the quantity of value added) adjusted with criteria unknown to the dataset users.