Measurement of EU agricultural total factor productivity growth

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General objectives for the CAP\textsuperscript{1,2}:

- Promoting a viable food production, with the focus on agricultural income, \textit{agricultural productivity} and price stability;
- Promoting sustainable management of natural resources and climate action, with a focus on greenhouse gas emissions, biodiversity, soil and water;
- Promoting balanced territorial development, with a focus on rural employment, growth and poverty in rural areas.

TFP is one of the three impact indicators for the general CAP objective of promoting a viable food production

- TFP growth has to increase compared to the 2009-2011 baseline of 104 (with TFP index for 2005 equalling 100)

\textsuperscript{1}Communication from the Commission on The CAP towards 2020 for the next programming period (2014 – 2020), further specified in the Regulation (EU) No 1306/2013, Article 110(2)
\textsuperscript{2}Treaty of the Functioning of the European Union (TFEU) Article 39
Relevancy

It is also used to evaluate the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-Ag)

TFP indicator is reported yearly:
- in the Statistical and Economic Information Report on Rural Development in the EU
- in the DG AGRI Management Report

Missing global measure since 2002 when Eurostat stopped calculating it because of land value missing
EU TFP growth, EC calculation

TFP growth

TFP CAGR between (2004-2006) and (2012-2014)
"Despite the positive TFP development in many countries we did not observe catching up process between the regions. The metafrontier analysis showed that despite a period of almost 10 years after accession the productivity differences in agriculture among as well as within countries are quite substantial."

EU TFP growth, USDA

Agricultural TFP growth in EU countries 2001-2010, USDA estimates
Where do differences originate from?

Different measure: TFP vs. TFP growth
- Compete: regional differences in TFP
- USDA: TFP-growth, chained index

Different methodology and functional form
- Compete: Törnqvist-Theil index, deviations from the sample mean, meta-frontier approach, SFA
- USDA: Törnqvist-Theil index, Cobb-Douglas

Different data sources
- Compete: FADN
- USDA: FAOSTAT/Eurostat

Different (sub)samples
- Compete: sector (dairy, porc, cereals), only specialized production
- USDA: Czechslovakia, Belgium-Luxembourg
Where do differences originate from?

Different output and input factors
- Compete: y1 milk production, y2 other animal production, y3 plant production, x1 labour, x2 land, x3 capital, x4 specific material and x5 other material
- USDA: crop and livestock commodity outputs and land, labor, livestock, farm machinery, inorganic fertilizers and animal feed inputs

Different ways to calculate output and input volumes and weights
- USDA: labour quality adjusted for skills; capital: livestock and machinery in use on farm; land: quality weights to adjust permanent pasture and irrigated land into rainfed equivalents
- USDA: cost shares varied per decade, revenue shares constant (base year)

Different ways to circumvent data gaps and outliers

...
How do we get an overall picture on productivity?

INPUT

Management skills

Area allocation

Economies of scale

OUTPUT

Technical progress

Mechanisation
With a Fischer index!

TFP Laspeyres index:  
Base = year t-1

\[
\frac{TFP^t_0 - L}{I^t_0 - L} = \frac{O^t_0 - L}{I^t_0 - L} = \left( \frac{q_{1t} * w_{10} + q_{2t} * w_{20} + \ldots + q_{nt} * w_{n0}}{q_{10} \cdot w_{10} + q_{20} \cdot w_{20} + \ldots + q_{n0} \cdot w_{n0}} \right) \left( \frac{i_{1t} \cdot x_{10} + i_{2t} \cdot x_{20} + \ldots + i_{rt} \cdot x_{r0}}{i_{10} \cdot x_{10} + i_{20} \cdot x_{20} + \ldots + i_{r0} \cdot x_{r0}} \right) \left( \frac{w_{10} + w_{20} + \ldots + w_{n0}}{x_{10} + x_{20} + \ldots + x_{r0}} \right)
\]

TFP Paasche index:  
Base = year t

\[
\frac{TFP^t_0 - P}{I^t_0 - P} = \frac{O^t_0 - P}{I^t_0 - P} = \left( \frac{q_{10} * w_{1t} + q_{20} * w_{2t} + \ldots + q_{nt} * w_{nt}}{q_{1t} \cdot w_{1t} + q_{2t} \cdot w_{2t} + \ldots + q_{nt} \cdot w_{nt}} \right) \left( \frac{i_{1t} \cdot x_{1t} + i_{2t} \cdot x_{2t} + \ldots + i_{rt} \cdot x_{rt}}{i_{1t} \cdot x_{1t} + i_{2t} \cdot x_{2t} + \ldots + i_{rt} \cdot x_{rt}} \right) \left( \frac{w_{1t} + w_{2t} + \ldots + w_{nt}}{x_{1t} + x_{2t} + \ldots + x_{rt}} \right)^{-1}
\]

TFP Fisher index:

\[
TFP_F = \sqrt{TFP_L * TFP_P}
\]
Data needs and sources

Data needs: change in volume and production value or expenditure

Available sources:
- EAA (Economic accounts of agriculture)
- FADN data (Farm accountancy data network)
Output

Output of the whole agricultural 'industry':
- All products of the holding
- Services
- Non-separable secondary activities s.a. transformation of agricultural products
- Most detailed level
- No distinction between sectors

Change in output volume ($q_{lt}/q_{l0}$):
- Volume Indices, $n-1 = 100$, Production value at producer price

Output weights:
- Production value at producer price, real price in Euro, $2005 = 100$
Intermediate inputs

Change in input volume \( \left( \frac{i_{lt}}{i_{l0}} \right) \) for every input except land and labour cost:
- Volume Indices, n-1 = 100, Production value at basic price

Input weights:
- Production value at basic price, Real price in Euro, 2005 = 100

CAGR IC 2005-2014
Labour Input

Volume index for labour costs:
- Change in Total labour input measured in 1000 AWU

Labour weight:
- Correction of the weight for labour costs to cover the family labour costs
- The compensation of employees is divided by the share of paid labour (also directly available from the EAA)

Observations:
- Differentiation between MS by skills captured by cost component
- AWU: people employed converted to full time equivalents
Land input

Volume index for land costs:
- Change in Total UAA available in the EAA

Land weight:
- Correct the value to include own land: similar procedure compared to labour
- Total UAA (hectares) x average rent
- Average rent: Total expenditure for rents/number of hectares of rented land
- Share of rented land derived from FSS
- Total UAA derived from Agricultural Production Data – Crop products
Capital input

Volume index for capital costs:
- Change in Fixed capital consumption, Volume Indices, n-1 = 100, Production value at basic price

Capital weight:
Fixed capital consumption
- Production value at basic price, Real price in Euro, 2005 = 100
+ Interest rate
- Interest rate: EMU convergence criterion bond yields
incl. opportunity cost to acquire capital goods with own resources
- Average depreciation rate per MS (from FADN)
- Interest rate: EMU convergence criterion bond yields
- De-depreciating

\[
Value \ fixed \ capital \ cons = fixed \ cap \ cons \ast \left[ 1 + \left( \frac{Interest \ rate}{Depreciation \ rate} \right) \right]
\]
Why do we apply the 3-y moving average?
TFP growth paths differ considerably between MS

TFP growth EU-15

TFP growth EU-N13
Higher labour productivity is the main factor for TFP increase in the EU-N13...

Conclusion

**TFP growth measurement**
- Need for harmonisation of approaches
- Adapt methods to objective
- Communicate with care

**EA TFP**
- Agreement on approach?
- Inputs and bad outputs to consider?
- Data availability?
- Interpretation?
How will we proceed

- Further thorough data check
- Data issues: ask feedback from MS
- Preparation of a publication in 2016
- Further revision of the methodology

Thank you!

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