EU Common Agricultural Policy Reforms and Crop Farms' Productivity Growth

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Project objectives

- To measure agricultural total factor productivity (TFP) at the farm level and to identify its major sources and drivers
- To evaluate the impact of policy reforms on the evolution of crop farms' productivity:
  - 1992 MacSharry reform – reduction in price support for cereals by 35%
  - 2003 reform – decoupling of direct payments from production (introduction of a Single Payment Scheme, which is conditional on compliance with environmental and other standards – GAEC)

Methodology

- Parametric estimation of a transformation function for each country sample
- Use of technology parameter estimates to measure TFP growth using Törnqvist-Theil index
- TFP decomposition: technical change (TC), scale effect and technical efficiency
- Regressing TFP/TE estimates to understand determinants of productivity growth

Methodology

- Estimation of an Input Distance Function (IDF)

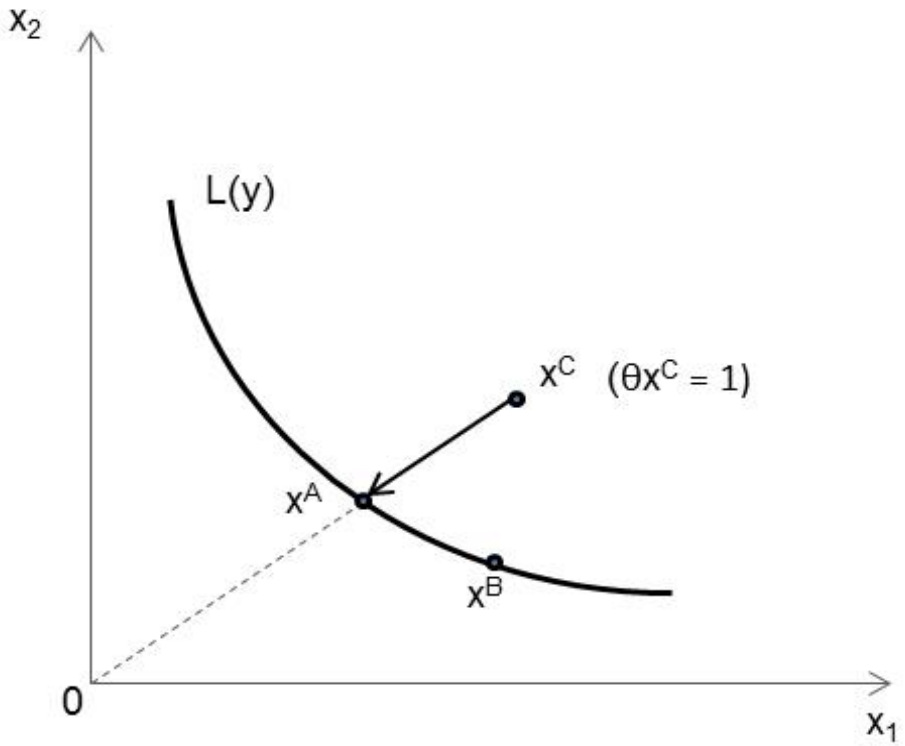
$$lnD_{Iit} = \alpha_0 + \sum_{m=1}^{M} \alpha_m ln\, y_{mit} \frac{1}{2} \sum_{m=1}^{M} \sum_{n=1}^{M} \alpha_{mn} lny_{mit} lny_{nit} + \sum_{k=1}^{K} \beta_k ln\, x_{kit}$$

$$+ \frac{1}{2} \sum_{k=1}^{K} \sum_{l=1}^{K} \beta_{kl} lnx_{kit} lnx_{lit} + \sum_{k=1}^{K} \sum_{m=1}^{M} \gamma_{km} lnx_{kit} lny_{mit}$$

$$+ \delta_t t + \frac{1}{2} \delta_{tt} t^2 + \sum_{m=1}^{M} \alpha_{mt} tlny_{mit} + \sum_{k}^{K} \beta_{kt} tln\, x_{kit}$$

Methodology

IDF with two inputs



4-step estimation procedure

1. step: use of GMM to estimate IDF parameters

2. step: Random effect (RE) model GLS-estimation

3. step: Stochastic frontier (SF) model ML-estimation to capture farm persistent TE (PTE)

4. step: SF model estimation to derive farm transient TE (TTE) estimates

Data

- EC FADN data for 24 EU member-states
- Two samples/periods:
  - 1992-2009 (sampling based on SGM typology) and
  - 2004-2013 (sampling based on SO typology)
- Eurostat ag. producer price indices for 1995-2013
- Final study period/s: 1995-2009 and **2004-2013**
- Country samples of specialised cereals, field crops, mixed crops, and mixed crops and livestock farms

Variable formulation

- 3 outputs:
  - Cereals – value of farm cereals production
  - Other crops – value of total crops output minus cereals
  - Other farm output – farm total output minus value of crops output
- 4 inputs:
  - Land – hectares of Utilised Agricultural Area
  - Labour – Annual Work Units (225 working days x 8 hrs)
  - Capital – Depreciation and contract work costs
  - Intermediate inputs - Specific production costs and total farming overheads

Summary statistics, 2004-2013

Outputs/Inputs	France		Germany				UK (England)	
			West Germany		East Germany			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cereals, Euro of 2010	85,473	67,166	61,085	51,755	289,324	363,151	138,595	143,274
Other crops, Euro of 2010	68,178	123,536	50,490	69,745	236,297	369,153	110,243	272,768
Other farm output, Euro of 2010	41,314	57,595	60,120	73,692	346,840	782,844	92,079	157,591
Materials, Euro of 2010	111,144	72,166	112,981	87,124	583,443	921,227	209,965	281,286
Land, ha of UAA	**135**	80	**103**	63	**601**	681	**229**	211
Labor, Annual Work Unit	**2.1**	1.7	**1.8**	1.2	**8.6**	13.6	**2.8**	5.1
Capital, Euro of 2010	52,470	41,551	34,793	25,623	153,660	214,903	61,027	61,995

Outputs/Inputs	Czech Republic		Hungary		Poland	
Cereals, Euro of 2010	250,520	285,392	206,510	391,146	29,484	74,382
Other crops, Euro of 2010	262,999	319,390	111,842	216,103	29,657	149,976
Other farm output, Euro of 2010	400,460	567,084	117,757	348,206	16,518	46,593
Materials, Euro of 2010	733,540	841,231	282,106	566,908	48,240	136,388
Land, ha of UAA	**873**	859	**433**	662	**73**	167
Labor, Annual Work Unit	**13.7**	29.0	**8.7**	16.9	**2.4**	3.7
Capital, Euro of 2010	141,428	163,956	67,507	117,118	12,451	43,114

Results: Output and Input shadow shares

Old MSs, sample averages, 2004-2013

Output/Input	France	Germany		United Kingdom (England)
		West Germany	East Germany	
Cereals	0.36 (0.48)	0.29 (0.40)	0.35 (0.41)	0.45 (0.54)
Other crops	0.20 (0.27)	0.22 (0.31)	0.26 (0.30)	0.21 (0.26)
Other output	0.18 (0.24)	0.21 (0.29)	0.26 (0.30)	0.17 (0.20)
Materials	0.53	0.51	0.66	0.57
Land	0.11	0.13	0.07	0.17
Labour	0.21	0.25	0.12	0.16
Capital	0.15	0.10	0.16	0.10
Economies of scale	1.34	1.39	1.16	1.21

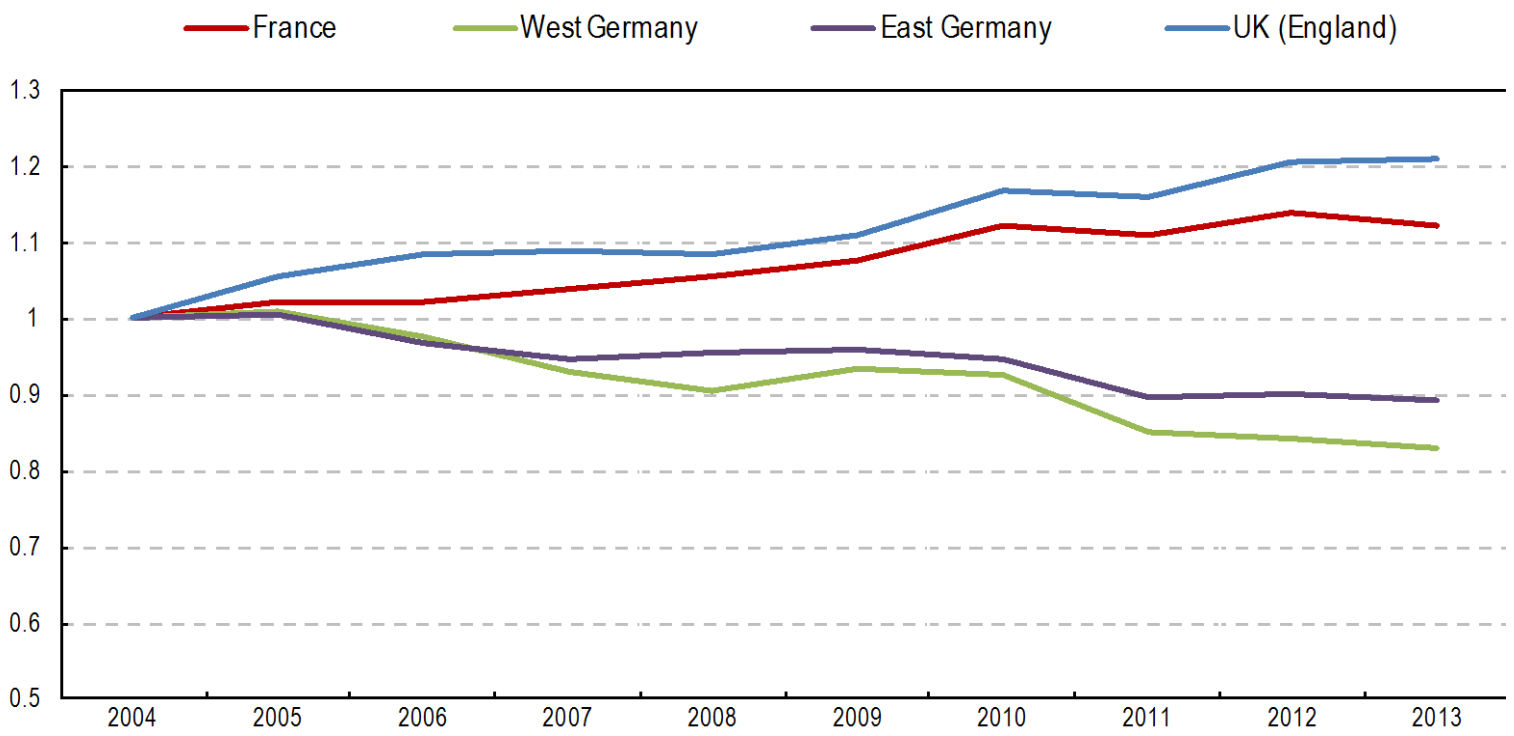
Output and Input shadow shares *cont.*

East-European MSs and East Germany, sample averages, 2004-2013

Output/Input	East Germany	Czech Republic	Hungary	Poland
Cereals	0.35 (0.41)	0.36 (0.38)	0.44 (0.49)	0.32 (0.46)
Other crops	0.26 (0.30)	0.32 (0.33)	0.26 (0.30)	0.21 (0.30)
Other output	0.26 (0.30)	0.28 (0.29)	0.20 (0.22)	0.16 (0.23)
Materials	0.66	0.71	0.56	0.50
Land	0.07	0.07	0.15	0.10
Labour	0.12	0.13	0.12	0.29
Capital	0.16	0.08	0.18	0.10
Economies of scale	1.16	1.04	1.11	1.45

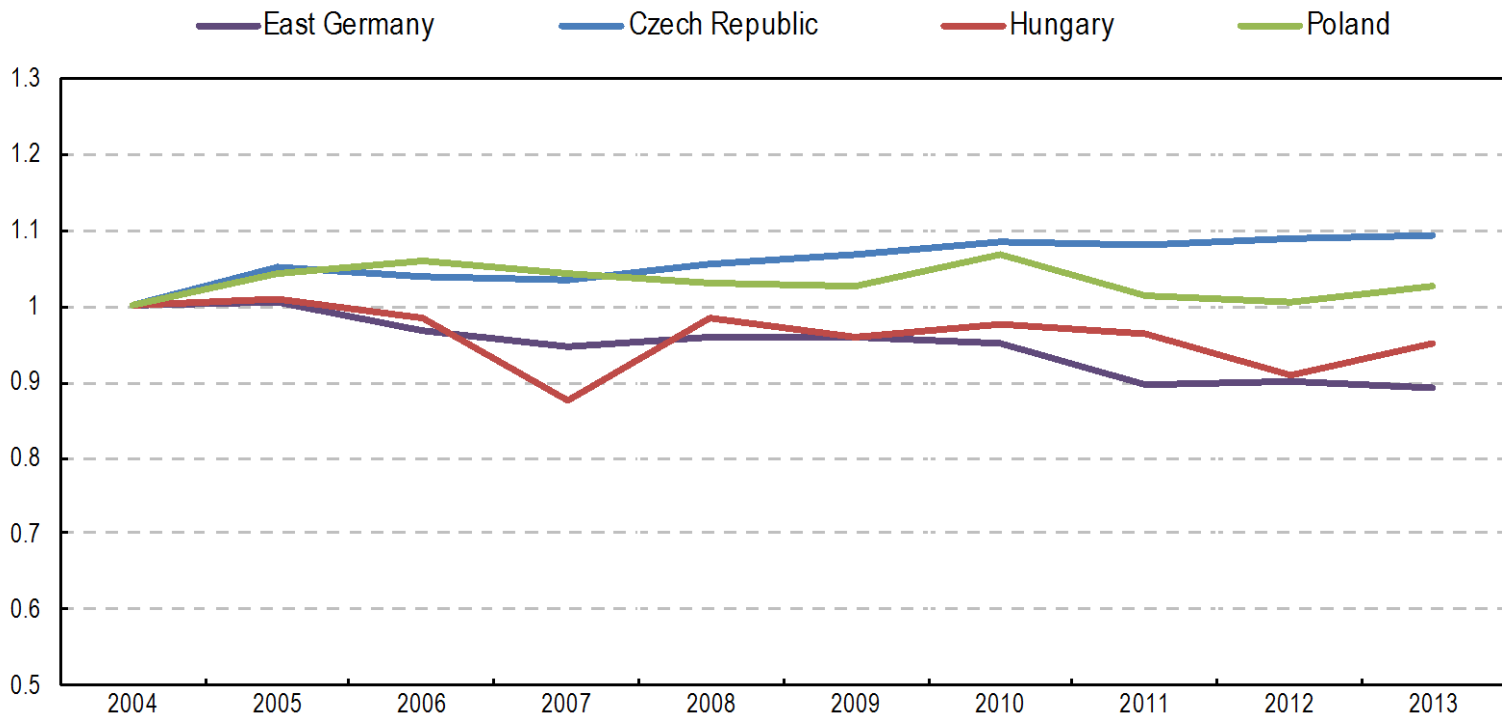
TFP trends

Old MSs, sample averages, 2005-2013 (2004=1)



TFP trends *cont.*

EE MSs, sample averages, 2005-2013 (2004=1)



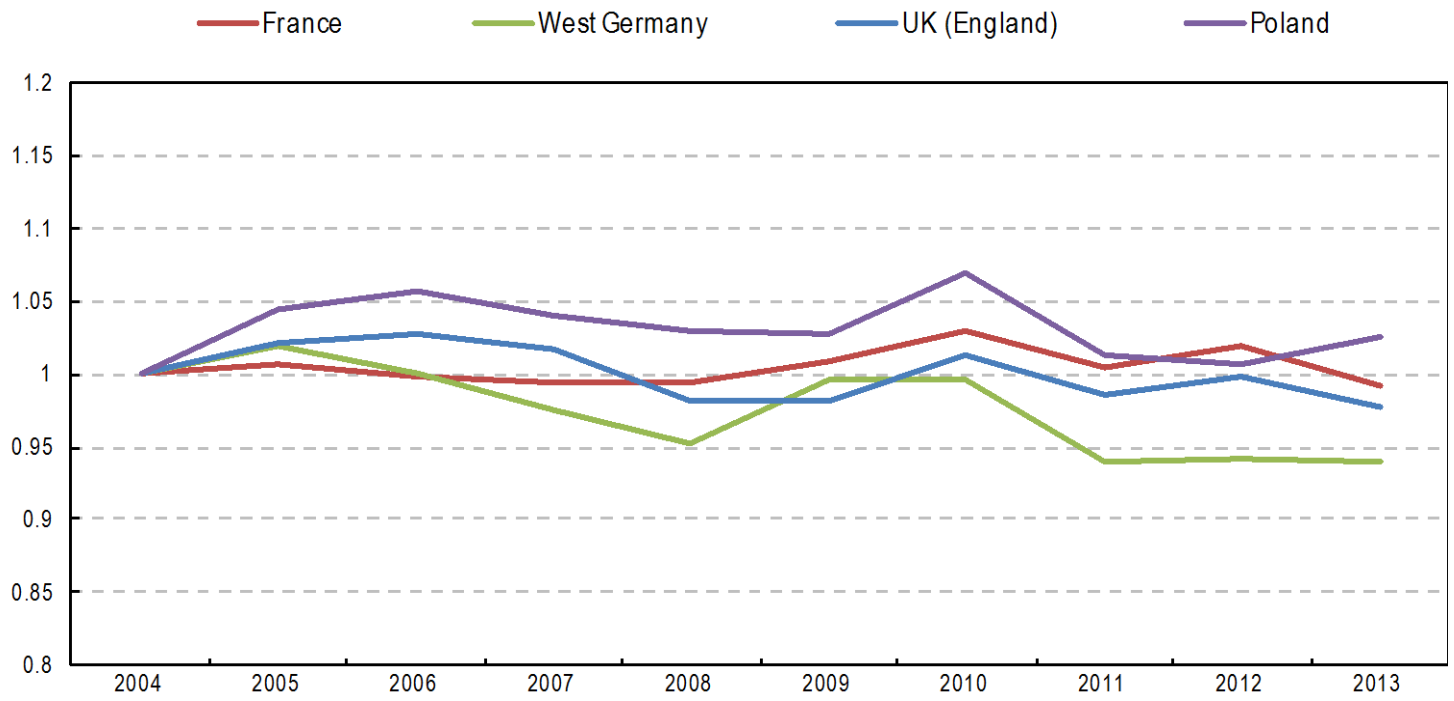
Sources of TFP growth

Average annual growth rates, 2005-2013

Country	TFP change	Technical change	Scale effect	Transient technical efficiency
France	0.013	0.012	-0.001	0.002
West Germany	-0.020	-0.012	-0.007	-0.002
East Germany	-0.012	-0.014	0.001	0.000
UK (England)	0.022	0.022	-0.002	0.002
Czech Republic	0.010	0.004	0.002	0.004
Hungary	-0.004	-0.002	-0.002	0.000
Poland	0.003	0.002	0.001	0.000

Scale effect

Sample averages, 2005-2013 (2004=1)



Drivers of TFP growth: **Preliminary results**

Old MSs, 2004-2013

Variable	France	West Germany	East Germany	United Kingdom
Utilised Agricultural Area (UAA), ha	0.0006 ***	0.0019 ***	0.0002 ***	0.0003 ***
Total subsidies per ha of UAA	-0.0001 ***	0.0000	-0.0001 **	0.0000
Farmer's age	0.0005	0.0001	--	0.0003
Farm organisational form	0.0660 ***	-0.0002	--	-0.0028
Paid labor share	-0.0001 **	0.0000	0.0000	0.0000
Rented land share	--	0.0002 **	0.0001	0.0004 ***
I/K ratio	0.0011	0.0108 ***	0.0158 ***	-0.0020 **
Contract work share	0.0013 ***	-0.0007 **	0.0003	0.0007 **
Crop prod. diversification	-0.0018	-0.0031 **	-0.0023 **	-0.0030 ***
Average share of LSTK production	-0.0004 **	0.0023 ***	0.0014 ***	-0.0004 **
Average share of other farm output	0.0005	0.0015 ***	0.0022 ***	-0.0005
Energy crop area share	-0.0001	0.0005 ***	0.0000	0.0000
Organic farming	-0.0221 *	-0.0400 **	0.0196	0.0078
LFA	-0.0510 ***	-0.0250 ***	-0.0289 ***	-0.1022 **
Constant	0.9015 ***	0.7150 ***	0.8029 ***	0.8965 ***
Number of observations	8703	5883	2653	1864

Drivers of TFP growth *cont.*

EE MSs, 2004-2013

Variable	East Germany	Czech Republic	Hungary	Poland
Utilised Agricultural Area (UAA), ha	0.0002 ***	0.0001 ***	0.0005 ***	0.0010 ***
Total subsidies per ha of UAA	-0.0001 **	-0.0001 *	-0.0001	-0.00005 ***
Paid labor share	0.0000	0.0000 ***	0.0000	0.0001 *
Rented land share	0.0001	--	0.0006	0.0013 ***
I/K ratio	0.0158 ***	-0.0138	0.0327 ***	0.1082 ***
Contract work share	0.0003	0.0000	0.0004	-0.0011 **
Crop prod. diversification	-0.0023 **	0.0012	-0.0005	-0.0044 ***
Average share of LSTK production	0.0014 ***	0.0007 ***	-0.0012 ***	-0.0012 ***
Average share of other farm output	0.0022 ***	0.0011 ***	0.0021 ***	-0.0002
Energy crop area share	0.0000	-0.0020 *	0.0001	-0.0008
Organic farming	0.0196	0.0058	0.0483	-0.0121
LFA	-0.0289 ***	-0.0012	-0.0093	-0.0233 **
Constant	0.8029 ***	0.9047 ***	0.8676 ***	0.9193 ***
Number of observations	2653	1194	2491	6554

Technical efficiency estimates

Sample averages, 2004-2013

	France	West Germany	East Germany	UK (England)	Czech Rep.	Hungary	Poland
Overall technical efficiency	0.89	0.88	0.88	0.88	0.86	0.75	0.88
Persistent technical efficiency	0.95	0.92	0.95	0.94	0.93	0.90	0.94
Transient technical efficiency	0.94	0.95	0.93	0.94	0.92	0.82	0.94

Main findings

- Different trends in TFP growth across study countries:
  - high rates in the UK (England), France and the Czech Republic
  - TFP was decreasing in Germany and Hungary
- Major source of TFP growth was technical change
- Scale effect played only a minor role and varied over time
- Larger farms appear to show higher TFP growth rates
- Subsidies were found to negatively affect farm TFP growth and to increase persistent inefficiencies

Questions, comments, suggestions?

Thank you!

Next steps

- TFP calculations – leapfrogging
- Measurement of economies of scope
- Cross-country comparison (meta-frontier)