



Productivity Growth and Convergence in European Agriculture

Masahiko Gemma

Waseda University, Tokyo, Japan

Mariusz Hamulczuk

Institute of Agricultural and Food Economics – NRI, Warsaw, Poland

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Motivation

- Productivity is an inevitable source of growth in agriculture.
- The impacts and roles of EU integration and CAP on agriculture can be better understood in relation to changes in production performance among European countries.
- The process of technical change among EU member countries can be also understood better as technology transfer generates convergence.



Objectives

- Highlight the development productivity in the EU agriculture (labor productivity and TFP)
- Quantify the unconditional convergence in productivity among the EU countries using different procedures
- Present briefly possible roles of the CAP in productivity growth in terms of convergence

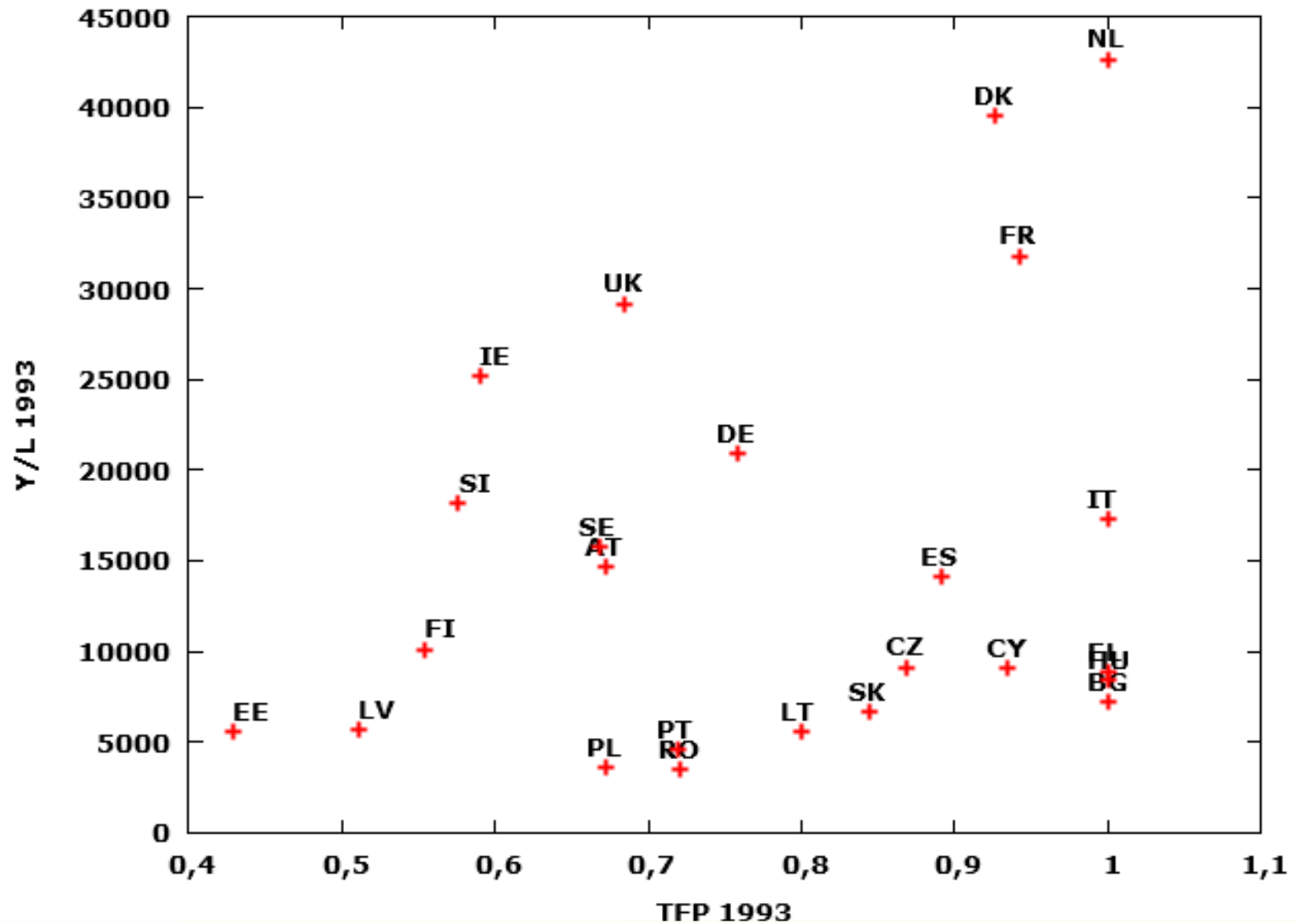


Productivity measuring methodology

- Labor productivity – Y/L (its importance in the context of ULC)
- TFP – Malmquist TFP indexes, based on nonparametric DEA contemporaneous frontier method, input oriented
- Data: 1993-2012 for 25 EU countries,
- National level aggregated data with five input variables (land, labor, fertilizer, machinery and livestock) one output (Net production value, 2004-2006 international USD adjusted for PPP differences)
- Source: FAOSTAT (FAO, 2014)



Y/L vs TFP frontier in 1993





Convergence measuring methodology

- **Beta convergence** – catch-up effect
Beta-convergence occurs when poor economies grow faster than rich ones (unconditional or conditional) - Solow (1956), Gerschenkron (1962), Barro, Sala-i-Martin (1992)

- Cross-sectional data

$$\ln\left(\frac{y_{i,t0+T}}{y_{i,t0}}\right) = a + b \ln(y_{i,t0}) + e_{i,t0+T} \quad \beta = -\ln(1 + b) / T$$

- Panel data (fixed effect model)

$$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = a + b \ln(y_{i,t-1}) + \eta_i + \nu_t + e_{i,t} \quad \beta = -\ln(1 + b)$$



Convergence measuring methodology

- **Sigma convergence** – narrowing dispersion of the cross-sectional distribution of a given indicator (and growth rate) over the time
Quach (1995), Sala-i-Martin (1995)
- cross-sectional data

$$Se_t = \sqrt{\frac{\sum_{i=1}^N (\ln(y_{i,t}) - \ln(\bar{y}_t))^2}{(N-1)}}$$

$$Se_t = a + b \cdot t + e_t$$



Convergence measuring methodology

- **Stochastic convergence** - examining for common long-run trends; Bernard, Durlauf (1996)
 - Variable (ratio of productivity $A_{i,t} / A_{m,t}$)

$$\ln\left(\frac{A_{i,t}}{A_{m,t}}\right) = (\gamma_i + \gamma_m) + (1 + \lambda) \ln\left(\frac{A_{i,t-1}}{A_{m,t-1}}\right) + e_{i,t}$$

and assuming: $\ln\left(\frac{A_{i,t}}{A_{m,t}}\right) = y_t$

- Levin and Lin (LL) panel unit root test; H0: unit root

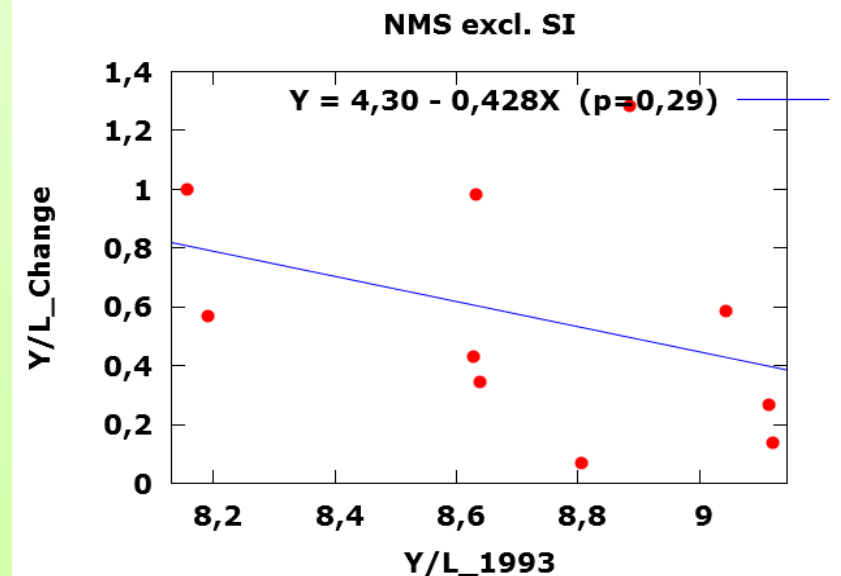
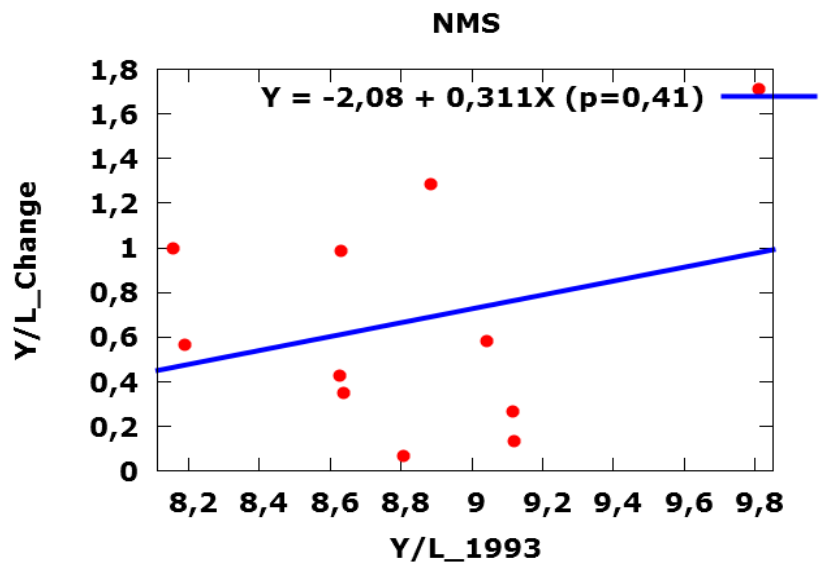
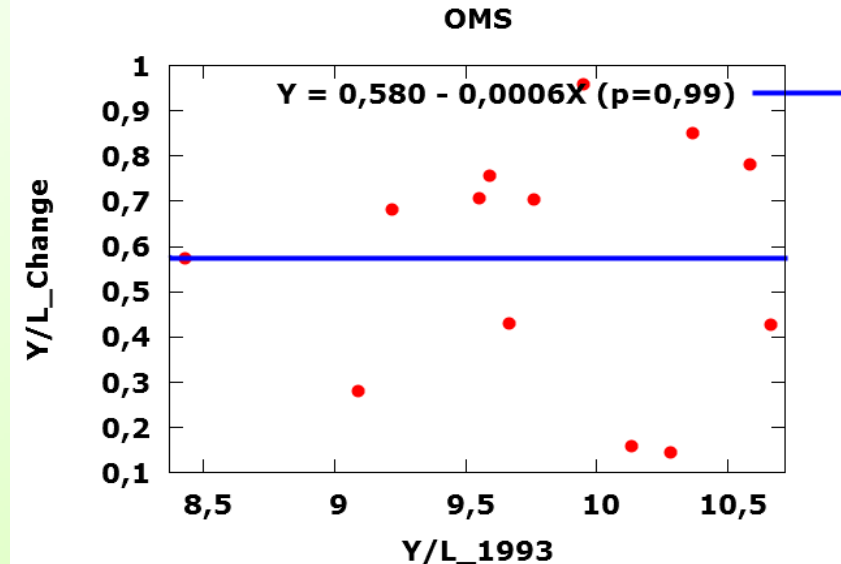
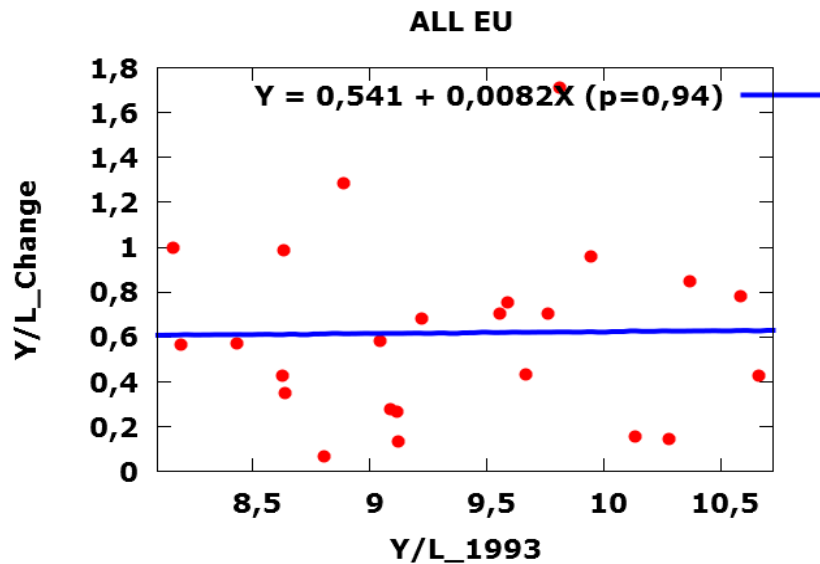
Test Name	Model	Hypothesis
LL_1	$\Delta y_{it} = \rho y_{i,t-1} + e_{it}$	$H_0: \rho = 0; H_1: \rho < 0$
LL_2	$\Delta y_{it} = \rho y_{i,t-1} + \delta_0 + e_{it}$	$H_0: \rho = \delta_0 = 0; H_1: \rho < 0$
LL_3	$\Delta y_{it} = \rho y_{i,t-1} + \delta_0 + \delta_i t + e_{it}$	$H_0: \rho = \delta_i = 0; H_1: \rho < 0; \delta_i \in R \text{ for all } i$



RESULTS: BETA CONVERGENCE TESTING



Labor productivity - beta convergence (cross-sectional framework)



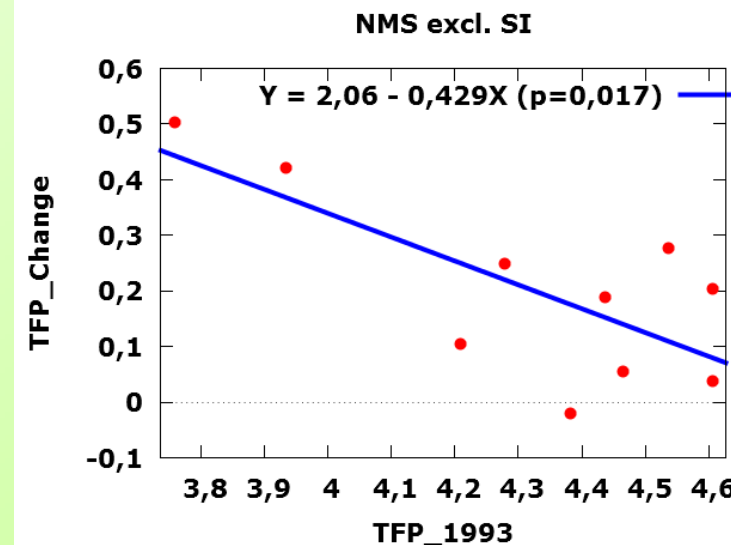
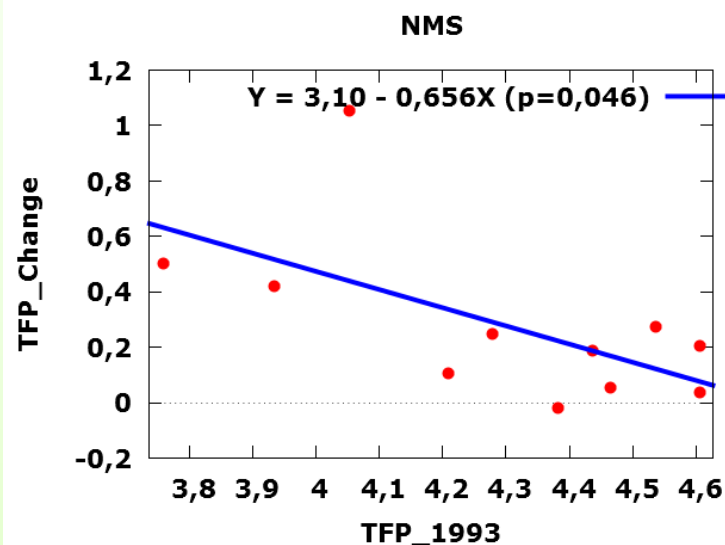
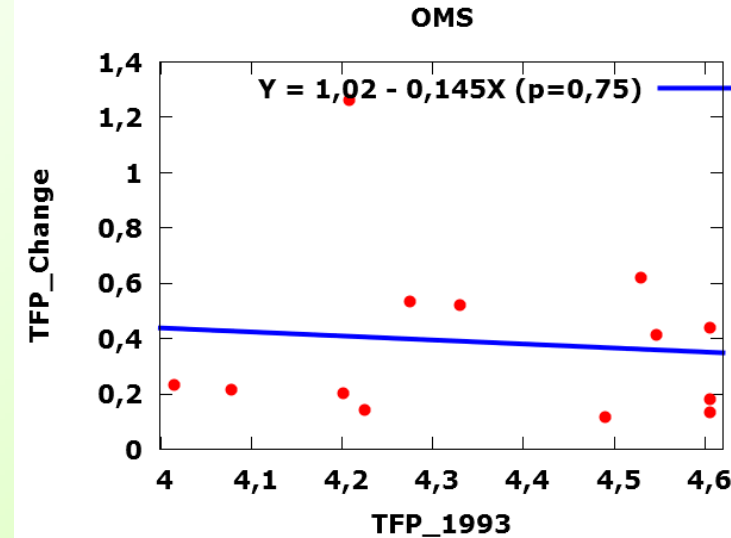
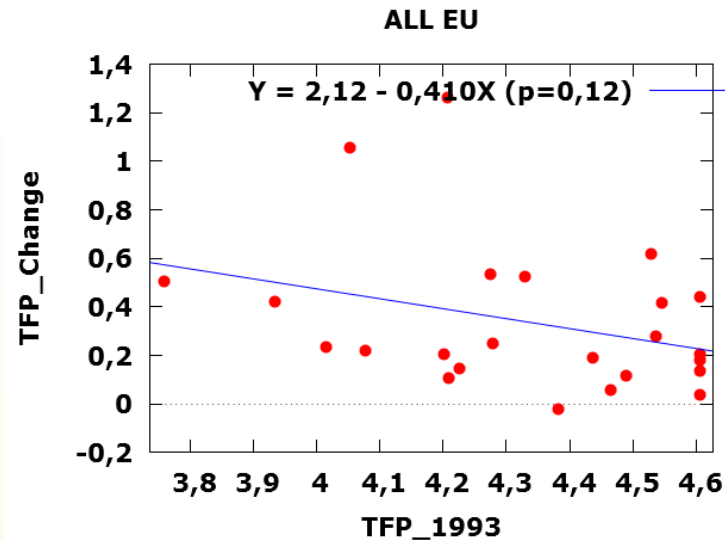


Labor productivity - beta convergence (panel data framework)

Country	Variable: lagged productivity	Coefficient	Se	t-Student	p - value	beta
ALL	Y/L_1	-0,089	0,015	-5,999	0,0000	0,093
NMS	Y/L_1	-0,092	0,020	-4,571	0,0000	0,097
OMS	Y/L_1	-0,116	0,018	-6,471	0,0000	0,124



TFP - beta convergence (cross-sectional framework)





TFP - beta convergence (panel data framework)

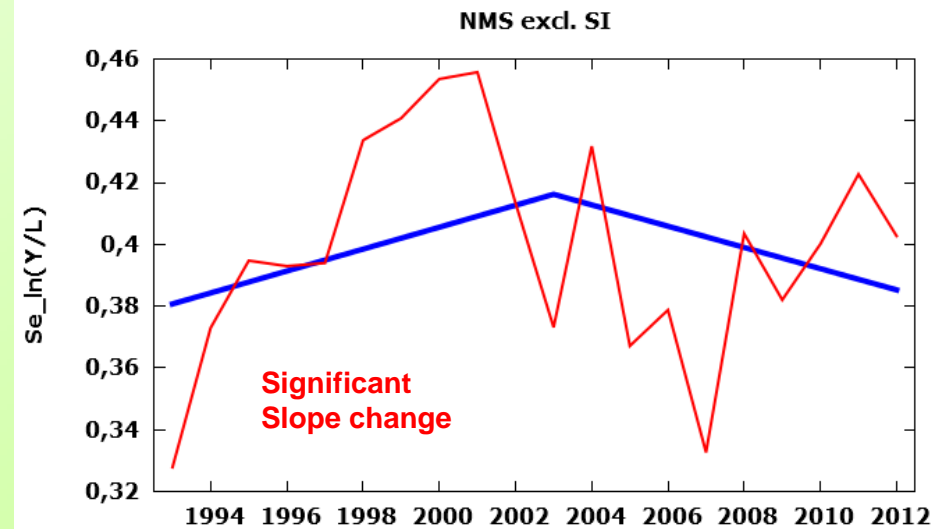
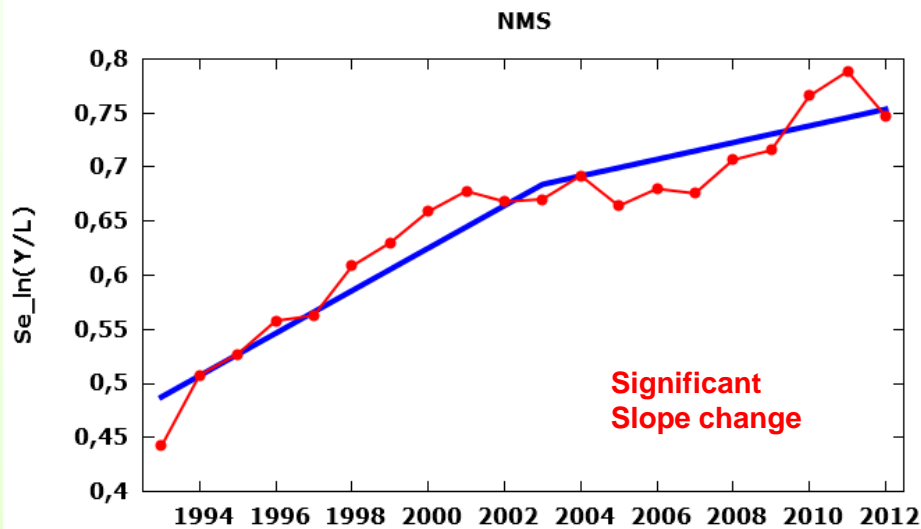
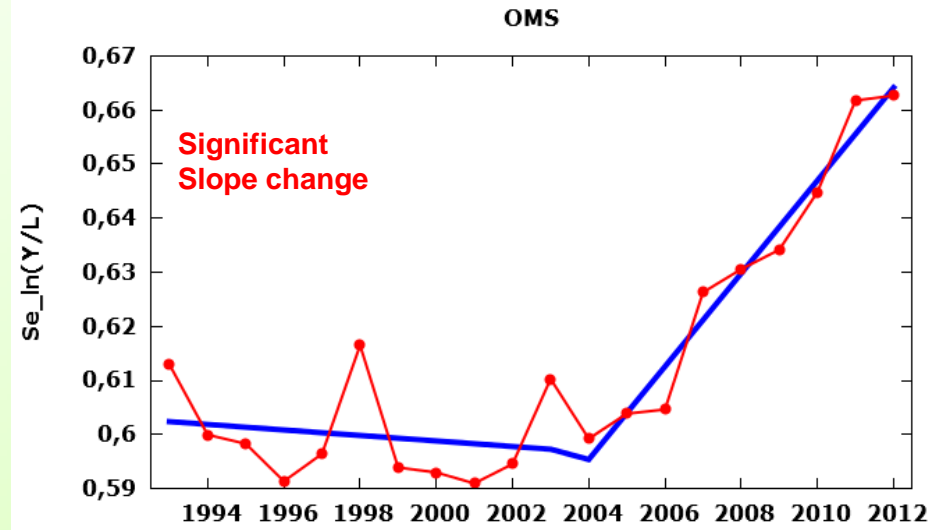
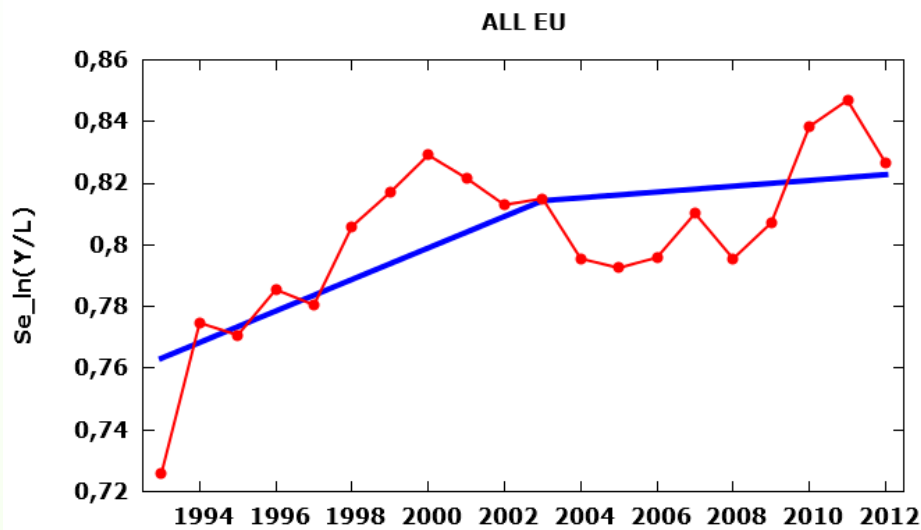
Country	Variable: lagged productivity	Coefficient	Se	t-Student	p- value	beta
ALL	TFP_1	-0,2257	0,0488	-4,6220	0,0000	0,2557
NMS	TFP_1	-0,3484	0,0656	-5,3080	0,0000	0,4283
OMS	TFP_1	-0,0454	0,0477	-0,9534	0,3415	0,0465



RESULTS: SIGMA CONVERGENCE TESTING

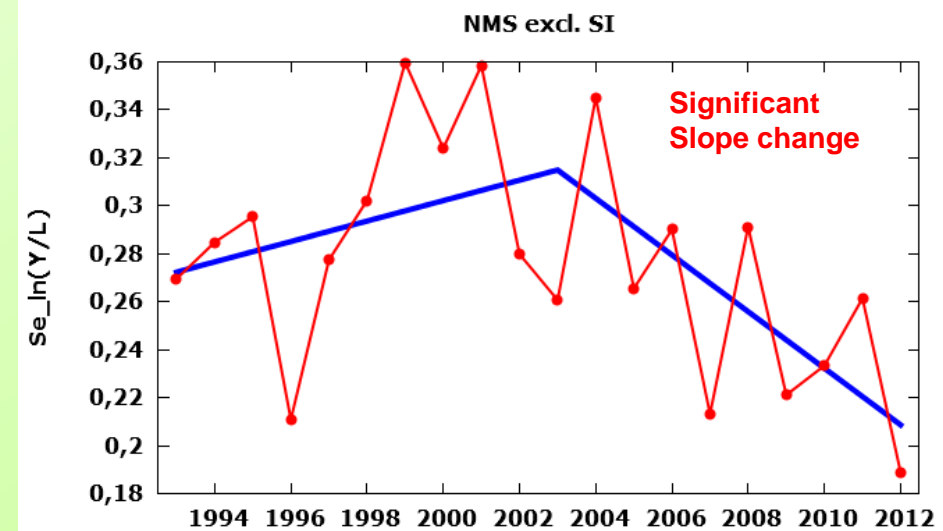
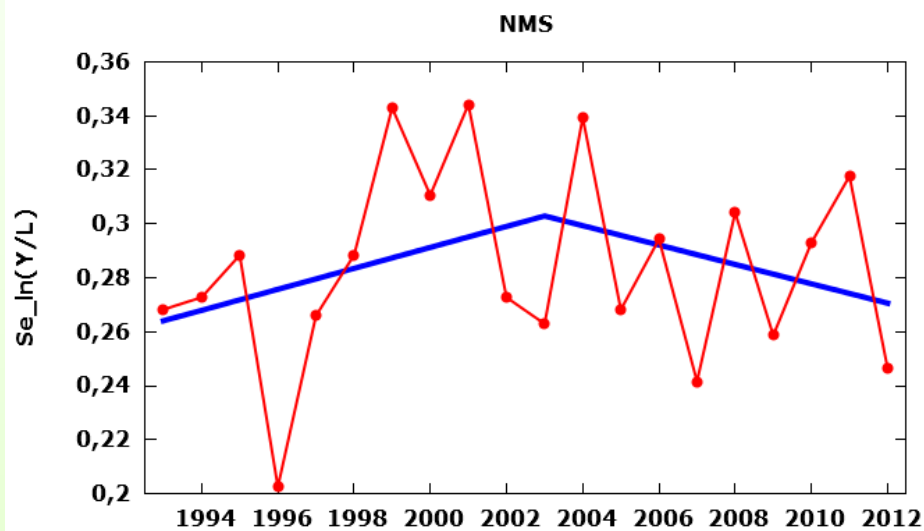
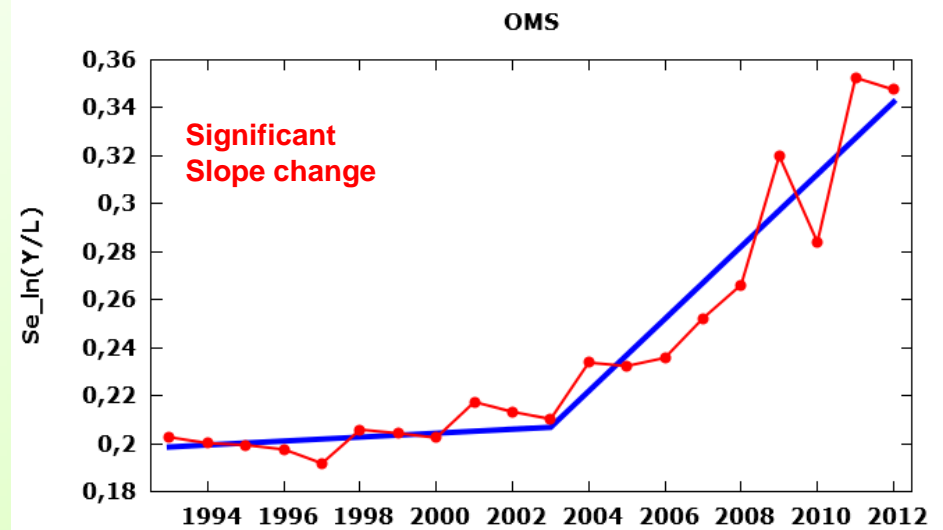
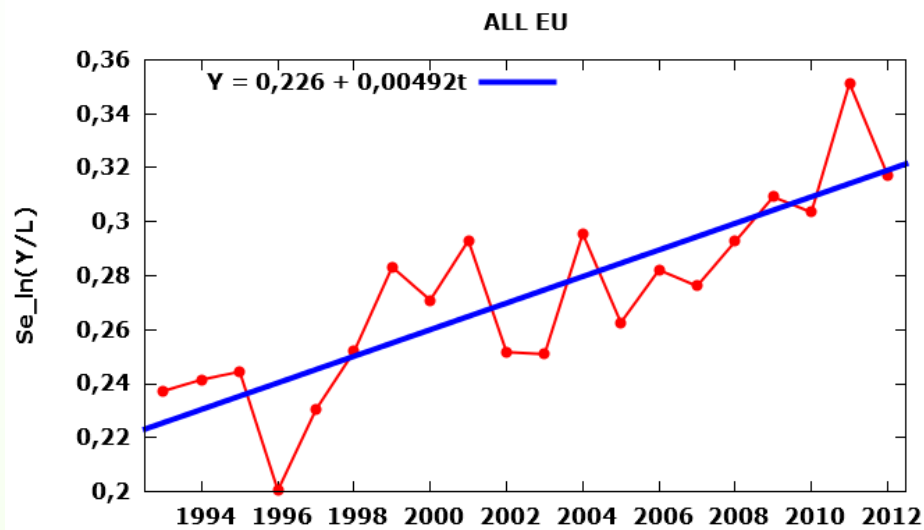


Labor productivity – sigma convergence





TFP - sigma convergence





RESULTS: STOCHASTIC CONVERGENCE TESTING



Labor productivity – stochastic convergence

Panel UNIT ROOT results					
Countries	Model	coeff	t-Student	Z- score	p-value
ALL	no const	0,00355	1,459	1,38618	[0,9172]
ALL	const	-0,09286	-4,591	-0,78539	[0,2161]
ALL	const, trend	-0,57169	-12,301	-2,88229	[0,0020]
NMS	no const	0,01222	1,412	1,33793	[0,9095]
NMS	const	-0,09073	-2,983	-0,35796	[0,3602]
NMS	const, trend	-0,57171	-8,455	-2,20432	[0,0138]
OMS	no const	0,01024	2,52	2,39803	[0,9918]
OMS	const	-0,07971	-3,173	-1,15602	[0,1238]
OMS	const, trend	-0,539	-8,431	-2,79222	[0,0026]



TFP stochastic convergence

Panel UNIT ROOT results					
Countries	Model	coeff	t-Student	Z- score	p-value
ALL	no const	0,015147	1,411	1,33052	[0,9083]
ALL	const	-0,15683	-4,69	0,219573	[0,5869]
ALL	const, trend	-0,75998	-13,482	-2,89985	[0,0019]
NMS	no const	-0,0363	-1,528	-1,47057	[0,0707]
NMS	const	-0,23432	-4,52	-1,06883	[0,1426]
NMS	const, trend	-0,87391	-11,279	-3,25299	[0,0006]
OMS	no const	0,028644	2,482	2,35718	[0,9908]
OMS	const	-0,10008	-2,279	1,44709	[0,9261]
OMS	const, trend	-0,60718	-8,142	-1,01036	[0,1562]



Conclusions

- Labor productivity and TFP are relatively weakly correlated
- Cross-sectional framework generally do not support beta convergence in Y/L and TFP in the EU (apart from TFP in OMS) – short sample
- On the other side panel data approach generally indicate the existence of a statistically significant convergence among EU countries (not TFP in OMS)
- There is no sigma convergence across EU countries,
- Stochastic convergence – only panel unit root test with trend support convergence hypothesis in TFP and Y/L : catching-up effect



Conclusions

- Policy – there is some evidence the policy may influence convergence or divergence in productivity
- Result of convergence testing are very sensitive to outstanding data and methodology applied
- Next:
 - Productivity measuring – window or sequential frontier
 - Cluster analysis and cointegration analysis
 - Heterogeneity and other panel data methods
 - Conditional convergence testing.



Thank you for your attention
Dziękujemy za uwagę