Convergence in Agricultural Productivity in the EU

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SEVENTH FRAMEWORK PROGRAMME

Background & Motivation

- Treaty of Rome: two of the main objectives of the CAP are:
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  - agricultural productivity $\rightarrow$ Total Factor Productivity (TFP)
  - fair standard of living $\rightarrow$ farm income/labor productivity
- Common market and convergence in productivity:
  - "*the main reason for divergent trends in cost competitiveness across countries is differences in productivity growth rates*"
  - Divergent productivity can lead to imbalances in farm income, trade and development

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Objectives

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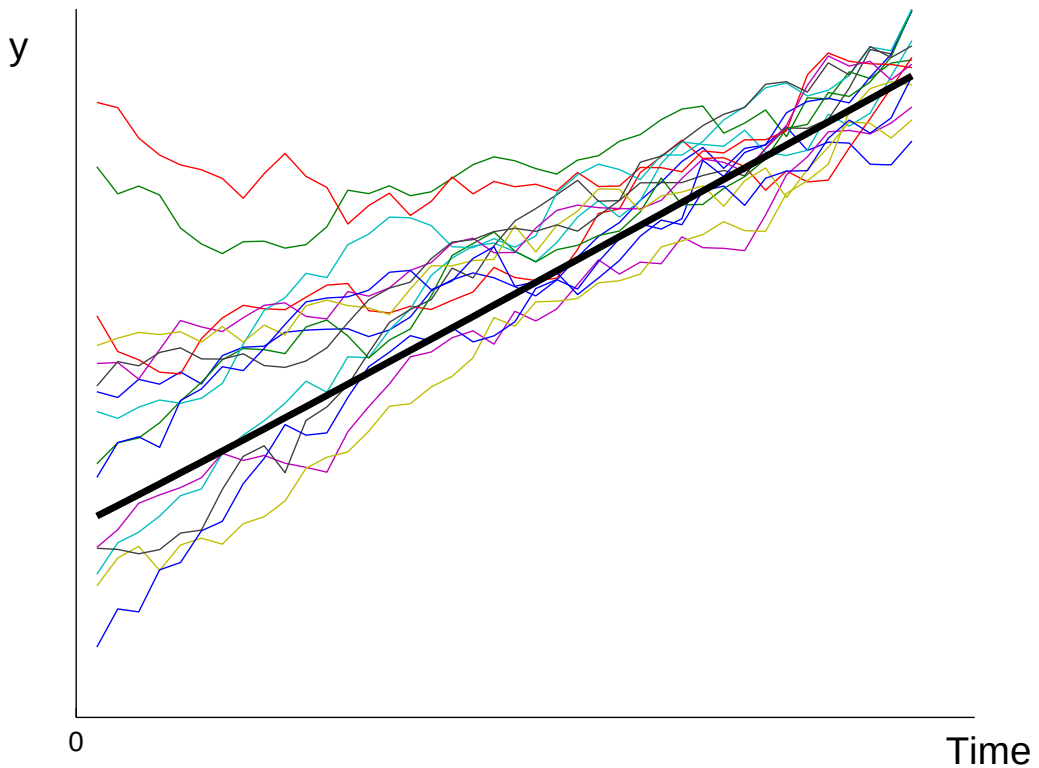
Objective:
Examine whether farm income (labor productivity) and Total Factor Productivity (TFP) converge across:

- countries
- FADN regions

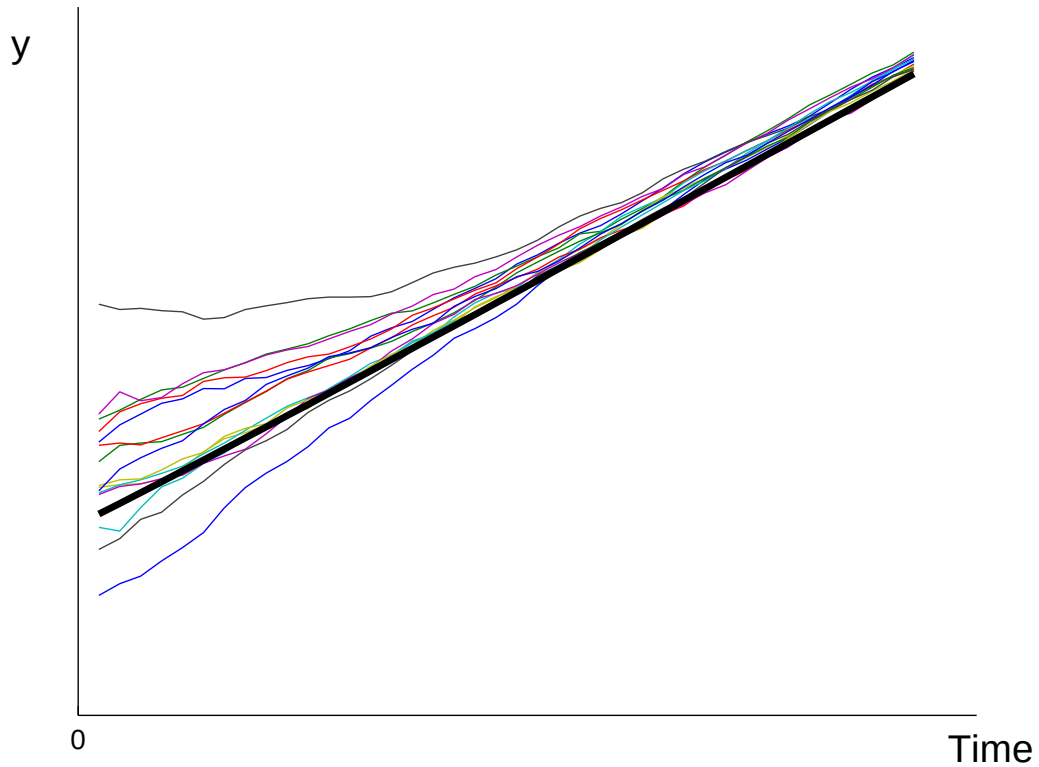
β-Convergence

- β-convergence implies that all units (countries or regions) are expected to reach the same steady state
- in the model: $y_{it} = \delta + \rho y_{i,t-1} + \gamma t + \varepsilon_{it}$,
  $\rho < 1$ implies β-convergence in y
  $\Rightarrow \mathrm{E}(y_t) = \left[\frac{\delta}{1-\rho} - \frac{\gamma\rho}{(1-\rho)^2}\right] + \left[\frac{\gamma}{1-\rho}\right] t$



σ-Convergence

- σ-convergence implies that differences across units (countries or regions) shrink over time
- if $\sigma^2(t)$ is the variance of y_{it} across units at time t, $\frac{\mathrm{d}\sigma^2(t)}{\mathrm{d}t} < 0$ implies σ-convergence in y



β-Convergence Model

- y is the variable of interest (labor productivity or TFP)
- i indexes units (countries or regions)
- t indexes time

β-convergence:

$$y_{it} = \delta + \rho y_{i,t-1} + \gamma t + \varepsilon_{it}, \qquad \varepsilon_{it} \sim \mathrm{N}\left(0, \sigma^2\right)$$

- $\rho < 1 \quad \rightarrow \quad \beta$-convergence
- $\rho = 1 \quad \rightarrow \quad$ no tendency for change
- $\rho > 1 \quad \rightarrow \quad \beta$-divergence

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σ-convergence:

$$y_{it} = \delta + \rho y_{i,t-1} + \gamma t + \varepsilon_{it}, \qquad \varepsilon_{it} \sim \mathrm{N}\left(0, \sigma_t^2\right)$$
$$\log \sigma_t^2 = -\zeta - \eta \cdot t$$

- $\eta > 0 \quad \rightarrow \quad \sigma$-convergence
- $\eta = 0 \quad \rightarrow \quad$ no tendency for change
- $\eta < 0 \quad \rightarrow \quad \sigma$-divergence

Estimation and Model Comparison

- Hypotheses can be (partly) tested using unit-root tests (strong assumptions & data requirements)

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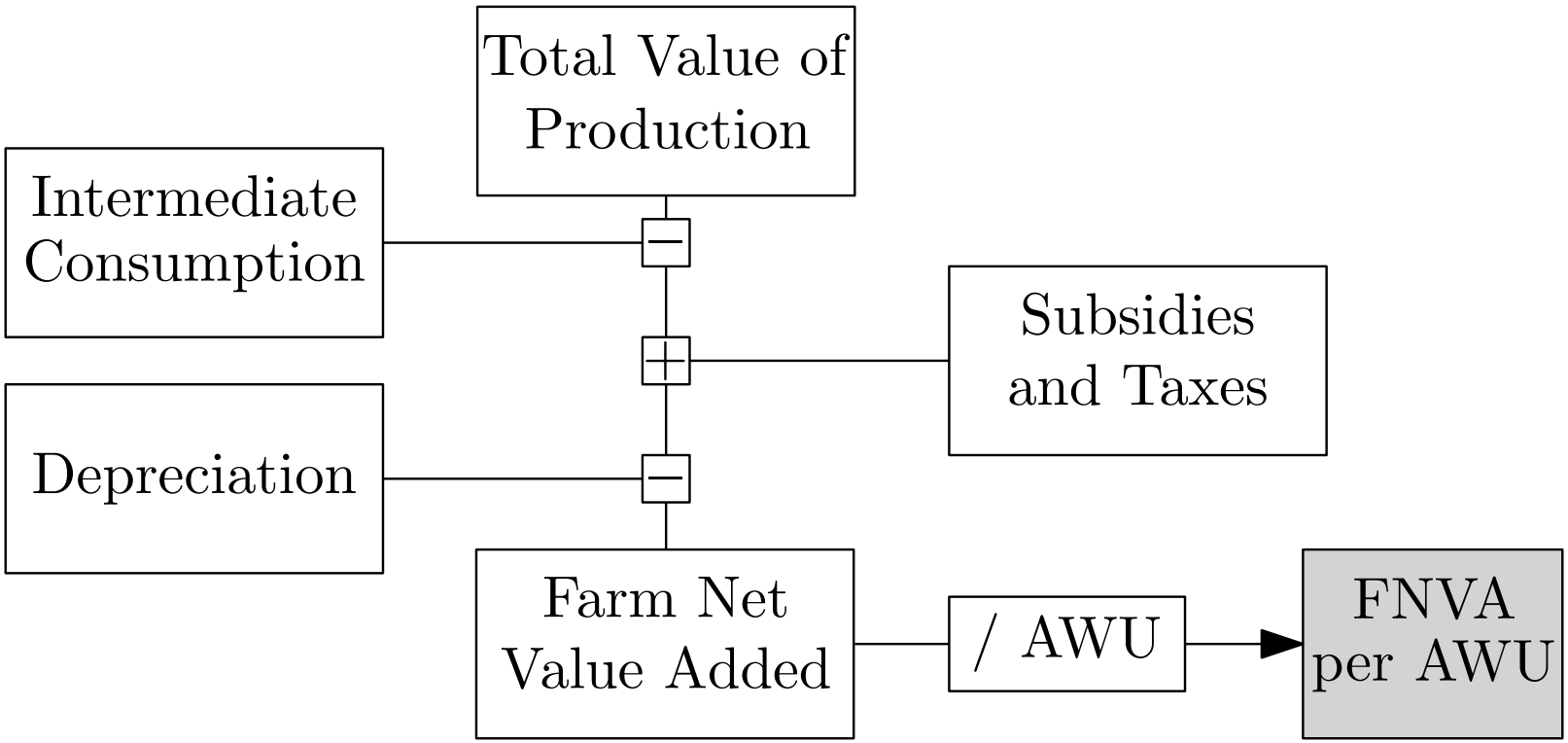
- Perform estimation in a Bayesian setting:
  - estimate three models per hypothesis
  - each model imposes restrictions on the parameters (ρ and η)
  - models are compared based on the posterior odds ratio:

$$\frac{\mathrm{Prob}\left(\mathscr{M}_1|\mathcal{D}\right)}{\mathrm{Prob}\left(\mathscr{M}_2|\mathcal{D}\right)} = \frac{\mathrm{p}\left(\mathcal{D}|\mathscr{M}_1\right)}{\mathrm{p}\left(\mathcal{D}|\mathscr{M}_2\right)} \cdot \frac{\mathrm{Prob}\left(\mathscr{M}_1\right)}{\mathrm{Prob}\left(\mathscr{M}_2\right)}$$

Definition of Variables

Labor productivity: Farm Net Value Added (FNVA) per Annual Working Unit (AWU)



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- Multiple methods to calculate TFP growth rates
- But we need TFP levels to test for convergence
- Use a transitive Törnqvist productivity index:
  - production process with N inputs and M outputs

$$\log \mathrm{TFP}_{i,j} =$$
$$\frac{1}{2}\left[\sum_{m=1}^{M}\left(r_{m,i}+\bar{r}_m\right)\left(\log q_{m,i}-\overline{\log q}_m\right)-\sum_{m=1}^{M}\left(r_{m,j}+\bar{r}_m\right)\left(\log q_{m,j}-\overline{\log q}_m\right)\right]$$
$$-\frac{1}{2}\left[\sum_{n=1}^{N}\left(s_{n,i}+\bar{s}_n\right)\left(\log x_{n,i}-\overline{\log x}_n\right)-\sum_{n=1}^{N}\left(s_{n,i}+\bar{s}_n\right)\left(\log x_{n,i}-\overline{\log x}_n\right)\right]$$

Data & Data Transformations

- Farm-level data from FADN
  - Period covered: 1995 to 2008
  - Analysis using data for EU15 and EU25

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- TFP:
  - Two outputs and four inputs (K L M and land)
  - Deflate monetary values by country-level price indexes
  - Construct transitive Fisher indexes for monetary values
  - Calculate opportunity costs for fixed inputs

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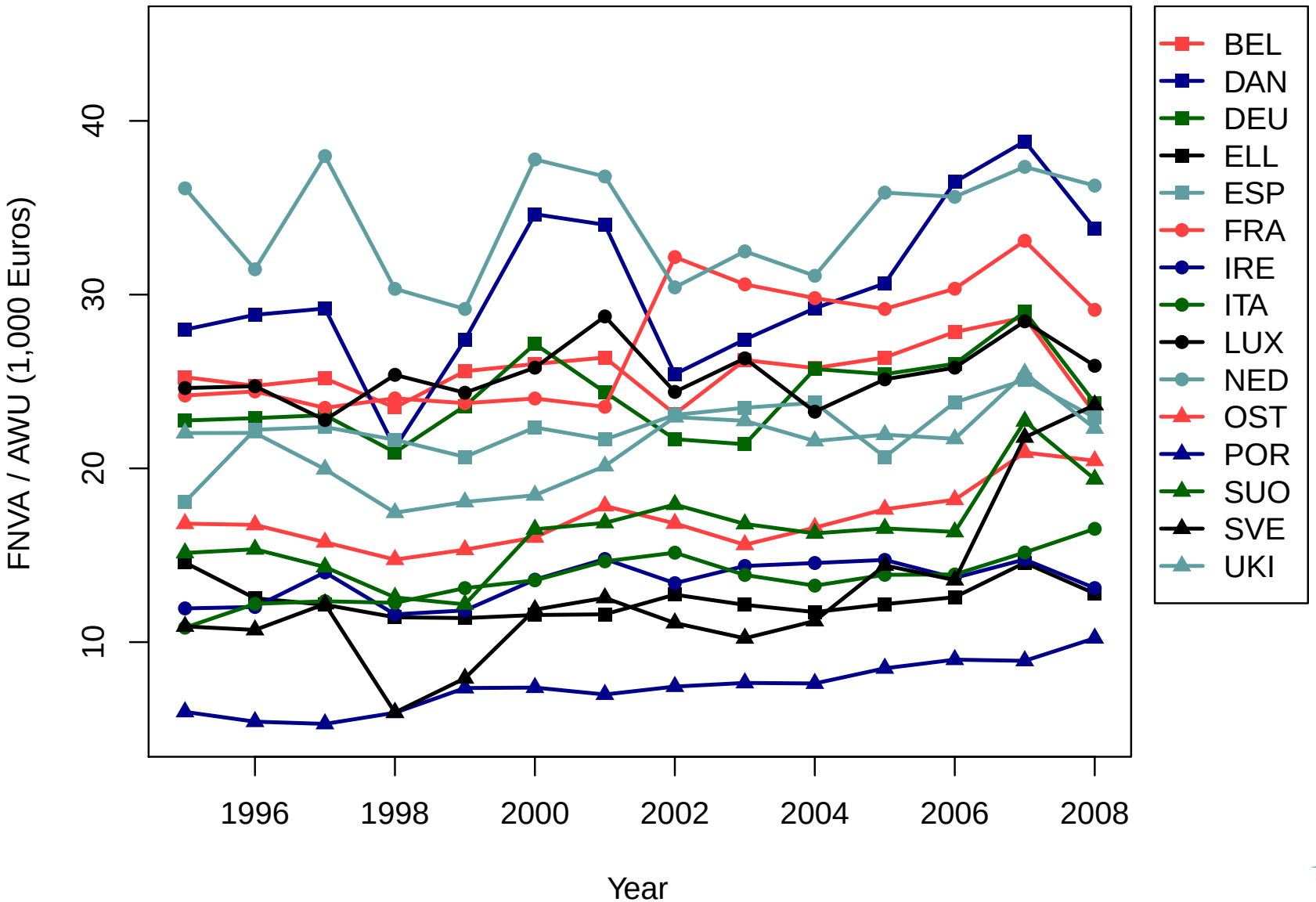
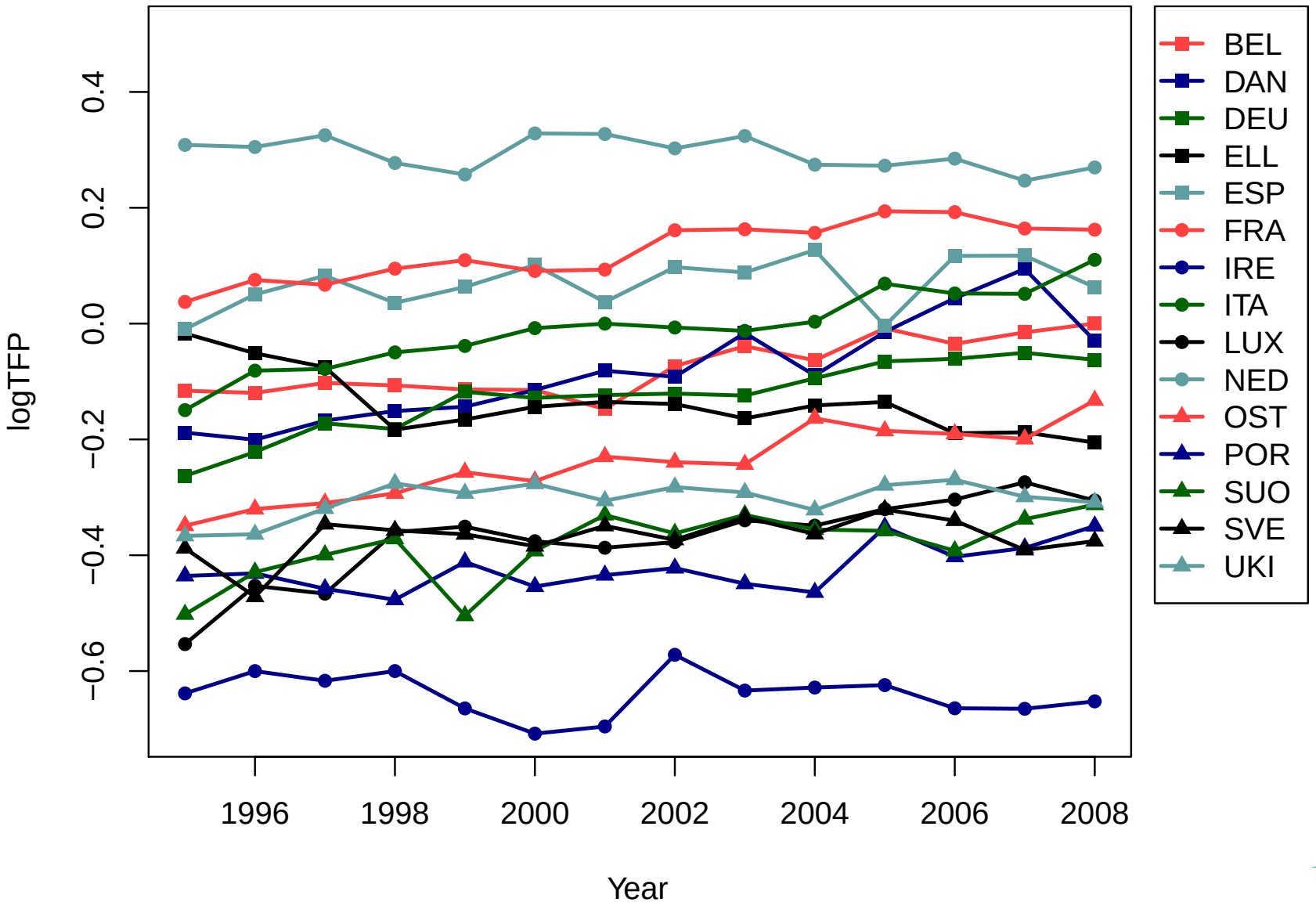
FNVA per AWU – EU 15



log TFP – EU 15



Convergence at the Country Level

		FNVA per AWU		
		convergence	non-convergence	divergence
EU15	β	0.822	0.177	0.002
	σ	0.119	0.650	0.231
EU25	β	0.934	0.065	0.001
	σ	0.016	0.204	0.780

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		logTFP		
		convergence	non-convergence	divergence
EU15	β	0.092	0.902	0.005
	σ	–	–	–
EU25	β	0.088	0.908	0.004
	σ	–	–	–

Convergence at the Regional Level

		FNVA per AWU		
		convergence	non-convergence	divergence
EU15	β	1.000	0.000	0.000
	σ	0.000	0.000	1.000
EU25	β	1.000	0.000	0.000
	σ	0.000	0.000	1.000

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EU25	β	1.000	0.000	0.000
	σ	0.000	0.000	1.000

		logTFP		
		convergence	non-convergence	divergence
EU15	β	1.000	0.000	0.000
	σ	0.869	0.127	0.004
EU25	β	1.000	0.000	0.000
	σ	0.992	0.008	0.000

Summary & Conclusions

- Country level:
  - no tendency for β-divergence in either EU15 or EU25
  - some evidence of σ-divergence in EU25
  - higher persistence in TFP than labor productivity

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- Regional level:
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  - higher persistence in TFP than labor productivity
- Regional level:
  - β-convergence and σ-divergence in labor productivity
  - β- and σ-convergence in TFP
- Economic integration and policy interventions do lead to convergence in productivity when targeting specific regions

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