

Real Convergence In The New Member States: Myth or Reality?

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Outline

- 1 Motivation
 - Research objectives
 - Background literature
- 2 Contribution
 - Main Results
 - Future Directions

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Research question.

- "Will countries with different starting levels of GDP per capita converge in the long run? "
- In the specific case: "Were new members converging during the enlargement process?"

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The EU enlargement.

- **Countries** under investigation (EU8): Estonia (EE), Lithuania (LT), Latvia (LV), Czech Republic (CZ), Slovakia (SK), Poland (PL), Hungary (HU), Slovenia (SL).
- **Data:** Eurostat New Chronos and Statistical Annex to the EU economy, GDP per capita PPS and Euros at 1995,2000 constant prices, annual or quarterly frequencies.

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Theoretical Background.

- **Economic theory:** Neoclassical model [10, 11] with a standard Cobb-Douglas production function (CES function, neutral technological progress),

$$Y_t = A_t \Delta (K_t^\alpha \Delta L_t^\beta), \quad \alpha, \beta \in (0, 1), \quad \alpha + \beta = 1 \quad (1)$$

where the process towards the steady state can be described as:

$$\frac{\dot{k}}{k} = sk^\alpha - (n + \omega + \delta)$$

with k - capital per unit of labour, n - growth rate of population, ω - rate of exogenous technical progress, δ - rate of capital depreciation and s - saving rate, *dot* means increase of given variable.

- **Empirical investigations:** Beta / sigma and time-series

Empirical convergence.

I. Beta convergence

The standard [1] regression:

$$T^{-1} \ln \left(\frac{Y_{T,i}}{Y_{0,i}} \right) = \alpha + \beta \ln(Y_{0,i}) + \varepsilon_{T,i} \quad (2)$$

from which $\beta_S = \frac{1-e^{-\beta T}}{T}$ (speed of convergence), is estimated in the alternative form¹ (e.g. [9]):

$$\frac{\dot{y}}{y} = \beta [\ln(y^*) - \ln(y)]$$

¹ a Taylor expansion of (1) in $\ln y$ about steady state y^* , assuming balanced growth equilibrium: $\dot{k}/k = \dot{y}/y$

Empirical convergence.

I. Sigma convergence

Given a set of N countries, we call σ_t^2 the variance of GDP per capita of the aggregate at time t :

$$\sigma_t^2 = N^{-1} \sum_{i=1}^N [\ln(y_{i,t}) - \bar{y}_t]^2$$

where $i \in [1, N]$, $t \in [1, T]$ and $\bar{y}_t = N^{-1} \sum_{i=1}^N \ln(y_{i,t})$.
Sigma-convergence occurs when: $\sigma_{t+n}^2 < \sigma_t^2$ with $n > 0$.

Empirical convergence.

II. Unit-roots and Cointegration - Fixed u.r.

According to [3] when the process:

$$g_t = \rho g_{t-1} + \varepsilon_t$$

where $g_t = \ln(y_{i,t}) - \ln(y_{j,t})$, has a unit root ($\rho = 1$), it is a non-stationary random walk and it should be interpreted as output divergence between countries i and j .

More generally, for $i = 1, 2, \dots, N$, consider the (unrestricted) VAR of order p :¹

$$\Delta y_t = \Pi y_{t-1} + \sum_{j=1}^{p-1} \Gamma_j \Delta y_{t-j} + Bx_t + \varepsilon_t$$

[2] conclude for convergence when $r(\Pi) = \tau = N - 1$.

[4] and [7, 6] are used for testing the two conditions.

Empirical convergence.

II. Unit-roots and Cointegration - Stochastic u.r.

Given the process ([5]):

$$g_t = a_t g_{t-1} + \varepsilon_t$$

where a_t is a stationary series such as $a_t \sim iid(1, w^2)$ and $\varepsilon_t \sim iid(0, \sigma^2)$. The null is set to the pure unit-root ($H_0 : w^2 = 0$), the alternative to the STUR ($H_1 : w^2 > 0$) and the test statistic is calculated [8] as :

$$\hat{Z}_T = \frac{\sum_{t=q+3}^T \left[\left(\sum_{p=q+2}^{t-1} \hat{\varepsilon}_p \right)^2 \left(\hat{\varepsilon}_t - \hat{\sigma}^2 \right) \right]}{\hat{k} \hat{\sigma}^2 \sqrt{T^3}}$$

where: $\hat{\varepsilon}_t = \Delta x_t - \hat{\alpha} - \hat{\gamma}t - \sum_{n=1}^q \hat{\beta}_n \Delta x_{t-n}$, $\hat{\sigma}^2 = T^{-1} \sum_{t=1}^T \hat{\varepsilon}_t^2$
and $k^2 = T^{-1} \sum_{t=1}^T \left(\hat{\varepsilon}_t - \hat{\sigma}^2 \right)$.

Empirical convergence

III. Hypothesis summary

Positive evidence of convergence is found when:

- 1 **Beta** convergence: $\beta < 0$.
- 2 **Sigma** convergence²: $\sigma_t < \sigma_{t-1}$.
- 3 **Fixed unit roots** (ADF): reject a unit root ($\rho = 1$). [3]
- 4 **Cointegration**: $N - 1$ cointegrating relations among N countries. [2]
- 5 **Stochastic unit-roots** (STUR): reject a pure unit-root ($w^2 = 0$) against a stochastic root. [12]

²Galton's fallacy: $\sigma_t < \sigma_{t-1} \Rightarrow \beta < 0$ but $\beta < 0 \not\Rightarrow \sigma_t < \sigma_{t-1}$

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Beta and Sigma Convergence.

Beta convergence

Fig. I - Euros

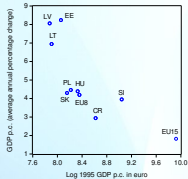
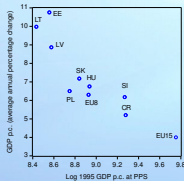


Fig. II - PPS



EU8	β (pps)	β (eur)	β_S (pps)	β_S (eur)	conv.?
1995-06	-0.046 (-0.0107)	-0.0331 (-0.0124)	4.11	2.28	yes
1995-00	-0.038 (-0.109)	-0.02 (-0.0123)	3.43	1.89	yes
2001-06	-0.0493 (-0.0163)	-0.0373 (-0.0182)	4.32	3.36	yes
Two Regions (EU8+EU15)					
1995-06	-0.0024 (...)	-0.0967 (...)	2.27	6.04	yes
1995-00	-0.0142 (...)	-0.057 (...)	1.37	4.9	yes
2001-06	-0.0421	-0.2074	3.75	13.47	yes

Beta and Sigma Convergence.

Sigma convergence.

Fig. I - Euros

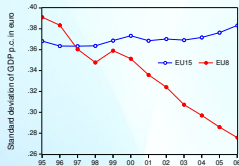
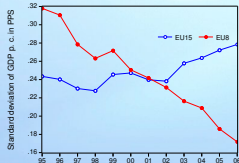


Fig. II - PPS



EU8	β_j (pps)	β_j (eur)	σ -conv.?
1995-06	-0.0125 (-0.0006)	-0.0118 (-0.0006)	yes
1995-00	-0.0134 (-0.0025)	-0.0081 (-0.0024)	yes
2001-06	-0.0141 (-0.0009)	-0.0122 (-0.0005)	yes
Two	Regions	(EU8+EU15)	
1995-06	-0.014 (-0.0012)	-0.1426 (-0.0012)	yes
1995-00	-0.0083 (-0.0019)	-0.0093 (-0.0016)	yes
2001-06	-0.0221	-0.00236	yes

Time-series Convergence.

Time-series Summary and Leybourne test

	hu	sl	ee	lt	lv	sk	pl	cz
ADF	Y***	N	N	N	N	N	Y***	N
STUR	Y	Y	Y	N	N	N	N	N
Cointegration	Y	Y	Y	Y	Y	Y	Y	Y
Overall	Y	Y-	Y-	N	N	N	Y	N

	lt	lv	ee	cz
Z-stat	-0.021092	0.025811	0.224499*	0.011203
STUR?	no	no	yes	no
	sk	pl	hu	sl
Z-stat	0.113485	0.011203	0.25118*	0.287285*
STUR?	no	no	yes	yes

Note: Leybourne et al. (1996) 5% critical value: 0.215. Source: EUROSTAT (2007).

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Future Directions

- Non linearities.
- Breaks.
- Sample size (time is limited, low frequencies).
- Seasonalities (seasonal unit roots).




Conclusions

- The EU enlargement is an attempt of promoting growth and convergence through integration. Our results show that, although positive signs are visible, it is **difficult to have a clear answer** about the achievement of this target.
- The evidence from **aggregated** beta and sigma analysis is pro-convergence but mixed from **disaggregated** time-series.
- A series of **technical difficulties** overshadow “reality” adding to the “myth”.




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