

# BETA CONVERGENCE IN THE EXPORT VOLUMES IN EU COUNTRIES

Miroslav Radiměřský<sup>1</sup>, Vladimír Hajko<sup>1</sup>

<sup>1</sup>*Mendel University in Brno*



EUROPEAN JOURNAL  
OF BUSINESS SCIENCE  
AND TECHNOLOGY

Volume 2 Issue 1  
ISSN 2336-6494  
www.ejobsat.com

## ABSTRACT

This paper investigates the  $\beta$ -convergence in the trade volumes of EU countries. We focus on a different approach to convergence analysis, namely trade's contribution to convergence. Neoclassical growth theory assumes there will be a convergence process among the economies, even in absence of trade. Trade relations might, however, speed up this process. We use panel data for trade volumes of 26 EU countries and test the presence and the speed of  $\beta$ -convergence pattern on SITC sectors 6 and 7 trade categories. The implied speeds of unconditional convergence of the export volume per capita are about 0.05–0.06 (implying half-lives around 12–13 years). When accounting for the country- or time-period specific effects, we can observe relatively high convergence rates (with half-lives somewhere around 2–4 years).

## KEY WORDS

trade, convergence, export

## JEL CODES

O47, F14

## 1 INTRODUCTION

The theory of income convergence has gained solid grounds in the economic literature in the past two decades.

Despite the applicability of the formalized logic, i.e. the countries will show differentiated rates of growth, depending on the initial level, it is only rarely applied to other economic variables.

The basic concept of convergence was introduced by Barro and Sala-i-Martin (1992) and Mankiw et al. (1992) in the context of the macroeconomic growth theory. Islam (2003) offers a detailed survey of convergence methods, and the prevailing conclusion seems to be that there is an evidence for the convergence of economic growth and income. Interested

reader can find further details regarding income convergence e.g. in the recent contribution by Cuaresma et al. (2013).

This paper focuses on a different approach to convergence analysis, namely trade's contribution to convergence. Neoclassical growth theory assumes there will be a convergence process among the economies, even in absence of trade. Trade relations might, however, speed up this process. Among the first papers dealing with this topic are contributions by Ben-David (1993, 1994, 1996).

The traditional view might indicate that primary role in the convergence process will be played by trade openness, rather than trade volumes. Nevertheless, it is an empirical rule that increased trade openness leads to higher specialization, and hence increased trade volumes.

In the seminal paper by Frankel and Rose (1998) the convergence of economic performance is closely linked to the development of international trade. Rivera-Batiz and Romer (1991) and Frankel and Romer (1999) argued about the problems caused by the presence of endogeneity and proposed a model of endogenous growth featuring a measure of economic integration. As argued above, trade and growth relationship is closely linked to trade openness and it is expected that economic growth spillovers increase with higher degrees of economic integration. Establishing a robust causal relationship, however, has been difficult.

Ben-David (1993) and Sachs et al. (1995) among others empirical papers showed open economies experience unconditional convergence. Sarkar (2008) examined cross-country panel data of 51 countries during 1981–2002. He showed that highly trade-dependent countries report positive relationship between the openness and growth. Billmeier and Nannicini (2009) confirmed a positive and significant effect of openness on growth, while controlling for endogeneity. Bernhofen (1999) showed that convergence of economies has significant impact on trade structure and its development. Hakro and Fida (2009) showed that trade liberalization helps in achieving convergence respectively leads to acceleration of convergence. Bértola

and Porcile (2006) identified main factors of convergence in selected states of Latin America. The factors are technological diffusion, openness, specialization and institutional arrangements at domestic and international levels. Three of these are subjects of international trade.

The aim of this paper is to test trade data for the presence of convergence using well established method from growth economics in the trade study. Based on approach of Bernhofen (1999) and the results of empirical studies mentioned above, there should be convergence in international trade data as well as in the growth data.

We test for the presence and the speed of the beta convergence in the trade volumes in EU countries. Essentially, we investigate whether the rates of change in trade depended on initial volumes.

With respect to the recent trade volumes development, we expect at least some evidence of beta convergence to be present, even in the stronger, unconditional version. Given the arguments in Frankel and Romer (1999), this relationship should be reciprocal due to the endogeneity. Given the apparent consensus of growth convergence, it is reasonable to expect it should be accompanied by trade convergence as well – as shown in Radiměšský and Hajko (2015), there was a rather significant spillover trade effect in case of EU countries during the sample period 1999–2011. The occurrence of convergence is dependent on existence of spillover effect between trade partners. Trade-divergence relationship should turn up otherwise.

## 2 METHODOLOGY AND DATA

Unconditional convergence assumes the variable of interest converges towards a unique steady state for the countries included in the dataset:

$$\Delta \log(T_{i,t}) = \mu + \beta \log(T_{i,t-p}) + \epsilon_{i,t} \quad (1)$$

The conditional convergence assumes multiple steady states that are conditional on country-specific characteristics  $\mu_i$ :

$$\Delta \log(T_{i,t}) = \mu_i + \beta \log(T_{i,t-p}) + \epsilon_{i,t} \quad (2)$$

The so-called implied speed of convergence (typically denoted  $\lambda$ ) and the half-life of convergence ( $H$ ) are the measures of the convergence speed typically reported to make for easier comparisons of the  $\beta$  estimates. Their usefulness shows especially if we account for the recommendation in Islam (2003), and focus on longer time windows. Apart from one year estimation window ( $T = 1$ ), we carry out the estimations also for the 5 year periods ( $T = 5$ ). The estimates carried out on longer time windows should help the error term to be less influenced by the business-cycle fluctuations and serial correlations.

The implied speed of convergence is derived from the approximation around the steady state ( $T^*$ ):

$$\frac{\partial \log(T_{i,t})}{\partial t} = \lambda [\log T^* - \log T(t)], \quad (3)$$

which implies

$$\log T(t) = (1 - e^{-\lambda t}) \log T^* + e^{-\lambda t} \log T(0), \quad (4)$$

where  $T(0)$  is the trade volume at the initial time.

This can be rewritten and manipulated to:

$$\begin{aligned} \log T(t) - \log T(0) &= \\ &= (1 - e^{-\lambda t})(\log T^* + \log T(0)) \end{aligned} \quad (5)$$

The difference between the unconditional and conditional convergence lies in the ability to differentiate for country-specific growth paths. In order to do so, the dummy variables (the panel fixed effects) are entered into the equation (1). Further elaboration therefore leads to two additional specifications with the additional country-specific dummies (i.e. establishing a fixed-effect model) and country and time-period specific dummies.

Note that the  $\lambda$  can be determined from the expression  $\beta = -(1 - e^{-\lambda t})$ , calculating with estimates from equation (1). The half-life ( $H$ ) can be derived from the expression  $e^{-\lambda H} = 0.5$ , or  $e^{-\lambda H} = \log(2)\lambda^{-1}$ . This is the approximate number of years it would take for half of the current disparities to be eliminated.

The data on trade volume exports are available from Eurostat database code DS-018995 trade by SITC classification (2016). In order to calculate the trade share, we take into the account all world trade partners. The selected sample covers years 2002–2014 in yearly frequency. The trade volumes are measured in euro value of trade. To factor for differentiated economy sizes, we have adjusted the export volume data by the total population of a given country (World Bank indicator SP.POP.TOTL). The estimates are thus carried out on the export trade volume per capita.

Equation (5) is estimated using panel regression. The actual estimation is done for the full panel of 26 countries (EU-28 countries without Malta and Cyprus), in both unconditional and conditional convergence specifications.

To account for possible heterogeneity of the estimation groups, we have repeated the estimation on the subsamples of countries, namely Eurozone countries, PIIGS, and the new EU countries.

### 3 RESULTS

The results of the estimations are summarized in Tab. 1–6. The results are not significantly different if we compare the SITC sectors 6 or 7. As might be expected the inclusion of the country-specific fixed effects improved the explanatory power, which apparently provides better description of the convergence. But it also shows there is a disparity between the steady state growth paths of the individual countries in all groups.

Tab. 1: Estimated coefficients (*t*-statistics in parentheses) of the unconditional and conditional convergence, SITC 6, 1 year period

	Unconditional	Country-specific fixed effects	Country- and time-period specific fixed effects
All	−0.053 (−4.856)	−0.293 (−9.119)	−0.132 (−7.16)
Eurozone	−0.027 (−1.89)	−0.384 (−7.508)	−0.147 (−5.289)
PIIGS	−0.098 (−1.847)	−0.453 (−4.386)	−0.177 (−2.765)
New EU 04	−0.084 (−3.814)	−0.244 (−5.901)	−0.180 (−4.373)

Tab. 2: Estimated coefficients (*t*-statistics in parentheses) of the unconditional and conditional convergence, SITC 7, 1 year period

	Unconditional	Country-specific fixed effects	Country- and time-period specific fixed effects
All	−0.055 (−5.883)	−0.214 (−8.263)	−0.149 (−6.849)
Eurozone	−0.022 (−1.619)	−0.230 (−5.878)	−0.160 (−4.792)
PIIGS	−0.055 (−2.092)	−0.201 (−2.76)	−0.230 (−3.096)
New EU 04	−0.064 (−3.694)	−0.202 (−5.76)	−0.170 (−3.856)

This especially holds for the Eurozone area with unconditional non-convergence. Considering the remaining groups, we can see the half-lives of convergence lie in the vicinity of 6–8 years for SITC 6 and 10–12 years for SITC 7 export volumes.

The 5-year estimation windows with country-specific fixed effects do not seem to be well-suited specification for the data in question, given the non-correspondence of 5-year window specifications for PIIGS groups, both for SITC

6 and 7, and Eurozone group in SITC 6 to expected values of beta coefficients, which disallows the calculation of half-lives (implicating explosive behavior). The inclusion of the period-specific fixed effects, apparently with some degree of explanatory power (but it is important to account for the fact the estimation sample includes the period of crisis), helps eliminate this issue, but at the same time leads to lightly slower convergence rates.

Tab. 3: Estimated coefficients (*t*-statistics in parentheses) of the unconditional and conditional convergence, SITC 6, 5 year period

	Unconditional	Country-specific fixed effects	Country- and time-period specific fixed effects
All	−0.187 (−7.833)	−0.872 (−19.024)	−0.552 (−11.782)
Eurozone	−0.069 (−2.108)	−1.007 (−14.689)	−0.649 (−8.262)
PIIGS	−0.303 (−2.357)	−1.271 (−9.233)	−1.090 (−6.135)
New EU 04	−0.262 (−6.127)	−0.786 (−13.122)	−0.700 (−7.162)

Tab. 4: Estimated coefficients (*t*-statistics in parentheses) of the unconditional and conditional convergence, SITC 7, 5 year period

	Unconditional	Country-specific fixed effects	Country- and time-period specific fixed effects
All	−0.238 (−9.219)	−0.836 (−18.243)	−0.638 (−12.353)
Eurozone	−0.096 (−2.141)	−0.934 (−10.916)	−0.637 (−6.451)
PIIGS	−0.226 (−2.885)	−1.207 (−5.364)	−0.841 (−4.026)
New EU 04	−0.240 (−5.693)	−0.776 (−14.144)	−0.769 (−8.118)

The implied convergence half-lives are strongly differentiated. The strong version of unconditional convergence among all observed 26 countries is not overly convincing, with implied speeds of 0.05–0.06 for both SITC sectors (implying half-lives around 12–13 years). Although this is still bit faster than the usual “2–3 percent” typically reported in income-related studies, Abreu et al. (2005) argue such lower rates are typically caused by not correcting for the unobserved heterogeneity in

Tab. 5: Implied speeds and half-lives of convergence (half-lives in italics, in years), SITC 6

	1-year windows			5-year windows		
	Unconditional	Country-specific fixed effects	Country- and time-period specific fixed effects	Unconditional	Country-specific fixed effects	Country- and time-period specific fixed effects
All	0.05 <i>12.7</i>	0.35 <i>2.0</i>	0.14 <i>4.9</i>	0.04 <i>16.7</i>	0.41 <i>1.7</i>	0.16 <i>4.3</i>
Eurozone	0.03 <i>25.6</i>	0.48 <i>1.4</i>	0.16 <i>4.4</i>	0.01 <i>48.6</i>	N/A <i>N/A</i>	0.21 <i>3.3</i>
PIIGS	0.10 <i>6.7</i>	0.60 <i>1.1</i>	0.19 <i>3.6</i>	0.07 <i>9.6</i>	N/A <i>N/A</i>	N/A <i>N/A</i>
New EU 04	0.09 <i>7.9</i>	0.28 <i>2.5</i>	0.20 <i>3.5</i>	0.06 <i>11.4</i>	0.31 <i>2.2</i>	0.24 <i>2.9</i>

Tab. 6: Implied speeds and half-lives of convergence (half-lives in italics, in years), SITC 7

	1-year windows			5-year windows		
	Unconditional	Country-specific fixed effects	Country- and time-period specific fixed effects	Unconditional	Country-specific fixed effects	Country- and time-period specific fixed effects
All	0.06 <i>12.2</i>	0.24 <i>2.9</i>	0.16 <i>4.3</i>	0.05 <i>12.7</i>	0.36 <i>1.9</i>	0.20 <i>3.4</i>
Eurozone	0.02 <i>30.9</i>	0.26 <i>2.7</i>	0.17 <i>4.0</i>	0.02 <i>34.4</i>	0.54 <i>1.3</i>	0.20 <i>3.4</i>
PIIGS	0.06 <i>12.2</i>	0.22 <i>3.1</i>	0.26 <i>2.7</i>	0.05 <i>13.5</i>	N/A <i>N/A</i>	0.37 <i>1.9</i>
New EU 04	0.07 <i>10.4</i>	0.23 <i>3.1</i>	0.19 <i>3.7</i>	0.05 <i>12.6</i>	0.30 <i>2.3</i>	0.29 <i>2.4</i>

technology levels in the income studies. On the other hand, Nerlove (1998) argues the more diverse country samples typically lead to slower convergence rate estimates.

The half-lives for the unconditional convergence in the sub-groups of countries do not show very similar results. Both 1 and 5 years estimation windows indicate non-convergence for Eurozone. The beta coefficients for PIIGS countries are either not significant (1-year) or

with test-statistic rather close to the critical values of the test (5-year).

Allowing for country-specific steady states, we can observe relatively high convergence rates (with half-lives somewhere around 2–4 years). The necessity of the inclusion of the conditional convergence however makes the attribution of the growth rate and its development purely to the initial level difficult and dubious.

## 4 CONCLUSIONS

While the initial assumption of the unconditional convergence of the export volume per capita shows some evidence to support it, with implied speeds of 0.05–0.06 for both SITC sectors 6 (manufactured goods) and 7 (machinery and transport equipment) implying half-lives around 12–13 years, there is a clear message in the data that the convergence process is far from universally applicable to the individual

countries. The Eurozone countries are showing non-convergence. All remaining groups clearly show that the conditional convergence rates are significantly different, implying the presence of multiple steady state paths. Nevertheless, when accounting for the country- or time-period specific effects, we can observe relatively high convergence rates (with half-lives somewhere around 2–4 years).

## 5 REFERENCES

- ABREU, M., DE GROOT, H. L. F. and FLORAX, R. J. G. M. 2005. A Meta-Analysis of  $\beta$ -Convergence: the Legendary 2%. *Journal of Economic Surveys*, 19 (3), 389–420.
- BARRO, R. J. and SALA-I-MARTIN, X. 1992. Convergence. *Journal of Political Economy*, 100 (2), 223–251.
- BEN-DAVID, D. 1993. Equalizing Exchange: Trade Liberalization and Income Convergence. *The Quarterly Journal of Economics*, 108 (3), 653–679.
- BEN-DAVID, D. 1994. *Convergence Clubs and Diverging Economies (No. 95)*. CEPR Discussion Paper No. 922.
- BEN-DAVID, D. 1996. Trade and Convergence Among Countries. *Journal of International Economics*, 40 (3–4), 279–298.
- BERNHOFEN, D. M. 1999. Intra-industry Trade and Strategic Interaction: Theory and Evidence. *Journal of International Economics*, 47 (1), 225–244.
- BÉRTOLA, L. and PORCILE, G. 2006. Convergence, Trade and Industrial Policy: Argentina, Brazil and Uruguay in the International Economy, 1900–1980. *Revista de Historia Económica/Journal of Iberian and Latin American Economic History*, Second Series, 24 (1), 37–67.
- BILLMEIER, A. and NANNICINI, T. 2009. Trade Openness and Growth: Pursuing Empirical Glasnost. *IMF Economic Review*, 56 (3), 447–475.
- CUARESMA, J. C., HAVETTOVÁ, M. and LÁBAJ, M. 2013. Income Convergence Prospects in Europe: Assessing the Role of Human Capital Dynamics. *Economic Systems*, 37 (4), 493–507.
- Eurostat. 2016. *EU Trade Since 1988 by SITC Database: DS-018995*. [online]. Available at: <http://appsso.eurostat.ec.europa.eu/nui/show.do>. [Accessed 2016, November 1].
- FRANKEL, J. A. and ROMER, D. H. 1999. Does Trade Cause Growth? *American Economic Review*, 89 (3), 379–399.
- FRANKEL, J. A. and ROSE, A. K. 1998. The Endogeneity of the Optimum Currency Area Criteria. *The Economic Journal*, 108 (449), 1009–1025.
- HAKRO, A. N. and FIDA, B. A. 2009. Trade and Income Convergence in Selected South Asian Countries and Their Trading Partners. *Lahore Journal of Economics*, 14 (2), 49–70.
- ISLAM, N. 2003. What have We Learnt from the Convergence Debate? *Journal of Economic Surveys*, 17 (3), 309–362.
- MANKIW, N. G., ROMER, D. and WEIL, D. N. 1992. A Contribution to the Empirics of Economic Growth. *The Quarterly Journal of Economics*, 107 (2), 407–437.
- NERLOVE, M. 1998. *Growth Rate Convergence, Fact or Artifact? An Essay on the Use and Misuse of Panel Data Econometrics*. Working paper No. 197853.
- RADIMĚŘSKÝ, M. and HAJKO, V. 2015. Economic Growth Spillovers: International Trade Links. In: KAPOUNEK, S. (ed.) *Enterprise and Competitive Environment : Proceedings of 18th Annual International Conference*, 5–6 March, Mendel University in Brno, pp. 756–765.
- RIVERA-BATIZ, L. A. and ROMER, P. M. 1991. International Trade with Endogenous Technological Change. *European Economic Review*, 35 (4), 971–1001.
- SACHS, J. D., WARNER, A., ÅSLUND, A. and FISCHER, S. 1995. Economic Reform and the Process of Global Integration. *Brookings Papers on Economic Activity*, 26 (1), 1–118.
- SARKAR, P. 2008. Trade Openness and Growth: Is There Any Link? *Journal of Economic Issues*, 42 (3), 763–785.

## AUTHOR'S ADDRESS

Miroslav Radiměřský, Department of Economics, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: [miroslav.radimersky@mendelu.cz](mailto:miroslav.radimersky@mendelu.cz)

Vladimír Hajko, Department of Economics, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: [vladimir.hajko@mendelu.cz](mailto:vladimir.hajko@mendelu.cz)