

SIGMA AND BETA CONVERGENCE OF SPORTSWEAR MARKETS IN EUROPEAN UNION COUNTRIES

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Abstract: *The convergence is a popular research topic however it is usually addressed in the context of the income (growth theory) or prices. This paper deals with sportswear sales convergence in European Union countries. The scope of the analysis is Sportswear market. Sportswear is defined as an aggregation of performance, outdoor and sports-inspired clothing and footwear. Two data sources were used: Passport database for Sportswear sales data, and Eurostat database for demographic data (population). The analysis covers all European Union countries except Cyprus, Luxemburg, and Malta which have been excluded due to lack of market sales data (not available in Passport database). Analysis has been performed for the period of eleven years from 2007 to 2017. The objective of the research was to investigate the presence of two types of convergence: sigma and unconditional beta convergence, that is to verify two hypotheses: sigma convergence is present in sportswear markets in selected 25 European Union countries, and unconditional beta convergence is present in sportswear markets in selected 25 European Union countries. The presence of sigma convergence was proved by analysis of standard deviation of the natural logarithm of sales figures. The presence of beta convergence was proved using beta convergence model formulated by Barro and Sala-i-Martin. The paper concludes that both sigma and unconditional beta convergence exist.*

Key words: β -convergence, σ -convergence, sportswear, sales, European Union

JEL codes: C10, O41, O52

1. Introduction

Convergence is a process in which values of certain measurable econometric characteristic converge over time. Opposite to convergence is a process called divergence which takes place when values of variable diverge over time. Testing convergence means not only proving that convergence exists but also calculating the speed towards convergence and its type (Gnat, 2014).

Convergence, as one of the macroeconomic theories, was born in second half or 20th century of the neoclassical growth theory. Initially, convergence was researched in the context of two competing economic systems: advanced capitalist economies (market economies) and socialist economies (centrally planned economies). Convergence was used to verify the hypothesis that both, so different types of economy, converge over time in terms of growth. Later, researchers extended the scope of studies going beyond the analysis of capitalist and socialist economies.

In 1990's convergence became a popular empirical, as well as a theoretical research topic. Soon, it became one of the fastest growing areas of research in the context of growth theory. The questions that researchers try to answer studying the theory of convergence are important not only from a scientific point of view but also in terms of economic policy. The fundamental question is whether per capita income among researched countries converges or diverges over time. In other words, whether in poor countries the material standard of living improves faster than in rich countries? Or it is the other way around, and over time poor countries become poorer and rich even richer.

In economic literature, there are several types of convergence defined however most common are σ -convergence and β -convergence. Additionally, two types of β -convergence were defined: unconditional

(absolute) β -convergence and conditional β -convergence. σ -convergence is present if the dispersion of variable (for example income per capita) measured by some convenient measure of dispersion, declines through time (Wójcik, 2008). β -convergence measures dependency between growth rate and the initial value of a variable (for example GPD). Unconditional (absolute) β -convergence is present when growth rates converge over time. Conditional β -convergence takes into account additional conditioning explanatory variables (for example social-demographic factors like average education levels).

There is a dependency between σ -convergence and β -convergence. β convergence is a necessary but not sufficient condition for σ convergence (Pittau et al., 2016). σ -convergence is a sufficient but not necessary condition for β convergence - if there is σ -convergence, then there must be β -convergence (Young et al., 2008). The implication of this is that the presence of σ -convergence implies the presence of β -convergence but the absence of σ -convergence cannot be taken as implying the absence of β -convergence (Boyle & McCarthy, 1997).

Boyle and McCarthy (Boyle and McCarthy, 1997) introduced the concept of γ -convergence defined as an index of rank concordance. γ -convergence is measured by changes in country rankings, and it increases with the degree in the extent to which country ranks change over time. Boyle and McCarthy used γ -convergence in addition to σ -convergence in testing for β -convergence.

One of the most comprehensive studies concluded that per capita income across the world does not converge but diverges. Other empirical studies suggest that income-level convergence can be observed in homogeneous groups of countries but is absent in more differentiated groups (Matkowski and Próchniak, 2007). This type of convergence is called convergence clubs (Pittau et al., 2016).

The convergence is a popular research topic however it is usually addressed in the context of country economics and focused on the income (growth theory), inflation or prices (Pittau et al., 2016; Iancu, 2007; Carree and Klomp, 1997; Shintani, 2006; Konopczak and Welfe, 2017; Rogers, 2007; Parsley and Wei, 1996). In Polish economic literature, the concept of convergence was addressed in real estate related researches (Dittmann, 2012, 2014; Gnat, 2014). So far convergence was not researched in the context of product markets. In this paper, the author aims to close this gap partially. The objective of the research described in this paper was to investigate the presence of two types of convergence: σ -convergence and unconditional β -convergence, that is to verify two hypotheses: hypothesis H1: σ -convergence is present in sportswear markets in selected 25 European Union countries, and hypothesis H2: unconditional β -convergence is present in sportswear markets in selected 25 European Union countries.

The rising awareness and importance of sports activities are driving the sports goods market across the globe. Global sporting goods market is anticipated to expand with high momentum. Sports goods market is fueled by popular sports events such as Olympics, Football World Cup, etc. This has increased the participation of consumers in sports activities which drives the demand for sporting goods. Other factors driving the demand for sporting goods are raising health concerns awareness and the increasing personal disposable income. Governments across the globe promote sports activities and the healthy lifestyle. Governments also invest in sports infrastructure. These governments' actions further uplift the demand of sports goods (*Sporting Goods Market: Global Demand Analysis & Opportunity Outlook 2023*, 2017). Passport database defines sportswear as an aggregation of performance, outdoor and sports-inspired clothing and footwear. Sportswear includes products designed for all age groups for example sportswear for children. Sportswear includes items across all clothing and footwear categories: shorts and trousers, dresses and skirts, tops, jumpers, jackets & coats, tracksuits/athletic sets, underwear, swimwear, hosiery, accessories including headwear, gloves, scarves.

The paper is organized as follows. Chapter 1 provides a short introduction to the topic of a theory of convergence, an overview of the different concepts of convergence, definition of sportswear and the motivation of the research. Chapter 2 defines the purpose of the research, describes methodology and data used for the research. In Chapter 3 we provide details of the research and describe results. Chapter 4 concludes and makes propositions for further research.

2. Methodology and Data

Presence of two types of convergence, σ -convergence, and unconditional β -convergence was verified using statistical and econometric analysis methods.

σ -convergence can be tested using standard deviation or coefficient of variation (Iancu, 2007). In this paper to test the presence of σ -convergence of sportswear market sales author used analysis of coefficient of variation which is defined as the ratio of standard deviation to the mean. Additionally, to assess statistical significance author conducted regression analysis (Dittmann, 2013). The unconditional β -convergence was tested using model defined by Barro and Sala-i-Martin (1992):

$$\frac{1}{T} \cdot \ln \left(\frac{Y_{iT}}{Y_{i0}} \right) = \alpha_0 + \alpha_1 \cdot \ln Y_{i0} + e_{it}, \quad (1)$$

where:

- $\frac{1}{T} \cdot \ln\left(\frac{Y_{iT}}{Y_{i0}}\right)$ – is an annual average per capita sales growth in country i in the period of time T ,
 Y_{i0} – is a value of per capita sales in country i in year 0 (2007),
 Y_{iT} – is a value of per capita sales in country i in year T (2017),
 α_0, α_1 – are parameters of the model,
 ε_{iT} – is a random component.

Unconditional β -convergence coefficient was calculated using the following equation:

$$\beta = -\frac{1}{T} \cdot \ln(1 + \alpha_1 \cdot T). \quad (2)$$

Statistically significant, greater than zero β implies a negative correlation between growth and initial sales and proves the presence of unconditional β -convergence. The β coefficient can be interpreted as the speed of convergence - it captures the rate at which a country's sales approach the steady state rate of growth.

Another way of analyzing the speed of convergence is by calculating so called half-life of the convergence parameter $T_{1/2}$. The $T_{1/2}$ parameter is defined as the number of years that it takes for the convergence process to reach a steady state. It is calculated as

$$T_{1/2} = \frac{\ln 2}{\beta}. \quad (3)$$

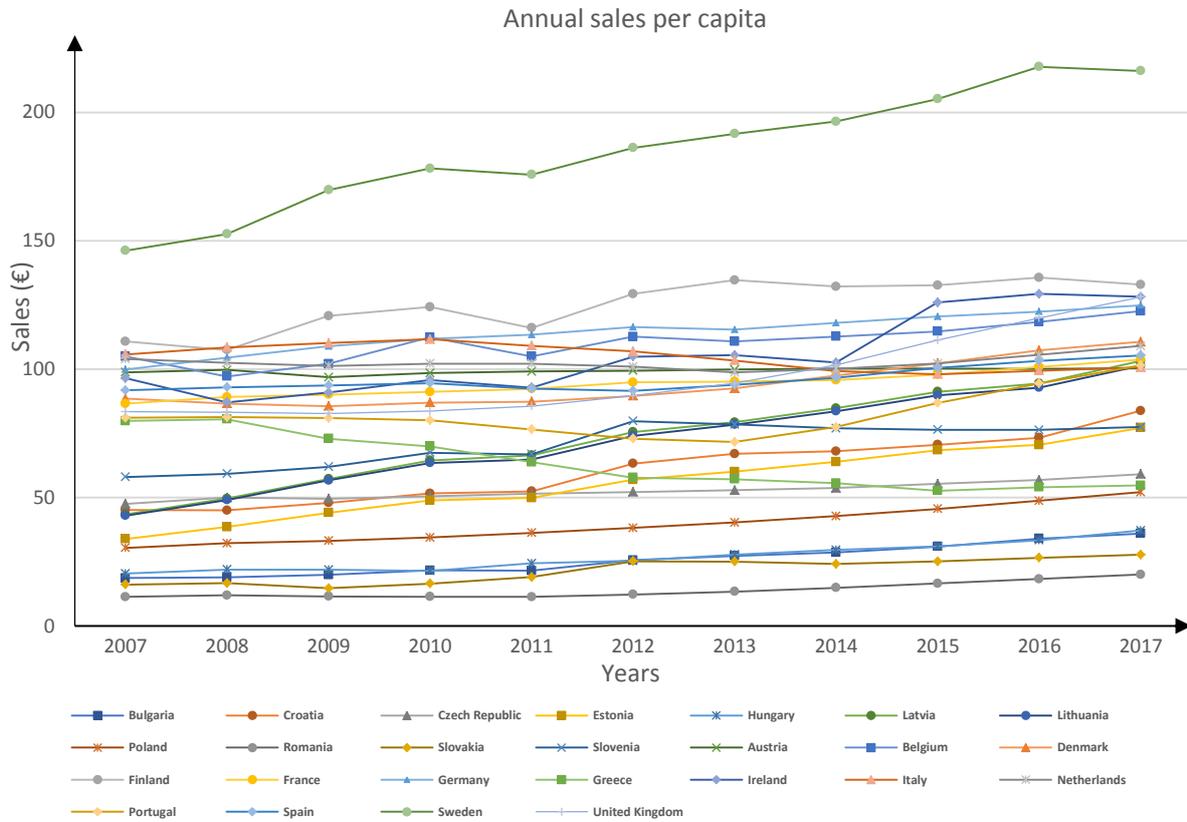
The scope of the analysis described in this paper is sportswear market. Two data sources were used: Passport database for Sportswear sales data, and Eurostat database for demographic data (population). The analysis covers all European Union countries except Cyprus, Luxemburg, and Malta which have been excluded from the research due to lack of related market sales data (not available in Passport database). Analysis has been performed for the period of eleven years from 2007 to 2017.

3. Results

Figure 1 shows per capita sportswear sales (currency conversion: fixed 2017 exchange rates) in selected 25 European Union countries from 2007 to 2017. Distributions are mostly unimodal which is important because interpreting measures of dispersion of not unimodal distributions is not straight forward (Pittau and Zelli, 2006).

Figure 1 shows that in the vast majority of the countries per capita sales increased significantly over time. Only in Greece and in Italy per capita sales in 2017 were lower than in 2007. In Sweden per capita sales were significantly higher than in any other country.

Fig. 1 Per capita sportswear sales in selected 25 European Union countries from 2007 to 2017



Source: Own study based on demographic data from Eurostat database and market sales data from Passport database.

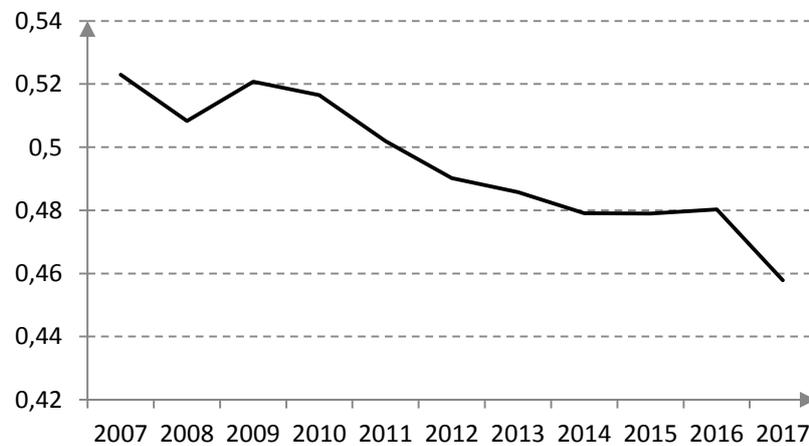
To verify hypothesis H1, variation coefficients of sportswear per capita sales from 2007 to 2017 were calculated (table 1). Figure 2 shows decreasing values of variation coefficients over time.

Tab. 1 Variation coefficients from 2007 to 2017

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Variation Coefficient	0.523	0.508	0.521	0.517	0.502	0.490	0.486	0.479	0.470	0.480	0.458

Source: Own study.

Fig. 2 Variation coefficient of sportswear per capita sales from 2007 to 2017



Source: Own study.

The value of variation coefficients at the end of researched period (0.458) is lower than the value of variation coefficients at the beginning of the researched period (0.523). Thus inequality $\sigma_{Y_{t_0}} - \sigma_{Y_{t_0+T}} > 0$ where $\sigma_{Y_{t_0}}$ is the value of variation coefficients at the beginning of the researched period (2007), and $\sigma_{Y_{t_0+T}}$ is the value of variation coefficients at the end of researched period (2017), is true. This proves σ -convergence of per capita sales in sportswear markets in selected 25 European Union countries. To confirm the results, parameters of linear trend function have been determined (table 2). Statistically significant (p-value = 1,103E-05), lower than zero linear function coefficient (-0.006) and good model fit ($R^2 = 0.89$) confirmed presence of σ -convergence.

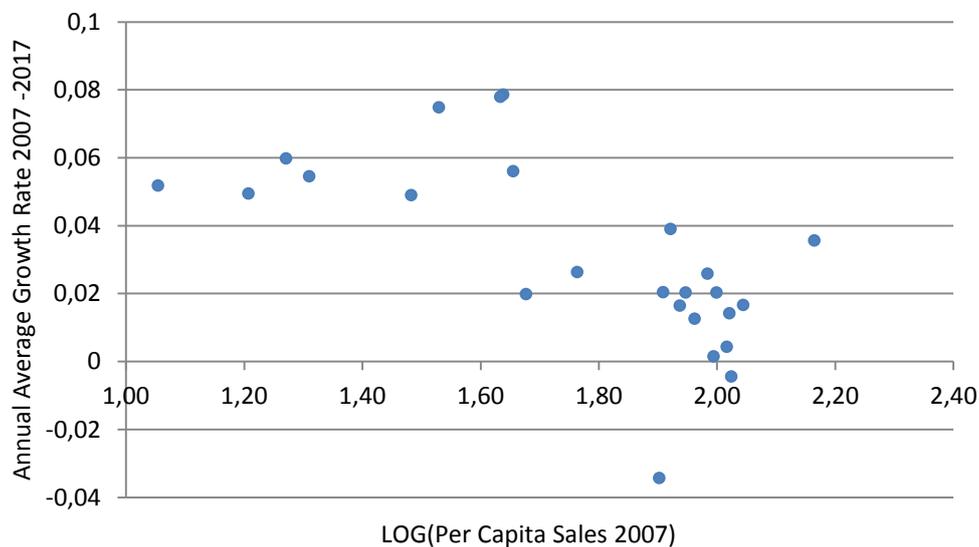
Tab. 2 Regression analysis results

R^2	Std. Err	F-test	p-value
0.894	0.007	76.063	0.00001

Source: Own study.

To verify hypothesis H2, regression analysis of the model (1) defined by Barro and Sala-i-Martin (Barro & Sala-i-martin, 1992) was performed. All calculations were performed using Statistica.

Fig. 3 Per capita annual sales growth rate from 2007 to 2017 vs. 2007 per capita sales



Source: Own study.

The regression equation calculation (1) is based on the annual average growth rates of per capita sales and the initial (2007) value of sales per capita of 25 countries. The chart in Figure 3 shows the correlation between these two indicators. The ordinate includes the annual average growth rates from 2007 to 2017, and the abscissa includes the initial value of sales per capita of each country. The results of the regression analysis are shown in table 3.

Tab. 3 Summary of β -convergence model

R^2	Std. Err	F-test	p-value	α_0	α_1
0.416	0.135	16.359	<0.0005	0.135	-0.059

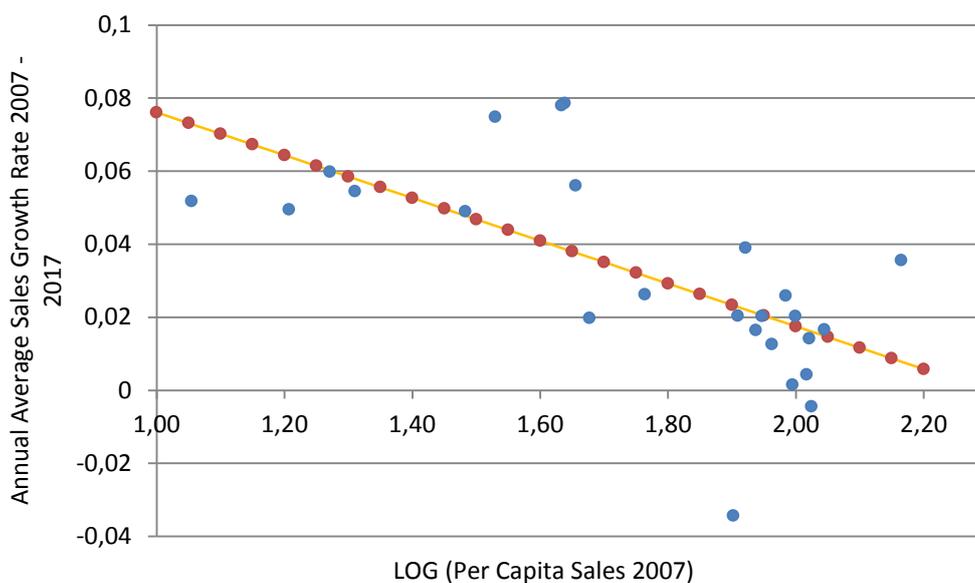
Source: Own study.

The unconditional β -convergence model defined by Barro and Sala-i-Martin takes the following form:

$$\frac{1}{T} \cdot \ln\left(\frac{Y_{iT}}{Y_{i0}}\right) = 0.134613 - 0.058560 \cdot \ln Y_{i0}$$

The model is graphically interpreted in figure 4.

Fig. 4 Beta convergence model



Source: Own study.

As seen from figure 4, the slope of the regression line is negative which proves decreasing annual average per capita sales growth over time. β coefficient equals 0.0939 which proves the presence of unconditional β -convergence of annual per capita sales in sportswear markets.

The $T_{1/2}$ parameter has been calculated based on equation (3) and equals 7.379. This means that in about 7 years convergence process is expected to be half way through to reach a steady state.

4. Conclusions

The objective of the research, to verify two defined hypotheses, has been realized. The research proved that in sportswear markets of selected 25 European Union countries from 2007 to 2017 both σ -convergence and unconditional β -convergence are present. This means that dispersion of per capita sales in sportswear markets declines through time and that annual average per capita sales growth rates converge over time. In this paper, only two types of convergence were analyzed. The author would like to conclude the paper by pointing out three possible directions of further analysis. For the same set of data (sportswear market, selected 25 European Union countries, 2007-2017) the following types of convergence can be tested: conditional β -convergence, convergence club, and γ -convergence.

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