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Eco-efficiency and convergence

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Eco-efficiency and convergence[1]

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Abstract
In pursuit of welfare, environmental issues constitute one important dimension to be taken into account in assessing the welfare along with the economic and social indicators. There has been a lively discussion about measures of social welfare *beyond GDP* articulated by *Stiglitz Report* (Stiglitz et al, 2009) which can be viewed as a summation of the earlier efforts to deal with those challenges. This study concentrates on environmental aspects of economic growth in European countries and the changes undergone in the period of 2000 – 2010. Time series of obtained eco-efficiency scores from SBM models were used to infer on the σ- and β-convergence analysed in line with the classical econometric approach. Results suggest that except of the post crisis disruption a process of convergence with respect to eco-efficiency has been taking place in European countries.

Keywords: eco-efficiency, data envelopment analysis, convergence

JEL codes: C43, C61, O47

1 Introduction

In the practice of economic policy decision making, often the claim for meeting multiple goals occurs, the example being the requirements of the Strategy Europe 2020 defining benchmarks for social and environmental dimensions while keeping the economy on the growth path. Theoretical support for decision making cannot be based on barely proportional indicators relating to goals which may require conflicting actions.

In pursuit of welfare, environmental issues constitute one important dimension to be taken into account in assessing the welfare along with the economic and social indicators. There has been a lively discussion about measures of social welfare *beyond GDP* articulated by *Stiglitz Report* (Stiglitz et al, 2009) which can be viewed as a summation of the earlier efforts to deal with those challenges.

In this study, we concentrate on environmental aspects of economic growth in European countries and the changes undergone in the period of 2000 – 2010. There are two main challenges – assessment of eco-efficiency and selecting the measure of intertemporal change.

The method of evaluating country´s performance – data envelopment analysis (DEA) – is employed, assessing economic (technical) and environmental performance simultaneously. A number of authors used the non-parametric applied to national economies acting as DMUs. DEA productivity studies date back to Charnes et al. (1978)..

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Intertemporal changes in productivity has been in the focus of the interest of researchers since the late 80s (Baumol, 1986) represented by later empirical works of Barro (1991) or Sala-i-Martin (1996) came out. These analyses of convergence used econometric approach and production function of a specific form as Solow model implied. Non- parametric approach to convergence can be traced back to Henderson – Russell (2005) who made inferences on convergence from distribution of factors of decomposition obtained by employing frontier approach. Intertemporal approach using Malmquist productivity index was pioneered Färe et al.(1994) with later investigations as Mahlberg et al. (2011). Concentrating on the two-dimensional assessment of economic performance, the aim of the study will be to (i) assess eco-efficiency of European countries and (ii) analyse trends in the distribution of eco-efficiency scores over time.

We proceed by establishing measure of eco-efficiency in Section 2 providing theoretical definitions of the concept of efficiency followed by measurement method as application of linear programming. SBM model is particularly paid attention to and the strategy of incorporating undesirable output into the model is presented. Section 3 recalls the standard approach to convergence which is adopted to assessment of the eco-efficiency change over the span of 2000 and 2010. σ- and β-convergence with respect to eco-efficiency is explored. Section 4 concludes.

2 Measuring eco-efficiency

2.1 SBM efficiency measure

The above-mentioned considerations need to be operationalized. First, measurement of efficiency should be introduced. There are several approaches leading to the same evaluation in the form of a linear program. To follow one of them, let´s organize data and give some definitions.

Economic subjects under examination be called DMUs (Decision Making Units) to reflect their independent economic behaviour. Let´s assume to have n DMUs transforming m inputs into s desirable outputs. Inputs are organized in the matrix **X**, element x_{ij} meaning amount of input i used by DMU j, and the similar way in the output matrix **Y**.

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdot & \cdot & \cdots & \cdot \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix}, \quad Y = \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1n} \\ y_{21} & y_{22} & \cdots & y_{2n} \\ \cdot & \cdot & \cdots & \cdot \\ y_{s1} & y_{s2} & \cdots & y_{sn} \end{bmatrix}$$

To assess technical efficiency, the general formula can be used:

$$efficiency = \frac{outputs}{inputs} \tag{2.1}$$

In classical DEA, every DMU aggregates its inputs and outputs by means of individually set weights so that the ratio 2.2.1 is maximized. In order to avoid unboundedness of maximization problem, the constraint is imposed so that normalized efficiency cannot exceed unit which also holds in case of using the weights of DMU under consideration (denoted DMU_0) for any other of $n–1$ DMUs. Formally:

$$\max \quad h_0(\boldsymbol{\mu}, \boldsymbol{\nu}) = \frac{\sum_{r=1}^{s} y_{r0}\mu_r}{\sum_{i=1}^{m} x_{i0}\nu_i} \tag{2.2}$$

$$\text{s.t.} \quad \frac{\sum_{r=1}^{s} y_{rj}\mu_r}{\sum_{i=1}^{m} x_{ij}\nu_i} \le 1 \qquad (j = 1, 2, ..., n) \tag{2.3}$$

$$u_r \ge 0 \qquad (r = 1, 2, ..., s)$$

$$v_i \ge 0 \qquad (i = 1, 2, ..., m)$$

The fractional program can be transformed into the linear one called CCR model (proposed by Charnes et al, 1978) which was first to evaluate performance in a non-parametric way.
The basic model had been improved and modified many ways. The slack-based model (SBM) by Tone is one of the powerful developments to capture all sources of inefficiency. The objective function has two important properties:

- unit invariance
- monotonicity.

A function $\rho = \dfrac{1 - \frac{1}{m}\sum_{i=1}^{m} s_i^- / x_{i0}}{1 + \frac{1}{s}\sum_{r=1}^{s} s_r^+ / y_{r0}}$ meet the requirements of the both, moreover, it can be shown that $0 < \rho \le 1$ (Cooper et al, 2007, p.100).
Evaluation of efficiency takes the form of a fractional program:

$$\min_{\boldsymbol{\lambda}, \mathbf{s}^+, \mathbf{s}^-} \quad \rho = \frac{1 - \frac{1}{m}\sum_{i=1}^{m} s_i^- / x_{i0}}{1 + \frac{1}{s}\sum_{r=1}^{s} s_r^+ / y_{r0}} \tag{2.4}$$

$$\text{s.t.} \quad \mathbf{x_0} = X\boldsymbol{\lambda} + \mathbf{s}^-$$

$$\mathbf{y_0} = Y\boldsymbol{\lambda} - \mathbf{s}^+$$

$$\boldsymbol{\lambda} \ge 0, \ \mathbf{s}^- \ge 0, \ \mathbf{s}^+ \ge 0.$$

Using substitution $t = \dfrac{1}{1 + \frac{1}{s}\sum_{r=1}^{s} s_r^+ / y_{r0}}$ one can obtain a linear program:

$$(SBMt) \qquad \min_{t, \boldsymbol{\lambda}, \mathbf{s}^+, \mathbf{s}^-} \quad \tau = t - \frac{1}{m}\sum_{i=1}^{m} t s_i^- / x_{i0} \tag{2.5}$$

$$\text{s.t.} \quad \mathbf{x_0} = X\boldsymbol{\lambda} + \mathbf{s}^-$$

$$\mathbf{y_0} = Y\boldsymbol{\lambda} - \mathbf{s}^+$$

$$\boldsymbol{\lambda} \ge 0, \ \mathbf{s}^- \ge 0, \ \mathbf{s}^+ \ge 0, \ t > 0$$

.

Substituting $t\mathbf{s}^- = \mathbf{S}^-$, $t\mathbf{s}^+ = \mathbf{S}^+$ a $t\boldsymbol{\lambda} = \boldsymbol{\Lambda}$, *SBMt* is converted into

$$(SBMt) \quad \min \quad \tau = t - \frac{1}{m}\sum_{i=1}^{m} S_i^- / x_{i0} \tag{2.6}$$

$$\text{s.t.} \quad t\mathbf{x_0} = X\mathbf{\Lambda} + \mathbf{S}^-$$

$$t\mathbf{y_0} = Y\mathbf{\Lambda} - \mathbf{S}^+$$

$$\mathbf{\Lambda} \geq 0,\ \mathbf{S}^- \geq 0,\ \mathbf{S}^+ \geq 0,\ t > 0.$$

The dual linear program associated with $SBMt$ is

$$\max_{\xi,\mathbf{v},\mathbf{u}} \quad \xi \tag{2.7}$$

$$\text{s.t.} \quad \xi + \mathbf{v}\mathbf{x_0} - \mathbf{u}\mathbf{y_0} = 1$$

$$-\mathbf{v}X + \mathbf{u}Y \leq \mathbf{0}$$

$$\mathbf{v} \geq \frac{1}{m}[1/\mathbf{x_0}]$$

$$\mathbf{u} \geq \frac{\xi}{s}[1/\mathbf{y_0}]$$

The first constraint enables to write the objective function as $\max \mathbf{v}\mathbf{x_0} - \mathbf{u}\mathbf{y_0}$ with the last constraint for $\mathbf{u}$

$$\mathbf{u} \geq \frac{1 - \mathbf{v}\mathbf{x_0} + \mathbf{u}\mathbf{y_0}}{s}[1/\mathbf{y_0}].$$

After solving *SBMt* formulated by 2.6 or 2.7, one can go back to $\mathbf{s}^{0+}$, $\mathbf{s}^{0-}$, $\boldsymbol{\lambda}^0$ as optimal solutions of *SBM* and determine ρ^0 for DMU_0. Efficient DMUs will have values of ρ equal unit. Inefficient ones will have $\rho < 1$ due to positive slack variables $\mathbf{s}^{0+}$, $\mathbf{s}^{0-}$ which express deviation from the frontier or "potential". Projections to the frontier are thus given by

$$\hat{\mathbf{x}}_\mathbf{0} \Leftarrow \mathbf{x_0} - \mathbf{s}^{-0} \tag{2.8}$$

$$\hat{\mathbf{y}}_\mathbf{0} \Leftarrow \mathbf{y_0} + \mathbf{s}^{+0}$$

Indexes of variables $\lambda_j > 0$ constitute the reference set R_0 (efficiency frontier), every frontier point $(\mathbf{x}_\mathbf{0}^*, \mathbf{y}_\mathbf{0}^*)$ being positive linear combination of the other elements of the reference set:

$$\hat{\mathbf{x}}_\mathbf{0} = \sum_{j \in R_0} \mathbf{x}_j \boldsymbol{\lambda}_j,\ \hat{\mathbf{y}}_\mathbf{0} = \sum_{j \in R_0} \mathbf{y}_j \boldsymbol{\lambda}_j$$

It obvious from the construction of ρ that it takes into account all the sources of inefficiency and therefore $\rho_{\text{SBM}} \leq h_{\text{CCR}}$. *SBM* efficient DMUs are also CCR efficient but not the other way round. It is possible to give model input or output orientation in order to reflect preferences and feasibility of the policy. Input orientation is carried out by omitting output *slacks* in (2.2.4):

$$\min \quad \rho = 1 - \frac{1}{m}\sum_{i=1}^{m} s_i^- / x_{i0}$$

$$\text{s.t.} \quad \mathbf{x_0} = X\boldsymbol{\lambda} + \mathbf{s}^-$$

$$\mathbf{y_0} = Y\boldsymbol{\lambda} - \mathbf{s}^+$$

$$\boldsymbol{\lambda} \geq 0,\ \mathbf{s}^- \geq 0,\ \mathbf{s}^+ \geq 0.$$

Output orientation (*SBM-O*) is achieved in a similar way by omitting input *slacks*:

$$\begin{aligned} \min \quad & \rho = \frac{1}{1 + \frac{1}{s}\sum_{r=1}^{s} s_r^+ / y_{r0}} \qquad (2.9) \\ \text{s.t.} \quad & \mathbf{x_0} = X\boldsymbol{\lambda} + \mathbf{s}^- \\ & \mathbf{y_0} = Y\boldsymbol{\lambda} - \mathbf{s}^+ \\ & \boldsymbol{\lambda} \geq 0,\ \mathbf{s}^- \geq 0,\ \mathbf{s}^+ \geq 0. \end{aligned}$$

2.2 Modelling undesirable outputs

Once the measure of efficiency has been defined, one can proceed to evaluating eco-efficiency. Individual European countries will be considered as 29 DMUs. As the concept encompasses two dimensions, it´s natural to divide the problem of evaluation into two separate parts – economic and "ecological" performance, the former being evaluated using the classical approach described above. In order to assess ecological efficiency, an SBM model can be employed with GDP acting as output and emissions as inputs which is in line with the work of Korhonen and Luptáčik (2004) where such specification is justified along with the assumption of *strong disposability* of outputs. Thus, model denoted *tech* gives values of technical efficiency evaluating use of capital and labor for producing output while model *eco* provides information on the efficient (i.e. as little as possible) "use" of emissions. This is a "pure ecological efficiency" approach of Kuosmanen and Kortelainen (2005). Each model gives values describing the two dimensions. To obtain the overall indicator, the two values have to be combined in a composite model. Such model is constructed by taking *tech* and *eco* scores as outputs for the composite output oriented model, inputs being equal unit. The resulting *eco_tech* score can be considered a measure of eco-efficiency. For the further progress, modelling undesirable outputs as additional inputs (Model B from Korhonen and Luptáčik, 2004) is adopted.

3 Convergence analysis

3.1 Data and models

For empirical analysis, two standard technical inputs – capital stock (*K*) measured in mil. EUR and labour (*L*) in thousands of workers were used. Units of measurement can be arbitrarily chosen since as has been shown in Section 2 SBM models have unit invariance property. The same applies to technical output GDP (*Y*) measured in mil. EUR. Emissions come in thousands of ton of greenhouse equivalent acting as undesirable output associated with the production. All data come from European databases AMECO and Eurostat. For intertemporal analysis, data from 29 DMUs (European countries) of 2000 and 2010 have been used. Statistical properties of the data for 2000 and 2010 are displayed in Table 1.

Table 1 Statistics on Input/Output Data

2000 2010

	K1	L1	E1	Y1
Max	6012960,0	39382,0	1038999,0	1840730,7
Min	14466,3	156,4	3845,0	7049,8
Avg	1050117,6	8079,9	191296,3	352374,6
SD	1454945,8	9769,7	245822,9	487381,2

	K2	L2	E2	Y2
Max	6466000,0	40603,0	936544,0	2028463,7
Min	21078,6	167,2	4542,0	8750,3
Avg	1288951,0	8494,5	178059,9	409727,7
SD	1705341,9	10264,7	222615,3	540928,3

Correlation

	K1	L1	E1	Y1
K1	1	0,973	0,975	0,992
L1	0,973	1	0,989	0,973
E1	0,975	0,989	1	0,971
Y1	0,992	0,973	0,971	1

Correlation

	K2	L2	E2	Y2
K2	1	0,979	0,964	0,994
L2	0,979	1	0,989	0,985
E2	0,964	0,989	1	0,973
Y2	0,994	0,985	0,973	1

Source: author´s calculation

As could be expected, the data show quite a big variance due to variability in size of individual economies.

3.2 Models and eco-efficiency scores

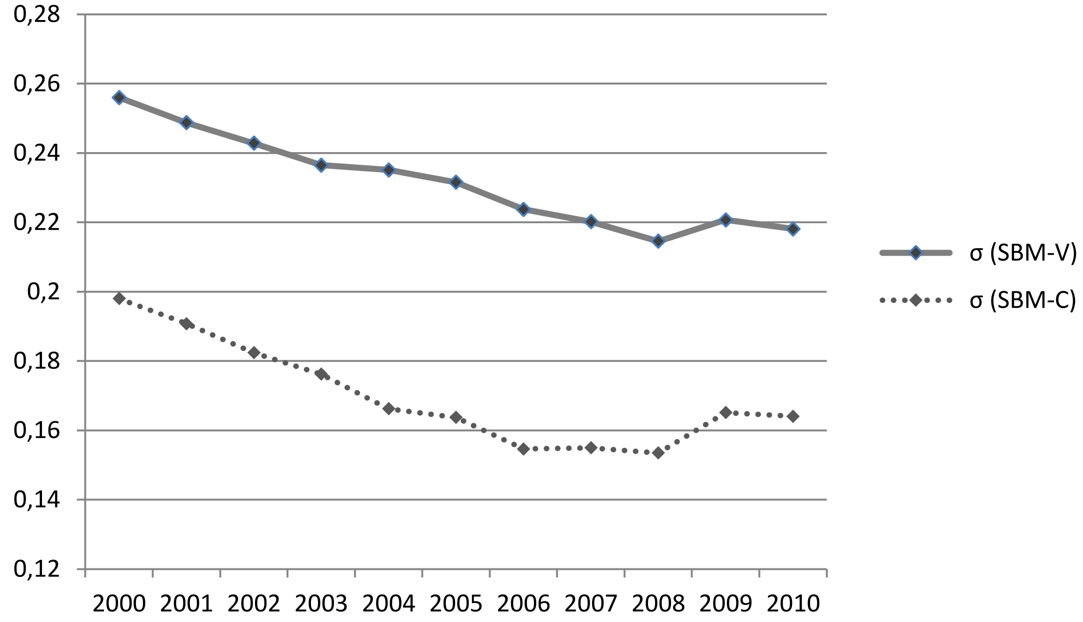
Having selected eco-efficiency measurement method a collected data, one can compute eco-efficiency scores for individual countries for each year from the span 2000 – 2010. Number of DMUs $n = 29$. Two variations of SBM model are run – with constant and variable returns to scale assumption denoted SBM-C and SBM-V. Variable returns to scale presumably better reflect different size of the economies evaluated. Models are non-oriented to capture all sources of inefficiency both on the part of outputs and inputs. Thus one obtains 11 samples for individual years each containing eco-efficiency scores of 29 DMUs . Results from SBM-V and SBM-C are exhibited in Table A1 and Table A2 in Annex.

3.3 Convergence assessment

3.3.1 σ-convergence

There are several approaches to investigating convergence with respect to economic performance. Analysing distribution of eco-efficiency scores among countries, we adopt standard approach of second moments in line with classical approach to convergence to establish whether the variance (or standard deviation) of the scores increases over time (σ-convergence). We do not compare two distant periods of time but rather focus on how the variance behaves during the period subject to analysis. Having computed 11 variances of eco-efficiency scores (Table 2), a time series model is selected to describe evolution over time. Time series plot of both CRS and VRS-based standard deviations of the eco-efficiency scores exhibited in Figure 1 suggest that there is a constant decline in time and a simple model with an autoregressive term should be sufficient to describe the change of variance over time. There is also a break in the time series starting in 2009 to be seen.

Figure 1 Time series of standard deviations of *EE* scores



Source: author´s elaboration

Results comprising coefficients and respective p-values of t-statistics are shown in Table 2 as well as some other test statistics. It is clear that the process is sufficiently described by the autoregressive term of order one. Chow forecast test was carried out to check the 2009 break point which proved to be significant at the 5% level.

Table 2 AR(1) model for standard deviation of *EE* scores

	SBM-C		SBM-V	
	Coefficient	p-value	Coefficient	p-value
constant	0,16	0,00	0,03	0,01
AR(1)	0,73	0,00	0,83	0,00
Inverted AR Roots	0,73		0,83	
R-squared	0,85		0,93	
AIC	-7,53		-9,57	
Chow forecast	0,02		0,05	

Source: author´s calculations

3.3.2 β-convergence

Staying in line with the previous productivity analyses, the following step is made to answer the question whether poorer performance in the past periods imply stronger improvement which would contribute to convergence. We thus run the cross-sectional regression

$$\ln(EE_{j,2010} / EE_{j,2000}) = \alpha + \beta.\ln(EE_{j,2000}) + \varepsilon_j \, , \tag{3.1}$$

where a country´s eco-efficiency at the time t is denoted $EE_{j,t}$ taking a look at whether countries with a poorer performance achieve significantly better results in increasing their eco-efficiency. Coefficients computed are shown in Table 3 accompanied by relevant test statistics, serial correlation of residuals was checked up to lag 4. Again, variants for CRS and VRS are displayed.

Table 3 β-convergence regression results

	SBM-C		SBM-V	
	Coefficient	p-value	Coefficient	p-value
constant	0,43	0,00		
EE_2000	-0,46	0,00		
R-squared	0,58		0,70	
AIC	-2,16		-2,22	
Serial corr(4)		0,17		0,16

Source: author´s calculations

Results presented in Table 3 suggest that there is an evidence of convergence in both variants of computing EE, i.e. there have been a convergence process taking place in Europe in the period of time analyzed.

4 Conclusion

Eco-efficiency has become part of the decision-making process both on firm and macroeconomic level. Non-parametric approach employed in the analysis is a proper tool to assessing efficiency in case quantities measured in physical units like pollutants are involved. Models identified eco-efficiency frontiers as well as generated eco-efficiency scores. Detailed outcomes may be subject to further analysis providing more insight into the sources of inefficiency. Time series of obtained eco-efficiency scores from SBM models were used to infer on the σ- and β-convergence analysed in line with the classical econometric approach.

Convergence analysis results suggest that despite many differences in economic performance, environmental standards, or access to technology, in the span 2000 – 2010, a process of convergence with respect to eco-efficiency has been taking place in European countries. The results appeared robust as to return of scale assumption staying qualitatively stable for both constant and variable returns to scale. The process appears to have been disrupted in the most severe period of the crisis but is presumably facilitated by European integration contributing thus to raising the standards of living.

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ANNEX

Table A1 Eco-efficiency scores from SBM-V model

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Belgium	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Bulgaria	0,377	0,391	0,411	0,423	0,437	0,450	0,467	0,482	0,510	0,499	0,501
Czech Republic	0,462	0,472	0,476	0,489	0,495	0,513	0,541	0,567	0,588	0,585	0,594
Denmark	1,000	1,000	1,000	0,956	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Germany	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Estonia	0,490	0,506	0,534	0,539	0,530	0,545	0,584	0,582	0,555	0,518	0,522
Ireland	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	0,927	1,000	1,000
Greece	0,606	0,630	0,643	0,669	0,673	0,660	0,683	0,694	0,706	0,724	0,693
Spain	0,894	0,903	0,888	0,871	0,848	0,830	0,829	0,809	0,835	0,854	0,858
France	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Italy	1,000	1,000	1,000	1,000	1,000	0,969	0,942	0,914	0,916	0,911	0,918
Cyprus	0,687	0,701	0,698	0,684	0,662	0,653	0,677	0,703	0,735	0,743	0,760
Latvia	0,610	0,627	0,653	0,675	0,686	0,706	0,751	0,778	0,738	0,647	0,621
Lithuania	0,563	0,589	0,611	0,661	0,666	0,681	0,745	0,787	0,799	0,697	0,712
Hungary	0,567	0,577	0,595	0,603	0,610	0,611	0,627	0,629	0,648	0,632	0,633
Malta	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Netherlands	0,899	0,898	0,884	0,867	0,864	0,866	0,872	0,875	0,895	0,890	0,878
Austria	0,911	0,894	0,887	0,861	0,846	0,828	0,837	0,851	0,869	0,881	0,861
Poland	0,578	0,575	0,578	0,586	0,599	0,602	0,616	0,633	0,660	1,000	0,696
Portugal	1,000	0,856	0,740	0,733	0,709	0,686	0,698	0,715	0,725	0,733	0,774
Romania	0,352	0,372	0,391	0,408	0,433	0,443	0,468	0,496	0,530	0,515	0,510
Slovenia	0,671	0,667	0,671	0,683	0,677	0,677	0,705	0,741	0,753	0,720	0,731
Slovakia	0,485	0,488	0,502	0,517	0,526	0,545	0,581	0,644	0,670	0,669	0,697
Finland	0,810	0,802	0,794	0,784	0,797	0,838	0,867	1,000	1,000	0,905	0,916
Sweden	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
United Kingdom	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Island	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Norway	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Switzerland	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Source: author´s calculations

Table A2 Eco-efficiency scores from SBM-C model

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Belgium	0,866	0,861	0,859	0,856	0,853	0,848	0,869	0,904	1,000	1,000	1,000
Bulgaria	0,376	0,390	0,410	0,422	0,433	0,433	0,467	0,482	0,508	0,497	0,499
Czech Republic	0,462	0,472	0,476	0,487	0,492	0,508	0,535	0,564	0,584	0,578	0,594
Denmark	0,890	0,882	0,890	0,873	0,877	0,888	0,902	0,934	1,000	1,000	1,000
Germany	0,742	0,742	0,736	0,733	0,723	0,718	0,740	0,766	0,782	0,769	0,792
Estonia	0,480	0,500	0,523	0,533	0,529	0,537	0,581	0,579	0,545	0,501	0,508
Ireland	1,000	1,000	1,000	1,000	0,877	0,868	0,887	1,000	0,876	1,000	1,000
Greece	0,589	0,610	0,619	0,644	0,646	0,635	0,668	0,691	0,703	0,706	0,693
Spain	0,798	0,803	0,785	0,783	0,757	0,739	0,750	0,751	0,771	0,795	0,790
France	0,882	0,881	0,870	0,864	0,854	0,840	0,855	0,857	0,860	0,872	0,861
Italy	0,881	0,881	0,863	0,843	0,828	0,813	0,824	0,831	0,834	0,839	0,838
Cyprus	0,652	0,670	0,664	0,657	0,650	0,651	0,662	0,692	0,724	0,734	0,743
Latvia	0,590	0,612	0,632	0,658	0,675	0,701	0,744	0,776	0,710	0,614	0,587
Lithuania	0,554	0,581	0,600	0,655	0,665	0,673	0,715	0,753	0,787	0,679	0,699
Hungary	0,567	0,577	0,594	0,603	0,610	0,611	0,627	0,627	0,646	0,632	0,629
Malta	0,801	0,772	0,772	0,753	0,737	0,734	0,742	0,746	0,781	0,791	0,806
Netherlands	0,818	0,816	0,800	0,795	0,788	0,790	0,812	0,839	0,860	0,844	0,859
Austria	0,879	0,857	0,846	0,823	0,815	0,804	0,829	0,851	0,868	0,880	0,860
Poland	0,535	0,536	0,542	0,556	0,563	0,561	0,585	0,614	0,648	0,685	0,696
Portugal	0,802	0,776	0,731	0,726	0,704	0,683	0,697	0,714	0,724	0,732	0,774
Romania	0,352	0,372	0,391	0,408	0,433	0,432	0,468	0,495	0,529	0,514	0,509
Slovenia	0,657	0,655	0,658	0,671	0,669	0,671	0,694	0,726	0,738	0,702	0,707
Slovakia	0,483	0,486	0,499	0,515	0,525	0,544	0,579	0,641	0,667	0,664	0,689
Finland	0,809	0,800	0,792	0,783	0,797	0,830	0,835	0,895	0,946	0,891	0,916
Sweden	1,000	1,000	0,970	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
United Kingdom	0,877	0,889	0,907	0,927	0,901	0,891	0,918	0,958	0,984	1,000	1,000
Island	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Norway	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Switzerland	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Source: author´s calculations