Measuring the influence of landscape on competitiveness of rural areas in Austria

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***Abstract* - In this study we apply a two-stage approach to test whether agricultural landscape has an influence on the competitiveness of rural areas. In the first stage we measure social and economic competitiveness of rural municipalities with a Data Envelopment Analysis (DEA) model. In the second stage we analyse with a regression model which landscape related and non-landscape related factors are driving competitiveness. The results show that, despite of data limitations, DEA is an applicable method and the results can be explained by up-stream qualitative research in four selected case study municipalities in the area of *Mittleres Ennstal*. The second stage analysis show that in particular non-landscape related factors are driving regional competitiveness.**

INTRODUCTION

The question how to measure 'regional competitiveness' is subject to a rather long-standing, yet still ongoing discussion – both on scientific and political level. Literature reveals that economic factors alone cannot represent all assets characterizing a region as social and sustainability factors must also be taken into account (e.g. European Commission, 2009; Porter, 1992).

In recent literature, increasingly the question is raised how and to which extent landscape can represent a factor of territorial development and regional competitiveness (e.g. van Zanten et al., 2013; Cooper et al., 2009). The cause-effect chains between the supply of goods from landscapes and the development and competitiveness of rural regions still remain mostly unclear and difficult to assess.

Against these backgrounds our paper aims at answering two main questions. First, we apply Data Envelopment Analysis (DEA) to measure the competitiveness of rural regions both in its economic and social sense in terms of "efficiency" on municipality level. Second, the paper targets to assess the influence of landscape on the competiveness of a region. Here we apply a linear regression model to selected, both landscape and non-landscape related factors. A special focus we put on the results of four rural municipalities located in an area *Mittleres Ennstal*.

METHODS

To analyse the competitiveness of rural municipalities, we conduct a Data Envelopment Analysis (DEA). The result is a technical efficiency score between 0 and 1 derived within DEA by benchmarking the output-to-input ratio of each observation against the output-to-input ratio of those with the best performance (Charnes et al. 1978). For our DEA model we choose an output orientation and we assume constant returns to scale. In a second stage we conduct a multiple linear regression analysis to measure potential influence of landscape related and non-landscape related factors. This means that we utilise our DEA efficiency scores as dependent variable and regress it on the contextual variables.

A list of all factors used in our analysis is provided in Table 1. In general, when choosing our input and output factors it became clear that most of the suggested economic and social indicators in literature are either not suitable for describing rural areas (in contrast to urban areas) or not available on municipal level in Austria. Therefore, we decided to choose population as input factor and education level, economic performance, employment rate and population development as output factors. The basic idea of this model is that the 'population' of a specific community is the main 'input' for economic and social outcome.

Table1. Factors for DEA and second stage regression.

Factors for DEA	**Explanation**
Population (I)	Number of population
Education level (O)	Highest educat. attainment
Economic performance (O)	Municipal tax (€)
Employment rate (O)	Number of pers. employed
Population development (O)	Population Change, 2002-10
Landscape related contextual Variables	**Explanation**
Openness of landscape (OL)	Proportion of non-forestry to forestry area (%)
Mountainous landscape (ML)	Altitude diff. btw. highest a. lowest agricultural field (m)
Characteristic Landscape (CL)	Landscape showing diverse/ complex structure (ha)**
Mountain pastures (MP)	(ha)
Non-landscape related contextual Variables	**Explanation**
Tourism (T)	Overnight Stays
Location (ND)	Dist. to next urban area (m)
Value of Land (VL)	Land tax (€)

* I=Input; O=Output
** Selected areas based on the classification of CORINE land cover: Heterogenous agricultural areas; shrub and/or herbaceous vegetationassociation; open spaces with little vegetation; inland wetlands

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We apply our model in three model regions: model region 1 consists of rural municipalities concerning Statistics Austria, model region 2 consists of rural and mountainous municipalities and model region 3 comprises rural, mountainous municipalities with tourism. Four case study municipalities are of specific interest in our analysis, namely *Aigen im Ennstal*, *Oppenberg*, *Pürgg-Trautenfels* and *Stainach*, all placed in the region *Mittleres Ennstal*. The main source of data for measuring regional competitiveness is taken from a public database *Statcube* run by Statistics Austria, the *CORINE landcover* from the Austrian Federal Environmental Agency and *INVEKOS* farm data from the Austrian Federal Ministry of Agriculture.

Results

The basic DEA results are presented in Table 2. Municipalities with high efficiency scores are particularly located to densely populated areas. Such agglomerations of highly efficient municipalities can be especially found in the areas around the largest Austrian cities. Municipalities located in the alpine areas show in general lower efficiency scores with a few exceptions, which are mostly municipalities of high touristic importance.

Table 2. Results DEA efficiencies.

	Model 1	Model 2	Model 3
Number total DMUs	1988	710	649
Efficient DMUs	7	11	11
Minimal*	0.70	0.76	0.76
Mean*	0.82	0.88	0.88
SD*	0.04	0.05	0.05
Stainach	0,85	0,92	0,92
Aigen im Ennstal	0,81	0,87	0,87
Pürgg-Trautenfels	0,80	0,86	0,86
Oppenberg	0,77	0,83	0,83

*based on efficiency scores of DEA

Looking at our case study municipalities, in all 3 model regions *Stainach* is the highest ranked case study municipality and is futhermore the only municipality with an efficiency score in the first quantile. The rank order is identical in all three models and the two municipalities located in the main valley show higher efficiency scores than the two municipalities located in side valleys.

The regression results are presented in Table 3. R^2 is the highest in model 1 followed by model 3 and model 2. The p-value indicates a high significance of all three models.

Table 3. Results second stage, OLS regression.

	Model 1	Model 2	Model 3
R^2	0.1898	0.0981	0.1592
Adj. R^2	0.1878	0.0905	0.1513
p-value	<2e-16	1.076e-13	6.371e-08
(log)T	0.0015***	0.0025***	0.0094***
(log)ND	-0.0215***	-0.0131***	-0.0121***
OL	0.0083**	-0.0133.	-0.0211**
(log)ML	-0.0098***	-0.0159***	-0.0168***
(log)CL	0.0002	-0.0003	-0.0009
(log)MP	-	0.0021	-0.0006

significance levels: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' '

Discussion

When looking at our DEA results, we observe that they are consistent to a high degree, despite the data limitations mentioned above. This becomes clear particularly when putting the results into a spatial context, as municipalities near big cities show higher efficiency scores. The consistency of the DEA results is also confirmed by our case study municipalities: The highest efficiencies we detect for the main-valley municipality *Stainach*. Referring to our up-stream qualitative research results, this is not surprising. In *Stainach*, the urban centre is located and a major local food industry company is offering broad employment possibilities.

Another demonstration that our model is reliable is given by the correlation between the DEA efficiencies and the value of land. This correlation is rather convincing, since the value of land (representing on the one hand the quality of agricultural area and on the other hand the real-estate and building values) to a high extent mirrors the competitiveness of a region.

As regards landscape related factors our results show that their influence on regional competitiveness is far lower than the influence of non-landscape related factors. The influence of the landscape factor OL varies throughout our three model regions as regards algebraic sign. While in Model region 1 the influence of OL is positive, in the 'mountainous' model regions 2 and 3, the influence is negative. This result is not surprising, as model 1 includes high percentages of productive, flat and open landscapes with good agricultural pre-conditions.

The last result of our analysis to be discussed is the influence of the factors CL and MP, which both represent very typical elements for Austrian mountainous landscape and, consequently, match very clearly the aesthetic and intrinsic value of landscapes. Our results reveal that such factors have no significant influence on competitiveness.

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