ESPON

ADES

Airports as Drivers of Economic Success in Peripheral Regions

Targeted Analysis 2013/2/17

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This report presents the interim results of a Targeted Analysis conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund.

The partnership behind the ESPON Programme consists of the EU Commission and the Member States of the EU27, plus Iceland, Liechtenstein, Norway and Switzerland. Each partner is represented in the ESPON Monitoring Committee.

This report does not necessarily reflect the opinion of the members of the Monitoring Committee.

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This basic report exists only in an electronic version.

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1. MEASURING ACCESSIBILITY

Transport infrastructure plays an important role in the development of regions. According to economic theory, regions with a well established access to markets are more productive, more competitive, and hence basically more successful than regions with less developed access possibilities. Economical reasons for this are lower transport and time costs enterprises and individuals have to bear in easily accessible regions. Such lower costs allow a division of labour between regions and thus regional specialisation, which entails economies of scale and benefits of specialisation. In an increasingly globalised world the extent a region can take part in economic growth and benefits of globalisation depends mainly on its accessibility. This is why the improvement of regional accessibility has a high priority in the European Regional Development Fund (ERDF), one of the four structural funds of the EU.

Accessibility is a complex term. Before specifying indicators it has to be clear what is going to be measured. The concept of accessibility is to evaluate or analyzes this gains to be achieved by accessing other places/regions. The advantages to be gained depend on what can be gained in other regions as well as on the efforts necessary to get access to other regions. In other words, two components of measures are necessary:

- Activity of regions (population, places of work, GDP etc.) and
- impedance (geographical distance, travel cost, travel time etc.).

The accessibility model focuses on the benefits for businessmen and employees, which come along with easy accessible markets for goods and services. This corresponds to the transmission channel of the increased productivity through the more efficient management of existing markets or the opening up of new markets, respectively. However, the costs of travelling reduce the benefits mentioned before. These costs are measured by the travel time (whereby the fastest daily connection is chosen), as well as by considering the geographic distance between the starting points and the destinations. Finally, the travel time is influenced by the chosen mode of transport. In our sample, we take a separate look at the shortest travel time by air, rail and road (multimodal) and the travel time by rail and road only.

The accessibility model calculates specific accessibility values derived from the above specified parameters. These are based on the approach of activity-based gravity indicators (Bleisch 2005). Concerning the travel time they follow the concept of an outbound activity, which means that one considers the travel time needed to reach other regions starting from one certain region. The regional accessibility index is calculated by discounting the sum of the achievable potential by the spatial resistance between starting point and destination. For this purpose we use a factor, which determines the so-called half-value resistance. The half-value resistance indicates at what extent of spatial resistance only half of the destination potential enters the calculation of the accessibility value. The sum of the hereby calculated values over all destinations amounts to the accessibility value of one certain starting point.

Equation

$$A_i = \sum_{j=1}^{m} w_j \cdot e^{-\beta_c \cdot c_{ij}}$$

A_i = Accessibility value of starting point i

w_j = potential/activity of the destination j

c_{ij} = spatial resistance between starting point i and destination j

β_c = spatial resistance sensibility (related to the spatial resistance c).

$e^{-\beta_c \cdot c_{ij}}$ = Discount factor

As this accessibility value is a rather abstract item, the final step includes its indexation. Additionally, it must be mentioned that accessibility is information on points, calculated on the basis of transport networks, which consist of nodes and connections. Therefore for every region (area) one representative junction must be assigned. In the BAKBASEL accessibility model the core city of each region is applied, because this approach coincides with the assumption that regions interact with each other via their core cities. In each city the main train station[1] is assumed to be the geographical center.

Hereafter the calculation and calibration of the parameters potential, activity, spatial resistance and spatial resistance sensibility need to be thoroughly discussed.

Potential/activity w_j

The parameter activity is not represented by the nominal GDP itself, but by the GDP of each destination divided through the sum of the GDPs of all destinations. Thereby one obtains the relative GDP-weight or the "market share" of a destination, which is the coefficient denoted as *w* (for "weight") in the above equation. The reasoning is the following: If the nominal GDP itself was used, the mere GDP-growth of the regions (disregarding any improvements in the infrastructure) would lead to improvements in accessibility. This may be reasonable for certain research questions, however in this study effects would be assigned to the accessibility which are not related with an improved infrastructure. As a result, spurious correlation would emerge. By definition, the weights sum to one.

Moreover, the relative GDP-weights are fixed in one year (the base year). These fixed GDP-weights are used in the accessibility calculations every year. This is reasonable, because, if a group of destinations gains weight in terms of GDP (e.g. Eastern Europe), the outbound accessibility of the cities nearby will improve (e.g. Vienna). Although this effect may be of interest for certain issues, in the context of this study it would capture implications are not directly linked to any improvements in the infrastructure.

Spatial resistance c_{ij}

In this study accessibility indices are calculated on the basis of two different spatial resistance measures. Basically, accessibility of a region can be divided into two components:

- The geographic location (central or peripheral), abbreviated as Geography or G
- The efforts of transportation (good or bad transport infrastructure and services), abbreviated as Transportation or T

In this context, the geographic location is exogenous and cannot be influenced. However, the efforts of transportation are amenable to be influenced by policy makers. Thus the cross-sectional regression should clarify, in addition to the question whether accessibility has an influence on economic prosperity/economic development, which part of accessibility is responsible for the crucial influence. If it is for the geographic location, all efforts will reach a natural limit at some point. If it is for the efforts of transportation, the endeavours for better accessibility will reach a natural limit sooner or later as well, though there is much more scope to take influence. The systematization is illustrated in the next graph.

Data for the spatial resistance measures of A (overall accessibility, travel time) and G (geographical accessibility, distances) are available. Thus the accessibility indices can be calculated using the above described methods. BAKBASEL receives the travel time data from the Institute for traffic management and transport systems of the Swiss Federal Institute of Technology in Zurich, which calculates this data by evaluating time tables (public transport) and by considering the distances and speed limits (private transport). The calculated global travel time is made up of:

1. Connection time from starting point (main station) to airport based on the road and rail models. The shortest connection of public and individual transport is used.

[1] In cities with more than one important train station (Paris, London) one specific station is chosen.

2. Transfer time from parking facility or public transport stop to check-in desk is assumed to be 10 minutes. Precise calculation of these transfer times for each airport would be prohibitively complicated.
3. Check-in time according to SWISS and Lufthansa, depending on airport and destination. The model uses arithmetic mean from business and economy class check-in times.
4. Flight travel time including time for changing planes, in each case the fastest possible connection assuming maintenance of the MCT (Minimum Connection Time). Plane changing outside Europe also possible.
5. Connection time from arrival airport to the centre of the destination city. Based on the data in official airline guides. The shortest connection of public and individual transport is used.

The following table shows detailed information about the different sources of the Accessibility Index.

Table 1 Accessibility Index: Sources

Source	Indicator	Time Periods Covered
	Original Data	
Institut für Verkehrsplanung und Transportsysteme (IVT) der ETH Zürich / OAG Data Base	Air traffic data	1980, 1991, 1996, 2000, 2002, 2003, 2004, 2006, 2008
Institut für Verkehrsplanung und Transportsysteme (IVT) der ETH Zürich	Rail data	1980, 1990, 2002, 2006, 2008
Institut für Verkehrsplanung und Transportsysteme (IVT) der ETH Zürich	Road data	1980, 1990, 2000, 2008
World Development Indicators (World Bank)	GDP World	1980-2008
BAKBASEL, Eurostat	GDP Europe	1980-2007/08

Source: BAKBASEL

1.1 ACCESSIBILITY INDICATORS: BAKBASEL VS. ESPON

Accessibility indicators were also used in the Interreg III Espon Programme. The Indicator "multimodal potential accessibility" is created by a very similar method like the BAKBASEL continental accessibility indicator. But there are some differences as well: The ESPON indicator uses the regional population as destination activity and the multimodal accessibility doesn't refer to the shortest mode of location, but of a function of the travel times by the three modes (road, rail, air).

The geographic distance is calculated as linear distance between starting point and destination. The sample allows for the earth's curvature, although the earth is approximately considered as a geometric ball. The linear distance (distance *d*) is calculated by the formula below:

Equation

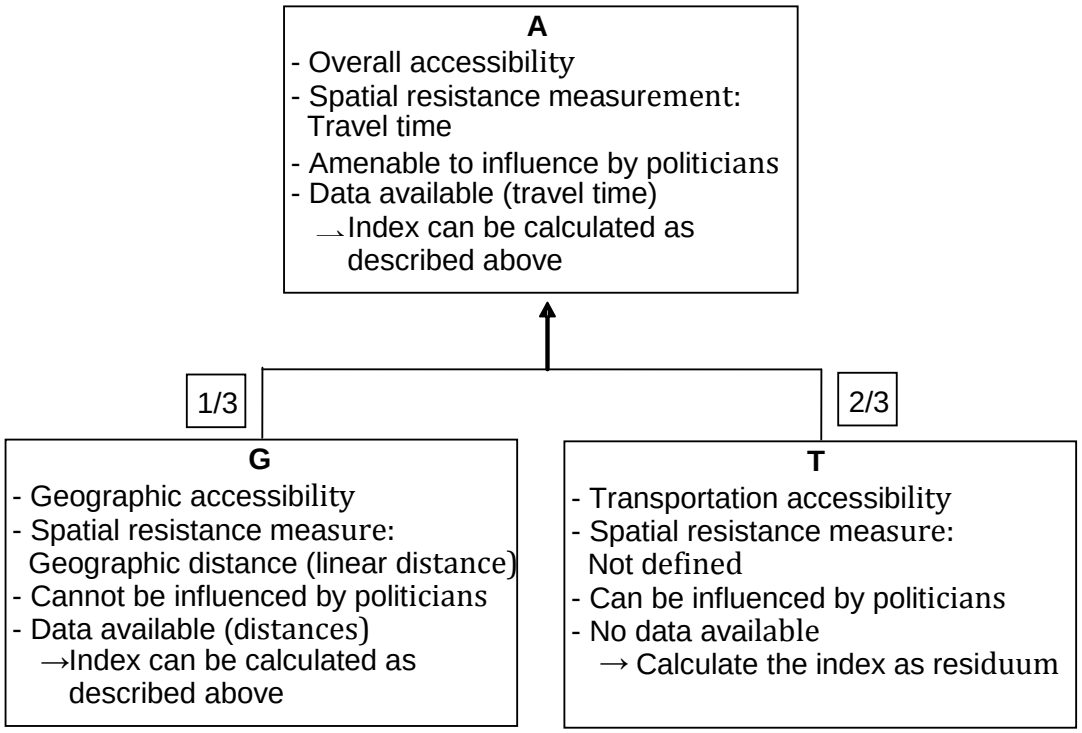
$$d = \arccos\left(\sin(\varphi_1)\sin(\varphi_2) + \cos(\varphi_1)\cos(\varphi_2)\cos(\lambda_2 - \lambda_1)\right) r_E$$

φ_i = geographic width of city i (in radian measure)

λ_i = geographic length of city i (in radian measure)

r_E = earth radius (in km), the mean radius of 6371.0008 km is used

Figure 1 Classification of the overall accessibility



Source: BAKBASEL

The definition of a spatial resistance measure for T (transportation accessibility) is incomparably more difficult. One possibility would be the travel costs, however they cannot isolate the effect of the mere transport efforts. Among others the geographic distance and energy prices (kerosene, fuel, electricity) have an influence on T. Therefore BAKBASEL chooses the approach of calculating T as the residuum of A and G. For this purpose a functional form of the relationship between A on the one side and G and T on the other side must be assumed. BAKBASEL chooses a linear relationship of the following form:

Equation

$$A = a_g \cdot G + a_t \cdot T \Leftrightarrow T = \frac{1}{a_t} \cdot A - \frac{a_g}{a_t} \cdot G$$

BAKBASEL considers the influence of transport infrastructure on the overall accessibility as more important than the influence of geographic distance and therefore the coefficients a_t and a_g are set to the values 2/3 and 1/3. These values are arbitrary and are based on assumptions.

Spatial resistance sensibility β_c

The spatial resistance sensibility parameter must be calibrated in a way that, in the respective context, a reasonable half-value resistance results. The parameter β distinguishes itself

concerning the chosen spatial resistance measure c : As travel time and geographic distance are measured in different scale units, it is not possible to use the same β -value. In this study the following approach is chosen in order to reach consistent β -values:

1. Reasonable half-life periods and thus β -values for the spatial resistance measure travel time are defined based on typical time distances within a spatial level.
2. In order to ensure that the discount factor in Equation yields values in the same order of magnitude for the spatial resistance measure geographic distance as for the measure travel time, the β -values for the resistance measure geographic distance is defined as the following:

Equation

$$\beta_d = \beta_c \cdot \frac{\mu_{c_{ijbaseyear}}}{\mu_{d_{ij}}}$$

c_{ijt} : Travel time between starting point i and destination j at the time t

d_{ij} : Distance between starting point i and destination j (constant in time)

β_c : Parameter concerning travel time sensibility

β_d : Parameter concerning distance sensibility

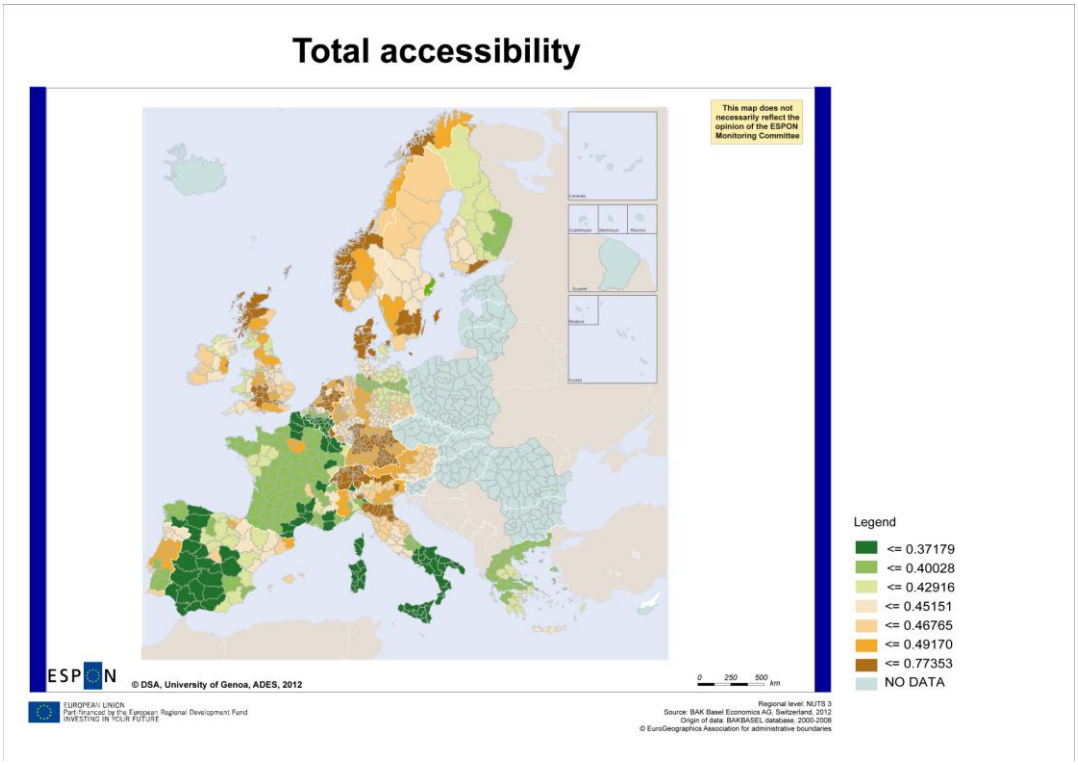
μ_A : Sample-average (non-weighted) of variable A within the cross-sectional dimension

Stylized Facts

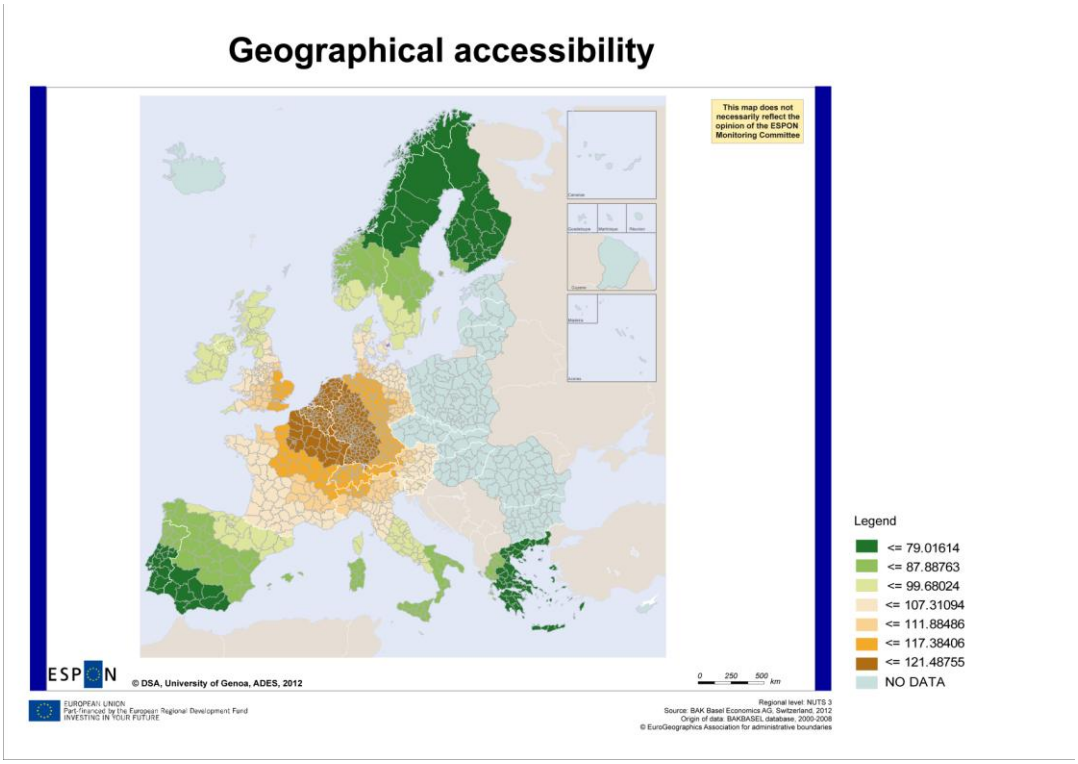
In the following three maps the mean values of the accessibility indices over the period 2000-2008 for total accessibility (A), the geographical accessibility (G) and the transport accessibility (T) are depicted in terms of the multimodal mode of transport. The geographical accessibility (G) clearly shows that the economic centre of gravity of Western Europe is located in the triangle «London/Berlin – Paris – Ruhr area». Around this core area the geographic accessibility declines in the form of concentric circles. Regions that are close to the centre perform well in terms of total accessibility (A) only due to their geographical proximity to this centre. Rather peripherally located regions are clearly harder to reach. However, regions with an important intercontinental airport (e.g. Stockholm or Madrid) stand out especially in terms of transport activity (T). Stockholm clearly illustrates that despite of geographical disadvantages the total accessibility is not necessarily bad.

Dusseldorf (DEA1) boasts the highest total accessibility index value (122.4). Dusseldorf is not only located in the Ruhr area and thus in the heart of Europe, it also has an important international airport which results in the leader position in terms of transport accessibility. Other regions with very high total accessibility include Île-de-France (FR1, 120.6), Cologne (DEA2, 120.6), Brussels (BEL1, 118.8), Noord-Holland (NL32, 118.5), Rhine-Hesse-Palatinate (DEB3, 118.2), Outer London (UKI2, 118.2), Inner London (UKI1, 118.2), Darmstadt (DE71, 117.4) and Stuttgart (DE11, 117). They all exhibit a total accessibility value exceeding the average of the sample (incl. Luxemburg) plus 5/3 standard deviations and are coloured with the darkest shading. In total, it should be noted that the west European metropolises are clearly recognizable (A) and that in the centre of gravity several less important regions (e.g. Zeeland, NL34) benefit from their geographic location.

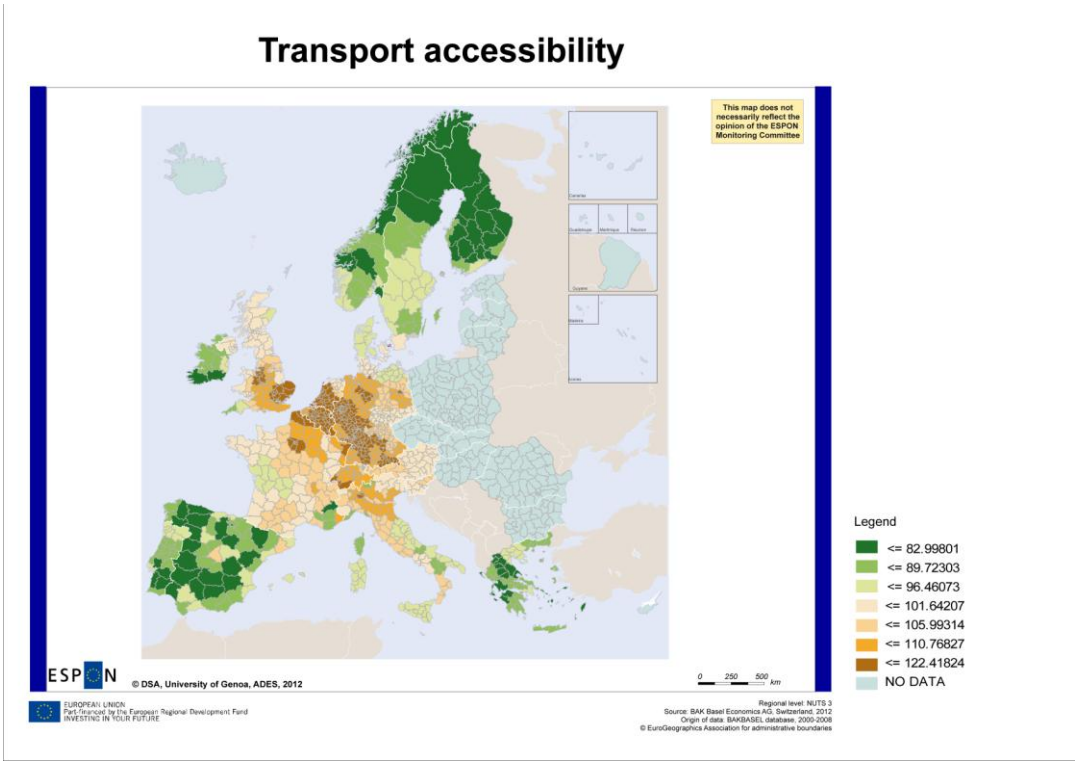
This becomes more apparent regarding transportation accessibility (T) where the metropolises stand out even more clearly. Zeeland (NL34), for example, slips down from the 13th rank to the 21st rank and is overtaken by West Midlands (UKG3), Berlin (DE30), Utrecht (NL31), Milano (IT205) and Greater Manchester (UKD3) among others. This is a clear indication that the proposed concept of subdividing A into G and T achieves, at least partly, to capture the influence of higher transport efforts.



Map 1. Total accessibility (A): Multimodal, Europe, 2000-2008



Map 2. Geographical accessibility (G): Europe, 2000-2008



Map 3. Transport accessibility (T): Multimodal, Europe, 2000-2008

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ANNEX 2. PANEL CAUSALITY TEST

1. THE CAUSALITY BETWEEN REGIONAL AIRPORTS AND REGIONAL GROWTH IN EUROPE

1.1 INTRODUCTION

The role of airports has become increasingly important with growing globalization. Air transportation as well as transportation in general can be seen as a facilitator that allows the economic potential of a region to be realized (Alkaabi and Debbage 2007; Debbage and Delk 2001; Goetz 1992). The provision of transportation does not, however, automatically lead to economic development. It may also be the other way round: economic development leads to the provision of transportation. Thus, while there is typically a strong correlation between air traffic and economic growth, the direction of causation is not entirely clear (Green 2007; Button et al. 2010). The causality may run primarily from transport infrastructure and accessibility to economic development, stressing supply side elements. In this case, airports act as a catalyst for local investment. On the other hand, it may primarily be economic development which determines transportation needs and services, stressing demand side elements. A largely unsettled question is which is stronger effect, the demand effect or the supply effect.

Evaluating the character of the causal relationship between two variables is not without problems. Attempting to get to the core of causal processes is an issue that is central to what econometricians do, and some progress has been made. Earlier airport studies by Brueckner (2003) and Green (2007) took advantage of the method of instrumental variables (IV) in panel data to control for the potential endogeneity of airline traffic. The problem, as almost always with the IV method, is to find appropriate instruments which, in this case, would explain only airport activity but not regional growth.

Button et al. (1999) used Granger causality tests to elicit that airport traffic leads development. Granger causality tests are designed to show causation by examining whether lagged values of (say) one variable, *x,* carry explanatory power in the presence of lagged values of the dependent variable, *y* and possibly other covariates, *z*. This exploits the fact that in time series there is temporal ordering, and the belief that effects cannot occur before causes. Conventional Granger causality test utilize time series data only from one observation, as was the case in the study of Button et al. (1999). Granger tests are, however, increasingly being used to evaluate causal relationships in panel data. Panel Granger tests are significantly more efficient than conventional Granger tests (Baltagi 2005; Hurlin and Venet 2001 and 2005; Hood III et al. 2008). But a potential flaw shared by many analyses is an inappropriate assumption of causal homogeneity. The literature based on early work by Hsiao (1986) and Holtz-Eakin et al. (1988) largely ignores the possibility of heterogeneity. A causal relationship may be present only in a subset of cross-sections and not in others. In our case, some airports may have a causal effect on development, while others do not have it, and vice versa.

To address the existence of causality, the nature of the relationship between regional development and transport infrastructure, i.e., air traffic is evaluated in this chapter. We ask whether accessibility is a key factor to economic success, or rather a consequence of it. As this question is of utmost importance for regional policy makers, we will analyze this causality in detail. In order to test the relative importance of various effects, the Granger non-causality method in a panel framework is applied. To be able to deal with the possible problem of heterogeneity, we employ the Hurlin and Venet (2001 and 2005) procedure, in which three distinct scenarios are identified to describe the possible causal processes: homogeneous non-causality, homogeneous causality and heterogeneous non-causality.

The chapter aims to shed further light on the relationship between regional airports and economic performance in different type of regions, including also remote and small airport regions. Prior studies of the economic impact of air transportation on regional development are small in number and concentrated mainly on large airports of the core regions (see, however, Button et al. 2010). In this chapter, we are especially interested in whether there are differences in causal processes between core and peripheral regions. Causality between regional performance and air traffic may vary according to peripherality, since especially remote regions need to be accessible via air connections in order to grow. The development of core regions are led by many agglomerative forces - their success is not inevitably dependent on the impact of airports, although they also naturally need efficient airlines.

1.2 METHOD AND DATA

To address the existence of causality, the nature of the relationship between transport infrastructure and economic development is evaluated. Evaluating the character of the causal relationship between two variables is, of course, problematic. A standard tool used in econometrics is the Granger technique, which can, at any rate, be used as a first step in this evaluation. In the case of two variables, say *x* and *y*, the first variable, *x,* is said to cause the second variable, *y,* in the Granger sense if the forecast for *y* improves when lagged values for *x* are taken into account (Granger 1969). By estimating an equation in which *y* is regressed on lagged values of *y* and lagged values of *x,* we can evaluate the null hypothesis that *x* does not Granger-cause *y.* If one or more of the lagged values of *x* is significant, we can reject the null hypothesis that *x* does not Granger-cause *y*.

The introduction of a panel data dimension permits the use of both cross-sectional and time series information to test causality relationships, which apparently improves the efficiency of Granger causality tests (Baltagi 2005; Erdil and Yetkiner 2009). Granger tests can generate significant results with shorter time periods as the number of observations increases. Following Hurlin and Venet (2001; see also Hood III et al. 2008; Erdil and Yetkiner 2009), we consider the variables to be covariance stationary, observed for T periods and N cross-section units (which consist of regions in our case). For each region $i \in [1, N]$, the variable $x_{i,t}$ causes $y_{i,t}$ if we are better able to predict $y_{i,t}$ when using all the available information than when using only some of it.

Let us consider a time-stationary VAR representation, adapted to a panel context. For each region *i* (*i* = 1,…, N) and time period *t* (*t* = 1,…,T) we have

$$y_{i,t} = \sum_{k=1}^{p} \gamma^{(k)} y_{i,t-k} + \sum_{k=1}^{p} \beta_i^{(k)} x_{i,t-k} + v_{i,t} \quad (1)$$

where $v_{i,t} = \alpha_i + \varepsilon_{i,t}$ are *i.i.d.* $(0, \sigma_\varepsilon^2)$ and *p* is the number of lags. The autoregressive coefficients $\gamma^{(k)}$ and the regression coefficients slopes $\beta_i^{(k)}$ are assumed constant for all lag orders $k \in [1, p]$. It is

also assumed that $\gamma^{(k)}$ are identical for all regions, whereas $\beta_i^{(k)}$ are allowed to vary across individual regions. This is a panel data model with fixed coefficients.

Employing conventional Granger tests with panel data is not unproblematic. These problems may be caused by heterogeneity between the cross-section units. The first potential type of cross-section variation is due to distinctive intercepts. This variation is addressed with a fixed effects model in which heterogeneity is controlled by the introduction of individual effects α_i. Another basis for heterogeneity is caused by heterogeneous regression coefficients $\beta_i^{(k)}$. This is a more problematic situation than the first one, and requires a more complex analytical response. If we consider model (1), the general definitions of causality imply testing for linear restrictions on these coefficients. The procedure has three main steps which are related to the homogeneous non-causality, homogeneous causality and heterogeneous non-causality hypotheses (Figure 1).

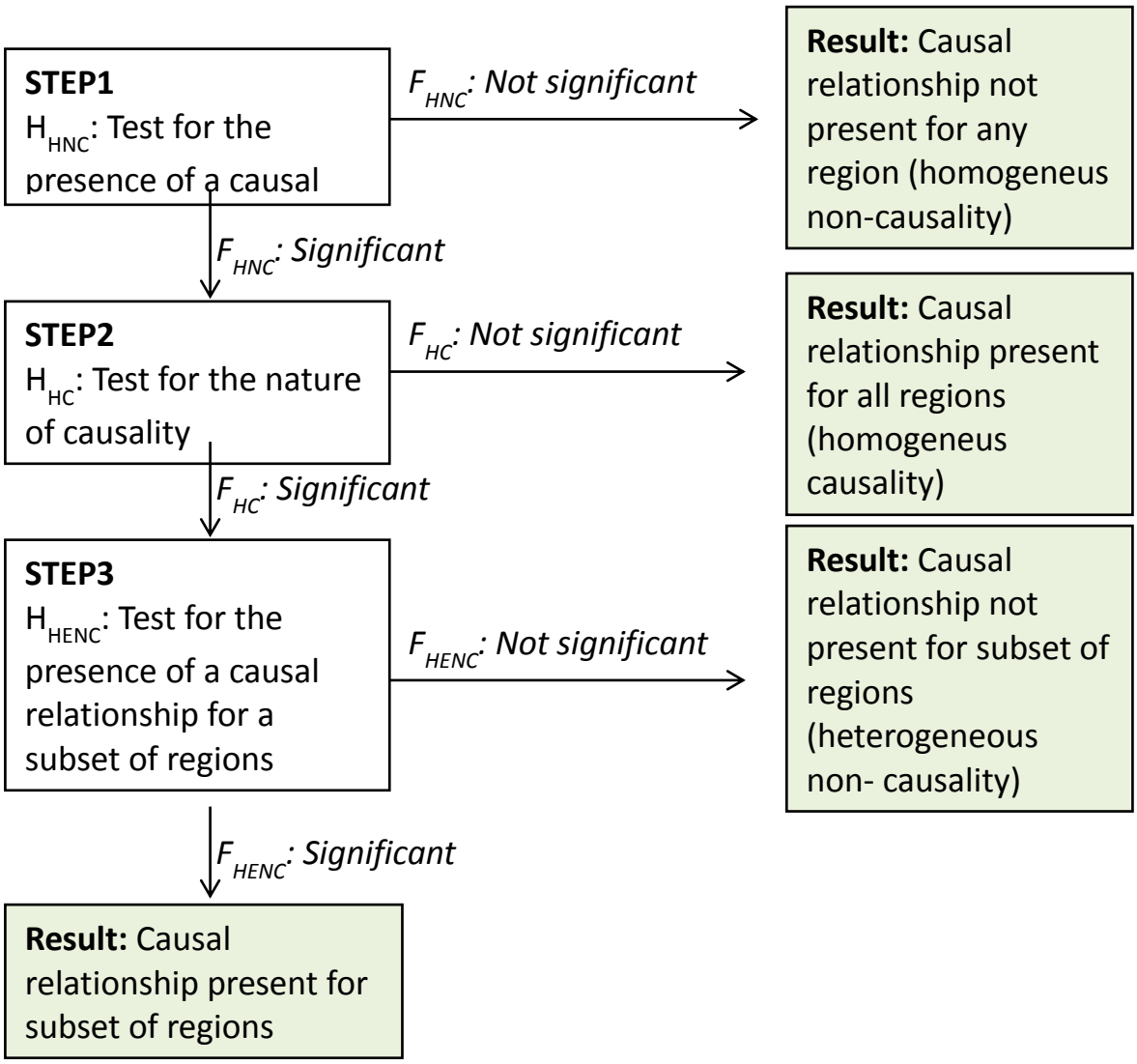

Figure 1. Testing procedure

The empirical analysis is based on regional level data from Europe in the period 1991-2010.[2] To carry out causal analysis between regional development and airport activity, we need two variables for their measurement for which we have different options. For the measurement of regional development, we use two variables, the first one measuring growth in employment and the second one growth in purchasing power corrected real GDP. For the measurement of airport activity, we use a variable depicting development in the number of commercial air passengers. An alternative variable depicts development in freight and mail cargo, but as e.g. Green (2007) and Freestone (2009) stated, this variable is imperfect. In addition, we use a geographical accessibility variable which measures weighted average travel time to 202 NUTS Level 2 regions in Western Europe. The measure is multimodal which takes into account the best combination of air, rail and road. The weight used is the relative GDP ("market share") of each region.

Airport Council International produces data on the use of airports in Europe but this data is limited by the number of reporting airports. The availability of airport data diminishes further as we go back in time. As the availability of airport data is incomplete it reduces remarkably the number of observations (regions) in the analysis. A complete airport data is available in the period 1991-2010 for 86 NUTS Level 2 or 3 regions from 13 countries in Europe (see Appendix). This data set includes 3 regions from Austria, 3 from Switzerland, 13 from Germany, 1 from Denmark, 22 from Spain, 12 from France, 2 from Ireland, 7 from Italy, 1 from Luxembourg, 2 from Holland, 2 from Norway, 3 from Portugal and 15 from the UK. To accomplish the panel causal tests, we have an adequate number of cross-sectional and time-series observations – in fact, the number of cross-sectional observations (regions) in relation to the length of time-series cannot be too large from the point of view of the method. However, there remains a question about the representativeness of the data. As the regions included in the data are distributed quite evenly across Europe, we may consider the data to represent Europe rather well.

To test the heterogeneous non-causality hypothesis in the third step of our testing procedure, we categorize the regions into three groups of equal size by means of the accessibility variable. This allows us to find out whether peripherality explains differences in causal processes. Accessibility is lowest in peripheral regions, highest in core regions and in between in intermediate regions. Table 1 shows that employment as well as real GDP is the higher the more accessible the region is. The number of air passengers is also lowest in peripheral regions and highest in core regions.

Table 1. Means of the variables by region type (yearly averages in 1991-2010)

Region type	Accessibility	Air passengers (1000)	Employment (1000)	Real GDP (Mio euro ppp)
Peripheral	88.7	1 981.8	376.4	19.992.3
Middle	102.4	4 794.8	703.2	44 819.7
Core	113.3	16 539.6	1 154.0	77 196.3
All regions	101.5	7 806.7	745.0	47 365.3

[2] Bak Basel Economics has produced the data set.

The Granger causality tests between regional growth and air transport in 86 European regions are performed for the period 1991-2010, with lags one and two. For both side variables in the analysis, we first take natural logarithms and then difference them in order to eliminate possible unit roots and to reach time stationarity. Consequently, we are in fact analysing growth rates. We follow the nested procedure described above to test different causality relationships. The tests are based on Wald statistics.

1.3 RESULTS

As a first step in exploring bi-directional Granger causality between airport activity and regional development, the homogeneous non-causality (HNC) hypothesis is assessed. The HNC hypothesis implies the non-existence of any individual causality relationships. In model (1), the corresponding test is defined by

$i \in [1, N], \forall k \in [1, p]$

H_1: $\exists$ (i, k) / $\beta_i^{(k)} \neq 0$.

For testing *Np* linear restrictions in (2), the following Wald statistic is computed:

$$(3) \qquad F_{HNC} = \frac{(RSS_2 - RSS_1)/Np}{RSS_1/(NT - N(1+p) - p)} ,$$

where RSS_2 denotes the restricted sum of squares residuals obtained under H_o and RSS_1 corresponds to the residual sum of squares of model (1). If the individual effects α_i are assumed to be fixed, the sum of squared residuals are obtained from the maximum likelihood estimation (MLE), which in this case corresponds to the fixed effects (FE) estimator. It has been shown that the FE estimator is biased in the case where T is small (Nickell 1981), but the bias decreases with T. We favour the FE estimator, since the bias may not be large and its use enables us to follow the testing procedure. Accordingly, the testing procedure can be implemented using the constrained regression technique (Hurlin and Venet 2001; Hood III et al. 2008). Interpretation of the statistic relies on the Fischer distribution with *Np* and *(NT – N(1+p) – p)* degrees of freedom.

For the measurement of regional performance (*y)*, we use two variables, GDP growth and employment growth, while for the measurement of air traffic (*x*) we also have two variables, the number of air passengers and accessibility. Table 2 includes the results from four possible combinations of the variables: air passengers and GDP; air passengers and employment; accessibility and GDP; and accessibility and employment.[3]

[3] In addition, despite its shortcomings, we also estimated the model with the air cargo-variable. The homogenous non-causality hypothesis was not rejected in either case, for which reason the testing procedure stopped in the first step, implying that there would not be causal relations in either direction between air traffic and regional development. This result, however, probably tells more about the limitations of the cargo variable than about the actual state of affairs.

Table 2. Test results for homogeneous non-causality (HNC hypothesis)

Direction of causality and lags	*F-statistic and its significance*			
	Air passengers - GDP	Air passengers - employment	Accessibility - GDP	Accessibility -employment
Causality from air traffic to regional growth				
Lag 1	1.602***	1.591** *	1.947***	1.947***
Lag 2	0.576	0.716	0.991	1.391***
Causality from regional growth to air traffic				
Lag 1	0.956	1.206*	0.694	1.016
Lag 2	0.420	0.604	0.470	0.586

All the test statistics related to the homogenous non-causality hypothesis are statistically significant with one lag, when the direction of causality is from air traffic to regional development. With two lags, they are not significant, with the exception of the pair of variables "accessibility – employment". These results allow us to reject the homogeneous non-causality hypothesis: for at least some regions (and possible all), there is statistical evidence of Granger causality from air traffic (accessibility) to regional growth.

The evidence of the opposite direction of causality - from regional development to air traffic - is only partial. The test statistic cannot be rejected even at lag one when using the combination of variables "air passengers – GDP", "accessibility – GDP" or "accessibility – employment". It is, however, rejected at the 10% significance level when airport activity is measured with the number of air passengers and employment is used instead of GDP. This result calls for the next step in the testing procedure.

If the HNC hypothesis is rejected, the next step is to test the hypothesis of homogeneous causality (HC). The F_{HC} test statistic is calculated using the sum of squared residuals from the unrestricted model described above (RSS_1) and the sum of squared residuals (RSS_3) from a restricted model in which the slope terms are constrained to equality for all the panel members in the sample. Thus, the hypotheses are

$$\forall\ k \in [1, p] \,/\, \beta_i^{(k)} = \beta^{(k)} \ \forall\ i \in [1, N]$$

$$H_1: \exists\ k \in [1, p], \exists\ (i, j) \in [1, N] \,/\, \beta_i^{(k)} \neq \beta_j^{(k)} ,$$

and the test statistic is

(5) $$F_{HC} = \frac{(RSS_3 - RSS_1)/p(N-1)}{RSS_1/(NT - N(1+p) - p)}$$.

As in the case of HNC, if the individual effects α_i are assumed to be fixed, the ML estimator is consistent with the FE estimator. As the results related to the use of two lags showed insignificance above in most cases, we used here only lag 1.

The results shown in Table 3 indicate significant test statistics for all pairs of variables when the direction of causality is from air traffic to regional growth. Accordingly, at this point we can say that there are causal processes from air traffic (accessibility) to regional growth, but these processes are not uniform. The opposite direction of causality according to which regional growth as measured in employment causes air traffic in all regions is not rejected which implies a homogenous causal process. An alternative interpretation is that there are no causal processes at all. This the result we obtain with all other pair of variables.

Table 3. Test results for homogenous causality (HC hypothesis)

Direction of	*F-statistic and its significance*			
causality	Air passengers - GDP	Air passengers - employment	Accessibility - GDP	Accessibility - employment
Causality from air traffic to regional growth				
Lag 1	1.646***	1.521***	2.018***	1.950***
Causality from regional growth to air traffic				
Lag 1	-	0.925	-	-

The results so far indicate that air traffic, or accessibility in general, Granger –causes regional growth in some regions but not in all regions. The data generating process is non-homogeneous and homogeneous causality relationships cannot be obtained. It may, however, still be possible that for one or more cross regions, causality relationships still exist. There is need for further analysis, i.e. for testing the heterogeneous non-causality hypotheses. As the number of regions is high, 86, we do not test individually the contribution of each region to the existence of causality, but use the categorization of the regions into three groups according to their peripherality. The categorization is important, since we especially want to analyze the significance of remote airports for their regions.

The third step is to test the heterogeneous non-causality hypothesis (HENC). The F_{HENC} statistic is calculated using RSS_1, obtained above, in addition to the sum of squared residuals (RSS_4) from a

model in which the slope coefficients for the panel members in the sub-group in question is constrained to zero.

The test examines the joint hypothesis that there are no causality relationships for a subgroup of regions. In this case, the Wald statistic is

$$F_{HENC} = \frac{(RSS_4 - RSS_1)/(n_{nc}p)}{RSS_1/(NT - N(1+p) - n_c p)}, \quad (6)$$

where RSS_4 corresponds to the realisation of the residual sum of squares obtained in model (1) when one imposes the nullity of the k coefficients associated with the variable $x_{i,t-k}$ on the n_{nc} regions of the subgroup. n_c is the number of regions not belonging to the subgroup (for which β is not constrained to 0).

Interestingly, the results shown in Table 4 suggest that peripherality indeed matters: the more peripheral the region is the more important for its development is to have efficient air connections. This result is most evident with the pair of variables "air passengers – GDP". For peripheral regions, the test statistics is significant with all combinations of variables, but for the other types of regions the result somewhat varies depending on the variables.

Table 4. Test results for heterogeneous causality (HENC hypothesis, lag 1)

Direction of	*F-statistic and its significante*			
causality and	Air passengers	Air passengers	Accessibility	Accessibility
region type	- GDP	- employment	- GDP	-employment
Causality from air traffic to regional growth				
Peripheral regions	2.527***	3.533***	2.952***	4.685***
Middle regions	1.374*	0.760	1.152	0.618
Core regions	0.873	0.393	1.607*	0.385

1.4 CONCLUSIONS

This study focuses on the importance of air transportation in different European regions. We are interested, particularly, in the relationship between air transportation and regional growth in peripheral regions. This starting point is different as compared to many prior studies which have concentrated hub airports and the development of metropolitan areas. In peripheral regions, air traffic may decrease the negative effects of long distances. Easy accessibility attracts firms, investments and other economic activity to the region and stimulates employment and production at established firms. Earlier studies and surveys clearly indicate that access to air transportation has a

very important effect on location decisions of many businesses. A well-developed transport infrastructure is a facilitator that allows the economic potential of a region to be realized.

The Granger non-causality method in a panel framework which allows possible heterogeneity between regions provides a new approach to the analysis of the relationship between air traffic and economic development. Our results give evidence in favor of causal processes in these relationships. The results suggest that air transportation is even more than a facilitator in remote regions - in addition that regional growth causes airport activity, air activity also gives a boost to regional development. Supply side effects are important for distant regions. In core regions, the reverse is only true: airport activity does not cause growth, but regional growth causes airport activity.

In the light of these results, the message for regional policy makers is apparent: there are good reasons to defend local airlines since they are important for the development in remote regions. The traditional challenge with many small local airports is that they are not financially viable which has led to the provision of financial support to airports and airport companies. Though subsidies often distort competition or are wasted money, our results suggest that there indeed might be a case for them if the result is increased regional growth and welfare.

It should be, however, remembered that although Granger causality represents an advance towards uncovering true causal processes, it is indicative rather than confirmatory. While airport activity may seem to cause economic development because lagged airport activity values carry explanatory power, the apparent causation may be due to some omitted variables that move in tandem with airport activity, and which are not being picked up by lagged economic development values, suggesting airport activity is the cause. Moreover, lagged airport values may in fact be in response to anticipated future economic development values. It may happen, e.g., that airports have originally been built to regions that have most potential for economic success.

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3. APPENDIX

3.1 REGIONS IN THE DATA

Country	NUTS	Name of the region	Region type*
Austria	AT12	Niederösterreich	m
	AT13	Wien	c
	AT32	Salzburg	m
Switzerland	CH01	Bassin Lémanique	c
	CH03	Basel	c
	CH04	Zurich	c
Germany	DE11	Regierungsbezirk Stuttgart	c
	DE21	Regierungsbezirk Oberbayern	c
	DE25	Regierungsbezirk Mittelfranken	c
	DE30	Regierungsbezirk Berlin	c
	DE42	Brandenburg- Südwest	m
	DE50	Regieringsbezirk Bremen	m
	DE60	Regierungsbezirk Hamburg	c
	DE71	Regierungsbezirk Darmstadt	c
	DE92	Hannover	c
	DE94	Weser-Ems	c
	DEA1	Regierungsbezirk Düsseldorf	c

	DEA2	Regierungsbezirk Köln	c
	DEA3	Regierungsbezirk Münster	c
Denmark	DK01	Hovedstaden	m
Spain	ES111	A Coruña	p
	ES114	Pontevedra	p
	ES12	Principado de Asturias	p
	ES13	Cantabria	p
	ES211	Álava	p
	ES212	Guipúzcoa	p
	ES213	Vizcaya	p
	ES243	Zaragoza	p
	ES415	Salamanca	p
	ES418	Valladolid	p
	ES431	Badajoz	p
	ES512	Girona	p
	ES514	Tarragona	p
	ES521	Alicante	p
	ES523	Valencia	p
	ES611	Almería	p
	ES613	Córdoba	p
	ES614	Granada	p
	ES617	Málaga	p
	ES618	Sevilla	p
	ES62	Región de Murcia	p
	ES64	Ciudad Autónoma de Melilla	p
France	FR22	Picardie	c
	FR24	Centre	m
	FR3	Nord-Pas-de-Calais	c
	FR421	Bas-Rhin	c
	FR422	Haut-Rhin	c

	FR61	Aquitane	m
	FR717	Savoie	m
	FR72	Auvergne	m
	FR81	Languedoc-Roussillon	m
	FR823	Alpes-Maritimes	m
	FR824	Bouches-du-Rhône	m
	RF825	Var	p
Ireland	IR21	Dublin	m
	IR23	Mid-West Ireland	p
Italy	IT111	Torino	m
	IT133	Genova	m
	IT201	Varese	c
	IT325	Venezia	m
	IT333	Gorizia	m
	ITE4	Lazio	m
	ITF3	Campania	m
Luxembourg	LU	Luxembourg	c
The Netherlands	NL32	Noord-Holland	c
	NL42	Limburg	c
Norway	NO033	Vestfold	p
	NO043	Rogaland	p
Portugal	PT11	Portugal Norte	p
	PT15	Algarve	p
	PT17	Lisboa	p
United Kingdom	UKC1	Tees Valley and Durham	m
	UKC2	Northumberland and Tyne and Wear	m
	UKD3	Greater Manchester	c
	UKE1	East Riding and North Lincolnshire	m
	UKE4	West Yorkshire	m
	UKF1	Derbyshire and Nottinghamshire	m

UKF2	Leicestershire, Rutland and Northamptonshire	c
UKG3	West Midlands	c
UKH2	Bedfordshire and Hertfordshire	c
UKI1	Inner London	c
UKI2	Outer London	c
UKK1	Gloucestershire, Wiltshire and North Somerset	m
UKL2	East Wales	m
UKM1	Aberdeen Region	m
UKM2	Eastern Scotland	m

* p = peripheral; m= middle; c = core

Figures

Tables

ANNEX 3. STRUCTURAL REGRESSION ANALYSIS

1. STRUCTURAL REGRESSION ANALYSIS

1.1 RESEARCH PLAN

This chapter presents the research plan for the regression analysis, which is pursued in the present study. First, a brief overview of the general procedure is given. This is followed by the detailed description of the applied econometric methods.

1.2 OVERVIEW

Based on the economic growth theory discussed previously, a theoretical relationship between accessibility and economic prosperity or development, has been postulated. Subsequently the question arises, whether this relationship can also be confirmed empirically. The according null hypothesis states that the influence of accessibility on economic prosperity is zero. Additionally, in our analysis we will distinguish between peripheral and non-peripheral regions.

We also investigate, whether economic prosperity has an impact on airport attributes (passengers, cargo). The implied null hypothesis says that the influence of economic prosperity on airport attributes is zero. Again, the distinction between peripheral and non-peripheral regions is tested. All the econometric estimations are performed using the software Eviews 7.2.

Theoretical equations to be tested

The following table displays the theoretical equations, derived from economic considerations that will be tested below.

Tab. 0-1 Theoretical equations to be tested

Name	Theoretical equations
Level	$\ln Y(t) = \beta_0 + \beta_1 \cdot \ln R_1(t) + \beta_2 \cdot \ln R_2(t)$
Difference1	$gY(t) = \beta_0 + \beta_1 \cdot gR_1(t) + \beta_2 \cdot gR_2(t)$

Source: BAKBASEL

Methods

In order to test the postulated relationships, we apply methods of inductive statistics, specifically linear regression analysis. **Tab. 0-1** lists the equations that will be tested. After defining the structural models, they are estimated as pure cross-section specifications and as panel specifications.
The applied methods are prioritized as follows: The main specification is the level equation of the cross-sectional structure model. The aim of the other equations is to verify the obtained results regarding the robustness and the sensitivity and to eventually disclose other aspects. These other equations are designed in order to emphasize the differences in comparison to the main specification, and not to identify the best coefficients. The difference equations of the cross-sectional structure model extend the main specification by the dynamic aspect. The equations of the panel model use the panel structure of the data in order to generate more efficient estimates, as well as to further reduce the probability of a distortion due to disregarded variables (by including so-called Fixed Effects into the model).

Samples

The sample includes 336 NUTS 2 or NUTS 3 regions of Western Europe (including Greece) for the period from 2000 to 2008. When the impact on airport attributes is estimated, the sample is smaller and consists of data for the period 2006-2010.

1.3 ECONOMIC PERFORMANCE

To explain the regional differences in economic performance, the dependent variable in the level equation is not defined as the overall economic output, typically measured by the gross domestic product (GDP). The measure of GDP contains pure size effects (large and populous regions, as well as regions with many employees, coincide with higher output) and would therefore need corrections by including further right hand variables. Instead, the economic output is standardized by means of the population data.

The resulting GDP per capita (GDP divided by population) represents the welfare of the region. Accordingly, the participation rate (employment divided by population) is used as another left hand variable. The third possible dependent variable is the real hourly productivity of labour. It is expressed in euros and adjusted for purchasing power parity (PPP), which allows cross-country comparisons. For the specification in differences, the dependent variable is set as the growth rate of GDP per capita, the growth rate of the participation rate or the growth rate of the hourly productivity of labour, respectively.

The different specifications are presented in the following table.

Tab. 0-2 Dependent variable: Economic performance

Level/ Difference	Measures	Indicator	Shortcut
Level	Economic prosperity	Real GDP per capita (GDP / Population) Participation rate (Employment / Population) Real hourly productivity of labour	XP, PPR, XAr
Difference	Economic development	Growth rate of GDP per capita Growth rate of the participation rate Growth rate of real hourly productivity of labour	gXP, gPPR, gXAr

Source: BAKBASEL

The table below lists the independent variables (the components of the residual variable R), divided into three groups:

- Location factor accessibility: Variables that measure the accessibility of a region. Highlighted in dark grey.
- Other location factors: Variables that capture other location characteristics. Highlighted in light grey.
- Other residual variables: Variables that cover other growth effects. Highlighted in white.

In the framework of this study we are mainly interested in the variables of accessibility. The other two groups serve as control variables and are included into the regression in order to isolate the impact of accessibility and to avoid at the best distortions due to omitted variables.

The detailed definition of the variables, their measurement and evaluation, as well as the corresponding sign hypothesis, are described in chapter 0. The overview of the independent variables is given by Tab. 0-3.

Tab. 0-3 Independent variables

Level/ Difference	Residual factors	Indicators	Mnem.	Sign hypothesis
Level	Accessibility (Level)	Accessibility Indices Higher index means more accessibility	AC[…]	+
	Regulation (Level)	Regulation Index Higher index means more regulation	RG	-
	Taxation (Level)	Effective average tax rate	TX	-
	Innovation (Level)	Share of employees with tertiary education	IV	+
Difference	Accessibility (Growth)	Accessibility Indices Higher index means more accessibility	gAC[…]	+
	Regulation (Growth)	Regulation Index Higher index means more regulation	gRG	-
	Taxation (Growth)	Effective average tax rate	gTX	-
	Innovation (Growth)	Share of employees with tertiary education	gIV	+
	Convergence Term (Level)	Dependent variable of previous period	CT	-
	Error Correction Term (Level) Only for panel model	Residual of the corresponding level equation, delayed by one period	ECT	-

Source: BAKBASEL

Structural models

Structural models focus on the cross-sectional dimension of the data, as they explain an endogenous variable at a point in time by exogenous variables. Delayed values of the endogenous variable are not included as explanatory variables. A partially dynamic component can only be introduced by using growth rates or panel methods.

The estimation of the structural models is carried out or by considering the data as pure cross-sections, or by exploiting the panel properties of the data. Although the data set is a panel, i.e. includes observations over a transverse and a longitudinal dimension, the main attention is paid to the cross-sectional model. It includes the average values over the period of 2000 to 2008 (economic prosperity) for each cross-sectional entity. The level values represent the arithmetic mean of the period and the difference values are expressed by the (constant) average growth rate over the time. The purpose of the subsequent panel regressions is the testing for robustness of the previously obtained cross-sectional results.

The focus on the cross-section model is due to the following reasons:

- The transmission mechanism from accessibility to economic prosperity, which has been described previously, is very complex in terms of timing. We cannot expect the impact, triggered by an improved accessibility in one period, to take effect in the same or the ensuing period. On the one hand, rational agents might already take into account the announced improvements in accessibility for their decisions, before the quality of the transport infrastructure is actually enhanced. As a result, the economic activity increases prior to the actual improvement. On the other hand, the adjustment process of economic subjects to changes in the location factors usually takes some time. Accessibility and economic prosperity are therefore linked by a complex "lead-lag relationship".
- The described transmission mechanism from accessibility to economic prosperity takes place primarily on the geographic level, and less over time. The increased attractiveness of a

location will cause more companies to locate at this site. This compares to other locations at the same time. Obviously, the number of companies at the same location also increases over time. However, the impact of accessibility can be better captured by the spatial comparison.

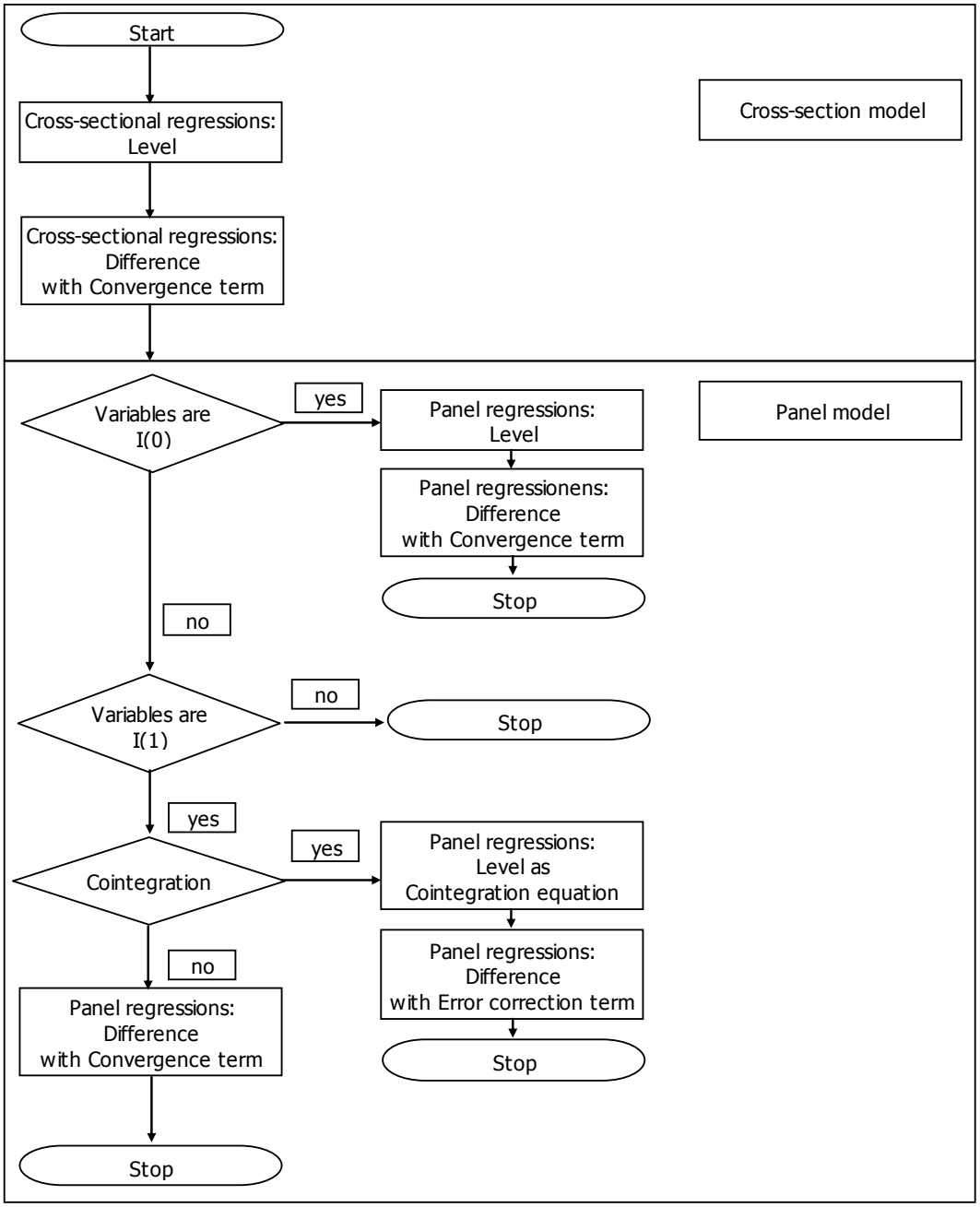
- The accessibility variable has been calculated for certain years only, based on specific timetables and other information. The years lying in between the "available" observations have been linearly interpolated. Critical observers could call the attempt of interpreting the exact dynamic structure of this variable as "bold" (because the dynamic structure might partially be caused by the computation of the data itself).

Calculating the average values for the level equations means to lose the dynamic information, while at the same time statistical noise is removed. For this reason, the results of the cross-sectional regressions are expected to be clearer and more explicit than those resulting from the panel estimations.

The detailed schedule of all the structural model estimations is shown in Fig. 0-1. The different equations are estimated as cross-section or as panel models. For each model, the estimated equations, presented in Tab. 0-4, are followed by the corresponding tests. In a first step, we undertake the cross-sectional regressions. The difference equation is extended by the convergence term as an additional right hand variable in order to capture convergence dynamics.

Due to the additional time structure in the subsequent panel regressions, the aspects of time series econometrics must be considered. First, it has to be verified whether the variables (in levels) are stationary, which means, whether the stochastic processes are integrated of order zero (I(0)). This is necessary in order to achieve meaningful statistical results. In the case of stationarity, the panel regressions can be specified according to the cross-sectional equations. If the variables in levels are non-stationary, we test for the stationarity of the variables' differences. If the differences are still non-stationary, the research agenda has to be cancelled and redefined. However, if the differences are found to be stationary, which means the stochastic processes are integrated of order one (I(1)), we continue according to the schedule. In a next step we examine, if there exists a cointegration relationship between the dependent and at least one of the independent variables. In the case of cointegration, the panel regressions can be specified similarly to the cross-sectional regressions: In this specification, the level equation has to be interpreted as the cointegration relationship, that only applies asymptotically and in the long term. In addition, the convergence term is replaced by the error correction term. This correction term captures the dynamic effect of the fact that both, the dependent and the cointegrated independent variable, tend towards their equilibrium condition in every period. Therefore, the error correction term is represented by the delayed (by one period) residual of the corresponding level equation. If the cointegration relationship cannot be established, there exists no interpretation of the level equation. However, having obtained stationarity for the variables' differences, the difference equations, extended by the convergence term, can be estimated and interpreted without problems.

Fig. 0-1 Schedule of the structure models



Source: BAKBASEL, based on Müller et al. (2011)

Testing for the characteristics of the stochastic processes is essential in order to ensure the validity of the panel regression results. If the regressand and the relevant regressors are non-stationary, they may seem significantly correlated, although they are completely unrelated. The correlation results from the fact that they both follow a trend over time. This spurious correlation should not be interpreted as a causal relationship (see Granger and Newbold (1974)) and the resulting high statistical significance of the regression outcomes may be misleading. In contrast to this, cointegration means that the non-stationary processes follow a common trend over time. In this case, the equation in levels is interpreted as the long-term cointegration relationship.

Cross-section model

The theoretical equations of Tab. 0-1 lead to the following estimation equations for the cross-section model (Tab. 0-4).

Tab. 0-4 Estimation equations of the theoretical equations to be tested: Cross-section model

Name	Theory / Estimation	Equation
Level	Theory	$\ln Y(t) = \beta_0 + \beta_1 \ln R_1(t) + \beta_2 \ln R_2(t)$
	Estimation	$\ln XP_i = \beta_0 + \beta_1 \ln AC_i + \beta_2 \ln RG_i + \beta_3 \ln TX_i + \beta_4 \ln IV_i + \varepsilon_i$
Difference	Theory	$gY(t) = \beta_0 + \beta_1 gR_1(t) + \beta_2 gR_2(t)$
	Estimation	$gXP_i = \beta_0 + \beta_1 gAC_i + \beta_2 gRG_i + \beta_3 gTX_i + \beta_4 gIV_i + \beta_5 \ln CT_i + + \varepsilon_i$

Source: BAKBASEL

The time index is omitted in the estimation equations, because the theoretical equation is only considered for one specific moment in time (the "arithmetic mean moment"). Further, we replace the residual variable R of the theoretical equation by the concrete location factors like accessibility (AC), regulation (RG), taxation (TX) and innovation (IV). The difference equation also includes the convergence term (CT), which is designed to capture growth dynamics resulting from the potential convergence amongst the regions. The convergence term is measured by the corresponding dependent variable in 1990. Here this would be GDP per capita in 1990. The subscript i indicates that the equations apply to all the cross-section entities of the sample. In econometrics this level equation is also called "log-log-model". It means that the estimated β-coefficients are interpreted as partial output-elasticities of the reduced-form production function. A one-percentage change in the independent variable AC therefore leads to a β_1-percentage change in the dependent variable XP.

The coefficients of the cross-section structural models are estimated by the means of linear regression and by the method of least squares (OLS). Further we used the heteroscedasticity-consistent estimation of the covariance matrix (White (1980)).

Panel model

Tab. 0-5 directly follows from Tab. 0-4.

Tab. 0-5 Estimation equations of the theoretical equations to be tested: Panel model

Name	Theory / Estimation	Equation
Level	Theory	$\ln Y(t) = \beta_0 + \beta_1 \ln R_1(t) + \beta_2 \ln R_2(t)$
	Estimation	$\ln XP_{it} = \alpha_i + \beta_1 \ln AC_{it} + \beta_2 \ln RG_{it} + \beta_3 \ln TX_{it} + \beta_4 \ln IV_{it} + + \varepsilon_{it}$
Difference	Theory	$gY(t) = \beta_0 + \beta_1 gR_1(t) + \beta_2 gR_2(t)$
	Estimation	$gXP_{it} = \alpha_i + \beta_1 gAC_{it} + \beta_2 gRG_{it} + \beta_3 gTX_{it} + \beta_4 gIV_{it} + + \{\ln CT_{it-1} \; oder \; ECT_{it-1}\} + \varepsilon_{it}$

Source: BAKBASEL

The equations of the panel model differ from the ones of the cross-section model in the following points:

- The subscript i is replaced by it .The equations apply to all cross-section entities, as well as to every point in time.
- The constant of the regression, β_0, is replaced by α_i. Estimating panel models means to estimate a regression constant for every single cross-section entity. These equations are called Fixed-Effect models. The introduction of the entity-specific constants allows to capture individually specific influences, that remain constant over time.
- In difference equations, that are based on a cointegrated level equation, the error correction term (ECT) replaces the convergence term CT. The error correction term is measured by the residual of the corresponding level equation, delayed by one period. If the convergence term CT is used instead (in non-cointegrated difference equations), it is expressed by the dependent variable delayed by one period.

Apart from that, the equations of the panel model can be interpreted in the same way as the ones of the cross-sectional model.

As mentioned before, the panel model is designed to test the robustness and the sensitivity of the cross-section model. The exploitation of the panel structure offers several advantages:

- The availability of observations for several points in time for each cross-section entity allows to capture influences that differ among the cross-section entities, but stay constant over time (they affect the entity specific constant α_i). This lowers the probability that the model estimation is distorted by disregarded variables.
- The existence of data over two dimensions increases the number of observations compared to the normal cross- or longitudinal-section datasets. This improves the efficiency of the estimators.

The panel structural models are specified as Fixed-Effect models. This decision is based on the Hausmann specification test, which is described in more detail in chapter 0. The coefficients of the

equations, transformed by the Within-Transformation[4], are estimated by the means of linear regression and the method of the least squares (OLS). In order to avoid potential heteroscedasticity over the regions and autocorrelations within each region (cross-section clustering), we correct the covariance matrix by the procedure of Arellano (1987).

Airport attributes

In this section, the airport attributes are linked to the explanatory variables of economic performance. As measures describing the airport performance, we consider the number of commercial passengers, as well as the cargo (freight and mail) in metric tones. It follows that there are two dependent variables and therefore two groups of equations to be tested. The number of passengers and the cargo contain pure size effects, which are corrected according to the proceeding of the last section. The size effects are taken into account by standardizing the data. The number of commercial passengers is standardized by means of the population data, while the cargo in metric tones is divided by the real GDP.

The resulting ratio of commercial passengers to the total population measures the importance of the airport. Accordingly, the ratio of cargo to the real output is also designed to represent the relevance of the airport. The equations in differences include the growth rates of these ratios.

The different specifications are presented in the following table.

Tab. 0-6 Dependent variable: Airport attributes

Level/ Difference	measures	Indicator	Shortcut
Level	Airport attributes	Ratio of commercial passengers to population (Passengers / Population) Ratio of cargo to real GDP (Cargo / GDP)	APT, ACX
Difference	Airport development	Growth rate of the ratio of commercial passengers to population Growth rate of the ratio of cargo to real GDP	gAPT, gACX

Source: BAKBASEL

The table below shows the independent variables (the components of the residual variable R), which are different measures of economic performance. In this analysis the focus lies on the influence of economic performance on the importance of the local airport. The different measures included in the estimations capture distinct transmission mechanisms and are designed to avoid at best distortions due to omitted variables.

The detailed definition of the variables, their measurement and evaluation, as well as the corresponding sign hypothesis, are described in chapter 0. The overview of the independent variables is given by Tab. 0-3.

[4] The Within-transformation is the subtraction of the entity-specific mean values of every variable included in the equation. This allows the elimination of the so-called individual effects, which are constant over time.

Tab. 0-7 Independent variables

Level/ Difference	Residual factors	Indicators	Mnem.	Sign hypothesis
Level	Economic performance (Level)	Productivity (real GDP / employment)	XN	+
	Economic performance (Level)	Participation rate (employment / population)	PR	+
	Economic performance (Level)	Share of related economic sector (sector product / nominal GDP)	A[…]	+
Difference	Economic performance (Growth)	Productivity (real GDP / employment)	gXN	+
	Economic performance (Growth)	Participation rate (employment / population)	gPR	+
	Economic performance (Growth)	Share of related economic sector (sector product / nominal GDP)	A[…]	+
	Convergence (Level)	Dependent variable of previous period	CT	-
	Error Correction Term (Level) Only for panel model	Residual of the corresponding level equation, delayed by one period	ECT	-

Source: BAKBASEL

Structural models

As explicated in chapter 0 the focus lies on structural models, which means on cross-sectional equations, including growth rates or panel structure in order to allow for dynamic effects. As before in the economic performance section, the level values are measured by the arithmetic mean, while the difference values are expressed by the (constant) average growth rate. The main purpose of the subsequent panel regressions is the testing for the robustness of the cross-sectional results.

The focus on the cross-section model is due to the following reasons:

- As before, economic performance and airport attributes are linked by a complex "lead-lag relationship". The transmission mechanism from economic performance to the characteristics of the local airport is complex in terms of timing. The exact timing of triggered impacts is often unclear and rational agents tend to anticipate announced changes before the actual event, while other adjustment processes take more time.
- The airport data on passengers and cargo is limited. For many regions data is only available starting in 2006. As a consequence these time series are too short for obtaining reliable panel regression results.

Calculating the mean values allows to remove some statistical noise, although the dynamic information is lost. For this reason, the results of the cross-sectional regressions are expected to be clearer and more explicit. We follow the detailed schedule as already shown in Fig. 0-1.
First, the cross-sectional regressions are estimated. The difference equation is extended by the additional convergence term in order to capture convergence dynamics.
For the panel regressions, several tests concerning the characteristics of the time series data are necessary. The same reasoning as explained in chapter 0 applies here, too.

Cross-section model

The theoretical equations of Tab. 0-1 lead to the following estimation equations for the cross-sectional model (Tab. 0-8).

Tab. 0-8 Estimation equations of the theoretical equations to be tested: Cross-section model

Name	Theory / Estimation	Equation
Level	Theory	$\ln Y(t) = \beta_0 + \beta_1 \ln R_1(t)$
	Estimation	$\ln APT_i = \beta_0 + \beta_1 \ln XN_i + \beta_2 \ln PR_i + \beta_3 \ln A_i + \varepsilon_i$
Difference	Theory	$gY(t) = \beta_0 + \beta_1 gR_1(t)$
	Estimation	$gAPT_i = \beta_0 + \beta_1 gXN_i + \beta_2 gPR_i + \beta_3 gA_i + \beta_5 \ln CT_i + \varepsilon_i$

Source: BAKBASEL

The time index is omitted in the equations above, because the cross-sectional equations are only considered for one specific moment in time (the "arithmetic mean moment"). Further, the residual variable R of the theoretical equations is replaced by the concrete economic performance factors like productivity (XN), participation rate (PR), and share of the relevant economic sector measured in GDP (A). In the specification including the ratio of passenger to population as dependent variable this relevant economic sector is represented by the tourism sector in order to control for its influence on the number of passengers transferred by the local airport. Accordingly, the ratio of the industry sector to nominal GDP is included into the specification with the cargo per real GDP as regressand in order to capture the export-promoting influence of the industry sector on the transportation dimension of the local airport. The difference equation also includes the convergence term (CT), which is designed to capture growth dynamics resulting from the potential convergence amongst the regions. The convergence term is measured by the corresponding airport attribute in 2006. The subscript i indicates that the equations apply to all the cross-section entities of the sample. In econometrics this level equation is also called "log-log-model". It means that the estimated β-coefficients are interpreted as partial output-elasticities of the reduced-form production function. A one-percentage change in the independent variable XN therefore leads to a β_1-percentage change in the dependent variable APT.

The coefficients of the cross-section structural models are estimated by the means of linear regression and by the method of least squares (OLS). Further we used the heteroscedasticity-consistent estimation of the covariance matrix (White (1980)).

Panel model

Tab. 0-9 directly follows from Tab. 0-8.

Tab. 0-9 Estimation equations of the theoretical equations to be tested: Panel model

Name	Theory / Estimation	Equation
Level	Theory	$\ln Y(t) = \beta_0 + \beta_1 \ln R_1(t)$
	Estimation	$\ln APT_{it} = \alpha_i + \beta_1 \ln XN_{it} + \beta_2 \ln PR_{it} + \beta_3 \ln A_{it} + \varepsilon_{it}$
Difference	Theory	$gY(t) = \beta_0 + \beta_1 gR_1(t)$
	Estimation	$gAPT_{it} = \alpha_i + \beta_1 gXN_{it} + \beta_2 gPR_{it} + \beta_3 gA_{it} + \{\ln CT_{it-1} \; oder \; ECT_{it-1}\} + \varepsilon_{it}$

Source: BAKBASEL

The characteristics of the panel model equations correspond to the ones described in the previous section. The time component t is introduced, the constant of the regression α_i now represents the entity-specific influence (Fixed-Effect model) and the cointegrated difference equations contain an error correction term ECT (delayed by one period) instead of the convergence term (starting year 2006).

As mentioned previously, the panel model is designed to test for the robustness and the sensitivity of the cross-section model. The exploitation of the panel structure offers the advantage of lowering the probability of distortion by including more information and the advantage of improving efficiency by increasing the number of observations.

According to the decisions when testing for economic performance, the panel structural models are specified as Fixed-Effect models (Hausmann specification test). The coefficients of the equations, transformed by the Within-Transformation[5], are estimated by the means of linear regression and the method of the least squares (OLS). In order to avoid potential heteroscedasticity over the regions and autocorrelations within each region (cross-section) clustering), we correct the covariance matrix by the procedure of Arellano (1987).

[5] The Within-transformation is the subtraction of the individually specific mean values of every variable included in the equation. This allows the elimination of the so-called individual effects, which are constant over time.

2. DATA FOR THE ECONOMIC PERFORMANCE MODELS

In the previous chapter, the linear regression models were presented. The variables, which flow into the regression analysis, were only briefly mentioned. This chapter discusses the transmission mechanism and the sign hypothesis of the coefficients for the economic performance models.

The regression models are based on a panel data set. The sections represent 336 regions[6], while the longitudinal axis covers the periods from 2000 to 2008. The data derives from the European sample of the database of the "International Benchmarking Programme" by BAKBASEL (IBP database). A detailed description of these data is listed in the appendix.

2.1 DEPENDENT VARIABLES

The GDP per capita, the participation rate and the real hourly productivity of labour are used as dependent variable. GDP per capita is the ratio of GDP and population and the participation rate is the ratio of employment and population.

2.2 INDEPENDENT VARIABLES

Accessibility

Accessibility as a residual factor

Referring to the reduced form of the classical production function in which production is based on the use of labor (L), capital (K) and residual factors (R), economic prosperity can be modelled as being dependent only on the residual factors. Its pivotal feature is the efficiency enhancement of the production process. For years, BAKBASEL has been approximating these residual factors by location factors such as the level of regulation, taxation or innovation potential. May accessibility be considered as a residual factor, too? In order to answer this question it is necessary to analyse whether accessibility leads to an increasing efficiency of the production process. From an economic point of view the following considerations can be made.

Easy accessibility, based on an efficient transport system, clearly leads to the reduction in transportation costs by saving time. In the framework of the transaction cost theory, the transport costs of goods or services, but also the costs of a person acting as a negotiation partner, can be interpreted as transaction costs. Thus accessibility leads to a reduction of transaction costs and therefore enhances the efficiency of these transactions. This is illustrated in Fig. 0-1. The investments in transport systems as the origin of the impact chain are also depicted.

The reduced transport/transaction costs have a positive influence on the economic process over several channels:

- Increase in productivity
    - Goods – both inputs and outputs of the production process – can be transported from and to the existing (procurement/sales) markets more cost-effectively. Further, new and more remote (procurement/sales) markets can be made accessible. As a result there is a reduction in the intermediate costs (more efficient management of existing markets) or an increased added value (opening up of new markets). Thereby the added value, which can be assigned to the production factors labour and capital, is augmented. Assuming constant use of labour and capital, the productivity of these production factors therefore increases.

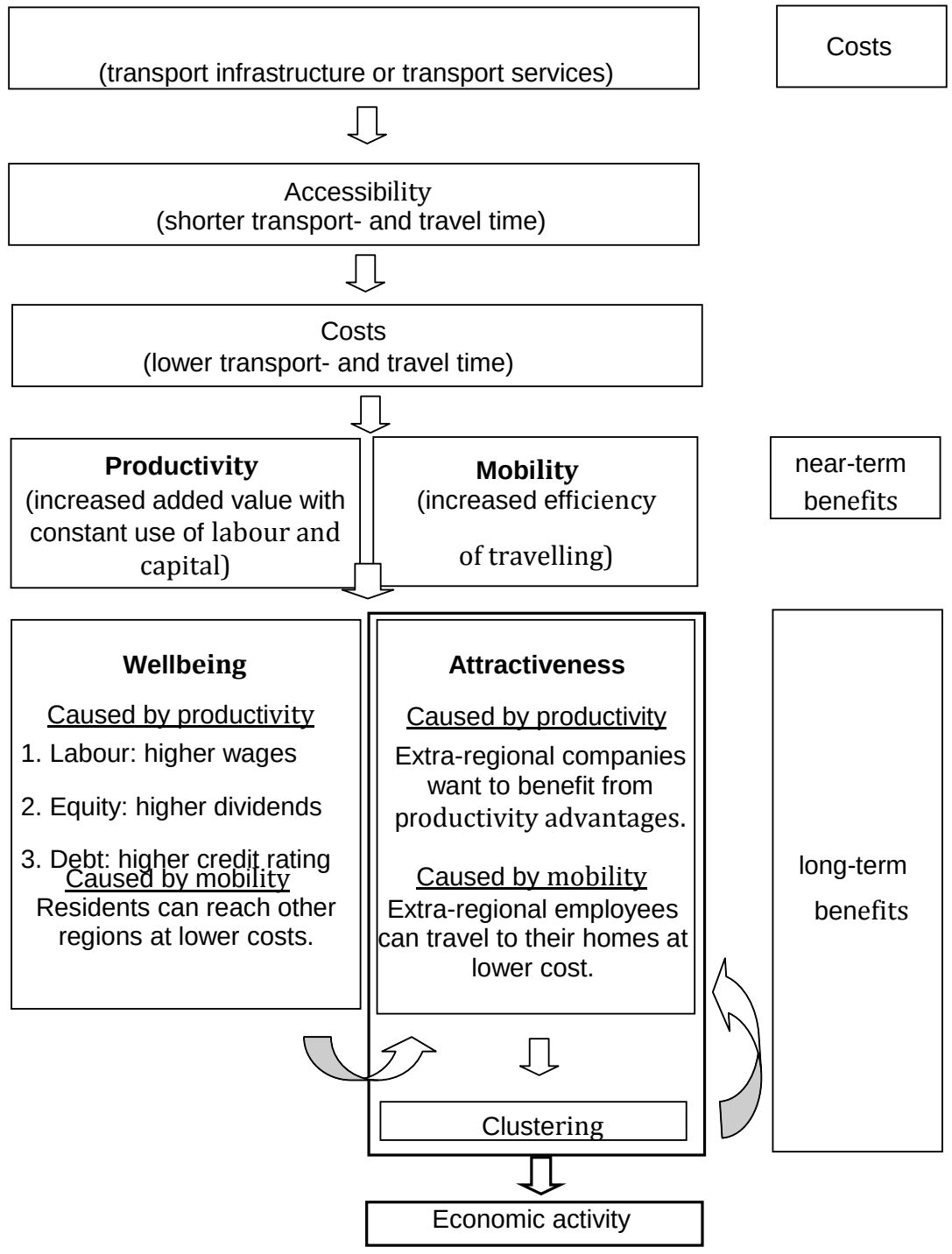
[6] Further information about the regions is given in the data description.

- The lower transportation costs allow for a division of labour between regions and thus enable regions to specialize. Thereby economies of scale and other advantages of this specialisation can be used. This results in a further increase in the added value and the productivity (under the assumption of constant use of labour and capital).
- An interregional/-national transfer of knowledge is strongly facilitated by lower transport costs. It is generally accepted in the economic literature that higher innovational strength leads to increases in added value and productivity.
- Higher productivity has a positive influence on the economic well-being of the already residentiary workforce and lenders of capital, who can expect higher wages and dividends, or alternatively, under the assumption of constant interest rate payments, higher credit rating of the companies. Further, increased productivity attracts labour and capital from other regions. This can lead to clustering in certain industries, which again reacts positively upon the attractiveness of a region (feedback).
- Increase in mobility
- People can travel for lower costs. This means not only increased well-being for the residents, who have better access to other regions (Vacation, business travel, etc), but also higher attractiveness for labour and capital coming from other regions, as it is closer from its origin in terms of travel time. Therefore, it also becomes easier to take part in the innovation processes of other regions.

The economic activity may benefit more from the increased attractiveness than from the increased well-being. First, the inflow of extra-regional capital is probably higher than the increase in the inner-regional capital. Second, there is not only an inflow of capital but also an inflow of labour due to the location's higher attractiveness. However, increased well-being also leads to higher attractiveness. For example, there are more means for cultural offers available, which is often a crucial location factor for extra-regional employees (especially in the case of high-skilled workers).

Summarising, it can be said that a region won't be able to benefit from the globalisation (opening up of new markets, division of labour, transfer of knowledge, interregional/-national mobility) until it has become easily accessible in terms of transport. Furthermore, a consistently high global accessibility has the consequence of a more productive world economy, because production factors can be easier allocated to the place of their most productive use.

Fig. 0-1 Economic functional chain of investments in transport systems



Source: BAKBASEL, based on Müller et al. (2011)

Tab. 0-1 allows to look at the relationship between accessibility (only multimodal) and economic prosperity. It displays the correlation coefficient for the total, geographical and transport accessibility. Thereby three kinds of influences of accessibility in accordance with the theoretical equations that will be tested are considered:

- Accessibility level on GDP per capita level (level)
- Accessibility growth on GDP per capita growth (difference)

It is evident that in level as well as in terms of growth rates a positive relationship seems to exist.

Tab. 0-1 Correlation: Accessibility and GDP per capita or participation rate, 1991-2008

		GDP per capita		Participation rate
		Level	Growth	Level
Total accessibility	**Level**	0.54	0.09	0.38
	Growth		0.29	
Geographical accessibility	**Level**	0.47	0.04	0.31
	Growth			
Transport accessibility	**Level**	0.52	0.10	0.37
	Growth		0.29	

Comment:

- Pearson correlation coefficient
- Accessibility level: natural logarithm of the average of 1991-2008
- GDP per capita level: natural logarithm of the average of 1991-2008, real GDP
- Accessibility growth: average annual growth rate 1991-2008
- GDP per capita growth: average annual growth rate 1991-2008

Source: BAKBASEL

It is interesting that the total accessibility level is slightly stronger correlated with the GDP per capita level compared to the transport accessibility level, while the opposite is true for the relationship between the level and growth values. However, when interpreting these results one needs to keep in mind BAKBASEL's computation method of the transport accessibility (division into 1/3 and 2/3). The correlation in growth rates could not be computed for the geographical accessibility, because this variable naturally has a growth rate of zero. Furthermore, concerning the relationship between accessibility and GDP per capita the question of causality remains unresolved: Does better accessibility level lead to a higher level of prosperity or vice versa? This uncertainty will be resumed in another chapter by means of the concept of the Granger causality.

Regulation

Transmission mechanism

Regulation corrects market failures and compensates for externalities, but it is also costly. There are direct costs, like administration and controlling, as well as indirect costs, as incompatible incentives or government failure. The optimal level of regulation cannot be determined theoretically; however, empirical studies are used in order to answer this question, at least partly. Regulations work through many channels of an economic system, and the relationship between regulation and growth is very complex.

Sign hypothesis

This study started from the premise that the optimal level of regulation is rather low. Low values of the regulation index should therefore be associated with a higher level of GDP per capita and growth; high index values would correspond to lower levels of GDP per capita and growth. The estimated coefficient in the regression should therefore have a negative sign.

Taxation

Transmission mechanism

There are several ways in which tax levels influence the regional economic development. Taxation is a key topic for businesses evaluating the attractiveness of a location. A lower tax burden attracts new companies to a location and provides an incentive for existing companies to stay. Even if no location decision is involved, a lower tax burden increases competitiveness in the market by decreasing the costs for a company, which in turn supports company survival or growth.

This connection between taxes and economic growth is obvious for direct company taxation. In the case of personal income taxation however, this is less straightforward. But a similar connection is expected for several reasons.

First, company owners and top management in general earn more and therefore have to pay higher income taxes in most countries or regions. Their individual preferences might influence the decisions for the company location.

Second, employees' decisions are affected as well. Employees focus on their net available income, which is different from a firm's costs. If employees have some bargaining power and are mobile between regions, the companies will be forced to bear at least parts of the difference in the tax burden between competing regions. Otherwise, flexible employees will move to regions with lower tax levels, since their available in-come is higher there (everything else kept equal). Therefore, higher income tax levels can result in higher costs for companies. Highly qualified individuals are especially and increasingly internationally mobile. At the same time, these individuals are becoming more important for the knowledge based economy. Income taxation, especially the burden on highly qualified employees, can work as a cost factor, just as much as company taxation does.

Sign hypothesis

Based on the above reasoning, a negative sign for the regression coefficient of the taxation variable is expected.

Innovation

Transmission mechanism

Innovation leads to more efficient production processes and to higher productivity of capital and labour. If the same amount of input can produce a larger quantity of output, economic prosperity has increased. In addition, innovative regions attract firms, as they expect a competitive advantage resulting from these new technologies. As a result, these regions show a stronger economical development.

Sign hypothesis

Based on the above reasoning a positive sign for the regression coefficient of the innovation variable is expected.

2.3 OTHER VARIABLES

Convergence term

The convergence term is introduced into all the difference equations, as well as into some of the panel specifications. It captures the effect of growth, resulting from the convergence of economic prosperity among regions in the long term. More prosperous regions are expected to grow less than poorer regions. The above-average growth rate of weaker regions may represent the impact of catching-up or the result of a well-directed promotion policy. We expect a negative sign for this variable's coefficient.

In the cross-sectional model, the convergence term is expressed by the level of the dependent variable of the region in the year 1990. In the panel model, as observations for several periods are available, the convergence term is defined as the level of the dependent variable of the region, delayed by one period. This dependent variable, as defined in the beginning, is or the GDP per capita, the participation rate or the real hourly productivity of labour, depending on the estimated equation.

Error correction term

If the panel model can be represented as a cointegrated level equation, the difference equation is extended by the error correction term as a right hand variable. It reflects the growth effects, which result from the cointegration of the variables that makes them moving towards their long-term equilibrium condition. If the value of the dependent variable exceeds its equilibrium value, the error correction term corrects for this difference by lowering the growth rate of the subsequent period and vice versa. For this reason, the sign of the error correction term is expected to be negative. The coefficient can be interpreted as the share of the deviation of the actual value from the equilibrium value, by which this difference is decreased every period back towards the equilibrium condition.

In order to measure the error correction term, first, the level equation is estimated and defined as the cointegration equation. Then, the residual of the same regression, but delayed by one period, is introduced to the difference equation as an additional right hand variable, the error correction term.

3. DATA FOR THE AIRPORT ATTRIBUTES MODELS

In this chapter the transmission mechanisms and the sign hypothesis of the coefficients for the airport attributes models are discussed.

The regression models are based on the panel data set. The sections represent 336 regions[7], while the longitudinal axis covers the periods from 2000 to 2008. The data derives from the European sample of the database of the "International Benchmarking Programme" by BAKBASEL (IBP database). A detailed description of these data is listed in the appendix.

3.1 DEPENDENT VARIABLES

Data on airport performance (assigned to the regions) such as the commercial passengers and the cargo (freight & mail) are used as the dependent variable.

[7] Further information about the regions is given in the data description.

3.2 INDEPENDENT VARIABLES

Transmission mechanism
All three indicators affect the demand for air travel. This is shown most clearly in the share of tourism on the GDP. If the proportion is large, it can be assumed that the region attracts more tourists and hence the demand for flights is relatively high. Further, higher participation rate indicates relatively high demand for flights, as there are often business travelers who take the plane. In addition, high participation rate signals more economic prosperity, which gives people the opportunity to travel. The same applies to a high labour productivity.

Sign hypothesis
Based on the above reasoning, the sign for the regression coefficients of all independent variables is expected to be positive.

3.3 OTHER VARIABLES

Convergence term
The convergence term, as mentioned above, is introduced into all the difference equations, as well as into some of the panel specifications. It is designed to capture the effect of growth, resulting from the potential convergence of the airport attributes among regions in the long term. Convergence would mean that already large airports grow less than smaller airports. The above-average growth rate of small airports would represent the impact of catching-up or the result of well-directed promotion policies. We expect a negative sign for this variable's coefficient.
In the cross-sectional model, the convergence term is expressed by the level of the dependent variable of the region in the year 2006. In the panel model, as observations for several periods are available, the convergence term is defined as the level of the dependent variable of the region, delayed by one period. The dependent variable, as defined in the beginning, is or the ratio of commercial passengers to the population or the ratio of cargo to the real GDP.
Error correction term
For the error correction term, the same applies as in the section on economic performance. If the panel model can be represented as a cointegrated level equation, the difference equation is extended by the error correction term. It reflects the growth effects, which result from the cointegration of the variables that makes them moving towards their long-term equilibrium condition. For this reason, the sign of the error correction term is expected to be negative.
In order to measure the error correction term, first, the level equation is estimated and defined as the cointegration equation. Then, the residual of the same regression, but delayed by one period, is introduced to the difference equation as an additional right hand variable, the error correction term.

4. EMPIRICAL RESULTS

After having discussed the key components of the empirical analysis, this chapter presents the results of the econometric estimations. The first section shows the results of the models, divided into the cross-sectional and the panel model, which investigate the relationship from accessibility to economic prosperity. In the second part, the results of the models that set airport attributes as the dependent variable are presented.

The results are shown in order of priority according to our research plan. Within the structure models we are more interested in the cross-sectional model. The panel model is only used to test the plausibility of the first model. In both structural models, the level equation is more relevant than the difference equation. To conclude, we have this sequence:

- Structure models
  - Cross sectional model
    - Level
    - Difference
  - Panel model
    - Level
    - Difference

4.1 ECONOMIC PERFORMANCE (DEPENDENT VARIABLE)

Cross-sectional models

Total accessibility

Tab. 0-1 shows an exemplary regression output. The indicator of interest is the total accessibility. The dependent variables in the level equations represent the mean values of real GDP per capita, of real hourly productivity of labour or of the participation rate. For the difference equations continuous growth rates are used. The investigated period is 2000-2008.

Tab. 0-1 Regression output: Cross-section, Total accessibility

Coefficient	GDP per capita		Hourly productivity of labour		Participation rate
	Level	Difference	Level	Difference	Level
Constant	4.42 ***	0.11 ***	-1.77 ***	0.03 ***	-2.99 ***
Accessibility	1.13 ***	0.18	1.07 ***	0.13	0.41 ***
Regulation	0.04	0.05 ***	0.08 ***	0.06 ***	-0.03 *
Taxation	-0.45 ***	-0.05	-0.21 ***	0.02	-0.26 ***
Innovation	0.06 ***	0.01	0.10 ***	-0.02	0.02
Convergence		-0.009 ***		-0.005 **	
R^2	0.38 ***	0.11 ***	0.46 ***	0.04 **	0.28 ***

Notes:
- Dependent variables: mean (natural logarithm) or growth rate (over the period 2000-2008); real GDP per capita (real GDP / population), real hourly productivity of labour, participation rate (employment / population)
- Level values are in logarithms. The growth rates are continuous.
- 336 observations
- ***, **, * means significance at the 1%-, 5%-, 10%-level
- Two-sided Hypothesis: H0: $\beta 1 = 0$, H1: $\beta 1 \neq 0$

Source: BAKBASEL

In the level equations, the coefficient of accessibility is positive for all dependent variables and highly significant. In the long-run equilibrium, accessibility has therefore a significant positive impact on the economic prosperity of a region. The coefficient of accessibility around 1.1 in the level equations is similar for the dependent variables real GDP per capita and the hourly productivity, whereas the coefficient in the model including the participation rate as dependent variable is lower by more than half. This means that the accessibility has a lower impact on the participation rate.

In the difference equations, the coefficient of the accessibility growth is positive, but there is no significance and it is clearly smaller than in the level equations. It follows that the long term impact of accessibility is much higher than the short term impact. This applies to the two dependent variables, the real GDP per capita and the real hourly productivity of labour. Nevertheless, we can assume that accessibility growth exerts a positive influence on the economic prosperity in a long-term growth process.

Real GDP per capita

In order to show how to interpret the regression output, we further investigate the results for the model including the real GDP per capita as the dependent variable. As mentioned before, the level coefficient of accessibility is 1.13 and highly significant. Accessibility has therefore in the long-run equilibrium a significant and positive impact on the real GDP per capita of a region. Also taxation and innovation show the expected signs and the coefficients are significantly different from zero. So we can conclude that low taxes and high innovation lead to a higher real GDP per capita (see also chapters 0 and 0 on transmission mechanisms). Regulation does not display the expected sign, but the coefficient is very small and not significantly different from zero[8]. The regression's R^2, which indicates the fraction of the sample variance of the dependent variable explained by the independent variables, is 0.38.

The model in the difference equations gives worse results. The coefficient of accessibility growth is slightly positive, but it is not significantly different from zero. The coefficients of the taxation, innovation and the convergence term also show the expected sign, but only the convergence term is highly significant. Consequently, there is a slight convergence movement between the regions. Regions with an already high real GDP per capita grow less than regions with a low real GDP per capita. As in the first model, the regulation coefficient has the "wrong" sign. In addition, the coefficient is significantly different from zero. The regression's R^2 of 0.11 is rather low.

The coefficients of the level and difference equations can be interpreted reasonably well. For this purpose the following equations are recalled: By differentiating the level equation with respect to time, we get an expression for the "average region", under the assumption that all other regressors remain constant over time (ceteris paribus).

1) $g\overline{X} = \beta_1 \cdot g\,\overline{AC}$

In the level equation, a one percent improvement in the level of accessibility (on average an improvement of one point, respectively 0.1 standard deviations) therefore leads to an approximately 1.1 percent improvement in the GDP per capita level.

The estimated difference equation (assuming again that all other regressors remain constant over time) is:

2) $g\overline{X} = \beta_0 + \beta_1 \cdot g\,\overline{AC}$

Ignoring the temporal trend, a one percent improvement in the accessibility level leads to an improvement in GDP per capita of 0.18 percent.

These considerations allow the following conclusions: A part of the growth effect, which is attributed to the accessibility in the level equation, could be explained by a temporal trend (β_{0t}). However, the second equation shows that even by taking into account temporal trends the accessibility still exerts a positive impact on the economic prosperity.

Transport and geographical accessibility

As described in chapter 0, the total accessibility can be divided into:

- the geographical accessibility, which measures the geographical location of a region and
- the transport accessibility, which measures the transportation efforts (transport infrastructure and services) of the region.

[8] A positive sign for the regulation coefficient is possible, as here the variable labour market regulation is included. It can be argued that a high labour market regulation (employment protection, minimum wage) makes it especially unattractive to hire poorly qualified people. Therefore it is possible that a high labour market regulation leads to higher productivity of labour, which can cause higher real GDP per capita. However, high labour market regulation always lowers employment. If we use the participation rate as the dependent variable, the coefficient should be negative. This is comfirmed in the regression output shown above.

The results in Tab. 0-2 provide information about which part of the total accessibility has a decisive influence on the economic prosperity. The growth of geographical accessibility is not included in the regression, since it is assumed to take the value zero.

Tab. 0-2 Regression output: Cross-section, geographical and transport accessibility

Coefficient	GDP per capita		Hourly productivity of labour		Participation rate
	Level	Difference	Level	Difference	Level
Transport	0.84 ***	0.14	0.43 ***	0.08	0.41 ***
Geographical	0.31 ***		0.58 ***		0.03

Notes:
- Dependent variables: mean (natural logarithm) or growth rate (over the period 2000-2008); real GDP per capita (real GDP / population), real hourly productivity of labour, participation rate (employment / population)
- Level values are in logarithms. The growth rates are continuous.
- 336 observations
- ***, **, * means significance at the 1%-, 5%-, 10%-level
- Two-sided Hypothesis: H0: $\beta 1 = 0$, H1: $\beta 1 \neq 0$

Source: BAKBASEL

Tab. 0-2 reveals the differences between the indicators. Regarding GDP per capita and participation rate, the transportation efforts are more important than the geographical accessibility. This is reasonable, because the air traffic limits the influence on the total accessibility by the geographical location. Also peripherally located cities such as Madrid, Dublin or Stockholm can achieve a good total accessibility. Concerning the hourly productivity of labour, the coefficient of geographical accessibility exceeds the one of transport accessibility. This is an undesirable result for politicians, as it means that the geographical location, which is unchangeable, has a greater impact on the productivity. To conclude, the level of hourly productivity that regions can achieve is partly predetermined. Further it is interesting that the coefficient of geographical accessibility is not significantly different from zero, while there is a significant relationship between employment and transportation efforts. Unlike previously this is a good result for policy makers. It shows the possibility to achieve higher employment by improving the transport infrastructure and services.

In the difference equation similar results for the growth of transport accessibility as for the growth of total accessibility can be derived: The coefficients of the growth rates are clearly smaller than those of the level values and the coefficients of the accessibility indices are not significantly different from zero. As concluded before, this means that the long term impact of transport accessibility is much higher than the short term impact.

The following conclusions can be drawn: By dividing the total accessibility in geographical location and transportation efforts, which rely to a large extent on transport infrastructure, the latter is shown to be more important than the exogenous geographical location. This effectively means that the disadvantage of peripherality can be made up by good transport connections.

Peripheral regions

In order to identify differences between peripheral and non-peripheral regions, we are working with dummy variables. Tab. 0-3 shows the coefficient of the accessibility dummy. The dummy takes the value 1, if the region is peripheral. In this sample, the 60 most remote regions in terms of accessibility are marked as peripheral. The coefficient of the dummy represents the difference in the impact of accessibility between peripheral and non-peripheral regions. For example, the coefficient of the level equation, where GDP per capita is the dependent variable, is 0.06. This means that the coefficient of accessibility is 0.06 higher for peripheral regions than for non-peripheral regions. However, none of the coefficients of the accessibility dummy is significantly different from zero.

In summary, it can be said that the impacts of accessibility on the dependent variables are similar for peripheral regions and for the non-peripherals.

Tab. 0-3 Regression output: Cross-section, accessibility dummy for peripheral regions

Coefficient	GDP per capita		Hourly productivity of labour		Participation rate
	Level	Difference	Level	Difference	Level
Accessibility Dummy	0.06	0.33	0.20	0.76	-0.41

Notes:
- 60 observations (the most peripheral regions)
- ***, **, * means significance at the 1%-, 5%-, 10%-level.
- Two-sided Hypothesis: H0: $\beta 1 = 0$, H1: $\beta 1 \neq 0$

Source: BAKBASEL

Panel models

As shown in the schedule in Fig. 0-1, statistical inference in panel model analysis is risky, if certain properties of the stochastic processes are ignored. Therefore, before interpreting the results of the panel regressions, we undertake statistical tests in order to clarify which conclusions can be drawn from the estimations. The following questions have to be answered:

- Which variables are stationary? ➔ Unit root tests
- Are the first differences of the non-stationary variables stationary? ➔ Unit root tests
- Is there a long-term cointegration relationship between several non-stationary variables? ➔ Cointegration tests

It has to be mentioned that for the panel model analysis the total accessibility is not divided into geographical location and transportation efforts. The Fixed Effects that are used in the regressions already capture the impact of the geographical accessibility. Therefore, defining the specific transportation accessibility as regressor would not result in additional information. In the following explanations the term accessibility is generally defined as the total accessibility.

Unit root tests

If the dependent and several independent variables are non-stationary, which means they contain a unit root, this jeopardizes the statistical inference. Just the case of two variables, each following a trend over time, can result in an illusive correlation between these variables (spurious regression). For this reason, the variables have to be tested for stationarity before undertaking any panel regression. Tab. 0-4 shows the results of two unit root tests:

- The test according to Levin, Lin and Chu (2002, LLC) considers the cross-sectional entities as homogenous and therefore assumes the same autoregressive coefficients for all of them in the equations to be tested. The null hypothesis (H0) states: All the cross-sectional time series contain the same unit root.
- The test according to Im, Pesaran and Shin (2003, IPS) deems the cross-sectional entities as heterogeneous and allows for different autoregressive coefficients in the equations to be tested. The null hypothesis (H0) says: All the cross-sectional time series contain a unit root, which does not have to be the same.

- The test according to Hadri (2000) allows the same flexibility as IPS. In contrast to the previous two tests, the null hypothesis (H0) is: All the cross-sectional time series do not contain a unit root and are therefore stationary.

The unit root tests are undertaken for various specifications. They differ in the deterministic components that are included into the ADF (Augmented Dicky-Fuller) specifications.

- With cross-sectional-specific constant and cross-sectional-specific trend
- With cross-sectional-specific constant
- Without cross-sectional-specific constant

The third option is only considered in the LLC test.

In the table below the stars indicate the significance level at which the null hypothesis can be rejected.

Tab. 0-4 Unit root tests

		Constant and trend			Constant			None
		LLC	IPS	Hadri	LLC	IPS	Hadri	LLC
GDP per capita	Level	***		***	***		***	
	Growth	***	**	***	***	***	***	***
Hourly productivity of labour	Level	***	***	***	***		***	
	Growth	***	***	***	***	***	***	***
Participation rate	Level	***		***	***		***	***
	Growth	***	***	***	***	***	***	***
Accessibility	Level	***		***			***	***
	Growth	***		***	***	***	***	***
Transport accessibility	Level	***		***			***	***
	Growth	***		***	***	***	***	***
Regulation of labour markets	Level	***	***	***			***	***
	Growth	***	***	***	***	***	***	***
Regulation of product markets	Level	***		***	***	***	***	***
	Growth	***	***	***	***	***	***	***
Tax burden for companies	Level	***	***	***	***	***	***	
	Growth	***	***	***	***	***	***	***
Tax burden for manpower	Level	***	***	***	***		***	
	Growth	***	***	***	***	***	***	***
Research & Development	Level	***	***	***	***		***	
	Growth	***	***	***	***	***	***	***
Secondary education	Level	***	***	***	***	***	***	***
	Growth	***	***	***	***	***	***	***

Tertiary education	Level	***	***	***	***		***	***
	Growth	***	***	***	***	***	***	***

Notes:
- LLC: H_0: All cross-sectional time series contain a common unit root.
- IPS: H_0: All cross-sectional time series contain a unit root (but not necessarily the same).
- Hadri: H_0: All cross-sectional time series do not contain a common or distinct unit root (they are stationary).
- ***, **, * means significance at the 1%-, 5%-, 10%-level.

Source: BAKBASEL

As the LLC-test is based on the asymptotic properties assuming that the factor time (t) tends towards infinity for the given number of cross-sections (n), the IPS-test suits our sample better (n>t). The IPS-test including the individually specific constant leads to relatively explicit results: In most of the cases the logarithms of the level variables contain unit roots, while its' differences (the constant growth rate of the non-logarithmized levels) do not. The majority of the variables is therefore integrated by order one (I(1)). The exceptions are the variables regulation of product markets, tax burden for companies and secondary education. These three variables do not contain any unit root (at least until the significance level of 10%) and should therefore be stationary (I(0)).

The Hadri-test rejects the null hypothesis of no unit root for all the variables and its' growth rates. However, it is known that for small t and in the presence of autocorrelation, the Hadri test reveals significant size distortions when there is no unit root. As a result, the Hadri test tends to be over-reject the null hypothesis and may yield contradicting results compared to alternative tests (Hlouskova and Wagner, 2006).

Although the results of the unit root tests are not completely coinciding, we can observe a strong tendency towards unit roots in the log-levels, while the differences of the variables (the growth rates) are stationary. Concluding, it seems to be reasonable to suppose unit roots for the logarithmized levels and stationarity for the first differences of the variables. The assumption I(1) will be the basis of the following parts of this study.

Cointegration tests

A regression using non-stationary regressands and regressors may jeopardize the statistical inference and lead to the mistake of interpreting spurious regressions as real relationships between variables. This is avoided, if the dependent variable is cointegrated with one or several of the independent variables. Cointegration means that the so-called "cointegrated" variables follow a common trend, which results in stationary residuals and therefore normal inference is valid interpreting the conclusions as properties of a long-run equilibrium relationship.

In the subsequent parts we test, if the variables that are used in the panel level equations are cointegrated. These tests are undertaken for the following variables:

- GDP per capita (in logs)
- Hourly productivity of labour (in logs)
- Participation rate (in logs)
- Accessibility (in logs)
- Transport accessibility (in logs)
- Regulation of labour markets (in logs)
- Tax burden for manpower (in logs)
- Research & development (in logs)
- Tertiary education (in logs)

For this purpose the test statistics of Pedroni (1999, 2004) are applied. These tests examine the residuals of a spurious regression[9]: If the residuals are I(0), the variables are cointegrated. If they are I(1), the variables are not cointegrated. Pedroni (1999) suggests the same distinction as between the LLC- and the IPS-test for his test statistics:

- The Within-dimension (panel statistics) considers the cross-sectional entities as homogenous and assumes a common autoregressive coefficient in all the equations to be tested. The null hypothesis (H0) states: All the (residual) cross-sectional time series contain the same unit root.
- The Between-dimension (group statistics) regards the different cross-sectional entities as heterogeneous and therefore allows for different autoregressive coefficients in the equations to be tested. The null hypothesis (H0) is: All the (residual) cross-sectional time series contain a unit root, which is not necessarily the same for the different series.

Pedroni (1999) proposes seven different test statistics: Four statistics for the Within-dimension (v, PP-ρ, PP-t, ADF-t) and three statistics for the Between-dimension (PP-ρ, PP-t, ADF-t). The panel statistics (Wihtin-dimension) can be calculated by a weighted or a non-weighted method. Towards the limit both methods of calculation follow the same distribution function. However, Pedroni (2004) shows by Monte Carlo simulations, that for small samples the non-weighted statistics outperform the weighted ones. Due to these findings we only consider the non-weighted panel statistics in the present study.

In the following, four of the seven mentioned test statistics are shortly discussed in the framework of already known (time series) unit root tests:

- v: According to its form a non-parametric variance-ratio-statistics.
- PP-ρ: Panel versions of the (non-parametric) Phillips-Perron-rho-statistics.
- PP-t: Panel versions of the (non-parametric) Phillips-Perron-t-statistics.
- ADF-t: Panel versions of the (parametric) Augmented-Dickey-Fuller-t-statistics.

These four statistics are commented here, because the other three test statistics are identical to test statistics of the Between-dimension. For the theoretical derivation of the test statistics the reader is advised to consult the original articles. Tab. 0-5 lists the seven test statistics. Like it was the case for the LLC- and the IPS-tests, the cointegration tests can be undertaken for different specifications. These specifications differ in the deterministic components that are included into the equations to be tested:

- With cross-sectional specific constant and cross-sectional specific trend
- With cross-sectional specific constant
- Without deterministic component

In the table below the stars indicate the significance level at which the null hypothesis can be rejected. The tests have been undertaken for all the possible combinations of regressands and regressors, while in the table only the following standard model is presented:

$$\ln X_{it} = \beta_0 + \beta_1 \ln AC_{it} + \beta_2 \ln RE_{it} + \beta_3 \ln TC_{it} + \beta_4 \ln FE_{it} + \varepsilon_i$$

Tab. 0-5 Cointegration tests

	Within-dimension (panel statistics)			**Between-dimension (group statistics)**		
	Constant and trend	Constant	None	Constant and trend	Constant	None

[9] Pedroni extends the Engle-Granger (1987) «two step residual based cointegration tests» to panel data.

GDP per capita	v	***					
	PP-ρ						
	PP-t	***	***	***	***	***	***
	ADF-t	***	***	***	***	***	***
Hourly productivity of labour	v	***					
	PP-ρ						
	PP-t	***	***	***	***	***	***
	ADF-t	***	***	***	***	***	***
Participation rate	v						
	PP-ρ						
	PP-t	***	***	***	***	***	***
	ADF-t	***	***	***	***	***	***

Notes:

- Within-dimension: H_0: All cross-sectional time series contain a common unit root.
- Between-dimension: H_0: All cross-sectional time series contain a unit root (but not necessarily the same).
- ***, **, * means significance at the 1%-, 5%-, 10%-level.

Source: BAKBASEL

According to Pedroni (1997) the statistical power of the ADF-t group and panel test statistics exceeds the other statistics' power in the case of short time series (t<100), followed by the PP-ρ panel statistics. In this study's framework we therefore focus on the ADF-t statistics. The test results in Tab. 0-5 show that for all the dependent variables (and the possible combinations of independent variables which are not shown here) only the tests based on the PP-t and ADF-t statistics, panel and group statistics, clearly reject the null hypothesis for all the specifications. This suggests cointegration amongst the variables. However, this conclusion cannot be drawn unambiguously, because based on the PP-ρ panel statistics it is impossible to reject the null hypothesis for any specification. Finally, the Within-dimension statistics strongly suggest cointegration for the specification including constant and trend for three of the four tests, with the exception of the dependent variable participation rate.

The results of the cointegration tests are not very clear. However, due to the transmission mechanisms of the economic theory described above the existence of a long-term cointegration relationship among the considered variables is very likely. Nevertheless we are going to discuss the version of cointegrated variables, as well as the alternative of no cointegration. The cointegration decision node in the schedule in chapter 0 can therefore not be clearly answered. Based on the economic theory, the focus of the following analysis lies on the level cointegration equations.

Regressions

Summing up the results of the previous chapters, we conclude:

- All the variables (the regressands and the regressors) are I(1), which means stationary in differences.
- The cointegration relationship between the regressands and the regressors cannot be clearly established.

Consequently, we decide to try both ways leaving from the cointegration decision node. The main focus, however, will be on the cointegration relationship.

The panel structural models are specified as Fixed-Effects (FE) models. Thereby the Fixed Effects are assumed only over the cross-sections. This means that every cross-sectional entity is given an individual intercept on the axis, which stays constant over time.

First, we need to test if the FE model with individually specific intercepts outperforms the Pooled model, which only allows one common intercept. For this purpose the Likelihood-Ratio test is undertaken. It compares the fits of the Pooled and the FE models or said differently, how probable the observed data is according to both models. The null hypothesis states: The Fixed Effects are redundant. Tab. 0-6 presents the significance levels at which the null hypothesis can be rejected. The tests have been undertaken for all the possible combinations of regressands and regressors. The table lists the results for the standard model:

$$X_{it} = \beta_0 + \beta_1 AC_{it} + \beta_2 RE_{it} + \beta_3 TC_{it} + \beta_4 FE_{it} + \\ + \{CT_{it-1} \; oder \; ECT_{it-1}\} + \varepsilon_{it}$$

Tab. 0-6 Likelihood-Ratio Tests

Cointegration	Dependent variable	Specification	
		Level	Difference
YES	GDP per capita	***	***
	Hourly productivity of labour	***	
	Participation rate	***	**
NO	GDP per capita		***
	Hourly productivity of labour		***
	Participation rate		***

Notes:
- H_0: The Fixed Effects are redundant.
- Level values are in logarithms. The growth rates are continuous.
- The level equations do not include CT or ECT.
- ***, **, * means significance at the 1%-, 5%-, 10%-level.

Source: BAKBASEL

The null hypothesis is rejected in all the cases except for the cointegrated specification in differences with the productivity of labour as the dependent variable. In this case the specific intercepts are redundant. In all the other cases, however, Fixed Effects allow to derive significantly more information from the data compared to the pooled model.

Further it has to be tested if the individually specific axis intercepts are fix or random. This corresponds to the choice between the Fixed-Effects and the Random-Effects (RE) model. If both is feasible, the RE model tends to be better, because the estimators are more efficient than the ones of the FE models. It is important to keep in mind that the RE model takes the assumption of Random Effects being uncorrelated with the regressors. If the assumption does not apply, the RE estimators are inconsistent. A current method of testing this assumption is the Hausman test (1978). Its null hypothesis says: The Random Effects and the regressors are uncorrelated. If the null hypothesis of the Hausman test is rejected, the Fixed-Effects model is more appropriate. Tab. 0-7 presents the significance levels at which the null hypothesis of the Hausmann test can be rejected for the same equations as above.

Tab. 0-7 Hausman Tests

Cointegration	Dependent variable	Specification	
		Level	Difference

YES	GDP per capita	***	(***)
	Hourly productivity of labour	***	(***)
	Participation rate	**	(***)
NO	GDP per capita		***
	Hourly productivity of labour		***
	Participation rate		***

Notes:
- H_0: The Random Effects and the regressors are uncorrelated.
- Level values are in logarithms. The growth rates are continuous.
- Level equations do not include CT or ECT.
- ***, **, * means significance at the 1%-, 5%-, 10%-level.
- (***) means that the estimated variance of the Random Effects is zero.

Source: BAKBASEL

The null hypothesis of uncorrelated Random Effects and regressors is significantly rejected for the specifications tested above. The stars in the brackets point out that the estimated variance of the (cross-sectional) Random Effects is zero.

The test results are rather clear except the estimated zero variances for the Random Effects in the case of the cointegrated specification in differences. It is important to remind that by choosing the FE model one only risks to get inefficient (but consistent) estimators. Applying the RE model in the inappropriate case, however, can lead to inconsistent estimators. Therefore, the consequence of a potential mistake in the choice of the model is less serious in the case of using the Fixed Effects. For the reasons above, the FE model is chosen for this study.

The coefficients of the panel models are estimated as follows: In a first step the estimation equations are rewritten by using a Within-transformation. Then, the coefficients are estimated by the linear regression and the method of least squares (OLS). In order to avoid potential heteroscedasticity over the regions and autocorrelation within the regions (cross-section clustering), the covariance matrix is corrected by the procedure of Arellano (1987).

Regression output

Tab. 0-8 shows in analogy to Tab. 0-3 (cross-section results) the estimated coefficients of the indicators and the corresponding significance levels. Only the total accessibility is considered. The coefficients can be interpreted in the same manner as in chapter 0. As we use panel models to test the robustness of the results of the cross-sectional estimations, only the differences to Tab. 0-1 (cross-section results) are highlighted. When interpreting the significance levels of the level equation, it is important to keep in mind that the OLS estimators in the cointegration equation do not follow the normal distribution and that the interpretation of the t-tests must be taken with caution.

Tab. 0-8 Regression output: Panel, Total accessibility

Coefficient	GDP per capita		Hourly productivity of labour		Participation rate
	Level	Difference	Level	Difference	Level
Constant	2.13 ***	0.01 ***	2.28 ***	0.01 ***	-2.28 ***
Accessibility	0.19	0.07	0.22	0.10	0.29 *

Regulation	-0.12	***	0.00		-0.09	***	0.01		-0.04	***
Taxation	-0.26	***	-0.04	***	-0.21	***	-0.03	***	-0.11	***
Innovation	0.03	***	0.01	**	0.03	***	0.00	*	0.01	*
Error-correction			-0.18	***			-0.26	***		
R^2	0.97	***	0.25	***	0.96	***	0.27	***	0.96	***

Notes:
- Dependent variables: real GDP per capita (real GDP / population), real hourly productivity of labour, participation rate (employment / population)
- Level values are in logarithms. The growth rates are continuous.
- 336 observations
- ***, **, * means significance at the 1%-, 5%-, 10%-level.
- Two-sided Hypothesis: H0: $\beta 1 = 0$, H1: $\beta 1 \neq 0$

Source: BAKBASEL

In comparison to the cross-sectional level equations it is remarkable that the coefficients of accessibility in the panel-level equation are all smaller than the cross-sectional coefficients. However, the signs of the coefficients remain the same (positive). It is striking that the coefficients have lost their significance. Only in the equation with the participation rate as the dependent variable, the coefficient of accessibility is significantly different from zero.

The plausibility of the cross-section equations in levels can be evaluated in the light of the panel results as follows: It is possible that the observed relationship in the cross-sectional models partly arises from unobservable fixed effects. However, this conclusion needs to be treated with caution, since the cross-sectional models seem to be "trustworthier" for the reasons listed in chapter **Errore. L'origine riferimento non è stata trovata.**.

In terms of the difference equations the story is similar. The panel coefficients of the accessibility are all smaller than the cross-sectional coefficients and no coefficient is here significantly different from zero.

In summary, the panel results (panel regression with a cointegration) weaken the conclusions that were drawn from the cross-sectional results.

4.2 AIRPORT PERFORMANCE (DEPENDENT VARIABLE)

Cross sectional models and panel models

Dependent variable: Commercial passengers

In Tab. 0-9 an exemplary regression output is shown. The indicators of interest are the performance variables: labour productivity, participation rate and share of tourism by GDP. The dependent variable is the number of commercial passengers. The difference equation in the cross-sectional model includes the continous growth rates. In terms of the panel models the same assumptions are made as in the previous chapter. The investigated period is from 2006 until 2010.

Tab. 0-9 Regression output: Cross-section and panel

Coefficient	Cross section		Panel	
	Level	Difference	Level	Difference

Constant	-23.94	***	-0.02	***	6.80	***	-0.01	***
Productivity	2.82	***	0.36		0.78	*	0.81	***
Participation	4.87	***	1.89	***	2.06	***	2.49	***
Tourism	0.86	***	-0.40		0.33	*	0.17	
Convergence			0.0089	**				
Error-correction							-0.98	***
R^2	0.22	***	0.11	***	0.99	***	0.56	***

Notes:
- Dependent variables: mean (natural logarithm) or growth rate (over the period 2006-2010)
- Level values are in logarithms. The growth rates are continuous.
- 200 observations
- ***, **, * means significance at the 1%-, 5%-, 10%-level.
- Two-sided Hypothesis: H0: $\beta 1 = 0$, H1: $\beta 1 \neq 0$

Source: BAKBASEL

In the level equation of the cross-sectional model, the coefficients of all the independent variables are positive and highly significant. The performance indicators have therefore in the long-run equilibrium a significant, positive impact on the performance of airports. The participation rate has the highest coefficient and the highest significance in explaining the number of commercial passengers. For example, a one percent improvement of the participation rate leads to an approximately 4.9 percent increase in the number of commercial passengers.

In the difference equation of the cross-sectional model, the results are worse. Only the coefficient of the participation rate growth is highly significant with the correct sign (positive). The coefficient of productivity growth is indeed positive, but not significantly different from zero. Additionally, the coefficient of the share of tourism displays the wrong sign (negative), while there is also no significance. Considering these results we conclude that especially the growth of the participation rate exerts a positive influence on the performance of airports in a long-term growth process.

An interesting outcome is the positive convergence term, which is significant at the 5 percent-level. This means that the regions diverge from each other instead of converging. These are rather bad news for the politicians, because it means that large airports tend to grow faster than smaller ones.

As we use panel models in order to test the robustness of the cross-sectional models' results, the differences in the results are highlighted. In comparison to the cross-sectional level equations it is remarkable that the coefficients of the panel level equations are all smaller. However, the signs of the coefficients remain the same (positive) and although the coefficients of productivity and tourism have lost significance, they are all still significantly different from zero.

Regarding the difference equations, the results of the panel model outperform the regression output of the cross-sectional model. The sign of the coefficients of all performance indicators is positive and the coefficients of the growth of labour productivity and of the participation rate are even highly significant.

To conclude, the panel models confirm the plausibility of the results of cross-sectional models. The panel results only slightly weaken the conclusions that were drawn from the cross-sectional

outcomes. Particularly the impact of the participation rate is obvious in each model. It is therefore proved that regional economic activity is very relevant for airport performance.

Dependent variable: Cargo (freight & mail)

By taking cargo as the dependent variable we achieve worse results. This is not surprising, since there are less cargo hub airports and the regional differentiation is difficult. Further the available data on airport cargo is limited. In addition there are regions with high GDP per capita and large export sectors, but the exports are transported by ships or trucks. For this reason, we dispense with the presentation of the results, where cargo is the dependent variable.

5. LITERATURE

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Figures

Tables

ANNEX 4. BENCHMARKING

1. BENCHMARKING THE THREE STAKEHOLDER REGIONS

1.1 REGIONS SELECTED FOR BENCHMARKING

Tab. 0-29 Benchmarking-Regions

	Shortcut	Accessibility	Rank
West Greece	ED23	77.85	332
Keski-Suomi	FI193	77.01	335
Savona	IT132	95.17	200
Övre Norrland	SE08	79.46	326
Finmark	NO073	77.19	333
South-West Ireland	IR25	81.34	306
Alentejo	PT18	82.25	294
Lugo	ES112	78.32	330
Mecklenburg-Vorpommern	DE80	92.47	219
Nordjylland	DK05	91.51	223
Northern Ireland	UKN	96.72	191
Alpes-Maritimes	FK823	107.65	84
Genova	IT133	102.37	143
Pohjois-Savo	FI132	81.64	304
Crete	ED43	84.89	278
All regions		97.97	all 336

INDEX, average 2000-2008
Quelle: BAKBASEL

Indicators

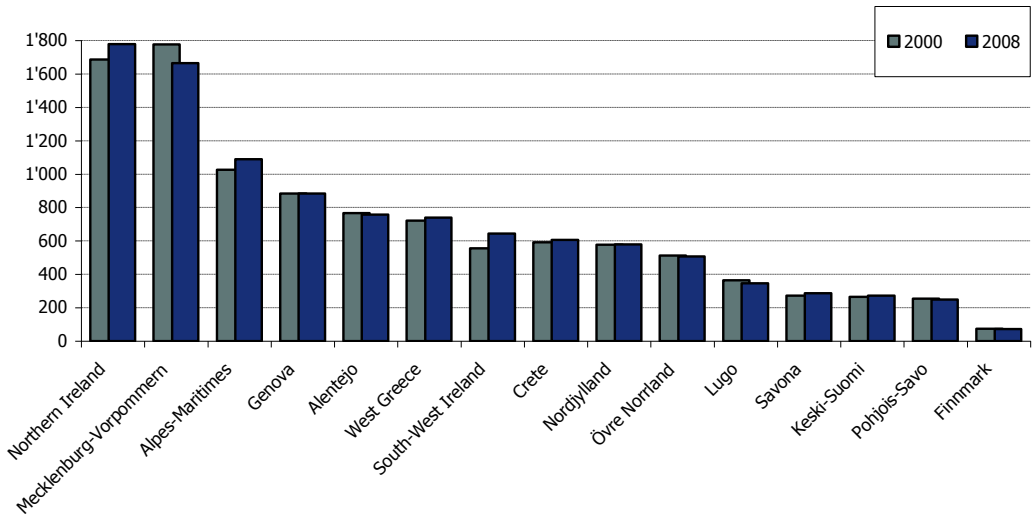
- Population
- GDP per capita
- Real GDP per capita growth or real GDP growth
- Participation rate
- Employment growth
- Labour productivity
- Hourly productivity
- Accessibility
- Expenditures on research and development
- Taxation
- Regulation
- Passengers
- Cargo
- Industry structure

Time

- Level: 2000 and 2008

1.2 RESULTS

Fig. 0-3 Population



Note: Population in 1'000 persons
Source: BAKBASEL

Methodological Notes
On a given date, the total population of a country consists of all persons, national or foreign, who are permanently resident in the economic territory of the country, even if they are temporarily absent. In the International Benchmarking Report population data is ascertained at the end of the year. Exception: Population data for the USA and the American regions refers to the beginning of July.

Population Breakdown
The total population of a country includes:

- nationals permanently resident in the country
- Civilian nationals staying abroad for a period of less than one year (frontier workers, seasonal workers, tourists, patients, etc.)
- foreign civilians resident in the country for a period of one year or more (including personnel of the Institutions of the European Communities and international civilian organisations within the geographic territory of the country)
- foreign military personnel working with international military organisations within the geographic territory of the country
- foreign technical assistance personnel on long-term assignments working in the country and deemed to be employed by their host government on behalf of the government or the international organisation which is actually financing their work

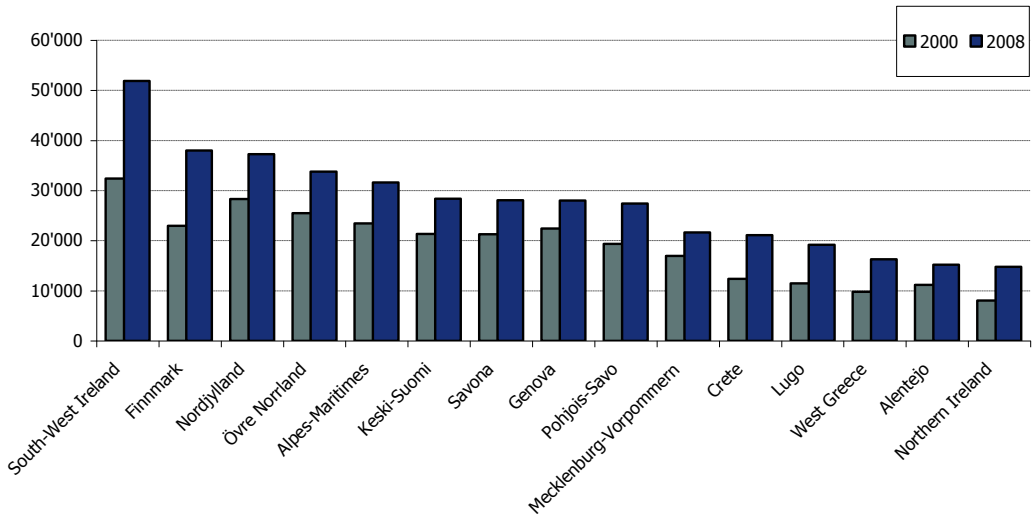
By convention, total population includes the following, irrespective of the length of their stay outside the country:

- national students, however long they study abroad
- members of the country's armed forces stationed in other parts of the world
- nationals on the staff of national scientific bases established outside the geographic territory of the country
- nationals on the staff of diplomatic missions abroad
- nationals who are members of the crews of fishing boats, other ships, aircraft and floating platforms operating partly, or wholly, outside the economic territory

For more information see International Benchmarking Report 2011.

Fig. 0-3 gives an idea about the size of the benchmark regions. The ranking reveals that Keski-Suomi and Savona belong to the smallest regions in this benchmarking, meanwhile bigger West-Greece lies somewhere in the middle span.

Fig. 0-4 Nominal GDP per capita



Note: In EUR PPP (at current prices and exchange rates)
Source: BAKBASEL

Methodological Notes

Gross Domestic Product per Capita

The Gross Domestic Product (GDP) related to the population of a region puts the final result of the production activity of resident producer units in a relation to the size of a region. This enables comparisons between regions of different size.

Gross Domestic Product

Gross domestic product at market prices is the final result of the production activity of resident producer units.

It can be defined in three ways:

- GDP is the sum of gross value added of the various institutional sectors or the various industries plus taxes but minus subsidies towards products (which are not allocated according to sectors and industries). It is also the balancing item in the total economy production account.
- GDP is the sum of final uses of goods and services by resident institutional units (actual final consumption and gross capital formation), plus exports but minus imports of goods and services.
- GDP is the sum of uses in the total economy generation of income account (compensation of employees, taxes on production and imports minus subsidies, gross operating surplus and mixed income of the total economy).

GDP in the IBD is measured at Market prices. Market prices are those paid by purchasers for the goods and services they acquire, excluding deductible value added tax (VAT) (Eurostat 1996, p.44).

Current prices and exchange rates

The GDP is in current prices (nominal). To compare data from different currency regions current exchange rates are used (annual average exchange rate).

Population

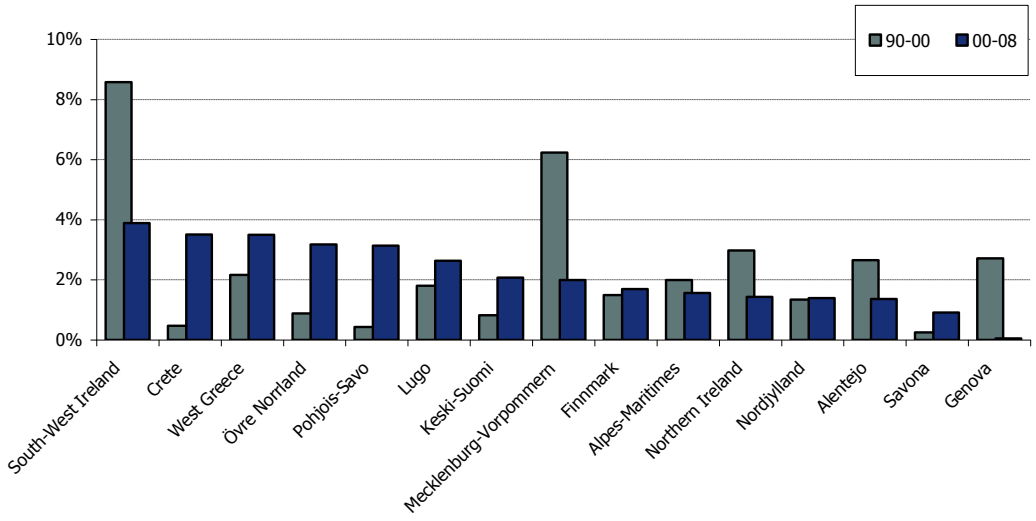
See methodological notes Fig. 0-3.

For more information see International Benchmarking Report 2011.

Nominal GDP per capita is a good measure of the wealth of regions. West Greece is clearly one of the poorest regions displayed in Fig. 1-2, independent of the year under consideration (2000 or

2008). The GDP per capita of Keski-Suomi and Savona is on a very similar level and lies around the average of this benchmarking.

Fig. 0-5 Growth of real GDP per capita 1990-2000, 2000-2008



Note: In % p.a. (at constant prices and exchange rates, PPP corrected)
Source: BAKBASEL

Methodological Notes

Gross Domestic Product per Capita

See methodological notes Fig. 0-4.

Gross Domestic Product

See methodological notes Fig. 0-4.

Constant prices and exchange rates (Eurostat 1996, p.13)

Valuation at constant prices means valuation of flows and stocks in an accounting period at the prices of a previous period. The purpose of valuation at constant prices is to break down changes over time in values of flows and stocks into changes in price and changes in volumes. Flows and stocks at constant prices are said to be in volume terms. In the International Benchmarking Report the basic year is 2000.

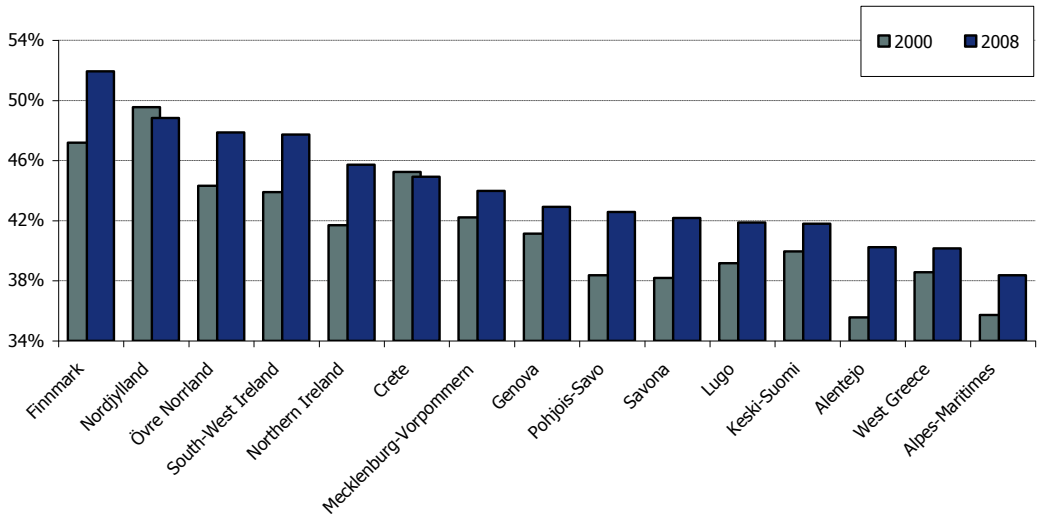
Purchasing Power Parity (PPP)

PPP is an exchange rate valuing the different purchasing power of the currencies instead of financial market exchange rates, which strongly fluctuate and are vulnerable to speculations. PPPs are usually used together with current prices and are supposed to compare output in real terms, in volumes. The PPPs used in the IBD are developed by the Growning Growth Centre (Prof. Bart van Ark) and follow a “production side” and industry specific approach most suitable for GDP and GVA data.

For more information see International Benchmarking Report 2011.

Concerning growth of real GDP per capita the three regions in focus display very different results. Over the period 2000-2008 West Greece had been one of the fastest growing regions, though based on a low level (compare Fig. 0-4). Keski-Suomi and Savona showed a rather weak growth in the Nineties. However, whereas for the period 2000-2008 Savona is still among the least dynamic regions, Keski-Suomi is now ranked somewhere in the middle.

Fig. 0-6 Participation rate



Note: Working population in % of the whole population
Source: BAKBASEL

Methodological Notes

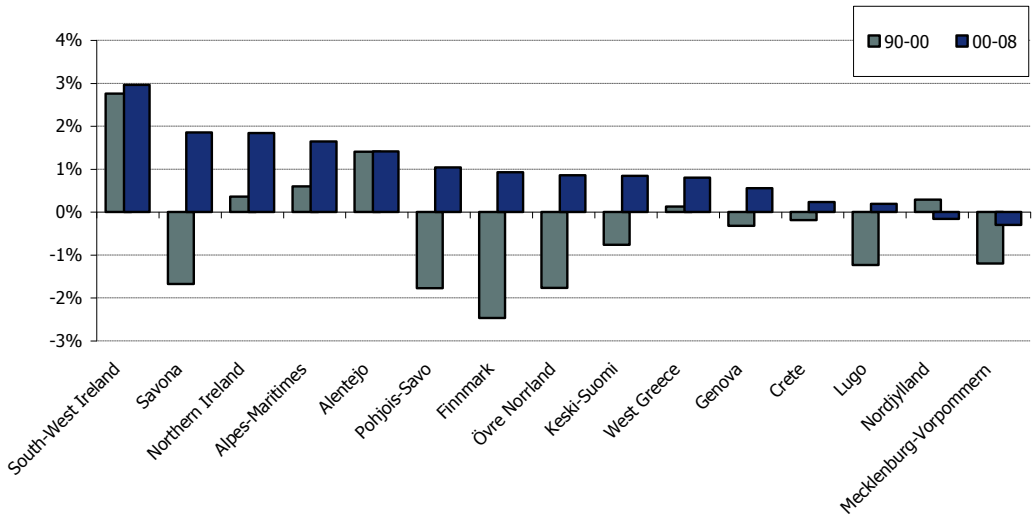
Participation rate is defined as employment divided by population.
Employment
See methodological notes Fig. 0-7.

Population
See methodological notes Fig. 0-3.

For more information see International Benchmarking Report 2011.

Concerning the participation rate, all three regions Keski-Suomi, Savona and West Greece are classified in the second half of the ranking with participation rates around 40 percent. It is noticeable that the ranking of Keski-Suomi is clearly worse than the ranking of its Scandinavian neighbours Finmark, Nordjylland and Övre Norrland.

Fig. 0-7 Growth of employment 1990-2000, 2000-2008



Note: In % p.a.
Source: BAKBASEL

Methodological Notes

The European System of Accounts (ESA 1995) introduced a number of measurements of employment:

- employment (= employees and self-employed)
- the number of jobs
- the full-time equivalence
- the total hours worked

Employment covers all persons, both employees and the self-employed, engaged in some productive activity that falls within the production boundary of the system.

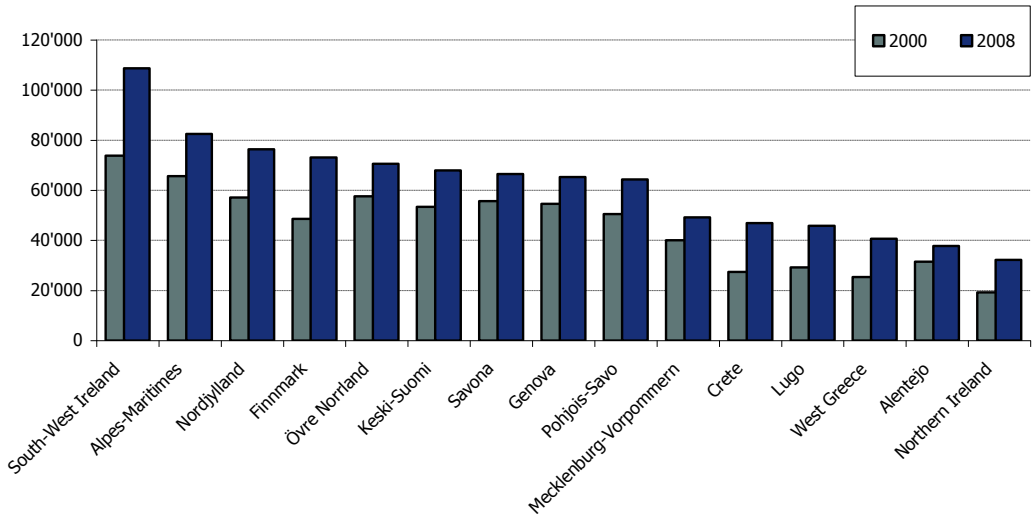
Employees are all persons who work under contract for another resident institutional unit and receive remuneration.

Self-employed persons are defined as persons who are the sole or joint owners of the unincorporated enterprises in which they work, excluding unincorporated enterprises classified as quasi-corporations.

For more information see International Benchmarking Report 2011.

Meanwhile its employment figures were shrinking over the Period 1990-2000, in the subsequent eight years Savona experienced a rather high growth of employment compared to other regions in this benchmarking. Keski-Suomi and West Greece also show a positive growth of employment for the later period (2000-2008) and are ranked somewhere in the middle.

Fig. 0-8 Nominal labour productivity



Note: In Euros per person employed (at current prices and exchange rates)
Source: BAKBASEL

Methodological Notes

Productivity is an economic key figure for the capability and competitiveness. Productivity is the ratio between inputs (production factors) and output (goods and services produced). The most common used productivity is labour productivity, as labour is easily measured.

Two measures of labour productivity are available in the IBD: hourly productivity and employment productivity.

Employment productivity

Employment productivity is the output per person in employment. The IBD provides information on the economy level as well as on the level of individual industries.

Please note: Within the IB, the term «labour productivity» is used with respect to a specific measure or data, it is employment productivity.

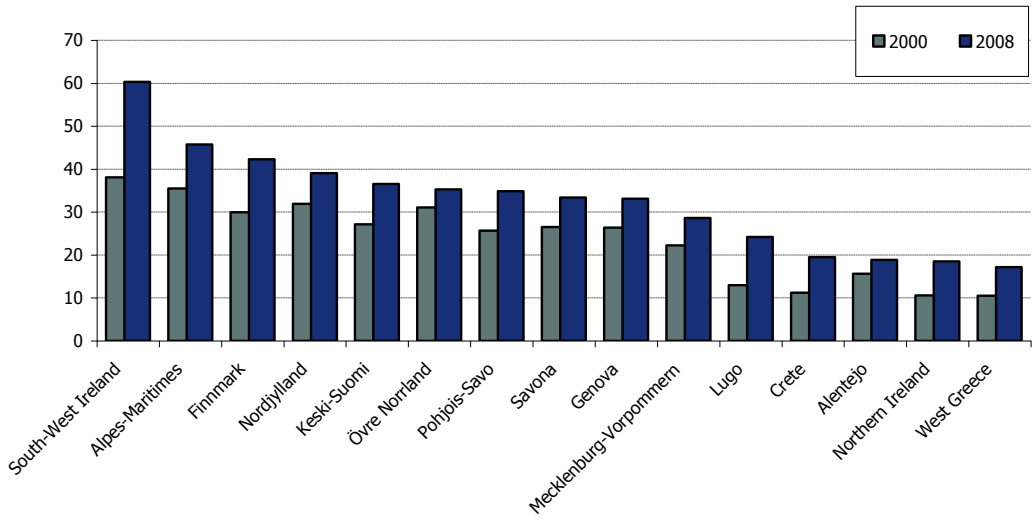
Current prices and exchange rates

See methodological notes Fig. 0-5.

For more information see International Benchmarking Report 2011.

Concerning labour productivity Keski-Suomi reveals the best performance among the three regions in focus, though there is still a rather large gap towards South-West Ireland as the leading region in this benchmarking. On the contrary West Greece exhibits a very low labour productivity, whereas Savona's labour productivity is around the average of the considered group and similar to the one of Keski-Suomi.

Fig. 0-9 Nominal hourly productivity



Note: In Euros per hour worked (at current prices and exchange rates)
Source: BAKBASEL

Methodological Notes

Productivity is an economic key figure for the capability and competitiveness. Productivity is the ratio between inputs (production factors) and output (goods and services produced). The most common used productivity is labour productivity, as labour is easily measured.

Two measures of labour productivity are available in the IBD: hourly productivity and employment productivity.

Hourly productivity

Hourly productivity is defined as output per hour of labour input. In the International Benchmarking Report hourly productivity is calculated as real value added divided by the effective total number of hours worked over the year.

Although basically providing the same information as employment productivity, the measures can differ from one another. Reasons for differences are especially found in the usual hours worked and the part time employment structures in the different countries. Other issues like overtime, holidays, average sick leave duration and similar issues influence the results as well. The differences can be observed in the levels as well as in the dynamics of the indicators.

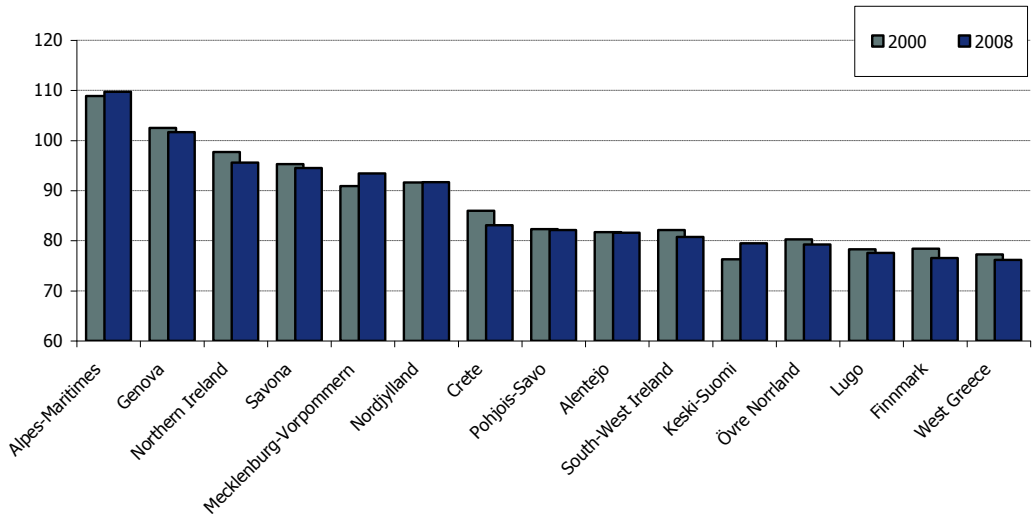
Current prices and exchange rates

See methodological notes Fig. 0-5.

For more information see International Benchmarking Report 2011.

The results for the hourly productivity are very similar to the ones for total labour productivity, showing a weak productivity for West Greece and an average hourly productivity for Keski-Suomi and Savona.

Fig. 0-10 Total Accessibility



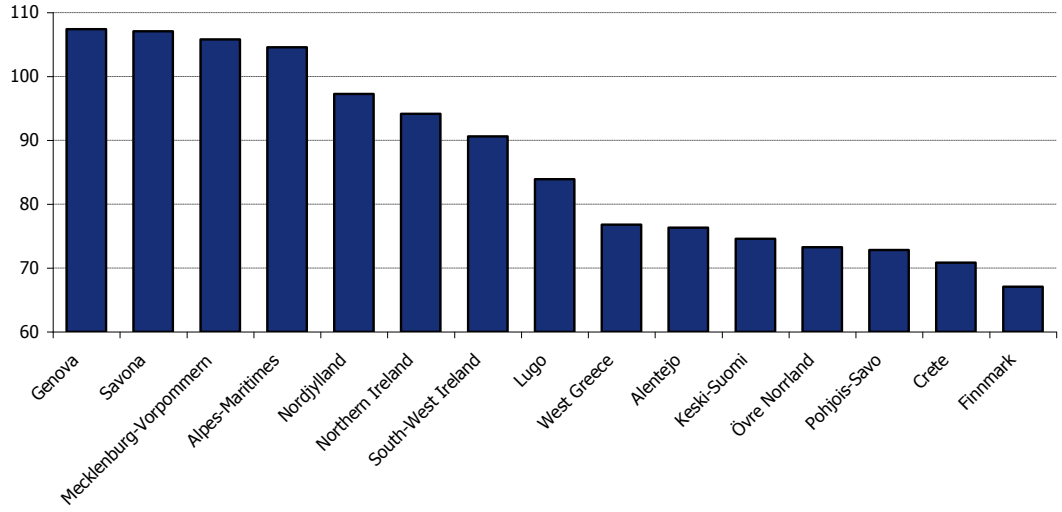
Note: Indexed (100 = sample mean)
Source: BAKBASEL

Methodological Notes
See Annex on Accessibility

For more information see International Benchmarking Report 2011.

Keski-Suomi and West Greece as peripheral regions naturally perform worse in terms of total accessibility compared to more centrally located regions like Savona (Fig. 0-10). But also concerning transport accessibility West Greece and Keski-Suomi are among the weakest regions in this benchmarking, though Keski-Suomi clearly could improve its position over the period 2000-2008 (**Fig. 0-12**).

Fig. 0-11 Geographical Accessibility



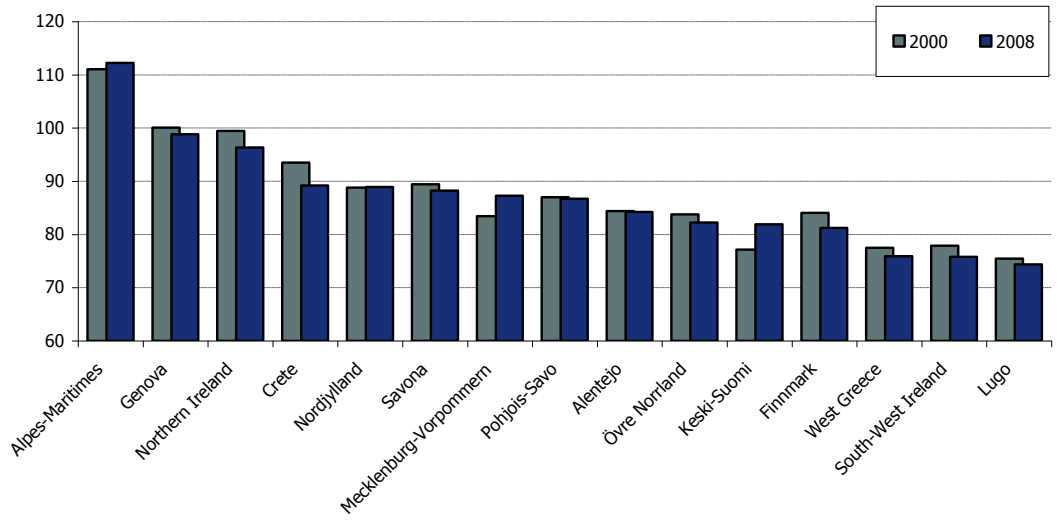
Note: Indexed (100 = sample mean)
Source: BAKBASEL

Methodological Notes
See Annex on Accessibility

For more information see International Benchmarking Report 2011.

More centrally located Savona clearly has a natural advantage in terms of geographical accessibility compared to the more peripheral regions West Greece and Keski-Suomi and is ranked second best in this benchmarking group. Geographical accessibility values of West Greece and Keski-Suomi lie clearly below the sample mean and are on a similar level as the ones for Alentejo or Övre Norrland.

Fig. 0-12 Transport Accessibility



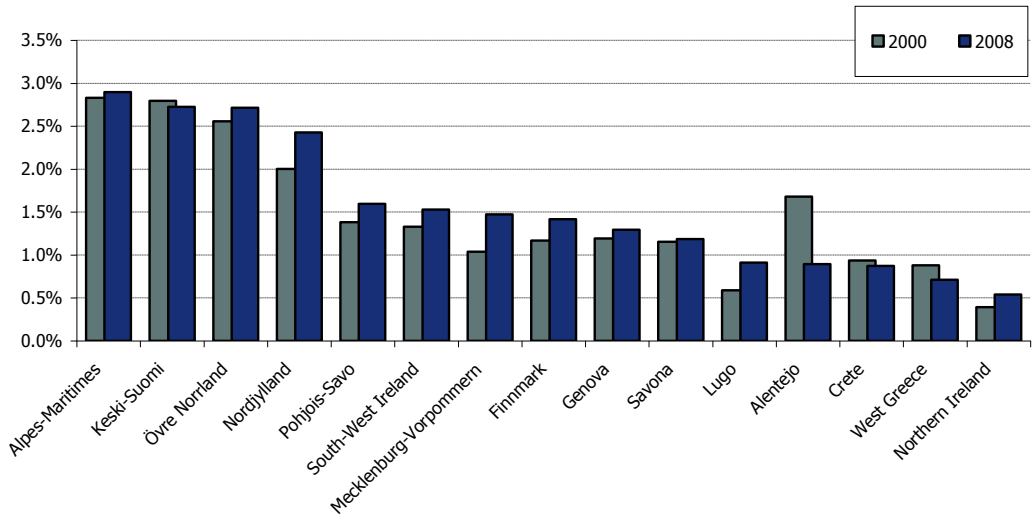
Note: Indexed (100 = sample mean)
Source: BAKBASEL

Methodological Notes
See Annex on Accessibility

For more information see International Benchmarking Report 2011.

Concerning transport accessibility all three regions Savona, Keski-Suomi and West Greece underperform in comparison to the whole sample (values below 100 index points). Compared to this smaller benchmarking group Savona lies somewhere in the middle, meanwhile Keski-Suomi and West Greece clearly belong to the weakest regions. However, Keski-Suomi exhibits one of the highest growth rates in transport accessibility between 2000 and 2008 among this benchmarking.

Fig. 0-13 Expenditures on Research & Development



Note: In % of GDP
Source: BAKBASEL

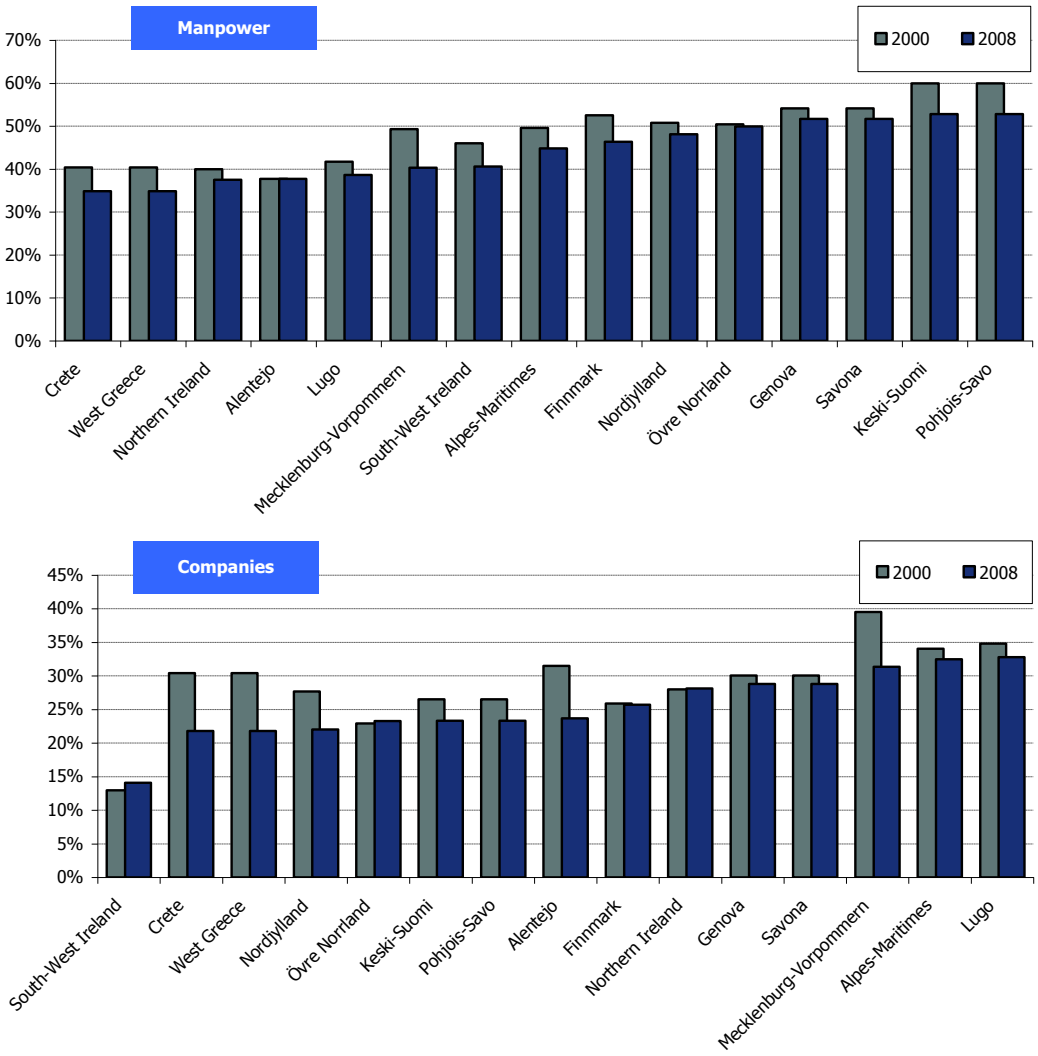
Methodological Notes

This indicator measures the expenditures on research and development as a percentage of GDP. It comprises total intramural R&D expenditures in all sectors of performance, i.e. business enterprise sector, government sector, higher education sector and private non-profit sector.

For more information see International Benchmarking Report 2011.

In this benchmarking group Alpes-Maritimes and Keski-Suomi take a leading position concerning expenditures on Research and Development, whereas Savona is ranked slightly below the average. On the other end of the ranking, West Greece exhibits the second lowest level of expenses on R&D.

Fig. 0-14 Taxation



Source: ZEW/BAKBASEL

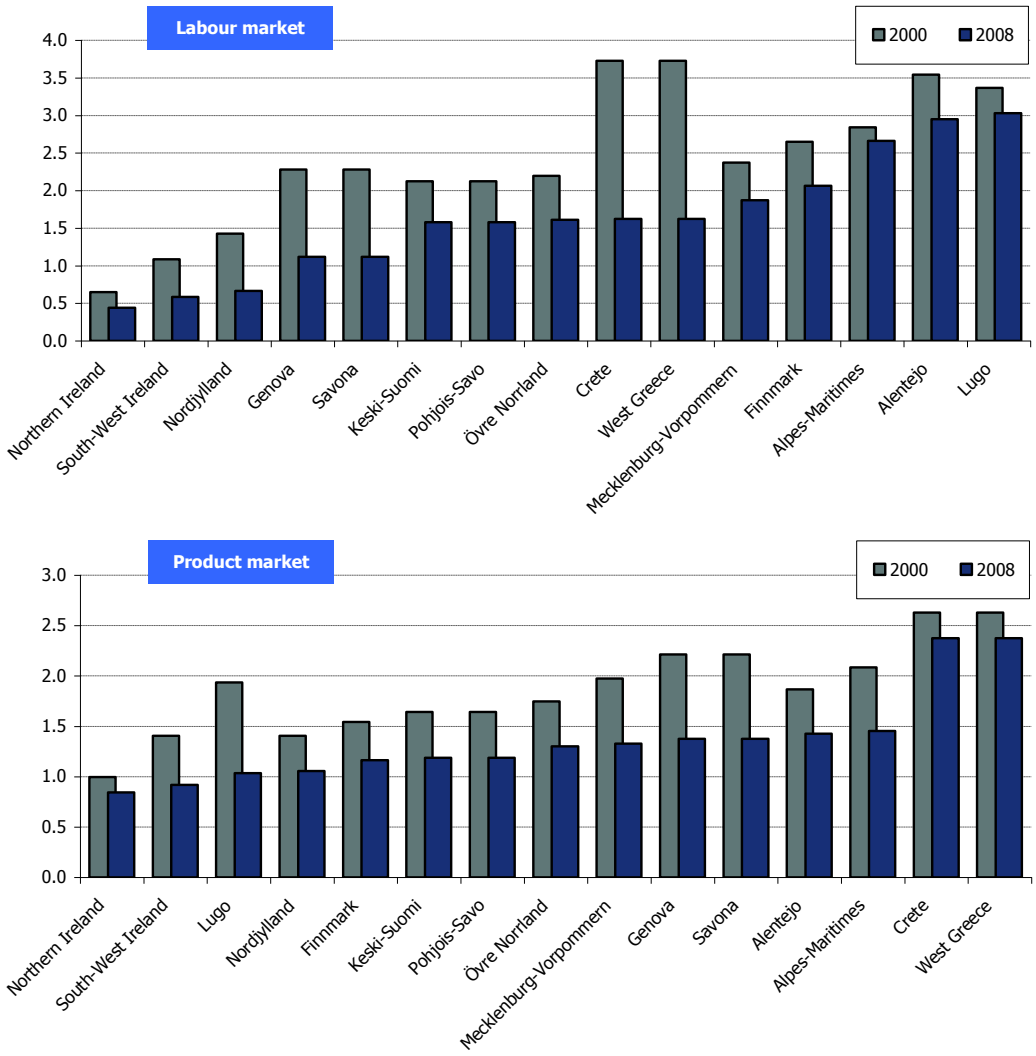
Methodological Notes

See Annex on data

For more information see International Benchmarking Report 2011.

West Greece exhibits rather low levels of manpower as well as company taxation. In contrary, Savona imposes a rather high tax burden in terms of manpower and company taxation. For Keski-Suomi especially the manpower taxation is among the highest in this benchmarking group.

Fig. 0-15 Regulation



Note: Both indexes are scaled between 0 (no regulation) and 6 (restrictive).
Source: BAKBASEL

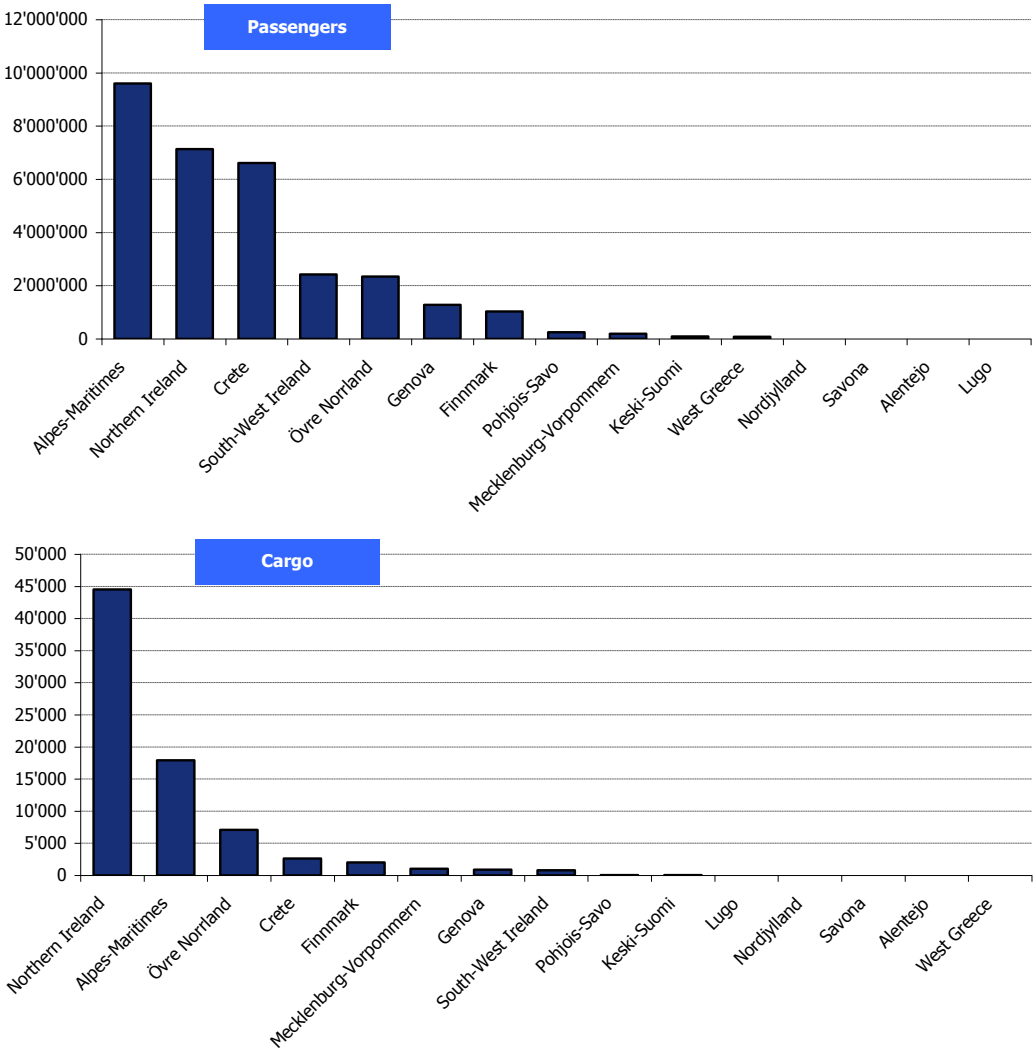
Methodological Notes

See Annex on data

For more information see International Benchmarking Report 2011.

Regarding labour market regulation it is noticeable by how much Savona and West Greece could improve their position from 2000 to 2008. Savona now reveals the lowest labour market regulation of the three regions under consideration. In terms of product market regulation Greece in general has some clear disadvantages. Between Keski-Suomi and Savona there is a rather small difference and both regions are ranked somewhere in the middle.

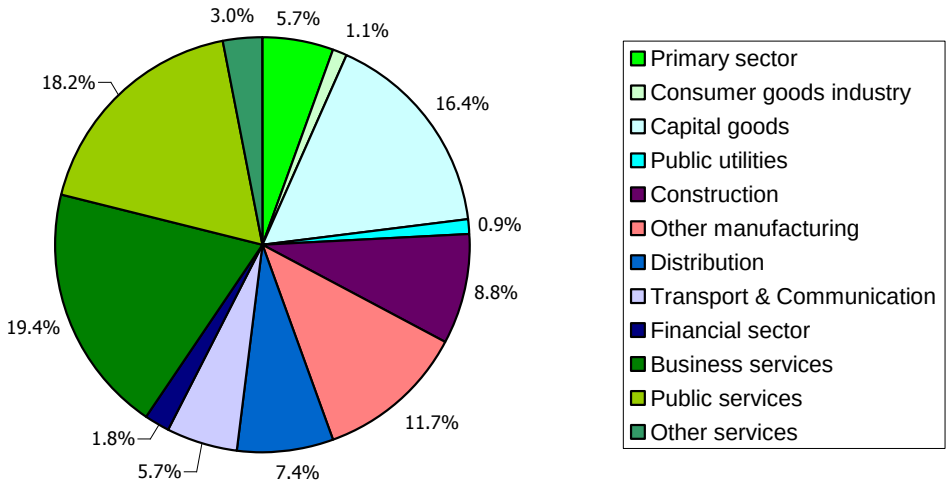
Fig. 0-16 Transportation



Note: Passengers are the number of commercial passengers in a region during year 2010; Cargo (freight&mail) in metric tones in 2010
Source: BAKBASEL

Regions with no international airport within its area naturally display a value of zero for both variables. This is true for Lugo, Alentejo, Savona and Nordjylland. West Greece and Keski-Suomi only have a very small number of passengers arriving each year and no (or almost no) Cargo.

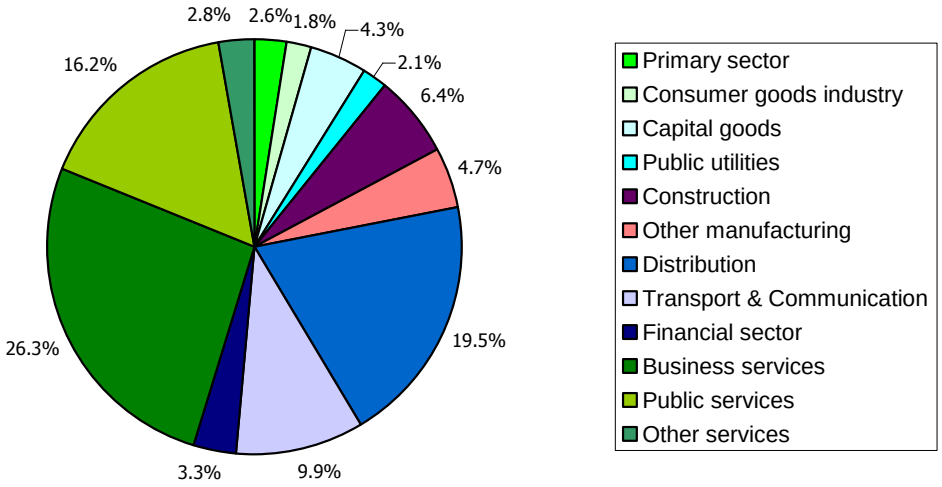
Fig. 0-17 Industry structure Keski-Suomi, 2010



Share of total economy, in %
Source: BAKBASEL

The pie shows the industry structure of the Central Finland economy in the year 2010 as shares in GDP (using the NACE classification). The service sector has the largest share with 55.4 percent, while the primary and the secondary sector contribute 5.7 and 38.9 percent to total GDP. The most important industries in the service sector are the business services and the public services. Most important for the industry sector is the production of capital goods.

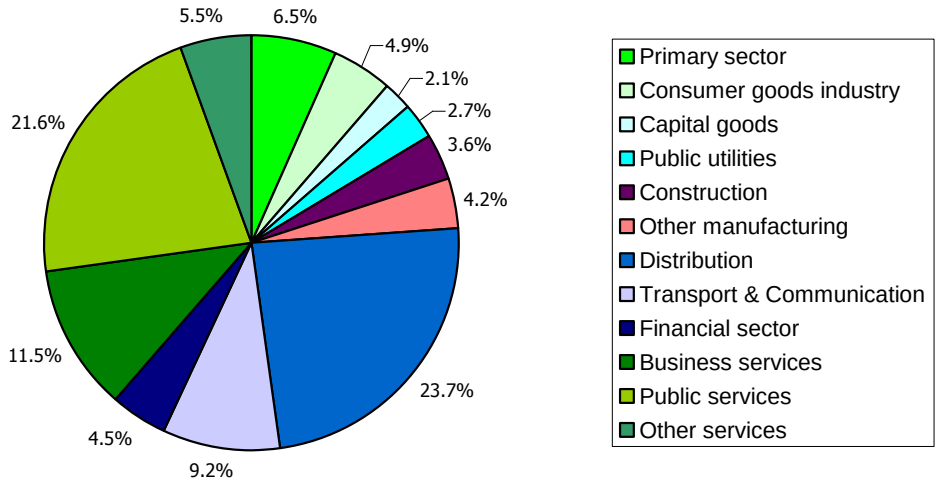
Fig. 0-18 Industry structure Savona, 2010



Share of total economy, in %
Source: BAKBASEL

The pie shows the industry structure of the economy in Savona in the year 2010 as shares in GDP (using the NACE classification). The industry structure is dominated by the service sector which accounts for more than 75 percent of the total economy in 2010. The most important industries in the service sector are the business services (26.3%) and the distribution (16.2%). The primary and the secondary sector contribute 2.6 and 19.4 percent to total GDP. Beside construction there cannot be identified any important (export-oriented) industry cluster in the secondary sector.

Fig. 0-19 Industry structure West Greece, 2010



Share of total economy, in %
Source: BAKBASEL

The pie shows the industry structure of the economy in West Greece in the year 2010 as shares in GDP (using the NACE classification). The industry structure is dominated by the service sector which accounts for more than 75 percent of total economy in 2010. The most important industries in the service sector are the public services (21.6%) and the distribution (23.7%). The primary and the secondary sector contribute 6.5 and 17.5 percent to total GDP. Most important for the industry sector is the consumer goods industry.

Figures

1.2 RESULTS

ANNEX 5. CASE STUDIES

1. INTRODUCTION

The *Annexes 5* document is thought as a report that archive all the materials and the full information used to write the main Report. In the *Annexes of the Interim Report*, we present the complete information regarding the 3 case studies.

The introduction is an integration of the urban and territorial theory that is above the research. We believe in the promotion and development of the airport infrastructure but, at the same time, it's extremely urgent focused in the new cycle of the infrastructure: how could the infrastructure, in particular airports, be reused and become a new dynamic centralities of the surrounding territory?
The central issue is to investigate the possibility of recycling existing airport infrastructure and to re-use and maximize their potentiality through development strategies. It is referred not only to abandoned and obsolete infrastructure, searching for a new identity, but also to infrastructure that is still active, but poorly operative and productive. We present different example of existing recycled airports all over the word.

Then, we describe the situation in the 3 Stakeholder Regions through an in-depth collection of pictures, maps, graphics and photos that support the description of the Interim Report.

At the end of this document, we include the complete forms that LP, P3 and P4 produce together for the Interview and the Questionnaire.

The *Annexes 5* document contains the technical and complementary information and data, that support and integrate the *Interim Report* in a graphical and theoretical way.

2. CASE STUDIES

2.1 DIFFERENCES OF REGIONS AND AIRPORTS

Nowadays, the proliferation of low-cost airlines promotes the revitalization of small regional or secondary airports. These infrastructures, generally constructed for military use, over the years have been underutilized or even abandoned, becoming obsolete, and compromising the development of the surrounding area. Since the late 1990s several secondary airports have been incorporated into the low-cost airport network, resulting in both an infrastructural and functional renewal, and in the growth of activities (not only related to air transport). The recycling of the small airports is crucial on a local scale as this generates a rapid transformation of land use and of the infrastructure network relative to land transportation: the airport therefore becomes a landmark in the territory and an important element for the local economy.

Lleida-Alguaire airport: *on hold*

The Lleida-Alguaire Airport started to operate on February, 5th 2010. One year later, both main fight companies (Pyrenair first, Air Nostrum and Ryanair one month later) moved their flights activities to the Lleida-Alguaire Airport.
Alguaire, with its small population of 3.000 inhabitants and located far 15 km from Lleida, was chosen between twenty candidates by the Government to host the aviation infrastructure. After 23 years of debate over its location, the small scale airport began a process which wanted to connect Lleida and its surrounding territories to the world. In this context, the Lleida-Alguaire Airport was configured as a key infrastructure to promote and stimulate the economy and the development of Lleida province, Pyrenees and Adorra. It was supposed that this infrastructure would increase tourism and promote several logistic and business services.

This is never happened.

Two years after its opening, the Lleida-Alguaire Airport has a few private small airplanes coming to visit its runway rarely during the week. Any fly companies are landed from it. Few technical operators are working to build two new alien extensions for further tourists. A huge sheep flock is the only main subject who lives on the immense grass and cornfields.
Now it is an *on hold infrastructure*, a cathedral in the desert (Figure 1).

Figure 1. Lleida-Alguaire Airport in September 2011

For this work, a high quality project team by the head of Fermìn Vazquez (b720 Architects) was involved to provide a unique design and recognisable project and they has been able to solve the program requirements with a sophisticated exercise of integration.
The airport finds a balance between trying to avoid a strange artefact landed and not losing the character of landmark reference recognizable in the distance.
The design of the airport control tower Lleida-Alguaire (Lleida) is designed as a singular work that goes beyond the structure, encompassing and integrating architecturally the projects of the terminal and the outbuildings. In it, the architecture responds equally effectively to the requirements of aviation, territory and landscape. Tower and base have a total area around 3.742 m2.
The building's visual unity is achieved also with the whole front cover with several green, brown and yellow metal sheets that will contribute to the integration with their surrounding landscape. The cover (horizontal continuous cover) will have a vegetal layer combined with stripes of wood and veneer. It is proposed to use a vegetal cover that emulates the vegetable-farming plot environment, and also acts as a thermal barrier.
The main envelope is conceived as a continuous blanket covering the most visible faces of the building (covering the base and longitudinal side of the tower) to give formal unity to the whole and consolidate its presence into the context. For this reason, the deck floor, on both sides of the tower, curves up to become the façade of the tower. Both planes (horizontal and vertical) have different functions and structures but they share formal and material characteristics that make them act as an individual item.

The unquestionable architectonical quality of the building, the integration with the context and the smart ecological and sustainable system make Lleida-Alguarie Airport one of the more interesting and well studied airports. More questionable is its function: was it really necessary to build this airport?

In the hope to improve the Lleida-Alguaire Airport's activities, recently a commitment was signed for five years between the British Isles and Lleida-Alguaire Airport. It has agreed to perform flights in the airport over the next five winter seasons. This agreement gives a boost to the Lleida-Alguaire Airport and it will improve the use of the skiing area by Britannic tourists. It's the first time that a regional airport could fly beyond the Schenghen area. "That means, therefore, a new impulse for the future of this airport and the development of its area of influence, thereby giving effect to a claim of all institutions in this field since it opened" as the Government claimed[10].

[10] From: El Mundo (29/07/2011). Alguaire multiplica su capacidad para recibir a pasajeros internacionales, Spain.

It is certain that the airport could be a fundamental infrastructure to promote and develop local economies and the tourism sector in the Lleida province.
The questions are therefore: what are the best strategies to re-attract new visitors and local inhabitants? Will it be sufficient to activate a new winter air route between England and Catalonia in order to re-activate culture, heritage, business and tourism dynamics?
What are possible futures for this recent infrastructure already in decline?

Re-use IT!

The context changes the economic frame but it also brings into the foreground specific conditions in the construction of cities and territories, put aside for a long time, but that may return to be expendable and important values.
Existing peripheral areas that have been infrastructured but do not work. Therefore it is more correct to talk about *peripheral infrastructures* and make questions about the strategies to re-use them. Through the construction of new infrastructure, up until the recent past, marginal areas became less remote and more related to centralities (geographic, economic, territorial, etc). Once construction was completed, these infrastructures were often isolated, proving that the best strategy would perhaps have been not to build them at all. Today, even more in this moment of crisis, building new infrastructure does not reveal itself as the most sustainable strategy.
This moment in time does not seem to be that of great innovation. It's rather a time of reflection and re-use of what has already been produced. The concept of reuse has always been present in the city and in architecture, however, the conditions in which it proposes the reuse change.

Recycling means the reuse of waste materials, which have lost value and/or meaning. It's a practice that helps to reduce waste, to limit its presence, to reduce disposal costs and to limit production of new waste. Recycle means, in other words, to create new value and new meaning. Another cycle is another life. Recycling is the ecological action that pushes into the future by transforming the existing waste in the prominent figures and producing the city's culture, the beauty and the urban quality.
Recycle infrastructure is an attitude quite diffuse in the reactivation of obsolete urban infrastructures. These recycled infrastructure projects reinterprets a fragment of transportation infrastructure, converting it to pedestrian and public use. The projects are experiments in the reuse of an industrial site, a reinvention of the infrastructure's significance and identity, the mending of a tear in the urban fabric. They want teach that gardens born in an asphalt crib.

The High Line[11] is a new 1.5-mile long public park built on an abandoned elevated railroad stretching from the Meatpacking District to the Hudson Rail Yards in Manhattan (Figure 2a). Inspired by this post-industrial ruin, the new park interprets its inheritance, translating the biodiversity in a string of site-specific urban microclimates along the stretch of railway that includes sunny, shady, wet, dry, windy and sheltered spaces. Through a strategy of agri-tecture – part agriculture, part architecture – the High Line's surface is digitized into discrete units of paving and planting which are assembled into a variety of gradients from solid paving to richly vegetated biotopes. The long pre-cast concrete paving units have tapered ends that comb into planting beds creating a textured, "pathless" landscape where the public can meander in unscripted ways.
The park accommodates the wild, the cultivated, the intimate and the social (Figure 2b). Access points are durational experiences designed to prolong the transition from the frenetic pace of the city streets to the slow, otherworldly landscape above.

[11] Ciorra P., Marini S. (a cura di), (2011). Recycle. Strategie per l'architettura, la città e il pianeta, Electa, Milano.

Figure 2a,2b. The High Line, James Corner Field Operation, New York (2007-2011)

The Trento Tunnel[12] is a minimal intervention which re-converts two high-speed tunnels (Figure 3a) into museum galleries where it is possible to re-feel the sense of place and palaces of memory. To enter them is to travel in time through the 20th century. To see the light at their end is to spy the seam where a territory's past meets its future. The project merges recycling, restoration and renewal (Figure 3b).

Figure 3a-3b. The Trento Tunnel, Elisabetta Terragni, Trento, Italy (2007-2008)

Airport afterlife

In particular airports, today, have never been more central to the life in cities, yet they remain peripheral to many discussion in urban design and planning. Airports are an architectural structure and an urban function: in most cases they lack a physical and spatial integration with their urban context. This situation generates the emblematic role for transport architecture, particularly airports and railway stations. The conflict between these, their fundamental role in the urban structure, the oppressive impacts that they generate on the surrounding territory, their potential role as attractors and/or generators of local economies through their strategical connection with their surroundings, gives them an ambivalent, but fundamental, role in contemporary urban development strategies.

[12] Ciorra P., Marini S. (a cura di), (2011). Recycle. Strategie per l'architettura, la città e il pianeta, Electa, Milano.

> «The world's architects and planners are increasingly treating the airport not as a separate entity but as just another part of the urban condition. (…) The task now is to design effectively for the whole physical, environmental and emotional experience of the airport over a wide area.» Pearman (2008), 236.

Operative airport hubs, both small and large scale, generate iconic images marking their presence in the territory and acting and being used as a centrality to their new urban condition.

However there is a widespread condition of underused and potentially obsolete airport structures that have never managed to gain of have lost their central role, causing them to totally or partially lose their use.
The question is therefore: how can these be re-used, re-generating themselves, their central role and the surrounding territory?
The central issue is to investigate the possibility of recycling existing airport infrastructure and to re-use and maximize their potentiality through development strategies. It is referred not only to abandoned and obsolete infrastructure, searching for a new identity, but also to infrastructure that is still active, but poorly operative and productive.
The primary aspect related to the recycle of small airport is the requalification and development of good level of accessibility, allowing these to become dynamic centralities for the surrounding territory. In fact, more accessible larger scale national and international trade has often overshadowed these territories. Accessibility is therefore fundamental and central resource for territories, helping them to attract and activate (or re-activate) diverse incoming flows, such as tourism but also activities related to commerce, culture, education, health, agriculture, high tech or energy.

Airports Afterlife Case Studies:

1. Abandoned Airports_Urban development + Parks: *Stapleton, Denver, CO; München Riem, Germany*.
2. Abandoned Airports_Urban Parks: *Crissy Field, San Francisco; Tempelhof, Berlin, Germany.*
3. Postmodern Airports: *Skavsta Airport, Sweden; Liege Airport, Wallonie*, *Hispaniola Airport, Dominican Republic.*

1. Abandoned Airports (Urban development + Parks)

After their dismissing, many former military airports were not used and they remain in an abandoned state for years. Due to the growing of population and the high request of new dwellings, many former airports could be re-developed as a new part of the city. Starting from the transformation of the infrastructure air connection (runway, technical street) into urban mail road and street, there was planning a new urban development with houses, public services, commercial and business areas and extremely well connected to the nearby main cities. Public urban parks add value to the gradual renovation of existing structures and the new urban development area.

Stapleton, Denver, CO
Stapleton was opened on October 17th, 1929 as Denver Municipal Airport. Its name was changed to Stapleton Airfield after a 1944 expansion and the major force behind the project when it began in1928. By the 1980s, plans were under way to replace Stapleton with a new airport. Stapleton was plagued with a number of problems concerning inadequate physical and technical structures for flights (runways, little or no room for other airlines) and noise and pollution problems. Meanwhile, the new Denver International Airport (DIA) officially opened in north-eastern Denver. The runways at Stapleton were marked with large yellow "Xs", which indicate it was no longer legal or safe for any aircraft to land there.
While Denver International was being constructed, planners began to consider how the Stapleton site could be redeveloped.

A private group of Denver civic leaders, the Stapleton Development Foundation, convened in 1990 and produced a master plan for the site in 1995, emphasizing a pedestrian-oriented design rather than the automobile-oriented design found in many other planned developments. Nearly a third of the airport site was slated for redevelopment as public park space (Figure 4).

Figure 4. Forest City Enterprises, Denver (2001-2008)

The former airport site (4,700 acres / 19 km^2), 10 minutes from Downtown Denver, is now being redeveloped by *Forest City Enterprises* project. Construction began in 2001 on single-family houses, row houses and condominiums. The new community is zoned for residential and commercial development, including offices, parks, and a "big box" shopping centre.

München Riem, Germany

Construction on the airport started in1936. The first plane landed on October 25th, 1939, signalling the beginning of air traffic. At that time, it was one of the most modern airports in the world. In 1992 it was completely dismissed.

For an interim time after the move, the remaining facilities were used as a venue for large events such as concerts and raves. Riem was well known internationally in the techno, alternative and rock scenes.

Figure 5. Munich Riem Airport Re-transform in Messestadt Riem, Germany (from late 1990s to the beginning of the 21st century)

The transformation of the former airport to the *Messestadt Riem* (Convention City Riem) with a name-giving convention centre, apartments houses and parks was one of the largest projects in urban planning of the City of Munich in the late 1990s and the beginning of the 21st century (Figure 5). The only structures that

remain of the airport today are the tower and the original terminal building, the *Wappenhalle* (hall of the coats of arms). Both structures are protected monuments. Moreover, a small stretch of the former runway still exists at the eastern end. In 2005, the former airport was the site of the *Bundesgartenschau* (Federal Horticultural Show).

2. Abandoned Airports (Urban Parks)

Many problematic airports no longer present themselves in the potential range of urban expansion. These airports, which were once peripheral but have now been engulfed in the urban context, become physical centralities of the city and simplify their re-conversation into urban facilities. The case studies propose as the suitable urban solution for the re-use and re-conversion of abandoned airports the transformation of them into public urban parks.

Crissy Field, San Francisco
Crissy Field is a park in San Francisco. It was originally an airfield, part of the United States' Presidio Army base. The Presidio ceased all military operations and the base became part of the federal Golden Gate National Recreation Area under the Base Closure Act, in the 1990s. Redesigned by Hargreaves Associates in 1994, Crissy Field re-transformed itself, from a military airport into a public open space.
Now it is parte of the *Golden Gate National Recreation Area* (Figure 6).

Figure 6. Crissy Field Park, San Francisco (1994)

It is divided into 6 major naturalistic zones: the rehabilitation of a 1920s grass airfield; a mile-long promenade; wetlands; beach & dunes; a pic-nic area; and East Beach. Those are the parts that re-create the Crissy Field Airport into a park, a new green heart of San Francisco.

Tempelhofer Park, Berlin, Germany
Berlin Tempelhof Airport, often called the "City Airport", ceased operating in 2008 in the process of establishing Schönefeld as the sole commercial airport in Berlin.
During its post-airport usage it hosts numerous fairs and events. Officially re-opened in May 2010 as a city park, today more than 200,000 Berliners have visited the park to enjoy its wide open spaces for recreation ranging from biking and skating to baseball and kiting (Figure 7).

Figure 7. Tempelhofer Park, Berlin, Germany (2010)

3. Postmodern Airports

Most of these small and medium airports were minor war airfields from the beginning of the XX century. After their post war dismissal, they remained unused for years until when local municipalities put their attention on these to find alternative solutions for their use. Meanwhile, the proliferation of low-cost companies started to promote the revitalization of secondary airports. In this context, the fundamental role of these airports as strategic hubs in the new low-cost fluxes and their moderate, but well connected, dimensions make them become crucial airport infrastructure on the local and European scale. They generate a rapid transformation of land use and of the infrastructure network relative to land transportation. The integration of new economical, cultural and leisure activities to these airports, permitted to make the surrounding territory more dynamic and to improve local business. In that sense the secondary low-cost airports became a landmark in the territory and an important element for the local economy.

Skavsta Airport, Sweden

An airbase during the Second World War, the airport was used as a military airport until 1980, when it was taken out of service. Today, Stockholm-Skavsta Airport is an international airport near Nyköping in Sweden, approximately 100 kilometres southwest of Stockholm. Low-cost airlines and cargo operators serve it. Approximately 40 established companies already with 1300 people employed on site[13] (Figure 8).

[13] Source: Stockholm-Skavsta Airport web site (www.skavsta.se)

Figure 8. Business Park Airport. Skavsta Airport, Sweeden (from 1997)

The Skavsta Airport and its *Buisness Park* represent the potentiality of the airport as a *productive ecosystem* in which different industrial activities could take advantage of using the logistic infrastructure of the airport itself. The possibility, therefore, to combine passenger transport with the transport of goods is the central point of this airport which entails a rigorous evaluation of both the strengths and weaknesses of the industrial production of the surrounding municipalities that actually could benefit from better opportunities for innovation in the logistics market.

Liege Airport, Wallonie

The Liege Airport (Figure 9), connected to the Euro Space Centre (Figure 10), is a centre of technology and aerospace innovation. The network in the region generated by *Liegi Airport*, *Charleroi Airport* and the different *Euro Space Centre* bases in Wallonie, shows: the implementation of activities related to design prototypes for the aviation industry; the impulse for knowledge of the universe for educational purposes, teaching and divulging of issues related to space research; and, finally, the advantages of exploiting cultural, social and business tourism in the area of innovative projects, education and entertainment.

Figure 9. High Tech Aerospace in Airport. Liege Airport, Wallonie

Figure 10. High Tech Aerospace in Airport. Euro Space Center, Transinne, Wallonie

Hispaniola Airport, Dominican Republic

The Island of Hispaniola is a natural beauty that attracts people from all over the world. In the island there are abundant raw materials to produce biofuels and available work force to grow biomass and process it into fuels. The growth of biomass and the processing of that biomass into the refines fuels produces economic incentives to attract inner cit population back to the rural area with the promise of a higher quality of life for the workers and their families. A network of airports and aviation community managed and supported this policy. The Green Airport (Figure 10) serves as a catalyst to the ongoing development of an energy policy promoting the use of domestically renewable energy sources in the island. To adopt sustainable energy systems thereby alleviating pollution.

Tge green Airport activities are: flight training; educational and demonstration programs to show the feasibility of new renewable energy technologies; academic courses in conjunction with local and international universities; research certification programs on alternative fuels for both piston and turbine

engines; Agricultural Spray Aircraft; eco-tourism activities using biofuels powered aircraft; recreational flying; small efficient aircraft powered by renewable fuels used for environmental monitoring and security patrolling.

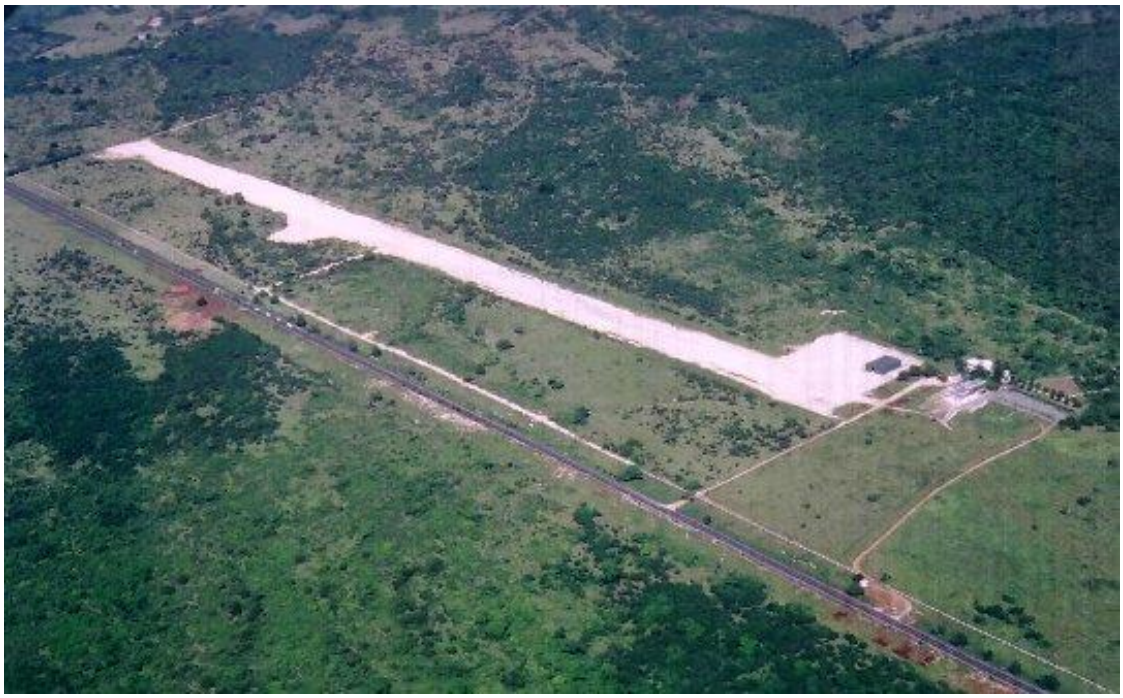


Figure 11. The Green Airport. Hispaniola Airport, Dominica Republic

2.2 ANALYSIS OF THE SITUATION IN THE REGION

Stakeholders Data Required

Infrastructures

The time and the way in which people travel on the space are fundamental parameters on which is based an assessment of satisfaction and appreciation of the places. It's important to be aware of how the different infrastructures connected those areas that they cross and which relationships they established.

- Airports: numbers, localization, flows and classification. (Airport's typology: airports, small airport, airfields, aerodromes. Airport's use: civil, military or mixed, cargo).
- Harbour
- Road: classification (high way, primary roads, secondary roads)
- Train (within main direction and connection)

Servicies

Living the territory: the diversity and density (or not) of services offered by each context to those who live and work on that territory. The activities of the industrial and the tertiary services for the local and global context.

- Companies (ex: agriculture, fishing, mining industry, manufacturing industry, energy, gas and water, constructions, commerce, hotels and public stores)
- Industrial district (ex: ceramic district, stone district, aerospace district, clothing district, chemistry and pharmacy district, agro-industrial district, electronic district, high tech and innovation district, audiovisual district, …)
- Commerce, import and export: agricultural products, fishing products, chemistry products, textile products, wood products, electronics products, petrochemical products, etc..)
- Shopping mall
- Research institutions
- Universities

- Hospitals
- Sport complex (football stadium, athletics track, golf courses, ..)

Landscape

The potential inside the landscape, the history and the cultural characterize each region, making it unique. Cultural heritage is the set of things, more precisely those goods, that particular historical and cultural aesthetics are of public interest and constitute the richness of a place and its people.

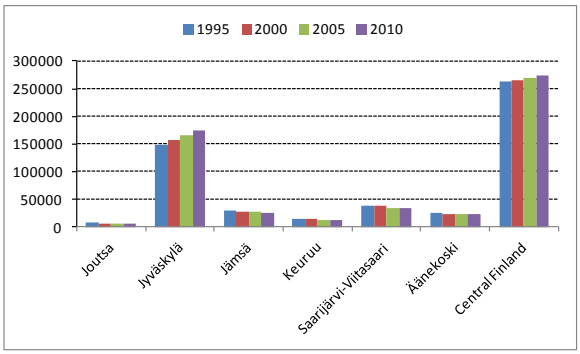
- Landscape heritage: natural parks, natural reserve, natural monuments, beaches (blue flag)
- Cultural heritage
- Tourism

2.2.1 CENTRAL FINLAND

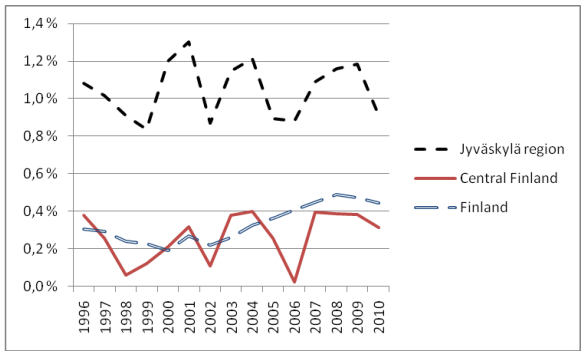
Population

In terms of population, the Jyväskylä is the seventh largest region in the country and one of the fastest growing regions in Finland alongside the regions of Helsinki, Tampere, Turku and Oulu. Population growth from the mid-1990s onwards in Central Finland has been 4% and the average annual growth rate has been 0.3% whereas in the Jyväskylä region the growth rates have been 17% and 1%, respectively (in the whole country 5% and 0.3%) (Figure 17). According to the population projection by Statistics Finland, the population in Central Finland may increase by nearly 4% in 2010-2020. The Jyväskylä region will be among the ten fastest growing regions in Finland also in the future as the population increase is projected to be nearly 9% in next ten years.

In the next few years ageing of population will be faster in Finland than in most other countries. The projected increase in life expectancy and lower fertility rate will lead to a permanent change in the age structure of the population. The number of children, young people and working-age population will decrease and the number of older people increase. However, in the central regions the forecast is more positive. In the region of Jyväskylä the regional age dependency ratio has remained rather stable in the past 20 years. In 2010 it was 0.48, which means that there were 48 individuals aged 0-14 or older than 64 per one hundred individuals within working age. In Central Finland, the dependency ratio was 0.53 in 2010 that slightly exceeds the national level 0.52.



Population development in Central Finland by sub-regions



Population growth in 1995-2010,%

Figure 12. Central Finland by sub-regions

Economic base/performance

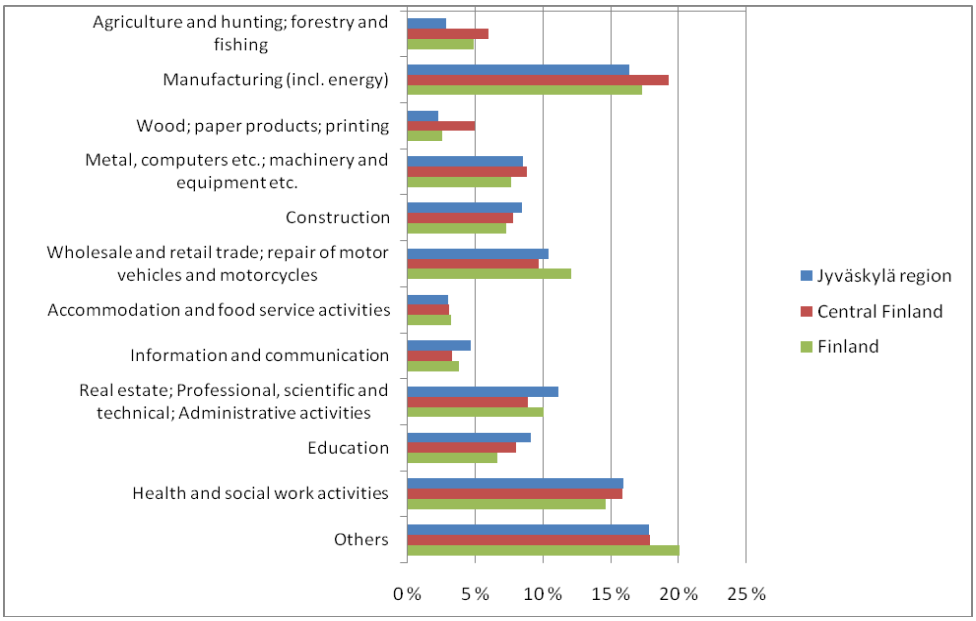


Figure 13. Employment by industries in 2009

Figure 14. Jyväskylä Airport, Finland

2.2.2 WESTERN GREECE

Figure 15. Aktion Airport, Western Regions, Greece

Figure 16. Araxos Airport, Western Regions, Greece

Figure 17. Andravida Airport, Western Regions, Greece

2.2.3 PROVINCE OF SAVONA

Figure 18. Airport of Villanova d'Albenga

Figure 19. Savona

Figure 20. Savona Harbor

Figure 21. Vado Ligure Harbor

Figure 22. Public Promenade, Albisola Superiore

2.3 INTERVIEWS AND QUESTIONNAIRES: FORMS

Interviews

The objective is to know what relevant stakeholders in the region think about the role and situation of airports and accessibility in their region.
The infrastructure, without real and widespread processes of economic support, without coherent strategies and territorial projects, don't bring any development.
But things are changing and the persistence of a crisis that changes the nature of the phenomena, their speed and priority of the solutions requires new forms of analysis and sustainable alternatives with the new context that will lead to a greater sensitivity to changes and stays the present time. In this framework, the infrastructure becomes the main topic: one thing is to talk about the infrastructure issues in a context of development, and other thing is to talk about it in a state of constant slowdown and perhaps stable situation.
Even more today, in this moment of crisis, build new infrastructure does not reveal the most sustainable strategy, considering sustainability as a aim in relation to social and territorial changes. The European Commission's White Paper (2001) indicates that as a strategy that provides absolutely necessary to interrupt the connection between increased mobility and economic growth.
An alternative to the excessive construction of new infrastructure is it possible: don't built new roads but strengthen the existing public system; at the same time don't built new airports, but reuse the existing airport infrastructure and use them as activators of economies and local contexts.
The recycle of existing infrastructure, that does not work, and re-use in order to optimize their potentialities become the solution most sustainable and desirable. Re-think not only on the infrastructure abandoned and unused that are looking for a new identity, but re-use all those infrastructures that are already active but poorly operating and production.

Notes: XXX Airport is the name of each local regional airport. YYY city is the name of the main city connected to the airport (e.g. Villanova d'Albenga Airport - Savona city).

History of the XXX Airport

- Are you informed about the political-economic process, the reasons and the data that brought to the decision to build the XXX Airport? Who wanted it?

- How was the economical and infrastructural situation before the construction of the XXX Airport? Was there a noticeable change on the economical and logistic assets after the construction of the XXX Airport or the situation has remained unchanged?

- In your opinion, did have the infrastructural intervention led the territorial development? Why? Do you have the data to argue your answer?

Importance of regional Airport

- How relevant is the presence, efficiency and growth of the XXX Airport to improve the accessibility and the regional transport system?

- Which are the main groups of passengers (firms' staff/customers, other organizations' staff, tourists, inhabitants of the region)?

- Why are the air connections important in different organizations (their function)?

- From how large area does the XXX airport attract passengers?

- How does the instability (uncertainty) of air connections affect firms' location and investment decisions, international operations etc.?

- Which organizations or actors suffer most from the small number of flights/lack of flights? How does this affect regional development (internationalization, production, knowledge base, tourism, events, etc.)?

- What is the minimum number of flights that supports the economic performance of the region (importance of schedules)?

- What are the main final destinations of the passengers leaving from the XXX airport?

- Is the air connection to Helsinki (YYY city) sufficient or are there needs for direct flights to the European cities (viewpoint of the European accessibility)?

- Is the XXX airport easily accessible and what is the role of intraregional accessibility?

- How does the XXX airport affect regional image (competitiveness)?

Role of the nearest airports - competition

- Are there other airports competing with the XXX airport? Why?

- What are the characteristics of the XXX Airport compared to the nearby airports?

- How could the competitiveness of XXX airport be improved in regard to competing airports?

Development of the XXX Airport

- In recent times, the data of the passengers traffic show a decreasing trend for the airport: what do you attribute the decline of the passengers number?

- How could regional authorities support the growth of the number of passengers (marketing, airport transportation, financial support, etc.)?

- Where are the main bottlenecks and infrastructural inefficiencies in the regional transport system? How are they relevant for the regional development?

- What can be done to improve the actual situation and who could be the best coordinator in the process (cooperation between regional authorities, firms, airline companies etc.)?

- How does the national/regional transport policy work (relations to regional policy, industrial policy)? How are the air traffic issues taken account in the regional decision making, strategies etc. (in relation to other forms of transportation)? What would be the optimal/most effective transport policy (in a given region/at the European level)?

- How could the XXX airport and its surroundings be developed in order to support the competitiveness of the XXX airport?

- Which are the destinations with more affluence that lead the people to choose the XXX Airport to fly?

- Which are the new destinations that you would like to activate in the near future? Do you have already some negotiations going on?

- Does there are possibilities to develop cargo transportation?

- If the cargo vocation is confirmed, could it coexist with the scheduled flights?

- The XXX Airport is already equipped with all the specifics structures that it could need with the possibility to accommodate a cargo airport?
- (If not) Which are the politics in act to improve the infrastructures as support to the airport?

- What is your dream/vision for the XXX Airport?

Alternatives for air traffic

- What is the principal alternative form of transportation for air traffic (at this moment / in the future)?
- What are the main determinants affecting the choice of transportation (prices, schedules, etc.)?
- Which are the links with the activities and the companies in the airport area and all around it? For example, regarding the land, who is the owner? What processes were followed to give that land? Were you involved in the "chosen" of the actual companies?
- The White Book of the European Commission (2001) shows as absolutely necessary strategy to interrupt the existed connection between the growing of mobility and the growing of economy. Do you think that this strategy could involve the XXX Airport development in the further vision of a re-used structure, not only for flights activities but also for commercial and productive activities, as activator of locals' contexts and economies?
- In your opinion the XXX Airport could be occasion for the development of local economies (agriculture, industry, tourism, ..)? In which way? Do already exist any political strategies on going?
- Which are the initiatives already actives and which ones you want to realize to keep high the attention of the authorities and of the public opinion about the XXX Airport?

Questionnaire

Structured questionnaires distributed in local languages to relevant regional/national stakeholders:

- Relevant regional/national stakeholders: big firms, politicians, spatial planners, companies (infrastructures, industries, ..). **(50-100)**
- Telephone interviews

Basic Information:

Location:

Country:

Industry:

Annual turnover (in 2011):

Trend during the last years:

- Growth
- Decline
- Remain stable
-

Number of employees:

- 1-10
- 11-25
- 26-50
- 51-100
- more than 100

Export (share of turnover, in 2011):

Trend during the last years:

- Growth
- Decline
- Remain stable

Number of other domestic units:

Location of other domestic units (in km from your unit or country and cities):

Number of foreign units:

Location of other foreign units (in km from your unit or country and cities):

Importance of regional Airport:

1) How important are the air connections for your company with regard to domestic accessibility?

- Not important at all
- Somewhat important
- Important
- Very important
- Of crucial importance

2) How important are the air connections for your company with regard to international accessibility?

- Not important at all
- Somewhat important
- Important
- Very important
- Of crucial importance

3) How the following operations in your company affected by the supply of air connections?
Please assess the importance by giving a value from 1 (No importance) to 5 (Crucial importance).

	1	2	3	4	5
International business contacts					
Domestic business contacts					
Production					
Research and development					
Investments					
Provision of services					
Imago					
Cargo transportation					
Location					
Other (please specify):					

4) How important do you consider the development of the *XXX Airport* to improve the accessibility and the regional transport system?

- Not important at all
- Somewhat important
- Important
- Very important
- Of crucial importance

5) How accessible is the XXX airport for you?

- Very easily accessible
- Rather easily accessible
- Not so easily accessible
- Poorly accessible
- Not accessible

6) What is the minimum number of flights per day leaving from *XXX Airport* from the viewpoint of your company's needs?

- 1-3
- 4-6
- 7-8
- more than 8

7) What is the minimum number of bi-weekly flights leaving from *XXX Airport* from the viewpoint of your company's needs?

- 1-5
- 6-10
- 11-20
- more than 20

8) How large share of your company's trips are done annually by air:

a. If the final destination is domestic?
- 0-24%
- 25-49%
- 50-74%
- 75-100%

b. If the final destination is abroad?
- 0-24%
- 25-49%
- 50-74%
- 75-100%

9) Which cities are your company's main final destinations abroad?

- Domestic destinations (Please indicate 1-2): _____
- European cities (Please indicate 1-2): _____
- Cities outside Europe (Please indicate 1-2): _____

10) What is the average number of flights per week departing or arriving from/to *XXX Airport* that is used by your unit (staff, customers, collaborators, etc.)? *(One trip means that one person travels to one direction - one-way ticket):* _____

Role of the nearest airports – competition:

11) Does your company use other provincial airports?

- YES. Which ones: _____
- NO

12) What are the main reason for using that airport? (Please, choose maximum 3 options).

- Lower prices
- Better airport services
- Direct flights to abroad
- Better transportation to airport increased accessibility
- Increased reliability of airport flights
- More flights per week/day
- Other (please specify): _____

Alternatives to air travel:

13) What is your principal alternative to the air travel at this moment? (Please, choose only 1option).

- Car
- Bus
- Taxi
- Train
- Ship
- A solution based on information technology (as web conference, online meeting, etc.)
- Other (please specify): _____

14) How significant are the following issues from your company's view with regard to flights from the XXX airport?
Please assess the importance by giving a value from 1 (No importance) to 5 (Crucial importance).

	1	2	3	4	5
Prices					
Schedules					
Traveling time					
Reliability of the transportation					
Direct flights to domestic destinations					
Direct flights to destinations abroad					
More flights per day/week					
Airport's location					
Airport's services					
Airport transportation					
Other (please specify):					

15) Could the XXX Airport be the occasion for the development of local economies?

- YES
- NO

16) If YES, which local economies could be developed by the XXX Airport?
Please assess the importance by giving a value from 1 (No importance) to 5 (Crucial importance).

	1	2	3	4	5
Agriculture					
Industry					
Tourism					
Leisure experiences					
Culture creation and					

consumption					
High tech research and productions					
Other (please specify):					

Development of the XXX Airport :

17) In which way regional actors should support airline operators in *YYY city*?
Please assess the importance by giving a value from 1 (no importance) to 5 (crucial importance).

	1	2	3	4	5
Marketing					
Airport transportation					
Direct financial support to airline operator					
Infrastructure improvement					
Development of new economies connected to the airport					
Firms and other regional employers advise their employees to use air connections					
Other (please specify):					

18) Should it be needed some new important destinations for your company's point of view?

- There is NO need for new destinations
- YES, the useful destinations would be:
  - Domestic destinations (Please indicate 1-2):_____
  - European cities (Please indicate 1-2): _____
  - Cities outside Europe (Please indicate 1-2):_____

19) From your viewpoint, how should the surrounding area of the airport or the airport itself be developed to support the growth of passengers' number and the competitiveness?
Please assess the importance by giving a value from 1 (not at all) to 5 (need for significant improvement).

	1 Not at all	2	3 Medium improvement	4	5 Need for significant improvement
Physical Characteristics of the airport					
Connections infrastructure to the airport					
Facilities					
Green areas					

Lounge areas					
Air companies' private areas					
Touristic information					
Food and beverage service					
Shops					
Multifunctional spaces					
Other (please specify):					
Business organization and operation management					
Business air travel					
Cargo transportation					
Tourism					
Cultural hub					
Energy operator of the territory					
High tech industrial pole					
Systems for energy self-sufficiency					
Recourses					
Personnel					
Management procedures					
Safety					
Other (please specify):					

20) What is your dream or visions related to the XXX Airport?

_____
_____
_____
_____

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Figures

2.1 DIFFERENCES OF REGIONS AND AIRPORTS

2.2.1 CENTRAL FINLAND

2.2.2 WESTERN GREECE

2.2.3 PROVINCE OF SAVONE

ANNEX 6. DISSEMINATION

1. LIST OF DISSEMINATION ACTIVITIES

The events in which different TPG participated until now are:

- International VDH3 Seminar, 19th-20th September 2011, IUAV Venice, Italy (DSA, Genoa).
  "Europeénne Peripherique: Transport Infrastructure for Peripheral Regions' Economic Development"_Sara Favargiotti

- International Workshop "Emerging Infraestructural Landscapes", 16th-21st October 2011, Lleida-Alguaire, Cataluña, Spain (DSA, Genoa).
  "Skywalk"_Mosè Ricci
  "Emerging Infraestructural Landscapes: Case Study"_Sara Favargiotti

- International VDH3 Seminar, 1st-2nd December 2011, MAXXI, Rome, Italy (DSA, Genoa).
  "Europeénne Peripherique: Airports for Peripheral Regions' Development"_Sara Favargiotti

- International VDH3 Seminar, 8th-10th March 2012, TU Delft, The Netherlands (DSA, Genoa).
  "The Afterlife Airports. The Re-Cycle of secondary airports and new opportunities for the territory"_Sara Favargiotti

- Joint NS-RSA and ESPON Norba Scientific Seminar, 14th-15th March 2012, Oslo, Norway (Jyväskylä University).
  "Regional airports and regional growth"_Tervo Hannu, Mukkala Kirsi

- AIRDEV 2012 Conference, 19th-20th April 2012, Lisbon, Portugal (DSA, Genoa).
  "The Re-Cycle of secondary airports and new opportunities for the territory – ADES Research (ESPON 2013 Project)"_Mosè Ricci, Sara Favargiotti

- Regional Studies Association European Conference, 13th-16th May 2012, Delft, The Netherlands (Jyväskylä University).

- MED.NET.EU.12 International Congress, 28th-29th June 2012, Genoa, Italy (DSA, Genoa).
  "*MED Airports On Hold - ADES Research (ESPON 2013 Project)_Sara Favargiotti*

- Dissemination of the project scope to over 2000 firms in the Region of Western Greece through information for the Project presented the introductory letter of the questionnaire.

- 52nd European Congress of the RSAI (ERSA), 21st-25th August 2012, Bratislava, Slovakia (Jyväskylä University).

- Jyväskylä University wrote a Finnish summary about the results of the case study of Jyväskylä, which was delivered at the end of August to all those persons who were interviewed in March 2012 plus to other influential local politicians and other persons. The title of this summary was *"Lentoliikenteen merkitys Keski-Suomessa" ("The significance of air traffic in Central Finland").*

- In September, Jyväskylä University gave a (media) release about the results of the Jyväskylä-case. The title of the release is *"Keski-Suomi tarvitsee hyvät lentoyhteydet – Jyväskylän lentoliikennettä analysoitu eurooppalaisessa tutkimuksessa" ("Central Finland needs good air connections – air traffic in Jyväskylä has been analyzed in an European research"*). This release will be circulated by University of Jyväskylä to all newspapers and electrical media.

Future dissemination activities, already planned, are:

- EAAE/ISUF "New Urban Configuration" Conference, 16th-19th October 2012, TU Delft, The Netherlands (DSA, Genoa).

  The Conference invites professionals from both research and practice dealing with the built environment (architecture, engineering, urbanism, landscape architecture, planning, geography, sociology and urban history. It deals with the following themes: 1. Innovation in building typology, 2. Infrastructure and the city, 3. Complex urban projects, 4. Green spaces: the city and the territory, 5. Delta urbanism: Living with water in the urban Deltas.
  In our opinion, it will be important to participate at this conference in order to share common experiences with other experts in our sector (2. Infrastructure and the city). All the papers will be published and will have a Europe-wide distribution.

- Internal ESPON Seminar, 5th-6th December 2012, Paphos, Cyprus (TPG).

- Jyväskylä University has written an article based on our results into a Finnish Espon-publication, which will be published in December. The title of the article is *"Lentoliikenne ja alueiden kehitys"* (*"Air traffic and the development of regions"*). The title of the book will (probably) be *"ESPON tekee tulosta"* (*"ESPON bears fruit"*) edited by Timo Hirvonen and Ossi Kotavaara and published by the Ministry of Employment and the Economy). Based on this article, they will present the main results of the project in a Finnish ESPON seminar in Helsinki in December.

- The TPG will coordinate the organization of 3 meeting in the stakeholders regions. The meetings will organize by the local partner in coordination with the local stakeholder. It will address to local actors and regional authorities.

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