**Scenario analysis for** Territorial attractiveness and mobility flows

**Documentation and applications of the ATTREG-future model**

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1. **Introduction**

This paper considers the potential trajectories and ambitions for regional/urban attractiveness into the future. This involves a number of interrelations in the territorial development, which are assumed to be valid for the future development:

Firstly, the future development is often assumed – ceteris paribus – to be “path dependent”, which implies that the future is similar to the past: Following this the population develops according to basic and stable demographic factors, such as the regional patterns of mortality, fertility as well as path dependent patterns of interregional migration. Similarly, tourism develops according to path dependent patterns of travelling flows.

Secondly, interregional migration and tourism flows are determined by the relationship between territorial capital/attractiveness and migration/tourism flows: the attractiveness of a city or region can be assessed by analyzing its ability to attract and retain users (visitors, residents, firms) and investments that are considered beneficial for a region. This ability to attract depends on the quality of the (living, business, visitor) environment. Cities and Regions can be considered attractive if they have sufficient urban amenities to offset agglomeration disadvantages such as high housing and land prices.

Thirdly, the attractiveness of a place and its quality are based on aspects both unique and provided by government’s actions and by other semi‐public and private actors. It brings to the fore the (complex) notion of territorial capital and the mobilization of assets. This last point directs attention to the notion of multilevel governance and the way assets are used (or mobilized by actors) to make a place attractive.

Fourthly, future development is the results of cumulative mechanism, involving spill-over mechanism from changes in outcomes (flows of migrants and tourists) to population, labor force and jobs, which in turn have feed-back impacts on the territorial attractions: These cumulative impacts involve changes in population density from inflow of migrants, which in turn changes the attractiveness and will modify the “direct effects from changes in attractions”. It also involves derived changes in accessibility from changes in population and tourism (such as congestion problems), which in turn involve cumulative changes in the territorial attractions of a region. And it involves impacts on regional wealth, measured by GDP per capita derived from changes in the ability to export, derived from changes in labor force and employment and jobs.

Fifthly, migration and population development in turn interacts with the regional economic system: In the regional markets demand and supply of commodities and labor, which involves the determination of regional wage rates (GDP per capita) as well as regional commodity prices. This in turn influences migration and population. However, even though it seems relevant to include regional market variables, especially to understand migration and population changes during the last years of the financial and debt crisis, they have only sporadically been included in the analysis.

The main conclusions of the analysis of regional/urban attractiveness into the future are, that relations between assets and outcomes not only depend upon present relations, but also upon future spill over and feed-back mechanism, which might intertwine the result and conclusions from a static analysis with the results from dynamic analysis taking into account spill-over and feed-back effects from the system of territorial attractions on itself. It also seems plausible, that migration flows as well as the resulting population interact with changes in the market system, although this has only sporadically been included in the analysis that follows.

The future development can be examined from both quantitative and qualitative perspective: Within quantitative approaches, the use of multi-variate models of the relations between mobility and outcomes (Russo et al. 2011) can further be examined on the basis of a dynamic quantitative model approach (the ATTREG-future model), which include the spill-over and feed-back mechanism between attractions and outcomes.

The quantitative analysis based on the ATTREG-future model concludes, that the total effect in general is different from the direct effects from changes in attractions. Further, there are negative effects on other regions, because migrants come “from somewhere”. In terms of the time profile, the effects might be smaller or even negative just after the introduction of an attraction policy, but later impacts will increase and be higher than the direct effects and peak after 10-20 years.

In a qualitative approach, case studies can apply. This might be undertaken by case study based upon panel of regional stakeholders, who explore the trajectories and ambitions for regional attraction under relevant scenarios / attraction policy experiments. Part of the qualitative approach would therefore include a confrontation of the results of the quantitative analysis (results from the multi-variate models of the past together with the ATTREG-future model scenario forecast) and the findings from the qualitative case studies.

**In section 2 the analysis of mobility and outcomes (Russo et al. 2011) is presented together with the basic set-up for the analysis of the cumulative impacts from changes in territorial attractions on mobility flows included in the ATTREG-future model.**

**The point of departure for the present analysis is demographic development and modeling. In section 3 the basic structure of interregional demographic models are presented. The DEMIFER MULTIPOLES-model is presented as ESPON state of the art demographic models together with the scenario analysis included in the DEMIFER project. The MULTIPOLES-model is an example of an interregional demographic model ***with no interaction*** between territorial capital and attraction and population and migrations. The DEMIFER scenario approach is presented as reference for the impact studies with the ATTREG-future model.**

**This is in section 4 followed by the presentation of the structure of the extended interregional demographic model developed for scenario analysis in the ATTREG-project. This involves an examination of the structure of the ATTREG-future model for scenario building, which can be characterized as an extended demographic model ***with interaction*** between territorial capital and attraction and population and migrations is examined.**

**In section 5, the results of the following 3 packages of attraction policy experiments are presented:**

* **Smart policy bundle involving**
  + **Investment in accessibility of places and transport connections, in order to increase spatial factors of economic development**
  + **Boosting tourism performances and investment in tourist facilities and infrastructures**
  + **Investment in Research and Development strategies in high education and attracting high skilled labor**
* **Sustainable policy bundles, which involves**
  + **Protection of cultural and natural environments**
  + **Implementing a number of tourist attractions and re-valuing environmental sites protecting from antropic pressure**
  + **Limitation of polluting factors in particular related to transports (higher cost of fuel, taxation, etc.) policies related to quality of life and capacity of retention, in particular for the younger population, with investment in public sector**
* **Inclusive policy bundle, involving**
  + **Investment on social capital supporting residential economy and the quality of place**
  + **Investment on the accessibility of services of general interest and through employment of teachers, doctors, etc.**
  + **Investment on education and on services to youngest populations**

**The impacts of the 3 attraction policy packages are examined for the following two clusters of NUTS 2 regions:**

* **Objective 1 Regions**
* **Superheating Regions**

**Section 6 summarizes the analysis.**

**In appendix 3, a mathematical presentation of the basic demographic model and the ATTREG-future model together with the mathematical solutions to the model are provided. The solution to the model is applicable in evaluation of the direct effects and the derived effects of attraction policies as well as the impacts during time, involving a comparison of the impacts of attractions policies, which can be derived directly from the statistical analysis of changes in territorial capital and migrations flows and population (Russo et al. 2010) and the total direct and derived impacts over time.**

1. **Scenarios on attractions and mobility**

The prerequisites for this paper are the exploration of relationships between territorial assets and outcomes. In Russo et al. (2011) results of the analysis of territorial attractiveness and mobility flows across Europe are presented. On the basis of the concept of territorial capital it was found that flows of people, such as regional migration flows (at the NUTS2-region level) by three age cohorts, tourist divided into domestic and international visitors react to differences in attractions. In the analysis, 5 types of territorial capital was identified – antropic capital, economic and human capital, environmental capital, institutional capital and socio-cultural capital. It was found that mobility flows for the NUTS-2 region can be explained with differences in territorial assets with different emphasis to the different types of territorial capital for different audiences.

The findings of Russo et al. are summarized in the following diagram:

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From figure 1 it can be seen, that the in-migration depends upon 19 different attraction variables. The first 4 attraction variables (see the upper-left corner) are included in ***the antropic capital*** (marked with an “A”), which in **Russo et al. (2011) defines as “man-made features of the territory like cultural heritage, population density, have a large metro area within, tourism infrastructure”. From figure 1 the following antropic capital variables can be identified:**

* Monuments and other tourist sights valued 2 stars in TCI "green guides series"
* Rank of airport embarcations and disembarcations of all airports within NUTS2 region
* Number of tourism accommodation beds in NUTS2
* Location of a metropolitan urban area in NUTS2

The four (exogenous or non-cumulative) antropic capital variables all have a direct impact on migration and tourism flows: The higher the number of monuments and other tourist sight, the higher the rank of airport etc. the higher the in-migration and the higher the tourism flows. From the diagram it can be seen that in-migration in turn determines the future population together with out-migration and born and deaths.

Further, from figure 1 it can be seen, that the population development influences two other types of antropic capital (double-lined box in the centre of figure 1), which have wider (endogenous or cumulative) effects on migration and tourism flows and which are

* The crude population density region and
* Sum of population accessibility scores (working age population accessibility per hour travel distance)

These two antropic capital attraction variables in turn influence the in-migration rates: Higher population density leads to higher in-migration of young and lower in-migration of old population and lower accessibility to lower the in-migration. These impacts represent the cumulative/endogenous territorial capital – outcome effects: If the population increases, the population density by definition increases, which leads to higher in-migration flows; which leads to higher population and population density etc. Similarly, higher population leads to lower population accessibility scores, which reduces the in-migration. A number of “rounds” in figure 1 are needed to find the net effects from changes in attractions. From this it can be concluded, that the results (Russo et al. 2011 based upon analyses with multi-variate models of the relations between mobility and outcomes) have to be adjusted with the cumulative effects from changes in population density and accessibility to capture the total impacts of changes in regional attractions.

Further, ***Economic and human capital*** (marked with an “E” in figure 1) **explains migration flows motivated by economic and human capital factors, such as differences in employment, levels of income, prices on commodities (such as housing prices), productivity (determined by human skills) etc. In Russo et al. 2011 the following** three economic and human capital attraction variables (out of which two are exogenous/direct and one is endogenous/cumulative variables) have been included:

* GDP per capita (endogenous/cumulative)
* % of working age adults with tertiary education (exogenous/direct)
* % of consumption-related employment (exogenous/direct)

The higher the share of working age adults with tertiary education and the higher the relative consumption related employment are in general the higher the in-migration rates etc.

For the GDP per capita attraction variable, the multi-variate model analysis show positive signs for the young and middle age cohort migration and negative of the old age cohort migration. This in turn gives cumulative effects in addition to the static, direct effects from changes in exogenous territorial capital variables.

Following the figure three other types of territorial capital – ***Environmental capital, Institutional and socio- and cultural capital*** – are included in the explanation of mobility flows. **Russo et al. (2011) defines environmental capital as the value of climate variability, geographic characteristics and protected green areas. Institutional reflect the fact that people seek “good institutions” and “freedom and openness”. And socio-cultural capital is defined as “age structure of population, level of education, social satisfaction etc.” Social and culture assets include the effect of being together with people with the same age and educational background as well as the degree of social problems and “satisfaction with life as a whole”.**

From a policy point of view, not all exogenous attraction variables can be used as instruments in an “attraction policy”. Some variables such as the “coastal” and “island” variables are just given by definition and cannot be manipulated in an attraction policy. In diagram 1, this type of variables is marked with an “N”. Other variables (which in figure 1 are marked with a “P”), such as

* the “ratio of the number of university students against people aged 15 to 24 years” and
* “% of respondents who were more satisfied with the ‘state of health services in country nowadays’ relative to the EU median score”

are all variables, which applies as instruments in an attraction policy. The university student-population ratio can be decided directly (through capacity increases at universities), whereas the state of health services satisfaction rate only can be manipulated indirectly (though improvements in level of service within health services).In the ATTREG-future model attractions are assumed to influence gross in-migration. But following figure 1, the in-migration “come from somewhere”, which might be from other European regions and from “rest of the world”. In other word: Migration patterns are assumed to be “path dependent” where the origin of the migration flows follows the historic or average pattern of migration. This means that the net-migration is a function of the gross in-migration driven by changes in attraction and “path dependent pattern of out-migration”: Migration takes place, when attractions increases and migrants will come from regions which have a tradition to migrate to the region in study. Following figure 1, the population is determined by the primo population, where in-migration is added and out-migration is sub-tracted as well as new-born are added and death’s are subtracted to determine the ultimo population.

In this paper experiments with the ATTREG-future model showing the impact of changes in the attraction variables (which are exogenous and which can be politically decided) will be presented. Further, the following question has been addressed:

* What are the policy implications of the project findings?
* How can public actions enhance the factors of attractiveness?
* More specifically, what is the role of EU policy in enhancing the attractiveness of EU regions within the framework of the territorial cohesion strategy?
* What type of indications can the project provide to enhance the functioning of multilevel governance processes?

In the presentation, regions can be seen as complementary to one another in the sense that they are caught up in mutual exchanges of specialized products and strongly competitive with one another, securing their own collective interests in a world of finite resources. Each city or region, as a community, has a direct interest in securing new inward investments, in widening external markets for its products, and in attracting visitors from outside (Camagni 2002).

Before results are presented, the ATTREG-future model will be presented. And before that two aspect of modeling population development is presented: Firstly, as reference completed and on-going work within the ESPON on demographic development and population forecast is presented. **The point of departure is the state of the art demographic analysis at the European level in the ESPON-project called DEMIFER (ESPON 2010). As a key element in the DEMIFER-project a demographic model for NUTS-2 regions was developed (the MULTIPOLES model) and population and labor force forecast and scenario analysis at NUTS-2 level was undertaken. In the ATTREG-project an extended interregional demographic model based upon** an analysis of territorial attractiveness and mobility flows across Europe (**Russo et al. 2011) has been developed. In this paper, the ATTREG-future model is documented, including the results of scenario experiments with the model.**

**Secondly, it is important to stress, that economic factors such as the financial crisis and its impact on the regional labor and commodity have not fully been included in the analysis of population development, especially in understanding development in regional migration flows. One reason is that migration behavior has been analyzed for the period 2004-6 on the basis of development in relations between outcomes and territorial capital for the period 2001-2003. Secondly, economic variables such as real estate prices have only sporadically been included in the economic and human capital as part of the** territorial capital – outcome effects.

1. ****Interregional demographic models and scenarios****

**In this paper the ATTREG-project results (Russo et al. 2011) are included into a demographic analysis based upon an interregional demographic model. The ATTREG-future model has been developed on the basis of the conventional demographic model extended with the interaction between territorial capital and outcome. In the ATTREG-future model interregional spill-over and feed-back effects from migration and population and from territorial capital to outcomes have been included into the basic structure of the conventional regional demographic model. The ATTREG-future model has in turn been used for scenario analysis: What happens, if the territorial capital or the attractions changes, and what are the spill-over and feed-back effects on the population and labor force from changes in territorial capital or attractions?**

**The point of departure is the state of the art demographic analysis at the European level in the ESPON-project called DEMIFER (ESPON 2010). As a key element in the DEMIFER-project a demographic model for NUTS-2 regions was developed (the MULTIPOLES model) and population and labor force forecast and scenario analysis at NUTS-2 level was undertaken. In the ATTREG-project an extended interregional demographic model based upon** an analysis of territorial attractiveness and mobility flows across Europe (**Russo et al. 2011) has been developed. In section 4 and 5, the ATTREG-future model is documented, including the results of scenario experiments with the model.**

**As a reference in section 3, conventional migration models, including the MULTIPOLES and the demographic core of the ATTREG-future models are presented. As further reference an overview of how the MULTIPOLES model has been used in forecasting and scenario analysis for European regions is provided. Section 3 gives a graphical presentation of the basic demographic model which includes an in-built interaction between the regional population and migration flows, but with ***no interaction between territorial capital and outcomes*** included.**

****3.1** **Migration and population – model based scenario analysis with no links between** territorial capital and outcomes **- The DEMIFER-project****

**Scenarios are intellectual devices for thinking about alternative futures (ESPON 2010f). The consequences of scenarios are often evaluated within a modeling framework and in the case of population, migration and labor force within a basic demographic model and a reference scenario modeling framework. Scenarios are hardly ever used as predictions of likely futures because there are so many uncertainties involved in their construction. On the other hand scenario results as much as possible should reflect realities, involving such facts as basic technical/accounting identities and facts on human behavior. In the case of scenarios for demographic development, a basic model technical/accounting identity is the primo-ultimo-identity, which ensures that changes in population is equal the number of new born minus deaths plus in-migration minus out-migration. A fact can be behavior as reflected in demographic behavioral equations, such as number of death’s as a function of death rates reflecting the underlying population and its age structure as well as rates from the years before.**

**In this section the MULTIPOLES model is presented, together with an examination of the DEMIFER scenario methodology. Although the DEMIFER-scenarios only can been seen as “consistent and intellectual devices for thinking about future”, the MULTIPOLES model in the DEMIFER scenario analysis reflects basic technical/accounting identities and assuming constant (or scenario-corrected) behavior.**

**The aim of the ATTREG-future model compared with the MULTIPOLES model is to increase “realism” in the scenario analysis: The main object is in first step to include the insight into the demographic model of the** analysis of territorial attractiveness and mobility flows across Europe with the intension of increasing the realism of scenarios for population and labor force. This will be the point of departure for the presentation of the ATTREG-future model in section 4. In second step both direct and derived impacts of changes in attraction development and policies are evaluated in the case study on scenarios, which is presented in section 5.

****3.2 Reference and Policy Scenario assumption in MULTIPOLES****

**In the ***first step*** three reference forecasts of population and labor force with MULTIPOLES from 2010 to 2050 including 5 year periods was undertaken:**

1. **A “status quo scenario”, where all sex and age specific demographic rates as well as labor force participation rates remains constant**
2. **“No migration scenario”, where all international migration is assumed to be numerically equal to zero, keeping other demographic and labor participation and internal migration rates unchanged**
3. **“No extra-Europe migration scenario”, where it is assumed that there is no international migration to and from rest of the world, whilst the internal and international migration within the Europe are assumed to remain constant**

**These 3 scenarios, denoted the reference scenarios, was inturn in ***second step*** the point of departure for 1 reference and 4 development/policy scenarios, which are the**

* **Growing Social Europe scenario**
* **Expanding Market Europe scenario**
* **Limited Social Europe scenario**
* **Challenged Market Europe scenario**

**The 4 development/policy scenarios, which all can be put on top of each of the 3 reference scenarios, involve the combination of economic development and policies in 2 dimensions, called the Economy / Environment and the Distribution-Fairness dimensions. The 2 x 2 scenarios generate the following four scenarios and can be illustrated in the following diagram:**

****Table 1. The four DEMIFER scenarios based on the dimensions “economy-environment” and “distribution-fairness”****

|  |  |  |  |
| --- | --- | --- | --- |
| **ECONOMY – ENVIRONMENT** | **Growth enabled by technical and social innovation** | **GROWING SOCIAL EUROPE**  **High growth / Collectivism**  ****GSE**** | **EXPANDING MARKET EUROPE**  **High growth / Individualism**  ****EME**** |
| **Growth limited by environmental constraints** | **LIMITED SOCIAL EUROPE**  **Low growth / Collectivism**  ****LSE**** | **CHALLENGED MARKET EUROPE**  **Low growth / Individualism**  ****CME**** |
|  |  | **Collectivism** | **Individualism** |
|  |  | **DISTRIBUTION – FAIRNESS** | |

**Source: ESPON (2010e)**

**The economy – environment dimension includes two different paths for economic development/policies: In the first option the growth is enabled by technical and social innovation, where economic development in the second dimension is limited by environmental constraints.**

**The distribution – fairness axis involves different bundles of policies: In the collectivistic path, development/politics is designed to achieve social solidarity: there is societal agreement that the difference between the poorest and richest people should be moderate. In the individualistic approach, politics is designed to improve the operation of the market and achievements of greater competitiveness in a global market place.**

****3.3 The demographic model MULTIPOLES****

**In the DEMIFER-project the demographic model MULTIPOLES (Kupiszewski and Kupiszewska (1998, 2005), Kupiszewski and Kupiszewska, 1999; Bijak et al, 2007, 2008a, 2008b; Bijak and Kupiszewski, 2008) was used to forecast population and labor force for each of the 3 reference scenarios and for each of the 4 policy/development scenarios giving in total 15 scenarios (3 reference scenarios x (1 reference scenario + 4 policy/development scenarios)). MULTIPOLES was revised considerably in the DEMIFER-program, among others to improve the scenario setting and analysis of all the results at the regional level.**

**MULTIPOLES follows the structure of a basic demographic model**[[1]](#footnote-2)**, where the population in region r in year t is determined as**

**..................................................................................................................(1)**

**In simple versions of basic demographic models, the demographic rates (such as mortality rates, fertility rates and migration rates) are often assumed to be equal to the rates of last year.**

**.....................................................................(2a)**

**................................................(2b)**

**..........................................(2c)**

**.............................................(2d)**

**Finally, labor force is determined as the population multiplied by labor participation rates:**

**..............................................(4)**

**Using these rates in forecasting and assuming that in-migration rates are constant, population and the labor force in the following period follows by definition.**

****3.4 Reference and policy scenarios and the demographic model MULTIPOLES****

**Although the simple population forecast model seems simplistic, it is an efficient tool in basic evaluation of population development and a bench marking what happens if everything else is unchanged. For the 3 reference scenarios, the results follow directly from equation (1)-(4): Death and fertility rates and labor force participation rates are assumed unchanged. Migration rates are assumed to be constant (in the “Status quo” scenario) or equal to 0 - in the “No migration scenario” both the international migration to Europe and the rest of the world are assumed to be 0, whether in the “No extra-Europe migration scenario” only the international migration to rest of the world are assumed to be 0.**

**Opposite, for the 4 development/policy scenarios assumptions on the development/policy for the demographic, migration and labor participations rates should be decided. The 4 development/policy scenarios give differences in assumptions for demographic policies in the respective fields of development/policy, such as development/policies on**

* 1. **mortality rates**
  2. **fertility rates**
  3. **internal migration rates**
  4. **external migration rates (Immigration (in-migration) from within Europe)**
  5. **extra Europe migration rates (migration to and from the rest of the world outside Europe)**
  6. **labor force participation rates**

**For each of the 4 scenarios the DEMIFER project established different assumption on the each of the 6 fields of development/policies.**

**An example: In the case of mortality rates, 6 sub-factors are assumed to be important for mortality, namely the development/policies concerning:**

* **Lifestyle: Smoking**
* **Lifestyle: Diet/Obesity**
* **Lifestyle: Drinking & Drug Use**
* **Medical advances**
* **National health inequalities**
* **Regional health inequalities**

**For each of the 6 sub-factors assumptions behind the 4 scenarios have been setup. The quantification was discussed/evaluated by experts. In appendix 1 a sub-specification of the elements in each of the 6 development/policy areas is presented.**

****3.5 Scenarios for migration flows and the demographic model MULTIPOLES****

**Especially, for migration rates the assumptions in the reference and policy scenarios are relevant for the analysis of the links between** territorial attractiveness and mobility flows. In the DEMIFER-scenario, it is assumed, that in the scenarios reflecting **collectivism** (the GSE and LSE-scenarios) the differences in the Destination Attractiveness Ratios[[2]](#footnote-3) diminish, which in most cases will reflect a de-concentration in population driven by higher migration flows to areas, which in the reference scenario only received limited in-migration. Opposite for the scenarios, that reflect individualism (the EME and CME–scenarios), where it is assumed, that the differences in Destination Attractiveness Ratios increase. As a consequence, migration to the regions which in the reference scenario received most in-migration, will receive even more migration flows, which in most cases will lead to a regional concentration of population.

For scenarios taking into account the limitation in economic capacity due to **environmental constraints (the LSE and the CME-scenarios) compared with scenarios with no environmental constraints (the GSE and EME-scenarios) it does not systematically influence the Destination Attractiveness Ratios and therefore it does not a priori lead to convergency/divergency. However, total international emigration from outside Europe is at a higher level for the scenarios with no environmental constraints than for scenarios with environmental constraints. The reason for this is that the European growth in GDP pr. capita in the no-environmental constraints scenarios is at a higher level than the environmental constraints scenario, which will lead to a higher international in-migration from outside Europe.**

****3.6 Development/Policy experiments with MULTIPOLES within the DEMIFER-scenarios (Impact assessment)****

**The MULTIPOLES model has been used for forecasting population, migration and labor force for the years 2010 to 2050, in 15 versions – 3 reference scenarios for 4 alternative scenarios for development/policies. On the basis of these forecast, an impact study has been presented within the DEMIFER-project (ESPON (2010h) on climate changes and migration (a “CC-impact study”)**[[3]](#footnote-4)**.**

**The point of departure is the ***reference scenario called “status quo”*** combined with the ***LSE*** (the LIMITED SOCIAL EUROPE Low growth / Collectivism) scenario. On top of this scenario, an alternative scenario including the effects on migration from climate changes generates new migration flows:**

**...........................(5)**

**Impacts on migration from climate change (, which is migration from region R to region S in year t due på CC) and migration is modeled outside the MULTIPOLES model (ESPON 2010h). The impacts on migration flows generated from climate changes can be seen from an origin (move-away-regions) and a destination (move-to-regions) point of view. The number of CC-migrants from move-away-regions (R-regions) is determined as follows:**

**............................................................................(6a)**

**And total number CC-migrants to move-to-regions (S-regions) is**

**.............................................................................(6b)**

**In the equations explanatory variables for push- and pull flows are the same, reflecting, that high share of area with sea level problems (R-regions) pushed population toward areas with low share of areas with sea level problems (S-regions) etc. The equation also reflect that the higher population the higher the number of out- and in-migrants.**

****3.7 What can be learned from the DEMIFER MULTIPOLES model project** – decision to be taken by the ATTREG-project?**

**From the DEMIFER analysis important questions on the appropriate structure of the ATTREG-future model, which include links between territorial attractiveness and mobility flows, can now be raised:**

**Firstly, a choice has to be made, whether the ATTREG-future model should have**

1. **an integrated and simultaneous model for territorial attractiveness and mobility flows and demography included into the model or**
2. **an independent model for attractiveness and mobility flows outside the basic demographic model, which was the case in the CC-impact study (ESPON 2010h).**

**Secondly, decision has to be taken, whether the ATTREG-future model only should be used for**

1. **impacts studies, where changes in migrations flows from changes in development/polities on attractions is included on top of a reference scenario, and/or**
2. **forecasting and scenario building as basic changes in the reference forecast**

**Thirdly, decision has to be taken, whether – in the case of an integrated for territorial attractiveness and mobility flows approach - feed-back and spill-over effects should be included in the ATTREG-future model: The question is whether the derived effects on attractiveness (such as derived changes in population density, GDP pr. capita, accessibility etc.) should be followed in a round-by-round process.**

**In next section a graphical presentation of the ATTREG-future model is provided. To summarize: it has been decided**

1. **only to include one reference scenario opposite to the 3 reference scenarios and 4 policy scenarios in the DEMIFER-project. In the reference scenario attractions are assumed to be unchanged and only the direct effects from the derived effects on dependent attractions, such as population density, GDP pr. capita etc. have been included in the reference scenario**
2. **only to use the model for impacts studies (based upon the one reference scenario)**
3. **to include the links between territorial attractiveness and mobility flows fully into the ATTREG-future model**
4. **to include the spill-over and feed-back effects on regional attractions and in turn on the feed-back on migration flows, involving a process of adjusting population and attractions in an iterative equilibrating process.**

1. ****Migration and population – model based scenario analysis with links between** territorial attractiveness and mobility flows **- The ATTREG-future model****

**In this section the ATTREG-future model, which is an extended demographic model, is presented. The ATTREG-future model includes empirically estimated links between territorial attractiveness and mobility flows (Russo et al. 2011)**. Although the ATTREG-future model therefore relies on empirical estimated demographic rates, we would still refer to the forecast as a reference scenario – and not as predictions: T**here are still many uncertainties involved in its construction.** Anyhow, the ATTREG-future model represents an improvement in the empirical basis for scenario building and impacts assessment, because the model built upon revealed attraction outcome relations.

**4.1 The ATTREG-future model – a graphical presentation**

This section includes a non-technical description on the ATTREG-future-model based on graphical presentation together with explanation of the result of an experiment with the model. For a detailed mathematical documentation see appendix 3.

The core of the presentation is the following flow diagrams of the ATTREG-future model:

***Figure 2 The structure of the ATTREG-future model – a graphical overview***

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From the diagram it can be seen, that the model consists of three elements:

1. a conventional demographic model in line with the MULTIPOLES model (the North-East corner of the diagram)
2. a regional economic model, which is “supply-driven”, which means that changes in population drives the labor force, which drives employment and local employment, which in turn drives export jobs and GDP per capita (the South part of the diagram)
3. a “feed-back” attraction-determined component, which relies on the relation between population density and GDP pr. Capita impacts on in-migration (the North-West corner of the diagram, where attraction variables are shown as “Bold boxes”)

From the diagram it can be seen, that regional activities / territorial capital are divided into two geographical concepts “place of residence” (the upper part of the diagram) and “place of production” (the lower part of the diagram). This corresponds to the unit of activity, which in the upper part of the diagram relate to type of persons (in the ATTREG-future model by gender and age groups) and to type of producers (in the ATTREG-future model by sector). The division is a simplified version of the LINE-model for the Danish local economy (see Madsen 2010 and Madsen and Jensen-Butler 2003).

***Ad a. Conventional demographic model in line with the MULTIPOLES model***

In the demographic part of the ATTREG-future model the population in the end of the year () is determined by population in beginning of the year () adding new born and subtracting dead and adding in-migrants and subtracting out-migrants (see equations 1-3 in section 3.3 and equations 1-6 in appendix 3). Forecasting or modeling population in this conventional demographic model is a result of demographic coefficients, such as death and fertility rates, out-migration rates and migration structure. These coefficients are normally assumed to be equal to values in latest years (or eventually forecasted including a prolongation of a historical trend). In the DEMIFER-project both reference and 4 development/policy scenarios have been establish (se section 3.1), whilst in this paper only one reference scenario has been undertaken.

***Ad b. A supply-driven regional economic model***

The ATTREG-future model is a “supply-driven model”, where the size and structure of the population is assumed to influence economic activities, such as labor force, employment, production and export.

***Impacts on population density and accessibility***

A first effect from an increase in population is rise in population density and reduction in accessibility, which follows by definition (see equation 7 in appendix 3). This in turn will change the attractiveness of a region, which will give a “feed-back” attraction-determined component (see section c) below and equation A in appendix 3).

***Impacts on GDP per capita***

In a supply-driven regional economic model changes in population drives regional economic activity (see figure 2). Changes in population drive changes in the labor force (see equation 8 in appendix 3), which in turn lead to changes in the employment (see equations 9 and 10 in appendix 3). The impact depends on labor participation rates – for the young and the old age groups labor participation rates are relatively low, giving low increases in employment for the young (15-24 year) and old population (50-64 year). And vice versa for the middle age population group (25-49 year). Given unemployment is unchanged (according to a supply driven model), changes in labor force leads to changes in employment by place of residence – positive for the mid-age and positive or eventually negative for the young and old age groups.

Further, employment by place of residence – in a supply driven model – drives jobs by place of production, according to pattern of commuting: If population and employment by place of residence in a region increases, then jobs by place of production also increases, if commuting pattern is “local”, given low out- and in-commuting, jobs by place of production increases in the region in study (see equations 11-16 in appendix 3).

Changes in population generate changes in jobs within population dependent activities (see equation 17 in appendix 3). In the case of in-migration and increasing population, jobs in population dependent activities also increase. Production dependent activities also tend to change (see equation 18 in appendix 3), because population dependent activities increase. The number of jobs in tourism activities do not change, because only population changes.

The increases in local jobs (population and production dependent activities) can be smaller or bigger than changes in the labor force and employment: If number of jobs within local activities increase more than the rise in labor force, jobs in export activities will decrease. If opposite jobs within local activities increases less than the increases in labor force, jobs in export activities will increase.

A reduction in number export jobs will change the long-run basic economic condition for a region: If number export jobs decreases, then the economic performance – measured by GDP pr. capita – will deteriorate and GDP pr. capita will go down. Opposite if the number of export jobs increase, then GDP pr. capita will increase (see equation 19 in appendix 3).

Finally, the change in GDP per capita will change the attractiveness of a region, which in turn give a “feed-back” attraction-determined component – see section c) below.

***Ad c. A “feed-back” attraction-determined component (population density and GDP pr. Capita impacts on in-migration)***

The third element is the relation between the two variables “changes in population density” and “changes in GDP pr. capita” to in-migration described above: If the ATTREG-future model provides a region with a change in population density and GDP pr. capita, these changes will in turn change the in-migration further. From the analysis of relations between net-migration and attractions (Russo et al. 2011) further changes in in-migration can be found. So: the ATTREG-future model will further include changes derived from changes in “population density” and “GDP pr. capita”.

The ATTREG-model also includes the derived (second and higher order) changes in in-migration, which follows from higher level changes in attraction.

**4.2 Attractions and mobility flows in the ATTREG-future model**

In the presentation of the core of the ATTREG-future model, the inter-link “from migration/population to attractions” and “from attractions to migration/population” was the key development of the conventional interregional demographic model. The attractions were part of the simultaneous blocks in the ATTREG-future model, where the 2 attraction factors – population density and GDP pr. capita – represent the “endogenous/cumulative attraction factors”. To complete the presentation of the ATTREG-future model also the “exogenous attraction factors” should be examined. In the figure 1 in section 2 the core of the basic demographic model is shown together with both the endogenous attraction variable (the boxes with a bold and striped line) as well as the exogenous attraction variables (the boxes with a bold and etched line). The exogenous attraction variables enter directly into the determination of migration flows and population – like it was the case for the endogenous attraction variables. But opposite the endogenous variables, the exogenous variables are not included in the simultaneous blocks of the ATTREG-future model.

In table 2 the results from the estimation of territorial attractiveness and mobility flows across Europe (Russo et al. 2011) for each of the 5 audiences are shown. From the table and for each of the audiences, the unit of the attraction variable and type of variable are shown in first two columns, the values of the coefficient which induce the change in in-migration rate from a change in the attraction variable are presented in column 3-5, whereas the column 6-7 shows the change in number of tourist arrivals.

***Table 2 Regression statistics by audience in the reduced regression model for territorial attractiveness and mobility flows for the ATTREG-future model***

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | Descriptive statistics | | | unstandardised Beta coefficients | | | | |
| Variable code | Variable name | Type of variable in relation to policy context | Unit for variable | min value | max value | 5-year net migration flow for 15-24 year olds 1 | | 5-year net migration flow for 25-49 year olds 1 | 5-year net migration flow for 50-64 year olds 1 | Resident visitors in collective accommodation (in 1 year) | Foreign visitors in collective accommodation (in 1 year) |
| Anthropic assets | | | |  |  |  | |  |  |  |  |
| an1 | monuments and other tourist sights valued 2 stars in TCI "green guides series", indexed, NUTS2 (AN2\_05) | Exogenous/ policy | index | .0000 | 20.7700 | 759.97373 | | 3399.4262 | -838.51304 | 81518.591 | 149786.52 |
| an2 | Average gross population density (persons per sqkm), 2001-03 | Cumulative (subject to derivative effects)/ policy | persons per sq km | 2.8544 | 8968.2361 | 4.2941866 | | -0.0111406 | -2.5900663 | -57.200308 | 236.37857 |
| an3 | Rank of regional air passenger flows based on passenger movements through regional airports (averaged 2001-03) (1=busiest) | Exogenous/ policy | rank where 1= busiest region | 1 | 264 | -39.757292 | | -65.893772 | 11.609763 | -1931.7272 | -1459.1919 |
| an4 | Average number of bed spaces in collective tourism establishments, 2001-04 | Exogenous/ policy | number | 804 | 673821 | 0.0498954 | | 0.1511144 | 0.0477038 | 8.9261283 | 7.2491332 |
| an5 | sum of population accessibility scores (working age population accessibility per hour travel distance, 2001) | Cumulative (subject to derivative effects)/ policy | persons per hour travel time | 1441302.46 | 63644721.82 | -0.0001543 | | -0.0003093 | -5.35E-05 | -0.0019682 | -0.0045646 |
| an6 | location of a metropolitan urban area in NUTS2 (AN2\_21) | Exogenous/ non-policy | dummy, 1 = metropolitan, 0 = non-metropolitan | 0 | 1 | 3459.591 | | 9382.4298 | 2598.2975 | -15122.695 | -15840.515 |
| Economic assets | | | |  |  |  | |  |  |  |  |
| ec1 | average GDP per capita 2001-03 | Cumulative (subject to derivative effects)/ endogenous | Euros per capita | 1267 | 75433 | 0.2553401 | | -0.1208534 | -0.2857106 | 19.084582 | 20.88407 |
| ec2 | Average proportion of people aged 15 and above educated to ISCED level 5-6 as highest level 2001-03 | Exogenous/ policy | proportion | .0000 | .4713 | 38148.044 | | 129265.21 | -6404.7459 | 4945212.8 | 2582966.4 |
| ec3 | Average proportion of total employment in Wholesale and retail trade; hotels and restaurants; transport - all NACE (rev.1) activities, 2001-03 | Exogenous/ policy | proportion | .0814 | .4455 | 760.53422 | | 18460.25 | -11172.693 | -3547729.8 | 4443542.5 |
| Environmental assets | | | |  |  |  | |  |  |  |  |
| env1 | difference between WARM and COLD (EN2\_23) | Exogenous/ non-policy | index | -2.00 | 35.30 | -626.36151 | | -2656.9106 | -623.45879 | 18979.893 | -6487.6726 |
| env2 | the percent share of the Natura 2000 sites within the NUTS (EN2\_34) | Exogenous/ policy | percentage | .0000 | 100.0000 | 84.416297 | | 173.14529 | 38.138013 | 2879.2062 | 2098.1638 |
| env3 | coastal classification from ESPON (EN2\_36) | Exogenous/ non-policy | dummy, 1 = 'coastal' NUTS2 | 0 | 1 | -6905.9923 | | -8421.6722 | 1547.4193 | -301025.84 | -352651.23 |
| env4 | island classification from ESPON (EN2\_35) | Exogenous/ non-policy | dummy, 1 = 'island' NUTS2 | 0 | 1 | -7131.6402 | | -22332.262 | -1197.1862 | -475880.85 | 86204.315 |
| Institutional assets | | | |  |  |  | |  |  |  |  |
| in1 | % of respondents who were more satisfied with the "state of health services in country nowadays" relative to the EU median score (IN2\_48) | Exogenous/ policy | percentage responding in category greater than EU median | 6.6015 | 87.8789 | 7.7628316 | | -211.53251 | -6.5787325 | -4030.1511 | 6718.8194 |
| in2 | Average proportion of employment in public administration and community services (NACE rev.1) 2001-03 | Exogenous/ policy | proportion | .1168 | .5582 | -66433.57 | | -193469.24 | 3846.772 | -985490.74 | -3720863.8 |
| in3 | number of NUTS2 region within country in which located | Exogenous/ non-policy | number | 1 | 39 | 122.20445 | | -155.22042 | -23.725316 | 20371.568 | -14477.149 |
| Social and cultural assets | | | |  |  |  | |  |  |  |  |
| soc1 | Average number of registered university students per 1000 registered residents aged 15 to 24 years, 2001-03 | Exogenous/ policy | number of students per 1000 inhabitants aged 15-24 years | 7.1680 | 1640.4672 | 22.980185 | | 29.339409 | 8.8082083 | -262367.53 | -219744.79 |
| soc2 | % of respondent in the area who were "satisfied with life as a whole" relative to the EU median score (SC2\_02) | Exogenous/ policy | percentage responding in category greater than EU median | 8.69 | 83.65 | 42.386149 | | 679.34383 | 130.71821 | -5061.8398 | -5904.7963 |
| soc3 | Average ratio of persons aged 65 and over to the working aged population aged 15-64 years, 2001-03 | Exogenous/ policy | ratio | .0511 | .4028 | -19474.684 | | 63230.414 | 59041.214 | 1120409.5 | -6107847.1 |

**Notes:**

1. **Regression analysis based on 2001-03 territorial assets (November 2011 data-set)**
2. **Regression analysis based on older version of territorial assets data –set (May-September 2011)**

**4.3 Economic crisis and attractions and mobility flows in the ATTREG-future model**

One critical issue for demographic models is to which extend the effects on the demographic development from the present financial and economic crisis has been included into the modeling framework. In this project the question is to which extend the ATTREG-future model is able to capture the pattern of regional down-turn of population, labor force, employment and unemployment and jobs in general and whether the model can replicate the change in a number of “heating” regions, which in the beginning of the decennium experienced high growth, but now seems to have lost momentum in the demographic development. Although the ATTREG-future model can be characterized as an “extended regional demographic model” (as compared with the DEMIFER-model), the model at the present stage has not sufficiently taken into account the effects of the economic and financial crisis on migration and tourism flows: One important reason for this is that in the statistical analysis of the relations between territorial capital and outcomes, on which the ATTREG-future model build, only the variable GDP per capita has been included. The fact that economic variables (such as regional debt ratios, wage and price development etc.) only sporadically have been included in the analysis, which seriously restricts the generality of the ATTREG-future model. This must be emphasized before drawing conclusions on the results of the impact from attraction development / attraction policies as well as the realism of the reference scenario.

The reason for this – as discussed in the presentation of the results from the statistical analysis on territorial capital and outcomes – is, the fact that the

* ESPON-database, which has been the basis for the statistical analysis, was only fully available for the pre-crisis period 2001-06
* Data on key economic variables – such as regional debt ratios, wage and price development etc. - are not yet available in the ESPON-database.

In this technical documentation of the ATTREG-future model, a more general model for how to include market variables into the ATTREG-future model as well as how to develop the ATTREG-future model into a combined extended demographic and regional economic model is outlined. In figure 3 the structure of an extended ATTREG-future model with integrated commodity and factor markets are presented:

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The structure of this model is similar, although a simplified version of the LINE-model for the Danish local economy (see Madsen 2010 and Madsen and Jensen-Butler 2003): In the upper part of the diagram activities are related to place of residence and by persons (divided by age and gender), which include the model for attraction, migration and population. In the mid part of diagram the activities are assigned to place of markets and to commodities. Finally, activities in the lower part of the diagram are related to sectors and related to place of production. Compared with the extended demographic model presented in figure 2 and which is used forbin the analysis of impacts of attraction policy packages (see section 5), this theoretical version of the ATTREG-future model include a description of activities in economic terms: At the market for commodities demand and supply for commodities are described in value terms, which on demand side involve demand for:

* intermediate consumption goods
* private consumption goods
* public consumption goods
* investment goods
* export to other regions and abroad

and on the supply side the

* production of commodities
* import of commodities from abroad and from other regions

The markets are cleared on the basis of commodity prices.

Looking at labor/factor markets these are cleared on the basis of real wages, which are adjusted according to supply and demand for labor. The demand for labor (employment) is derived from production (see the lower part of the diagram, which include the place of production as well as producers divided by sector). From production by sector jobs by sector are derived, which the commuting gives the employment by place of residence.

Models for demand and supply would include the factors, which is important for understanding the development of the economic and financial crisis and its implications for pattern of migration, including the role of regional debt, cost of financing and regional interest rates. The ATTREG-future therefore only reflects the interaction between territorial capital and outcome seen as quantity model, where the interrelations between outcome and regional market prices, debt position etc. are missing.

**5. Experiment with the ATTREG-future model**

Following the presentation of the causal structure of the ATTREG-future model in this section results of impact studies of the inclusion of 3 different attraction policy packages (the inclusive, the sustainable and smart scenarios) in 2 groups of regions are presented. The ATTREG-future model is used to model the impacts from changing the values of different combinations of changes in exogenous attraction variables.

The point of departure is the reference scenario, which has been calculated from 2010 to 2030, divided into 5 year time periods: 2010, 2015, 2020, 2025 and 2030. The ATTREG-future model has for each year been calculated, including the spill-over and feed-back effects between regions as well as the derived effects from the direct effects as described with the circle structure of the ATTREG-future model (see appendix 2).

**5.1 Choice of attraction policy packages and groups of target regions**

The focus of ATTREG project, thus, is to explore the relationships between specific policy bundles and territorial characteristics within the framework of a variety of policy scenarios which are based on a combination of different attraction policy instruments (variables). To this end, the project relies on previous ESPON elaborations on these specific instruments, in particular the DEMIFER project on demographic changes at EU level, which has developed different scenarios taking into consideration different attraction policy instruments.

Drawing on the cumulative work of the previous research activities, the last attempt is to identify, in relation to current policy documents and debates, the implications of our work for current and future European policies vis-à-vis attractiveness. In particular, we ‘critically interrogate’ the assumptions underlying key European (Territorial) debates and policies and the extent to which the results of our project support or contradict these assumptions. On this basis we can then begin to suggest future policy trajectories that may reinforce existing policies or suggest a need for their modification.

By drawing upon the policy proposals contained in key European documents (e.g. the Green Paper on Territorial Cohesion, Territorial Agenda, Europe 2020 Strategy, the Barca Report, the Fifth Cohesion) and EU research projects (among which of particular relevance are DEMIFER, FOCI, GEOSPECS, EDORA) and the overall territorial considerations elaborated in the First Espon 2013 Synthesis Report, we can, in relation to our evidence from the analysis of regional typologies:

* elaborate more **fine-tuned policy implications** for different types of regions/cities, taking into account different motivations and objectives;
* provide **cartographical presentations** of the above in terms of future scenarios under different policy trajectories;
* draw out the **overarching implications for Europe’s development** in relation to the main policy options and trajectories included in key policy documents (especially the new strategy EU2020);
* draft a summary of our **conclusions/policy implications** for dissemination.

This will entail a three step process (as summarized by the diagram in figure 4):

1. Identification of the normative policy discourses and their underlying assumptions as found in key policy documents, (emphasizing the consequences of the three main streams of the EU 2020 strategy)

2. Application of the different policy options in the ATTREG-future model, inquiring the territorial aspects emerging from the analysis of the relationship between territorial capital and forms of attractiveness

3. Produce policy analysis and estimation of consequences in relation to the different policy scenarios

**1.**

**Normative policy discourses**

**3.**

**Policy analysis**



**2. Policy application**

**- ATTREG model -**

**ATTREG analysis**

**Figure 4. Methodological scheme.**

In relation to the normative policy discourses this would entail a definition of a set of variables and *alternative policy bundles* in terms of smart, cohesive and sustainable growth (EU2020 strategy). The task is to define a set of key drivers within each normative policy discourse and their implications for attractiveness-enhancing policies.

Despite being aware on the fact that the three streams are not mutually exclusive alternatives, we have decided to emphasize three policy approaches (smart growth, inclusive growth and sustainable growth) mentioned in the EU2020 strategy, drawing out their territorial consequences. The idea is to extrapolate each of them to their logical conclusion thereby emphasizing the different potential trajectories.

Going through the policy document and EU research projects, and using a form of discourse analysis, some specific interlinked categories can be identified:

* Policy options
* Territorial evidences
* Key mobilization factors
* Spatial mobility trends

These would then be considered in relation to the following dimensions:

* (geography) **urban / regional**
* (audience) **resident / tourist**

In the **smart-growth policy approach** we forecast a concentration of resources and efforts in hi-tech investments, and in particular in the NBIC sectors (Nanotechnology, Biotechnology, Information technology and Cognitive science). The enhancement of Europe’s research and enterprise networks and their connections to global networks, together with strong investments on higher education institutions and private high-qualified companies, strengthen the role of big metropolitan areas and specific centres of specializations. Moreover, this trend is enhanced by investments in infrastructure networks and accessibility among European metropolitan places, combining public and private transport (highways and high-speed train connections). The metropolitan areas, thus, are the main drivers of territorial attractiveness.

At the same time, innovative and high-tech companies with worldwide trading for innovative rural regions are promoted. Thus, close links in rural areas to territorial hubs facilitated by ICT systems and network relationships favor advanced productive agriculture systems, and clusters of excellence in smaller towns are supported in order to have critical mass to face the global market. Moreover, characteristic of different rural areas are promoted to be used as tourist attractive factors, enhancing rural regions as consumption countryside regions with a strong role of the private sector services.

The **inclusive-growth policy approach** will be characterized by strong investments on social capital with a particular focus on deprived areas, on overcoming internal and external borders building cross-border metropolitan regions, and on balancing development capacities between EU core area and peripheral areas.

The demographic structure of Europe and its challenges (aging, labor force, etc), together with the neighboring countries’ opposite trends represents a crucial issue for a cohesive-growth policy approach.

We forecast that accessibility to the nearest urban centre, good secondary networks and levels of service provision (stronger focus on local accessibility than European scale) will be enhanced in this perspective, reinforcing the polycentric structure based on small and medium-sized towns. At the same time attention will be paid to policies toward immigration and to accessibility to services of general interests in small towns for rural residents, and increase the accessibility to job opportunities and services, among which local public transports and public networks among small and medium-sized towns.

Efforts on sustaining services of general interest in risk-of-deprivation areas (accessibility to the nearest urban centre, good secondary networks and levels of service provision) will be key factors for maintaining population in difficult areas.

Policies supporting the localization or the re-localization of traditional firms in lagging-behind regions in order to gain from the competitive labor-force costs will be a way to boost economic growth and employment strategies in peripheral areas.

The **sustainable-growth policy approach** will be characterized by strong emphasis on improving the resource efficiency in Europe especially in peripheral locations, by a proactive approach of regions and cities toward greener economic development strategies, and supporting measures of adaptation to climate change, regional resilience and capacity to bounce back.

The policy attention will be directed to the diversification of economic sources for area with exploited environmental capital (mass tourism along coastal areas, or mountain areas with snow-based winter tourism), and to a call for a new profiling of a region’s natural and ecological assets.

Being a strong urban dimension to climate vulnerability, several investments will be focused on the drastic reductions of traditional polluting economic sectors, and more resources on green economy innovative ecological approaches. Big investments will be directed to public infrastructures, together with policy and taxations to private transportation forms.

Traditional economic sectors such as intensive agriculture, forestry and mass tourism will be penalized, while the protection of existing landscapes and natural resources will favour selective forms of tourism and integrated local community approaches.

**5.2 R**esults of the 3 policy packages of attraction policy****

**Results of the 3 attraction** packages (Inclusive, sustainable and smart), which are assumed to be implemented for

* Objective 1 regions
* Overheating regions

**can be summarized as follows**:

Inclusive scenario:

1. In general the inclusive scenario seems to have a negative positive direct effects on target regions
2. The impacts in the surrounding regions – within each state – seems to be positive as the out-migration from target regions mainly is going tothe domestic regions.
3. The impacts on the labor force and employment seems to be mixed, because impacts in general are negative for the (target) regions where labor force participation rates for young and old age groups are high, whereas the impact are positive for (target) regions, where the decline in the population dependent employment more than outwigh the reduction in labor force.
4. The impacts over time seems to become more negative, the older the out-migrants for target regions become, because labor force participation increases for the mid year age groups.
5. The impacts for target regions on GDP per capita seem to be positive contributing to a process of European convergence. This happens because number of export jobs in target regions in general seems to increase.

Smart scenario:

1. In general the smart scenario seems to have negative direct effects on objective 1 region whereas the impacts for heating regions seems to be more mixed.
2. The impacts in the surrounding regions – within each state – seems to be positive as the negative in-migration (=out-migration) mainly go to the domestic regions.
3. The impacts on the labor force and employment in general seem to be negative for the (target) regions where labor force participation rates for young and old age groups seems to be high, whereas the impact are positive for (target) regions, where the population dependent employment leads to increases in labor force.
4. The impacts over time seem to become less negative, the older the out-migrant for target regions become, because labor force participation increases for the young age groups.
5. The impacts for target regions on GDP per capita seem in general to be positive contributing to a process of European convergence. This happens because number of export jobs in target regions in general seems to increase.

Sustainable scenario:

1. In general the sustainable scenario seems to have positive direct effects for objective 1 regions as well as heating regions
2. The impacts in the surrounding regions – within each state – seem to be negative because in-migration in general comes from domestic neighboring regions.
3. The impacts on the labor force and employment seems in general to be positive for the (target) regions where labor force participation rates for young and old age groups are high, whereas the impact are mixed for (target) regions, where the population dependent employment leads to both increases and decreases in labor force.
4. The impacts over time become more negative or positive, the older the out-migrant for target regions become, because labor force participation increases for the young age groups.
5. The impacts for target regions on GDP per capita seem in general to be positive contributing to a process of European convergence. This happens because number of export jobs in target regions in general seems to increase.

**5.3 Results: Technical description**

In this section, preliminary results of modeling the impacts of the 3 packages applied for the two regions ATT11 Vienna and the BG31 Severozapaden are presented. First, the baseline scenario for the impacts studies is presented. Then a technical specification of the 3 scenarios is provided. And finally the results for the 2 regions are presented.

***Reference scenario***

The ATTREG-future model is run for each 5 year periods, starting in the start year, 2010, which is then simulated 10 times or 10 “model iterations” for each year. One “model iteration” corresponds to one round in the graphical presentation in the ATTREG-future in figure 2 starting from the box “In-migration” and continuing in the clock-wise circle ending in the boxes with impacts on Population density and GDP per capita. One “model iteration” also corresponds to calculating equation 1 to 21 (see appendix 1 for a mathematical presentation of the ATTREG-future model).

***Policy package scenarios***

The reference scenario is now rerun 3 times assuming the 3 attraction policy packages are implemented. The assumptions in the 3 scenarios are the following:

***Table 3 Assumption for changes in attraction variables in the 3 scenarios (inclusive, sustainable and smart) for impacts assessment with the ATTREG-future model***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | Scenarios | | |
| Variable code | Variable name | Type of variable in relation to policy context | Unit for variable | Inclusive scenario | Sustainable scenario | Smart scenario | |
| Anthropic assets | | | |  |  |  | |
| an1 | monuments and other tourist sights valued 2 stars in TCI "green guides series", indexed, NUTS2 (AN2\_05) | Exogenous/ policy | Index | Not changed | Not changed | Not changed | |
| an2 | Average gross population density (persons per sqkm), 2001-03 | Cumulative (subject to derivative effects)/ policy | persons per sq km | Cumulative / endogenous | Cumulative / endogenous | Cumulative / endogenous | |
| an3 | Rank of regional air passenger flows based on passenger movements through regional airports (averaged 2001-03) (1=busiest) | Exogenous/ policy | rank where 1= busiest region | Not changed | Decrease with 10% | Increased with 10% | |
| an4 | Average number of bed spaces in collective tourism establishments, 2001-04 | Exogenous/ policy | Number | Increased with 1 % | Not changed | Not changed | |
| an5 | sum of population accessibility scores (working age population accessibility per hour travel distance, 2001) | Cumulative (subject to derivative effects)/ policy | persons per hour travel time | Not changed | Decreased with 1 % | Increased with 1 % | |
| an6 | location of a metropolitan urban area in NUTS2 (AN2\_21) | Exogenous/ non-policy | dummy, 1 = metropolitan, 0 = non-metropolitan | Cannot be changed | Cannot be changed | Cannot be changed | |
| Economic assets | | | |  |  |  | |
| ec1 | average GDP per capita 2001-03 | Cumulative (subject to derivative effects)/ endogenous | Euros per capita | Cumulative / endogenous | Cumulative / endogenous | Cumulative / endogenous | |
| ec2 | Average proportion of people aged 15 and above educated to ISCED level 5-6 as highest level 2001-03 | Exogenous/ policy | proportion | Not changed | Not changed | Increased with 2 % | |
| ec3 | Average proportion of total employment in Wholesale and retail trade; hotels and restaurants; transport - all NACE (rev.1) activities, 2001-03 | Exogenous/ policy | proportion | Not changed | Not changed | Increased with 1 % | |
| Environmental assets | | | |  |  |  | |
| env1 | difference between WARM and COLD (EN2\_23) | Exogenous/ non-policy | index | Cannot be changed | Cannot be changed | Cannot be changed | |
| env2 | the percent share of the Natura 2000 sites within the NUTS (EN2\_34) | Exogenous/ policy | percentage | Not changed | Increased with 1 % | Not changed | |
| env3 | coastal classification from ESPON (EN2\_36) | Exogenous/ non-policy | dummy, 1 = 'coastal' NUTS2 | Cannot be changed | Cannot be changed | Cannot be changed | |
| env4 | island classification from ESPON (EN2\_35) | Exogenous/ non-policy | dummy, 1 = 'island' NUTS2 | Cannot be changed | Cannot be changed | Cannot be changed | |
| Institutional assets | | | |  |  |  | |
| in1 | % of respondents who were more satisfied with the "state of health services in country nowadays" relative to the EU median score (IN2\_48) | Exogenous/ policy | percentage responding in category greater than EU median | Increased with 1 % | Not changed | Not changed | |
| in2 | Average proportion of employment in public administration and community services (NACE rev.1) 2001-03 | Exogenous/ policy | proportion | Increased with 1 % | Not changed | Not changed | |
| in3 | number of NUTS2 region within country in which located | Exogenous/ non-policy | number | Cannot be changed | Cannot be changed | Cannot be changed | |
| Social and cultural assets | | | |  |  |  | |
| soc1 | Average number of registered university students per 1000 registered residents aged 15 to 24 years, 2001-03 | Exogenous/ policy | number of students per 1000 inhabitants aged 15-24 years | All regions at least 5% | Not changed | All regions at least 5% | |
| soc2 | % of respondent in the area who were "satisfied with life as a whole" relative to the EU median score (SC2\_02) | Exogenous/ policy | percentage responding in category greater than EU median | Not changed | Increased with 1 % | Not changed | |
| soc3 | Average ratio of persons aged 65 and over to the working aged population aged 15-64 years, 2001-03 | Exogenous/ policy | ratio | Decreased with 1 % | Not changed | Increased with 1 % | |

In appendix 4 and 5 results of 3 attraction policy packages with any detailed presentation or explanation. The results are preliminary and are presented to illustrate the workings of the model. The results must not be quoted as final results. Results will be examined and eventually revised for the final report.

**Section 6 Summary**

In the final report

**Literature:**

ESPON (2010e) DEMIFER Demographic and migratory flows affecting European regions and cities of the ESPON Applied Research Project 2013/1/3 Deliverable 5 Reference scenarios (http://www.espon.eu/export/sites/default/Documents/Projects/AppliedResearch/DEMIFER/FinalReport/DEMIFER\_Deliverable\_D5\_final.pdf)

ESPON (2010h) DEMIFER Demographic and migratory flows affecting European regions and cities of the ESPON Applied Research Project 2013/1/3 Deliverable 8 Report on climate change and migration scenario (<http://www.espon.eu/export/sites/default/Documents/Projects/AppliedResearch/DEMIFER/FinalReport/DEMIFER_Deliverable_D8_final.pdf>)

Bjarne Madsen (2009): *Regional Economic Development from a Local Economic Perspective – A General Accounting and Modelling Approach*, Doctoral Dissertation, Department of Geography and Geology, University of Copenhagen, CRT

Bjarne Madsen and Chris Jensen-Butler (2004): *Theoretical and operational issues in sub-regional modelling, illustrated through the development and application of the LINE model,* Economic Modelling, Volume 21, Issue 3, p. 471-508.

****Appendix 1. Scenario assumptions in the DEMIFER projects****

* **Policies/development on mortality, which are**
  1. **lifestyles on smoking**
  2. **lifestyles on diet/obesity**
  3. **lifestyles on drinking & drug use**
  4. **medical advances**
  5. **national health inequalities**
  6. **regional health inequalities)**
* **Policies/development on fertility, which are**
  1. **Family versus individual goals**
  2. **Family friendly policies**
  3. **Assisted conception**
  4. **Abortion law**
  5. **National fertility inequalities**
  6. **Regional fertility inequalities**
* **Policies/development on internal migration (Immigration (in-migration) from within Europe as well as the rest of the world outside Europe)**
  1. **Destination attraction ratio trends**
* **Policies/development on external migration (Immigration (in-migration) from within Europe as well as the rest of the world outside Europe)**
  1. **Total level of Inter-State Migration**
  2. **Origins: Interstate out-migration**
  3. **Destinations: Inter-State in-migrations**
  4. **Explicit Inter-state Migration policy**
* **Policies/development on extra Europe migration, which are**
  1. **Total level of extra Europe Migration**
  2. **Origins: Emigrations**
  3. **Destination: Immigration**
  4. **Explicit Extra-Europe Migration policy**
* **Policies/development on labor force participation, which are**
  1. **Trends in Participation**
  2. **Participation of young persons**
  3. **Female participation**
  4. **Participation of elder people**
  5. **Part time/Full time/Self employed**

**In the case of mortality rates, 6 factors are assumed to be important for mortality, namely the policies concerning:**

* **Lifestyle: Smoking**
* **Lifestyle: Diet/Obesity**
* **Lifestyle: Drinking & Drug Use**
* **Medical advances**
* **National health inequalities**
* **Regional health inequalities**

**Appendix 2.**

***Figure 3.2 Attraction variables in the ATTREG-future model – a graphical overview of the full model***

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****Appendix 3 The ATTREG future model – a technical documentation****

**In this appendix, the ATTREG future model is documented in detail, including the equations in the model. The equations are presented followed by a verbal explanation of the model based upon the graphical presentation of the model in Figure 2. Next, the mathematical solution to the model is presented and discussed.**

*****A.3.1 The Model – Notation*****

**The equations in the model involve tensor algebra, which is multi-dimensional matrix algebra. We think that most of the notation from two-dimensional matrix algebra can be used in tensor algebra without further explanation, at least for the purposes of this appendix.**

**The upgrading from matrix to tensor algebra is necessary, because most variables involve one or two regional specifications. Migration, for example, is classified by the place of origin, by the place of destination and by age and sex group, which implies it that it is four-dimensional. If education and time are also included, the dimensionality will increase further.**

**To explain the tensor operations the equations are presented in two forms: In ‘conventional form’, where summation of variables, tensor multiplication, etc, are shown explicitly with full specification of all indices, whereas in the ‘tensor form’ (summation is shown as vector pre- or post multiplication and tensor multiplication is shown without summation sign and indexes). For practical reasons, the solution to the model (section A. 2) is only shown in ‘tensor form’.**

**Variables in the Model**

**The variables in the ATTREG future model are denoted in the following way:**

**b: Birth vector**

**bq: Birth rate vector**

**d: Death vector**

**dq: Death rate vector**

**e: Employment vector**

**eexp: Export dependent employment vector**

**eexppopq: Export jobs as share of population vector**

**epop: Population dependent employment vector**

**epopq: Population dependent employment coefficient matrix**

**eprod: Production dependent employment vector**

**eprodq: Production dependent employment coefficient matrix**

**i: Identity vector**

**M: migration matrix**

**min: In migration vector**

**mout: Out migration vector**

**MQ: Migration coefficient matrix**

**u: Population vector**

**us: Labor force vector**

**1 Primes (’) indicate transposition; Element-by-element multiplication is indicated by . Bold capitals are used to denote matrices (tensors) and bold lowercase letters denote vectors (tensors).**

**Superscripts:**

**Geographic axes**

**P: Place of production (regional axes)**

**R: Place of residence (regional axes)**

**R(t-1): Place of residence the year before (regional axes)**

**Subscripts:**

**a: age**

**e: education**

**g: gender**

**j: Sector**

**t: year**

*****A 3.2 The ATTREG future model in Structural Form*****

**The presentation follows the sequential structure described in Section 4. Referring to figure 4.1 and figure 4.2, the equations below present the ATTREG-future model (figure 4.1) together with the equations for modeling the impacts of changes in attractions (figure 4.2):**

**Equations in the ATTREG-future model**

**or ……(1)**

**or ..(2)**

**or ………….(3)**

**or ………….….(4)**

**or …..............(5)**

**or ….(6)**

**or ..(7)**

**or ……………….(8)**

**or …………………(9)**

**or ……………..………(10)**

**or ……...(11)**

**or ……………….(12)**

**or ………….(13)**

**or .(14)**

**or …………(15)**

**or ………………………(16)**

**or ….(17)**

**or ………(18)**

**or …(19)**

**or ……………(20)**

**or ..(21)**

**Equations for modeling the impacts of changes in attractions:**

**or (A)**

**or …(B)**

**or ……………(C)**

**or ………………………………………………………..(D)**

**or …………….…(E)**

**or ..(1+E)**

*****A.3.3 Equations in the ATTREG-future model*****

**Starting in the upper left hand corner in Figure 4.1 and examining equation 1 out migrations by place residence (R) in the beginning of the year (R(t-1)), by age (a) and gender (g) is determined by**

**The population () by age (a), gender (g) by place residence in beginning of the year (R(t-1))**

**The rate of out migration () by age (a), gender (g) by place residence in beginning of the year (R(t-1))**

**In equation 2 migration () between place of residence in the beginning of the year (R(t-1)) and the place of residence in the end of the year(R), by age (a) and gender (g) is determined by the migration pattern () and out migration (). Migration pattern () is defined as migrants moving to the place of residence in the end of the year as the share of out migrants by place residence in the beginning of the year (R(t-1)). The migration pattern is determined by age (a) and gender (g).**

**In equation 3 in migrants () is determined by summation ()**

**In equations 4 and 5 number of death () and born () is determined by death rates () by age and gender and fertility rates () by age of female multiplied with the population () by place residence in beginning of the year (R(t-1)).**

*****A 3.4 The Solution to the Model*****

**By rearranging the model in structural form (Equations 1–26), the solution to the model is**

**obtained**

**Appendix 4 Impacts of 3 packages of attraction policies (inclusive, sustainable and smart) assessed with the ATTREG-future model – 2 selected regions**

In this appendix the results of modeling the impacts of the 3 packages of attraction policies are presented for the two regions ATT11 Vienna and the BG31 Severozapaden are presented.

The results are preliminary and are presented to illustrate the workings of the model. The results must not be quoted as final results. Results will be examined and eventually revised for the final report:

Table A.4.1 Impacts of 3 attraction policy scenarios for the region ATT11 Vienna



Table A.4.2 Impacts of 3 attraction policy scenarios for the region BG31 Severozapaden



**Appendix 5 Impacts of 3 packages of attraction policies (inclusive, sustainable and smart) assessed with the ATTREG-future model – maps**

In this appendix the results of modeling the impacts of the 3 packages of attraction policies are presented in maps for European regions.

The results are preliminary and are presented to illustrate the workings of the model. The results must not be quoted as final results. Results will be examined and eventually revised for the final report.

1. **In MULTIPOLES the demographic rates is modeled on the basis of the average population of the year t and t-1:**

   **..........................................(3.a)**

   **......(3.b)**

   **.............(3.c)**

   **Further, in MULTIPOLES the migration between regions is modeled in geographical levels with separate equations for the internal migration, the international migration within Europe and the international migration to and from the rest of the world.** [↑](#footnote-ref-2)
2. The Destination Attractiveness Ratio (DAR) is equal to Share of migration inflow/Share of population. For a region which received a smaller share of migration, than its share of population will ceteris paribus in the long run loose share of population. For a region with higher share of in-migrants than its share of population the share of population will ceteris paribus in the long run have an increasing share of population. A convergence in DAR’s will in long run lead to a de-concentrated regional development, whereas divergence in the DAR’s will lead to concentration in regional development. [↑](#footnote-ref-3)
3. Opposite to DEMIFER-project in this presentation we refer to the Climate Change scenario as an impact study: The reason for this is, that the inclusion of the climate change results does not change the general forecast (the LSE-scenario on the basis of the reference scenario), but only include a marginal change in the DEMIFER-scenario. [↑](#footnote-ref-4)