Ulysses

Using applied research results from ESPON as a yardstick for cross-border spatial development planning

Targeted Analysis 2013/2/10

Scientific Report for the Final Report

Multi-Thematic Territorial Analysis

of the

Greece-Bulgaria Cross-border Area

Version 30/07/2012

EUROPEAN UNION
Part-financed by the European Regional Development Fund
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This report presents the Multi-Thematic Territorial Analysis 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.

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Chapter 1. Executive Summary

1.1. Ulysses Project in Brief

ULYSSES is an experimental and innovative project supported by 18 European border and cross-border areas (hereafter CBA) that aims at using applied research results from ESPON as a yardstick for decentralised cross-border spatial development planning. Within this overall framework, a targeted analysis including high-quality, comprehensive and multi-thematic territorial analyses (hereafter MTA), has been performed on six specific CBA across Europe. One of these areas is the Greece – Bulgaria Cross-Border Area (hereafter CBA), which was studied as consisting of three complete NUTS2 areas (Yuogozapaden, Yutsen tsentralen and Anatoliki Makedonia-Thraki). However, the impact of Sofia, as the capital on Bulgaria, on CBA's performance statistics has led to its exclusion thus avoiding the influence of significant bias on CBA's statistics (see Annex I).

The MTA has focused on the main topics mentioned by Territorial Agenda of the European Union (EU 2007, 2011), namely (i) cross-border polycentric development, (ii) patterns of urban/rural relationship, (iii) levels of accessibility and connectivity, (iv) effects of demographic change (*territorial profile*), and (v-vi) level of attainment of Lisbon/Europe 2020 and Gothenburg objectives by the CBA (*territorial performance*). In parallel, an in-depth statistical analysis focused on the six CBA was performed as well. This analysis included (i) a catching-up analysis; (ii) a principal components analysis, and; (iii) a multiple regression analysis.

Additionally, a comprehensive cross-border institutional performance analysis has been included as well in every MTA. This analysis captured the diversity of governance frameworks existing within each CBA by paying regard to both the *structural dimension*, i.e. the overall framework that can hardly be influenced by the partners of cross-border cooperation, as well as the *activity dimension*, i.e. the intensity and continuity of institutionalized cross-border cooperation on the regional level.

All the above mentioned activities crystallized in a comprehensive diagnosis for each MTA area that was delivered as an annex to the Interim Report of ULYSSES. On that basis, an integrated analysis taking account of previous inputs was performed at a later stage of the project. From a methodological perspective, this integrated analysis adopted the form of a two-phase SWOT analysis that included (i) a *status-analysis phase* in which the findings derived from previous research tasks were organized and prioritized as main *challenges*, and; (ii) an *action-decision phase* in which a response to each one of the identified challenges was proposed as a potential *strategy*.

Both the challenges and strategies were discussed and eventually validated by stakeholders of the MTA areas. This SWOT analysis is also seen as the main contribution that ULYSSES may do to the Practical Guide that the Association of European Border Regions will develop in the near future. All in all, the final results of ULYSSES project are fully aligned with the expectations set by the project specifications.

1.2. Key Analysis / Diagnosis

The Greece – Bulgaria CBA is considered as a region distanced from the central parts of Europe, facing population reduction, over-ageing and low fertility rates. Although fertility rate gradually increases over the latest decade, its value appears significantly lower than the corresponding EU27 rate. Population distribution shows strong disparities, with higher population densities near urban conglomerates. Excluding Sofia the CBA's population density almost halves, being at levels considerably lower than the national and EU27 mean values. Along the well-established transportation axes, the border seems to attract population and economic activities, affecting population density and growth patterns. On the contrary, newly opened crossings do not seem to affect borderline settlements.

Over the years, Sofia's population primacy appears increasing, although the CBA exhibits a rather polycentric pattern in its population distribution. On the other hand, Sofia's economic primacy over the remaining CBA is weak to moderate, implying a more polycentric economic development over the cross-border territory. Excluding Sofia the system appears even more polycentric, with Plovdiv excelling a limited and gradually decreasing with time primacy, in terms of CBA's population and GDP.

Population density decreases over the latest decade, due to strong depopulation, although the CBA may still be characterized as a 'strongly rural area'. This was mostly due to the impact of Sofia stolitsa. Excluding the Bulgaria capital, the status of urban influence in the CBA is changed from high into low. Over the latest decade a gradual increase in urbanism has occurred in the CBA, mostly shown by the

sharp decrease of population employed in the primary sector and the respective GVA produced. The exclusion of Sofia reduces slightly the level of urbanism of the CBA.

The accessibility and connectivity infrastructure has improved in the CBA during the latest years, especially through the construction of motorways and the expansion of airports. However, more developments in the cross-border transportation infrastructure are needed to integrate CBA's economy and improve its performance, especially at the lower accessibility group consisting of the Anatoliki Makedonia, Thraki areas, together with Smolyan and Kardzhali.

The Greece – Bulgaria CBA was in 2008 at 25.8 bn euros, with a significant contribution from Sofia (42.9%). Over the latest decade a mean annual GDP growth of 10.9% was exhibited, which excluding Sofia stolitsa falls to 7.4%. Significant disparities exist in terms of the convergence dynamism, as the Bulgarian part exhibits a steady catching-up behaviour, while the Greek areas are characterized by a slow converging pattern. Employment in the CBA seems distributed rather evenly among all economic activities, exhibiting a marginal annual rise over the last decade. The exclusion of Sofia produced an almost similar result. This increase seems attributed to the construction and the financial and real estate sector. Trade, tourism and transport are the main economic sectors supporting local CBA's economy. The reduction in the employment in the primary sectors is apparent. On the other hand, construction, public administration services and tourism increased their shares over the latest decade.

Social cohesion indicators, as total, long-term and youth unemployment rates are generally higher than the corresponding mean EU27 values, and only infant mortality seems comparable to the EU27 standard. Mean unemployment rate (10.8%) for year 2010 appeared higher than the national Bulgarian value (10.2%), but improved compared to the Greek corresponding rate (12.5%). Long-term Unemployment (3.17%) was comparable to the national rates of both countries, while youth unemployment (29.2%) was comparable to the EU27 and the national Bulgarian values. The Population at Risk of Poverty Index reached almost 20% in the Greece – Bulgaria CBA, with increased rates in Anatoliki Makedonia, Thraki (25.4%) and Yuzhen tsentralen (22.6%). This value is comparable to the corresponding national values for Bulgaria (21.4%) and Greece (20.1%). All social cohesion indicators gradually improved during the 1997-2008 period, but thereafter and due to the global financial crisis, all indicators degraded sharply, returning back to the 1997 levels.

The area lacks investments in the R&D sector, while appears as rather sensitive to climate change and environmental risks. Overall, area's poor economic performance seems related to its low centrality, the exaggerated public administration sector, the low R&D investments and the limited demographic dynamism.

1.3. Identified Challenges

The main future challenges for the Greece-Bulgaria CBA were explored, following the thematic topics covered by Ulysses as demographic change, polycentric development, urban-rural relationship, accessibility and connectivity and Lisbon and Gothenburg strategies.

In terms of demographic changes the challenges identified in the CBA were to retain the existing favourable demographic trends, (e.g., the increased fertility rates in all NUTS3 areas), and to reverse the negative demographic trends, as population ageing and rural depopulation.

The CBA should preserve its balanced and polycentric population distribution throughout its space by promoting territorial cohesion and encouraging territorial competitiveness, especially at the near-border areas. An urban network of centers located on an east-to-west orientation (Blagoevgrad and Haskovo in Bulgaria and Kavala, Xanthi, Komotini and Alexandroupolis in Greece) could be better served by the development of an internal secondary medium-sized cluster comprised of Petrich, Smolyan, Kardzhali, Svilengrad, Drama, Stavroupolis and Orestias.

The rural and sparsely-populated character of the area should be preserved placing efforts to achieve urban-rural synergies and to integrate the development of small and medium-sized cities within the rural space in the CBA. Primary production sector should be supported and the flux of people from villages to cities should be reversed, especially at the rural near-border areas, in both Greece and Bulgaria.

The improvement of cross-border transport connectivity through the construction of the planned motorway axes could reduce the distances for access in goods and services and allow the better integration of the labour market. In parallel, the upgrading of the existing railway network and its connection to the ports of Alexandroupolis and Kavala could stimulate growth in the CBA creating new potentials. The telecommunication network in the CBA should be improved and the IT should be promoted to encourage more flexible work patterns.

The protection and exploitation of the common water and forest resources constitute the main priorities for cross-border co-operation. Cultural and educational collaboration could also stimulate cross-border exchange. It occurred that there is a need to facilitate the better utilization of local development potentials, and to promote education, R&D and innovation within the CBA. The bilateral inter-firm co-operation in the quest for new markets and the integration of the labour market within the CBA could promote a more balanced economic development. The CBA should confront the present economic restructuring, leading to the increased role of private sector, in order to reduce the existing spatial economic disparities. Especially at the Greek part, the present and future reduction in construction and public administration sectors should be counterbalanced by investments in tourism, renewable energy and 'experience farming'. Tertiary education attainment levels should be improved in all NUTS2 regions of the CBA and cross-border collaboration between universities and research centers should be promoted.

Finally, the CBA is confronted with the need to successfully mitigate the potential environmental and climate change impacts, especially at its coastal part, and promote regional adaptation strategies. In terms of cross-border governance and institutional framework, the main challenge is the increase of cross-border co-operation, aiming towards a more balanced territorial development.

1.4. Proposed Strategies

For demographic improvement, it seems important to exercise policies to improve family potentials by improving the family childcare facilities at the urban centres of the CBA, to introduce flexible work forms using new technologies and to enhance cross-border health care covering especially the borderline area. The introduction of young people into the labour market through full-, part- and shelf-employment should be encouraged, especially at the rural and more remote parts of the CBA.

Polycentric development in the CBA could be promoted by reinforcing its existing balanced structure through the quality of life improvements in small and medium-sized cities of the territory. The transport infrastructure and the public networks between these small and medium-sized cities should be improved. Cross-border cooperation could increase the flux of products through the main perpendicular to the border transportation axes, linking urban centres from the Mediterranean to the Balkans and vice versa.

Rural areas could be revitalised by promoting local and traditional farm products, organic farming and eco-tourism. Mountainous and semi-mountainous areas should gain their energy independence, focusing on renewable energy production, through either solar parks or wind farms. The sustainable forest management and the agricultural production of energy crops could improve the primary sector's performance in employment and GVA.

In spite of CBA's low inter-connection level, the passage of the Trans-European road networks, and the passage of the Trans-European natural gas network, could advance and reinforce CBA's role, offering greater opportunities for economic and social mobilization and development. Investments in the improvement and expansion of the telecommunication network could foster cross-border business cooperation and allow the creation of multi-sectoral information networks employing modern technology.

Cross-border trade and the provision of services should be intensified, obstacles in the legal workforce mobility should be removed, labor market legislation over the CBA should be gradually harmonized and cross-border exchanges in the field of research, education and vocational training should be promoted. Cross-border health care provisions should be introduced for the citizens living at the border areas.

All economic activities especially at the rural and environmentally-sensitive CBA parts should diminish their 'environmental footprint', intensive agriculture, forestry and mass tourism should be penalized and living quality standards should be harmonized over the CBA. Climate change risks as water shortage, forest fires, floods and animal stock diseases should be confronted in an integrated and combined manner involving authorities from both sides of the border. Local traditions and cultural exchanges should be promoted.

1.5. Further Steps

The area currently performs in a transitional state, as Bulgaria entered the EU only in 2007, and therefore the border changes its status from a 'barrier-type' into an 'interface-type'. This transition needs closer and continuous monitoring from both sides of the border, to enhance collaboration and accelerate wherever possible the transition processes. Harmonization of the CBA territory is an inevitable procedure, leading

ultimately to the adaptation in salaries, the prices of goods and services and the integration of local markets in the broader CBA economy. Local Joint ESPON-AEBR Observatories could be established to monitor the harmonization and adaptation processes and provide 'know-how' to both parts. This way local data could be better integrated in the national and international (Espon, Eurostat, OECD) databases.

Chapter 2. General Overview of the Greece – Bulgaria CBA

2.1. ULYSSES project in brief

ULYSSES is an experimental and innovative project supported by 18 European border and cross-border areas (hereafter CBA) that aims at using applied research results from ESPON as a yardstick for decentralised cross-border spatial development planning. Within this overall framework, a *targeted analysis* including high-quality, comprehensive and multi-thematic territorial analyses (hereafter MTA), has been performed on six specific CBAs across Europe. One of these areas is the Greece-Bulgaria CBA.

The MTA has focused on the main topics mentioned by Territorial Agenda of the European Union (EU 2007, 2011), namely (i) cross-border polycentric development, (ii) patterns of urban/rural relationship, (iii) levels of accessibility and connectivity, (iv) effects of demographic change (*territorial profile*), and (v-vi) level of attainment of Lisbon/Europe 2020 and Gothenburg objectives by the CBA (*territorial performance*). In parallel, an in-depth statistical analysis focused on the six CBA was performed as well. This analysis included (i) a catching-up analysis; (ii) a principal components analysis, and; (iii) a multiple regression analysis. These analyses have been performed on different scales, so that the indicators of each CBA have been compared on different spatial levels (NUTS III, cross-border, national and EU27/ESPON levels). The data used in the analyses basically included ESPON datasets (e.g. morphological urban areas) and EUROSTAT indicators (e.g. demography indicators), together with additional information provided by local stakeholders.

Additionally, a comprehensive cross-border institutional performance analysis has been included as well in every MTA. This analysis captured the diversity of governance frameworks existing within each CBA by paying regard to both the *structural dimension*, i.e. the overall framework that can hardly be influenced by the partners of cross-border cooperation, as well as the *activity dimension*, i.e. the intensity and continuity of institutionalised cross-border cooperation on the regional level.

For the sake of simplicity and applicability, the *structural dimension* included factors like (i) the political status of the border (e.g. EU membership / historicity, Schengen status); (ii) the planning system (i.e. the planning culture family); (iii) the physical status (e.g. geomorphology), and; (iv) the language barrier (i.e. number of languages existing in the area). These domains have been combined in a synthesis score that allows saying if the borders function as *separation*, *interface* or *link*. In contrast, the *activity dimension* has taken account of: (i) the historicity of cross-border cooperation in general (i.e. earliest founding date of cross-border cooperation); (ii) the maturity of cross-border cooperation (i.e. INTERREG III participation); (iii) the institutional thickness in cross-border cooperation (i.e. number of permanent institutionalisations); (iv) the current activity (in terms of operative EGTC); (v) the cross-border spatial development on regional level (e.g. joint GIS tools), and; (vi) the existing cross-border transport projects (e.g. TEN-T corridors crossing the border). These domains have been combined in a synthesis score that classified the borders function as *integration*, *cooperation* or *separation*.

All the above mentioned activities crystallised in a comprehensive diagnosis for each MTA area that was delivered as an annex to the Interim Report of ULYSSES. On that basis, an integrated analysis was performed, taking account of previous inputs at a later stage of the project. From a methodological perspective, this integrated analysis adopted the form of a two-phase SWOT analysis that included (i) a *status-analysis phase* in which the findings derived from previous research tasks were organised and prioritised as main *challenges*, and; (ii) an *action-decision phase* in which a response to each one of the identified challenges was proposed as a potential *strategy*.

Previous ESPON scenarios developed by ESPON 3.2 (ESPON n.d.) were taken into account as well while defining the opportunities and threats linked to any given CBA. In fact, the opportunities and threats identified in the aforementioned research work were contrasted with the scenarios developed by ESPON 3.2. Concretely, (i) the Baseline / trend scenario; (ii) the Danubian Europe / cohesion-oriented scenario, and; (iii) the Rhine-Rhone Europe / competitiveness-oriented scenario and their implications for the CBA under analysis were taken into account while designing the final opportunities and threats.

Both the challenges and strategies were discussed and eventually validated by stakeholders of the MTA areas. This SWOT analysis is also seen as the main contribution that ULYSSES may do to the Practical Guide that the Association of European Border Regions will develop in the near future. Overall, the final results of ULYSSES project are fully aligned with the expectations set by the project specifications.

2.2. General Overview of the CBA

The Greece (GR) – Bulgaria (BG) Cross-Border Area (CBA) is defined by the 494 km borderline length between the two countries. The Greece – Bulgaria CBA is located at the north-eastern part of Greece and the southern part of Bulgaria. It comprises of three NUTS2 administrative regions:

- Yugozapaden, (BG41),
- Yuzhen tsentralen (BG42), and
- Anatoliki Makedonia, Thraki (GR11),

It is generally recognised that the inclusion of Sofia (stolitsa, BG411) and Sofia (BG412) may incorporates significant bias on the performance of CBA's statistics. For this reason, for each examined indicator, a short comment was included explaining the performance of CBA excluding the above-defined NUTS 2 areas. Further analysis on each indicator excluding the influence of Sofia was carried out and it is presented at Annex I of this report.

Each NUTS2-level is further divided into a number of NUTS3 level administrative districts (Table 1): 6 and 5 NUTS3 administrative districts (oblasts) in Yugozapaden and Yuzhen tsentralen regions, respectively, and 5 NUTS3 administrative districts (prefectures) in Anatoliki Makedonia, Thraki.

Table 1. Administrative levels of Greece – Bulgaria CBA.

	CODE	NUTS-ID
Bulgaria	BG	NUTS1
Yugozapaden	BG41	NUTS2
Sofia (stolitsa)	BG411	NUTS3
Sofia	BG412	NUTS3
Blagoevgrad	BG413	NUTS3
Pernik	BG414	NUTS3
Kyustendil	BG415	NUTS3
Yuzhen tsentralen	BG42	NUTS2
Plovdiv	BG421	NUTS3
Haskovo	BG422	NUTS3
Pazardzhik	BG423	NUTS3
Smolyan	BG424	NUTS3
Kardzhali	BG425	NUTS3
Greece	GR	NUTS1
Anatoliki Makedonia, Thraki	GR11	NUTS2
Evros	GR111	NUTS3
Xanthi	GR112	NUTS3
Rodopi	GR113	NUTS3
Drama	GR114	NUTS3
Kavala	GR115	NUTS3

The Greece – Bulgaria Cross-Border Area occupies a total area of 56,828.40 sq km. Anatoliki Makedonia, Thraki (GR11) covers an area of 14,157.0 sq km (i.e., 43.07%) of Greece, while Yugozapaden (BG41) and Yuzhen tsentralen (BG42) regions occupy in total 42,671.5 sq km (i.e., 51.20%) of Bulgaria.

At NUTS2 level, Yuzhen tsentralen represents 39.36% of the CBA's total area, Yugozapaden the 35.73% while Anatoliki Makedonia, Thraki only 24.91%. Sofia oblast (BG412) and Blagoevgrad (BG413) are the largest NUTS3 level units of the CBA, occupying 7,062.3 sq km and 6,449.5 sq km, respectively. Sofia

stolitsa (BG411) and Xanthi (GR112) are the smallest NUTS3 level units of the CBA, covering 1,348.9 sq km and 1,793.0 sq km, respectively (Figure 1).

Komotini, the administrative centre of Anatoliki Makedonia, Thraki is located approximately 746 km to the north-east of Athens, the capital of Greece. On the other hand, the capital of Bulgaria, Sofia, is part of the Greece – Bulgaria CBA, located at its north-western part. Sofia is further the administrative centre for Yugozapaden region, while Plovdiv, the administrative centre for the Yuzhen tsentralen region, is located 131 km to the south-east of Sofia (Figure 2).

Over the latest decades, the studied area has develop significant cross-border co-operation within the framework of INTERREG Programs.

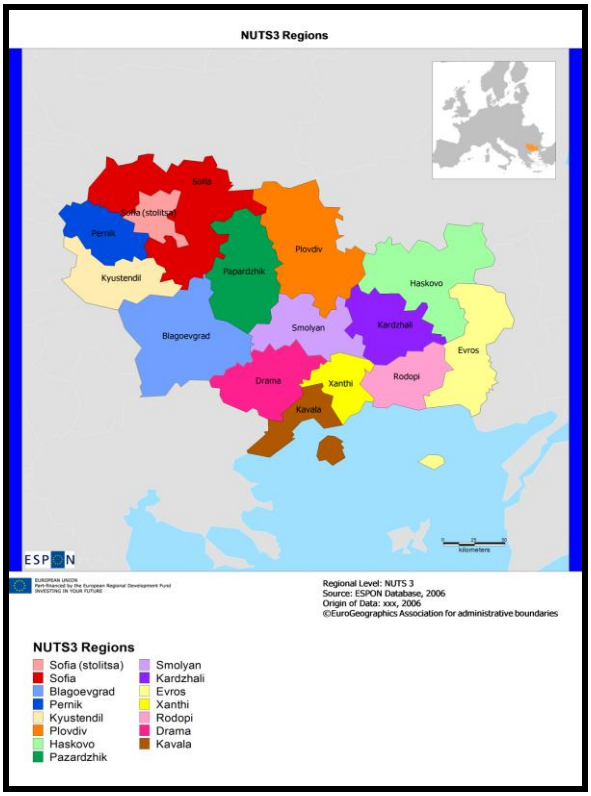

Figure 1. Map of NUTS3 level units of the Greece - Bulgaria CBA.

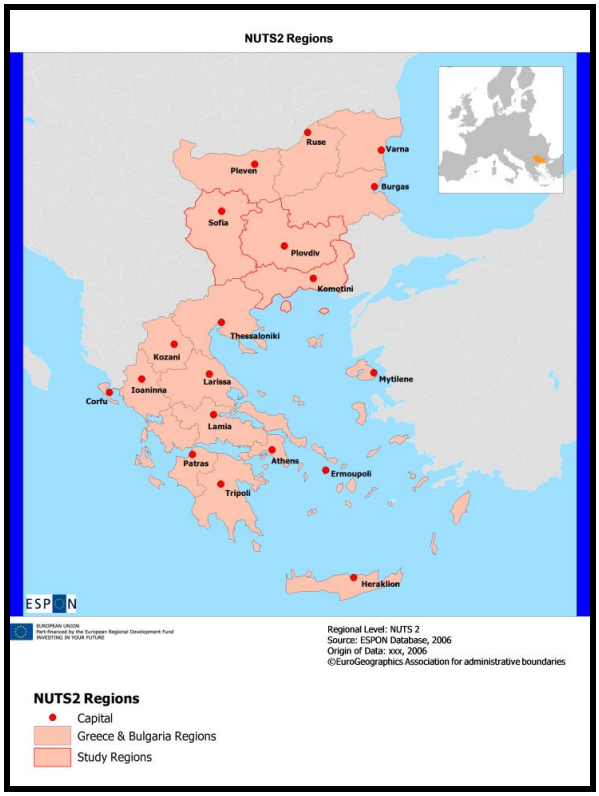

Figure 2. Administrative centers of Greece, Bulgaria and the CBA.

Chapter 3 – Demographic Analysis

3.1. Concept and Indicators

Demographic Analysis of the Greece – Bulgaria CBA aims to identify the behavior of the cross-border region in terms of population spatial distribution and temporal dynamics. The main objective is to understand the influence of the border on the settlement and population patterns of the CBA.

For the purposes of present analysis, the performance of the NUTS3 regions of the CBA was examined in terms of indicators, as the CBA's total population; the population growth; the population density; the total and partial dependency rates; the ageing index; and the fertility rates, covering the period 1999-2009. The demographic potential, i.e., the effect of the Greece-Bulgaria borders on the patterns of settlement, was analyzed at the NUTS4 unit level.

3.2. Demographic Dynamics in the Greece – Bulgaria CBA

The total population in 2009 of the Greece – Bulgaria CBA was 4,247,739 inhabitants. This population represented approximately 0.85% of the total EU27 population (499,705,496 inhabitants in 2009). Further, CBA's population represented 55.84% of the total population of Bulgaria (7,606,551 inhabitants) and 32.72% of the total population of Greece (11,260,402 inhabitants). Sofia stolitsa (BG111) and Plovdiv

(BG421) are the NUTS3 areas with the higher contribution to the total population of the CBA. Drama (GR114) and Xanthi (GR112) are the NUTS3 areas with the lowest total population in the CBA (Figure 3).

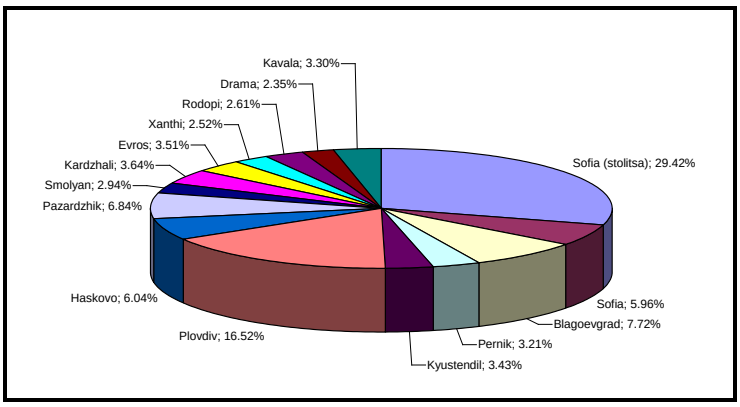

Figure 3. Percent of each NUTS3 level unit contribution in the Total Population of the Greece – Bulgaria CBA.

The major result produced by the analysis, is that over the latest decade, the total population of the CBA shows a significant decrease by approximately 4.3%, with the highest negative trend shown in the Yuzhen tsentralen area. Based on this trend, the total population of the CBA in 2020 will be diminished at the level of 4,062,969 inhabitants. Xanthi (GR113) and Sofia stolitsa (BG111) are the only NUTS3 areas of the CBA depicting positive population growth rates, even higher than the mean EU27 growth rate. Net migration is responsible for the population increase in Sofia (stolitsa) (BG411). On the contrary, population increase in Xanthi (GR113) appeared mostly affected by natural increase factors. Natural causes appear also responsible for the population reduction shown in Plodviv (BG421), Drama (GR114) and Kavala (GR115) areas. In the remaining NUTS3 unit levels of the Greece – Bulgaria CBA, population decrease is due to both natural causes and out-migration (Figure 4).

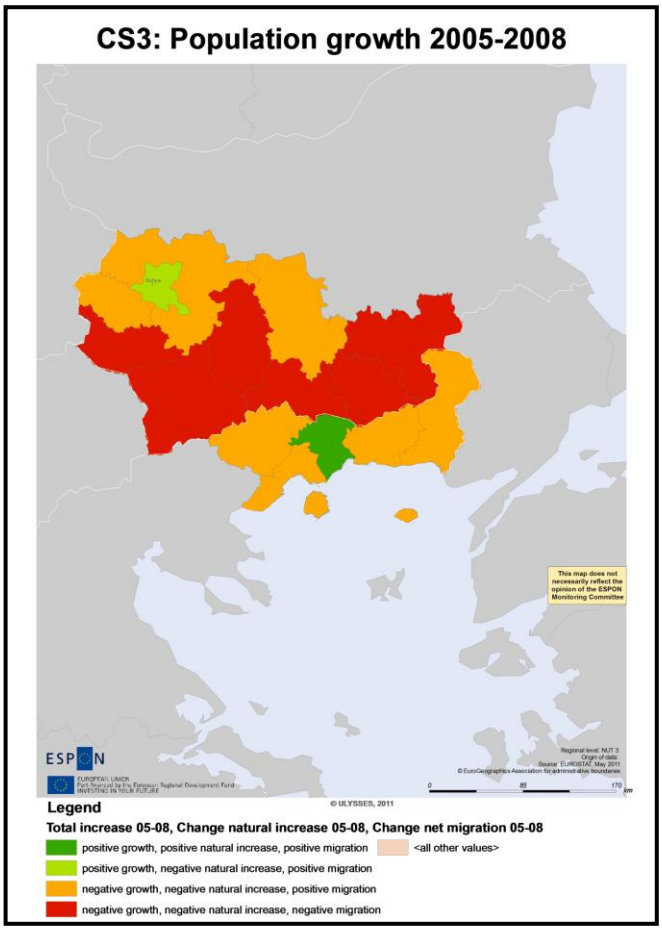

Figure 4. Category map of annual population growth of NUTS3 level units in relation to the average population growth rate of the Greece – Bulgaria CBA.

Excluding Sofia (stolitsa) the CBA's population reaches 2,9 million inhabitants in 2009, exhibiting depopulation with an annual rate of 5.0%. Kyustendil (BG415), Smolyan (BG424) and Haskovo (BG422) are the areas with the highest negative population change rates.

The mean fertility rate of the Greece-Bulgaria CBA is 1.48, equal to the corresponding rate of Bulgaria and slightly lower to that of Greece (1.51), but significantly lower than that of EU27 (1.60). Fertility rate temporal evolution depicts a gradual increase of fertility rates in all regions of the CBA. Anatoliki Makedonia, Thraki exhibits the higher fertility rate value (1.61), but the highest fertility rate increase over the latest decade was observed firstly for Yugozapaden (30.48%), then for Yuzhen tsentralen (19.83%) and lastly for Anatoliki Makedonia, Thraki (12.59%).

Population density in the CBA (111.4 inhabitants per sq km) is significantly higher than the mean national value of Bulgaria (68.7 inhabitants per sq km) and Greece (85.9 inhabitants per sq km), but of the same order as the EU27 mean value (116 inhabitants per sq km). In all NUTS3 level units, population density appears mostly affected by the existence of urban centres in some regions in Bulgaria, as Sofia (stolitsa) (BG411) with population density of 922.2 inhabitants per sq km and Plovdiv (BG421) with population density of 118.0 inhabitants per sq km. Indeed, the exclusion of Sofia (stolitsa) from the analysis shows that the mean population density of the CBA reduces to almost 53.2 inhabitants per sq km, significantly lower than the national and EU27 mean values.

The child dependency ratios in all NUTS3 level units were found consistently lower than the aged dependency ratios. This expresses the fact that the young population of the CBA represents a smaller portion of the total population than the aged population of the CBA. Such increasing proportions of aged persons have been accompanied, in both countries, by steady declines in the proportion of young persons. In the CBA, the most over-aged populations are found in Drama (GR114), Evros (GR111), Kavala (GR115), Pernik (BG414), and Kyustendil (BG415). In fact, Xanthi (GR112) is the only NUTS3 area of the CBA having higher child dependency ratio than the corresponding aged dependency ratio (Figure 5). The ageing index of the CBA was computed as 139, at the level of national Bulgarian and Greek corresponding values (130 and 131, respectively), but significantly higher than mean EU27 value (110). The impact of Sofia (stolitsa) on the ageing index of the CBA appears negligible.

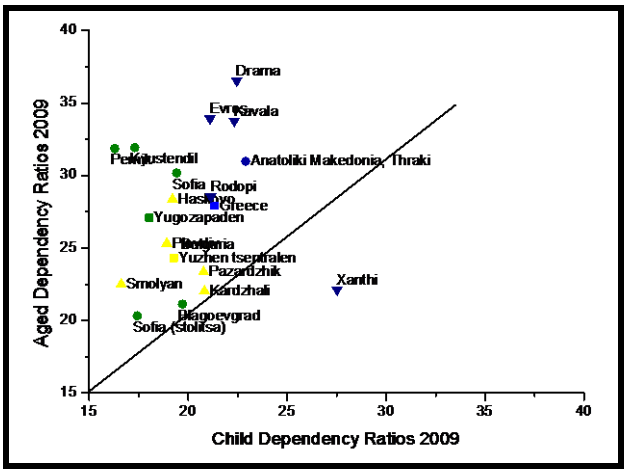

Figure 5. Scatter diagram of child vs. aged dependency ratios for year 2009 in Greece – Bulgaria CBA.

3.3. Border Effect for the Greece – Bulgaria CBA

In general, border regions tend to be disadvantaged economically and with regard to population growth and density. However, the enlargement of the European Union (EU) may create positive border effects in cities or regions located close to the national borders, as they are especially confronted with changes in market access, whereas the border effect for cities or regions further away from the border appears more subdued. This positive integration effect declines with distance, is about the same for new and old members, and is more important for large cities and regions (Redding and Sturm, 2008).

In the case of Greece – Bulgaria CBA, the border effect on demography was examined at NUTS4 level units, for cities located at a close distance to the border (maximum road distance of 70 km), in view of the fact that Bulgaria became a full EU member on 1/1/2007. In this analysis, NUTS4 regions were considered as located along the main transport axes along which road distances were determined. Four road axes were considered, the two main border crossing points[1]: a) the Strymon road axis (Thessaloniki – Blagoevgrad), part of Pan-European Corridor IV, and b) the Ardanio – Ormenio – Svilengrad axis (vertical Egnatia axis and part of the Pan-European Corridor IX), together with two newer crossing points:

[1] The road axes have been defined as follows:

a) The Strymon Axis: Petrich, Sandanski, Kresna, Simitli, Blagoevgrad.
b) The Ardanio-Ormenio-Svilengrad Axis: Didimotiho, Orestiada, Vissa, Haskovo, Harmanli, Simeonovgrad, Svilengrad, Madzharovo, Ljubimec, Ivaylovgrad, Dimitrovgrad.
c) The Drama-Exohi-Hadzhidimovo Axis: Sitagroi, Prosotsani, Kato Nevrokopi, Dospat, Devin, Borino, Yakoruda, Belitsa, Razlog, Bansko, Gotse Delchev, Satovcha, Hadzhidimovo.
d) The Thermes-Zlatograd Axis: Stavroupolis, Xanthi, Miki, Chepelare, Smolyan, Rudozem, Nedelino, Madan, Zlatograd, Banite.

c) the Drama - Exohi – Hadzhidimovo axis constructed in 2005, and d) the Xanthi - Thermes – Zlatograd axis opened in 2009.

The Komotini – Nimfaia – Kurdjali axis has not been completed yet; therefore the interaction between Komotini and Haskovo is limited.

Results showed that along the well-established transport axes of Ormenio – Svilengrad and Exohi – Hadzhidimovo, the border affects population change positively, thus attracting population. Population growth was positive from the Greek side along these axes, turning to slightly negative towards the Bulgarian side. As the distance to border increases, population growth becomes strongly negative, indicating the positive border effect. On the contrary, along the newly opened crossings, these dynamics are absent and population growth appears mostly related to the population density of these settlements.

Chapter 4 – Polycentric Development

4.1. Concept and Indicators

The concept of polycentricity plays a fundamental role in European regional policy and constitutes a priority for spatial development in Europe. Polycentricity can contribute to the economic, social and territorial cohesion, which constitutes one of the objectives of the Lisbon Treaty, as well as to the economic competitiveness, social justice and sustainable development. Especially for South-Eastern Europe, it is strongly believed that the existing or emerging polycentric structures should be strengthened by improving the accessibility of medium-sized centres and counterbalancing the reduced accessibility of rural and isolated regions (Spiekermann and Wegener, 2006).

Based on ESPON 1.1.1 Project (Nordregio, et al., 2004), polycentricity has a twofold feature: a) Morphological polycentricity, laying out the distribution of urban areas in a given territory, and b) Relational polycentricity, based on the networks of flows and cooperation between urban areas at different scales/levels. Both elements are strongly linked: relations between cities are crucial for polycentricity, as nodes without relations would not form a polycentric system.

The main aim of this chapter is to identify tendencies in the structure of the city network in the Greece – Bulgaria Cross-Border Area (CBA) and compare the urban network density to that in the non-border regions. Further, to examine the deviation of urban centres in the CBA from the rank-size distribution of EU27 and determine the impact of urban centres distribution on commuting patterns. The basic indicators in this analysis involve: a) the size polycentricity index, with four sub-indicators (the slope of the regression line of the rank-size distribution of population in the FUAs, the primacy rates in terms of the population distribution in the FUAs, the slope of the regression line of the rank-size distribution of GDP in the FUAs and the primacy rates in terms of the GDP in the FUAs; b) the location index, expressed as the Gini coefficient of the size of the Thiessen polygons around each FUA; c) the connectivity index with two sub-indicators, with two sub-indicators (the slope of the regression line between the accessibility and the FUAs population and the Gini coefficient of the accessibility of the FUAs).

4.2. Cross-border polycentricity in the Greece-Bulgaria CBA

Polycentricity analysis was performed on Functional Urban Areas (FUAs) dataset of population and GDP, aiming to obtain the CBA's population and GDP primacy rates. Analysis of location, accessibility and connectivity indices of each FUA was also taken place. An aggregated polycentricity index was derived based on the weighted values of the above indices.

Overall, sixteen Functional Urban Areas (FUAs) exist in the Greece – Bulgaria CBA[2], with Sofia (stolitsa) being the main urban center of the CBA. It occurs that Sofia (stolitsa) is the main urban centre in the Greece – Bulgaria CBA, having higher population share in FUA than the total NUTS3 level unit population (107.3%). Plovdiv (BG421) and Haskovo (BG422) have 2 FUAs representing 68.7% and 59.4% of their NUTS3 level unit population within these FUAs. The rest CBA appears well-balanced with almost equal total population (70,000 - 90,000 inhabitants) in FUAs.

[2] The FUAs of the CBA are: Sofia, Blagoevgrad, Petrich, Pernik, Kyustendil, Plovdiv, Asenovgrad, Haskovo, Dimitrovgrad, Pazardzhik, Kardzhali, Alexandroupolis, Xanthi, Komotini, Drama, Kavala.

4.2.1. Size Polycentricity Index

Characteristic for polycentric urban systems is that cities often tend to be relatively similar-sized. For the FUAs population, a linear regression of the absolute value of the size of each city and of the corresponding location of the city in the size rating is performed. The performance of a linear regression between the population of the FUAs and their location in the aforementioned classification results in the indicator "primacy rate", which expresses the degree of primacy of the FUA with the highest population (in this case Sofia). Population primacy rate of the CBA was calculated at 3.35 in 2001 and at 3.66 in 2006, implying that population primacy of Sofia FUA in relation to the rest of the FUAs of the CBA gradually increases over time. This finding suggests that although the system seems rather polycentric, it moves slowly towards a more monocentric pattern over time (Figure 6).

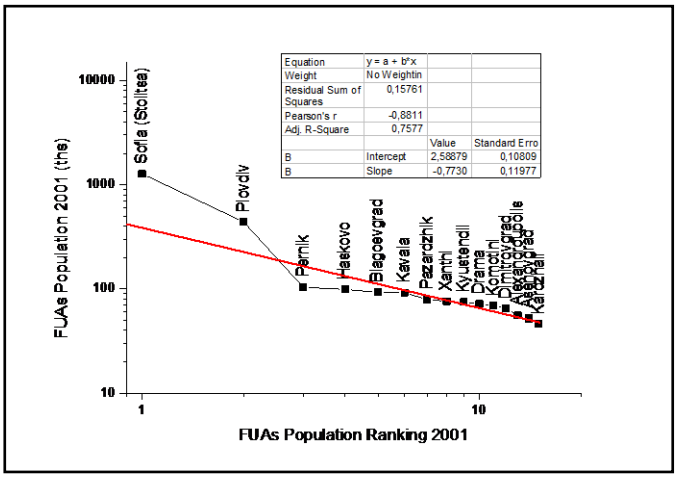

Figure 6. Rank-size distribution of FUAs GDP in the Greece – Bulgaria CBA for year 2006.

By solving the produced regression equation, it was derived that based on the population distribution of the CBA, the population of Sofia should be approximately at the level of 380,189 inhabitants in 2001 and 363,078 inhabitants in 2006, to achieve polycentricity. Moreover, based on the distribution of cities in relation to the regression line, it occurs that Plovdiv is over-represented, while the medium-sized cities of the CBA (Pernik, Haskovo and Kavala) are under-represented.

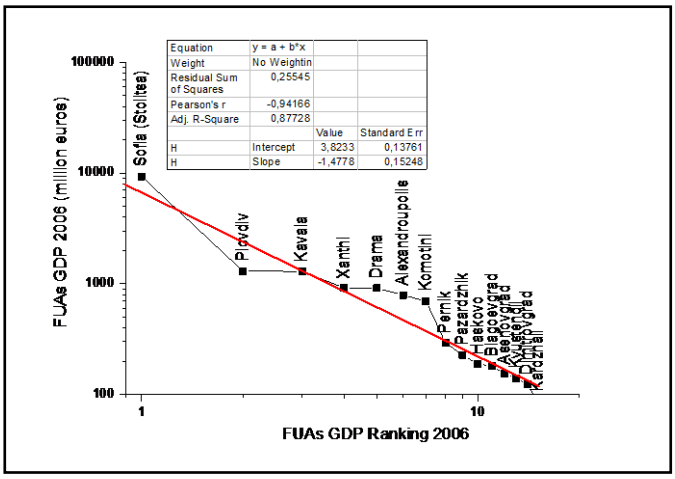

Figure 7. Rank-size distribution of FUAs GDP in the Greece – Bulgaria CBA for year 2006.

The CBA appears slightly more polycentric than Greece and Bulgaria, but more monocentric than other Greek NUTS1 areas as Voreia Ellada (GR1) and Kentriki Ellada (GR2). The primacy of the biggest city over the rest FUAs of the CBA (Sofia) is moderate and definitely lower than the corresponding primacy of Athens and Thessaloniki over the rest FUAs of Greece and Voreia Ellada, respectively. However, the primacy of Sofia in the CBA territory appears higher than the corresponding primacy of Sofia in Bulgaria, of Athens in Kentriki Ellada and of Irakleion in N. Aigaiou – Kriti. The change in the slope of this regression line shows a slight reduction from -0.77 in the year 2001 to -0.75 in year 2006, meaning that the system moves slowly towards a more monocentric pattern. This trend is mainly due to the population increase of Sofia FUA, which appears relatively higher than the corresponding population increase evident in the Greek FUAs with relatively small size, located exactly in the middle of the rating between positions 6 and 13, such as the FUAs of Kavala, Drama, Komotini and Alexandroupolis.

The Gross Domestic Product (GDP) was used to express the FUAs size of the markets. GDP per inhabitant data for all European FUAs for year 2006 was provided by Eurostat. The values of this parameter were multiplied by the 2006 FUAs population to derive the 2006 FUAs GDP. It occurs that the FUAs of the Greece – Bulgaria CBA produce a GDP of 16.6 billion Euros. The highest GDP is produced in the FUA of Sofia (9.3 billion Euros), followed by Plovdiv (1.3 billion Euros) and Kavala (1.3 billion Euros). FUAs with the lower GDPs are Kardzhali (88.5 million Euros), Dimitrovgrad (124.5 million Euros) and Kyustendil (140.5 million Euros).

The GDP primacy rate of the CBA was found at 0.20 in 2006, meaning that Sofia excels a rather weak economic primacy over the rest of the FUAs of the Greece – Bulgaria CBA (Figure 7). This suggests a more balanced economic growth distribution of FUAs over the CBA territory. The economic primacy of the

city appears significantly lower than the corresponding primacy of the more economically active FUAs in Greece, Bulgaria and the NUTS1 unit levels of Greece. Overall, the fact that the GDP rank-size distribution is similar to that of population proves the general principle that 'largest cities are most likely to be most economically successful' (ESPON, 2005).

Comparative results of the polycentricity size indicators for Greece – Bulgaria CBA and the respective NUTS0 and NUTS1 revealed that in terms of population distribution the CBA appears as a rather polycentric area, with relatively mild slope of the regression line. The CBA appears slightly more polycentric than Greece and Bulgaria, but more monocentric than other Greek NUTS1 areas as Voreia Ellada (GR1) and Kentriki Ellada (GR2). The primacy of the biggest city over the rest FUAs of the CBA (Sofia) is moderate and definitely lower than the corresponding primacy of Athens and Thessaloniki over the rest FUAs of Greece and Voreia Ellada, respectively. However, the primacy of Sofia in the CBA territory appears higher than the corresponding primacy of Sofia in Bulgaria, of Athens in Kentriki Ellada and of Irakleion in N. Aigaiou – Kriti.

In terms of the GDP distribution in FUAs, the Greece – Bulgaria CBA shows a moderate polycentric economic development, but with higher slope than the respective NUTS0 and NUTS1 unit levels. The economic primacy of the city with the highest GDP (Sofia) is very low, significantly lower than the corresponding primacy of the more economically active FUAs in Greece, Bulgaria and the NUTS1 unit levels of Greece.

4.2.2. Location Polycentricity Index

This index examines the distribution of cities over the territory, by sub-dividing the territory into service areas in a manner that each point of the territory is allocated to the nearest centre. The method utilises the Thiessen polygons to define individual areas of influence around each of a set of points. In this way the area served by each centre can be measured. Such area of influence represents the PUSH (Potential Urban Strategic Horizon) areas, including all municipalities of which at least 10% of the area can be reached within 45 minutes from each FUA centre by car. As a measure of the inequality of the size of service areas the Gini coefficient of inequality was used.

It occurs from the Location Index analysis that Kavala, Drama and Xanthi are the PUSH areas with the higher number of municipalities assigned in them, using the full-area and the 50% criterion. When the 5% criterion is used, then Drama, Kavala and Plovdiv are the PUSH areas with the higher number of municipalities assigned in them.

The mean PUSH population in the CBA is 498,140 inhabitants. Sofia and Pernik are the biggest in terms of population PUSH areas. Orestias, Alexandroupolis and Kyustendil are the lower in population PUSH areas. PUSH territories show a mean overlap of 79% with adjacent PUSH areas. The mean settlement area for each PUSH covers 195.83 km^2, with the highest settlement area in Sofia (495.00 km^2) and the lowest in Alexandroupolis (37.31 km^2). Settlements cover on average 4% of the PUSH areas in the CBA.

Location Index analysis reveals that the settlement structure in the Greece – Bulgaria CBA is considered as polycentric for most PUSH areas, while only Sofia, Pernik, Plovdiv, Asenovgrad and Pazardzhik are considered as monocentric. A mean Gini Coefficient of 0.5123 reveals the moderate polarization in the distribution of settlements in the PUSH areas of the CBA. Increased polarization is shown in the PUSH area of Sofia (Gini = 0.7370). The Area Concentration Index (ACI) was developed and applied, taking account both the size of the settlement areas and their relative location against each other. The highest ACI was calculated in Sofia and the lowest in Orestias, Kavala and Drama (Figure 8).

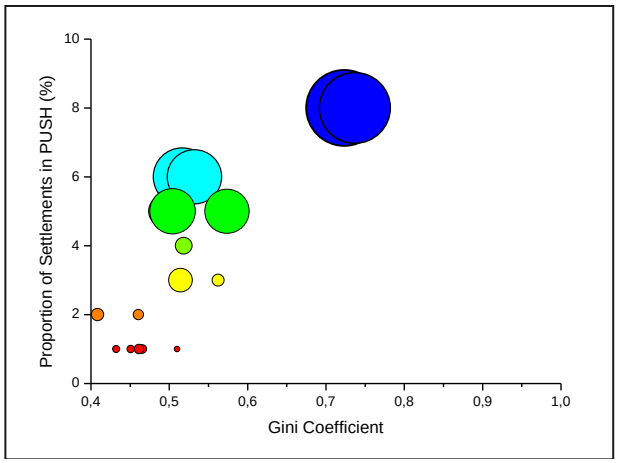

Figure 8. Gini coefficients and proportion of settlement area of total PUSH areas in the CBA. Circles radii represent the total settlement area within the PUSH.

The Area Concentration Index (ACI) was developed and applied, taking account of both the size of the settlement areas and their relative

location against each other. The highest ACI was calculated in Sofia and the lowest in Orestias, Kavala and Drama.

4.2.3. Connectivity Polycentricity Index

The connectivity of the FUAs constitutes one of the central factors of polycentrism. Based on ESPON 1.1.1 it occurs that in a polycentric system, both small and large FUAs have good accessibility. The more accessible lower-level centres are compared to the primary city, the less monocentric is the urban system. To measure the actual interactions, accessibility was considered by the area covered by the 45-minutes isochrones, i.e., the area that can be reached from the respective FUA centre in 45 minutes, travelling by car with a mean travel speed (Shürmann et al., 1997).

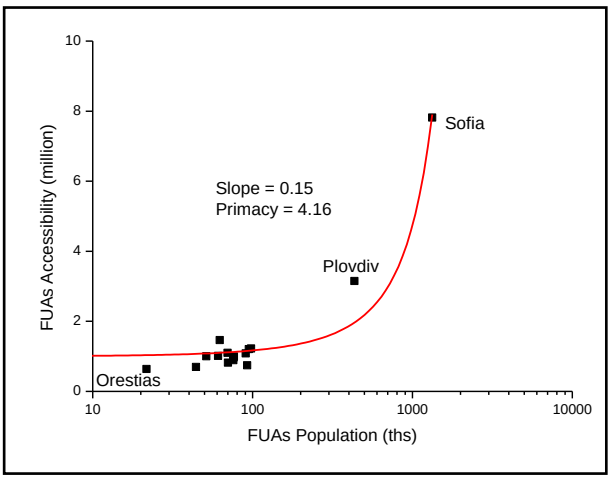

Figure 9. Population and accessibility of the FUAs in the Greece – Bulgaria CBA.

Accessibility Index analysis illustrates that Sofia and Plovdiv are the FUAs with the higher accessibility of the CBA, while Orestias with the lower. Most FUAs in the CBA depict a relatively low change in accessibility over time, attributed to the limited FUAs population change. Accessibility primacy rate of Sofia was computed at 4.16, indicating a relatively low degree of primacy over the remaining CBA. Similarly, the Gini coefficient of accessibility (0.39) indicates a rather homogeneous distribution of accessibility throughout the Greece – Bulgaria CBA (Figure 9).

4.2.4. Combined Polycentricity Index

Using the above determined partial polycentricity indices, namely the Size Index, the Location Index and the Connectivity Index; a combined Polycentricity Index can be derived.

The Greece – Bulgaria CBA combined Polycentricity Index appears significantly higher than the corresponding value for Greece and slightly lower than that of Bulgaria. The CBA obtained the lower Location Index probably due to the inequality in the FUAs service areas. Connectivity Index was found at very high levels, significantly elevated than Bulgaria, Greece and the Greek NUTS1 examined areas. Finally, the combined Polycentricity Index shows relatively increased level, at quite similar level with the examined NUTS0 and NUTS1 areas.

Chapter 5 – Urban – Rural Relationships

5.1. Concept and Indicators

ESPON Project 1.1.2 defined the ‘urban’ and ‘rural’ space in Europe, examined their structural and functional inter-relationships and analyzed the EU policies affecting these relations (Bengs et al., 2006). With regard to the definition of a rural area in the EU, it is a territorial unit that has “a) population density up to 100 persons per km^2, or share of agriculture equal or twice higher that the Community average for any year after 1985; b) average unemployment for the last three years higher than the community average, or a reduction of population after 1985”.

The elaborated typology produced by ESPON 1.1.2 is based on the idea of two main dimensions, that is, the *degree of urban influence* on the one hand, and the *degree of human intervention* on the other hand. In determining degree of *urban influence*, two factors were taken into account: population density and status of the leading urban centre of the region. Only two classes were defined, i.e. *high urban influence*, and *low urban influence*. In terms of the *degree of human intervention* three classes were defined: *High human intervention* corresponding to the situation where the share of artificial surfaces (and possibly one of the two other land cover categories) is above European average, *medium human intervention* equals the cases where the share of agricultural land (and possibly the share of residual land cover) is above European average, and *low human intervention* concerns all cases where only the share of residual land cover is above European average.

5.2. Urban-rural relations in the Greece – Bulgaria CBA

Urban-rural relationships of the Greece – Bulgaria CBA were examined in terms of population density, urban-to-rural population shares, employment and GVA in the primary sector and land type coverage.

5.2.1. Population Density

The mean population density of the CBA (111.4 inhabitants per sq km) was found significantly higher than the mean value of Bulgaria and Greece but slightly lower than the mean EU27 corresponding value and significantly higher than the corresponding value for EU10+2. This was mostly due to the impact of Sofia stolitsa. Excluding the Bulgaria capital, the CBA's population density reduces to 53.4 inhabitants per sq. km, thus the status of urban influence in the CBA is changed from high into low.

In most NUTS3 regions, population density depicted a decreasing trend over the last decade. Linear population density projections showed that by year 2020 most NUTS3 level units are expected to be characterised as 'strongly rural areas' (having population density below 50 inh per sq km), thus experiencing strong depopulation. Sofia stolitsa is the only 'strongly urban area' of the CBA and Plovdiv the only 'moderately urban area'.

5.2.2. Urban-Rural Population and GVA Analysis

Urban-to-rural population analysis showed that that the level of urbanism for Bulgaria and Greece is relatively high and quite similar (71.41% and 72.79%, respectively). In terms of NUTS2 areas, Yugozapaden (BG41) shows the stronger urbanism proportion, with 82.35% of total population living in urban areas. Yuzhen Tsentralen (BG42) region shows significantly lower urban population proportion (66.46%), with Plovdiv (BG421) having the higher urban population percentage (74.45%) and Kardzhali (BG425) being a relatively rural area with urban population percentage of 41.79%. Finally, Anatoliki Makedonia, Thraki (GR11) is a NUTS3 region with almost balanced 'urban-to-rural' population (59.11%). Drama (GR114) and Kavala (GR115) present the higher urban population proportions (63.08% and 62.77%, respectively). Rodopi (GR113) appears as the most rural NUTS3 area of the region, having the 51.43% of its total population living in urban centres (Figure 10). Temporal analysis revealed that over the last five years a gradual increase in urbanism has occurred, as urban population increased by 0.23% per year in Yugozapaden (BG41) and by 0.42% per year in Yuzhen Tsentralen (BG42). The exclusion of Sofia reduces slightly the level of urbanism of the CBA, as urban population share is reduced from 63% to 61%.

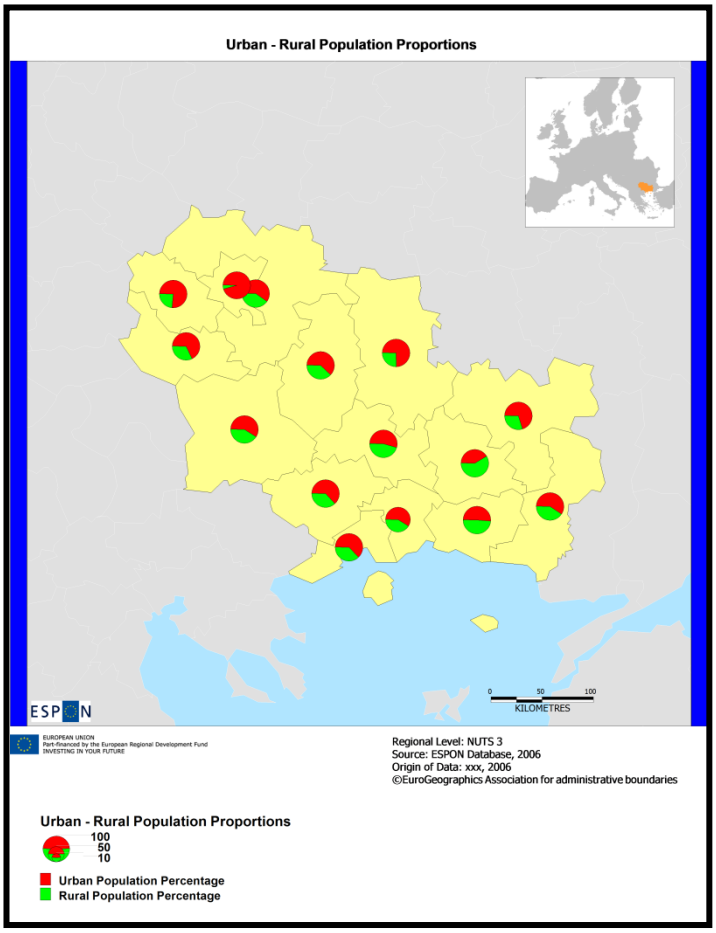

Figure 10. Urban-to-rural population proportions (%) at the NUTS3 areas of the Greece – Bulgaria CBA.

Present analysis revealed that the primary sector employment in the Greece – Bulgaria CBA seems to be characterized by an increased 'level of ruralism', as approximately 15.85% of the economically active population is employed in the agriculture, forestry and fishing sector. This increased primary sector employment appears mostly affected by the high employment in Yuzhen tsentralen (BG42), where almost 27% of the total economically active population is employed in this sector. In Anatoliki Makedonia, Thraki

(GR11) this percentage reduces to approximately 25%, while in Yugozapaden (BG41) rural employment is diminished to only 7.6%. Rural employment over the last decade shows a gradual reduction trend of 1.2% per year; in Anatoliki Makedonia, Thraki this reduction is the highest, reaching 3.5% per year.

The produced GVA in the agriculture, forestry and fishing sector of the CBA was of the order of 1.3 billion Euros in 2008. Plovdiv (BG421), Blagoevgrad (BG413), Evros (GR111) and Kardzhali (BG425) are producing the higher GVA in the CBA. In fact, all Bulgarian areas located closely to the Greece – Bulgaria borderline depict the higher percentages (>10%) in GVA production from primary sector activities. GVA's temporal variability depicts an increasing tendency through time in Bulgarian areas (>10%), especially those close to the borderline. All Greek areas show a strong opposite effect, following well the national trend (from -7 to -10%). As a result the CBA's GVA by 2020 seems to remain unchanged. A cluster of areas (Pazardzhik, BG423; Blagoevgrad, BG413; Smolyan, BG424; Drama, GR114 and Xanthi, GR112) show almost equal behaviour in their annual primary production sector GVA change (from -7 to -10%).

5.2.3. Land Coverage

Land cover is here taken as an indicator of degree of human intervention. Harmonised data of land cover are made available by the CORINE dataset. In this data set, the total land cover is divided into three main categories: artificial surfaces, agricultural land and a residual group. Artificial surfaces consist of urban fabric, industrial, commercial and transport units, mine, dump and construction sites, and artificial, non-agricultural vegetated areas. Agricultural areas include arable land, permanent crops, pasture and heterogeneous agricultural areas. The residual group is composed by forest and semi-natural areas (forests, scrub and/or herbaceous vegetation associations, open spaces with little or no vegetation), wetlands (inland wetlands, maritime wetlands), and water bodies (inland waters, maritime waters).

The European average of artificial surfaces was 3.48% of the total land cover. The corresponding figure for agricultural land was 50.36% and for the residual group it was 46.16%.

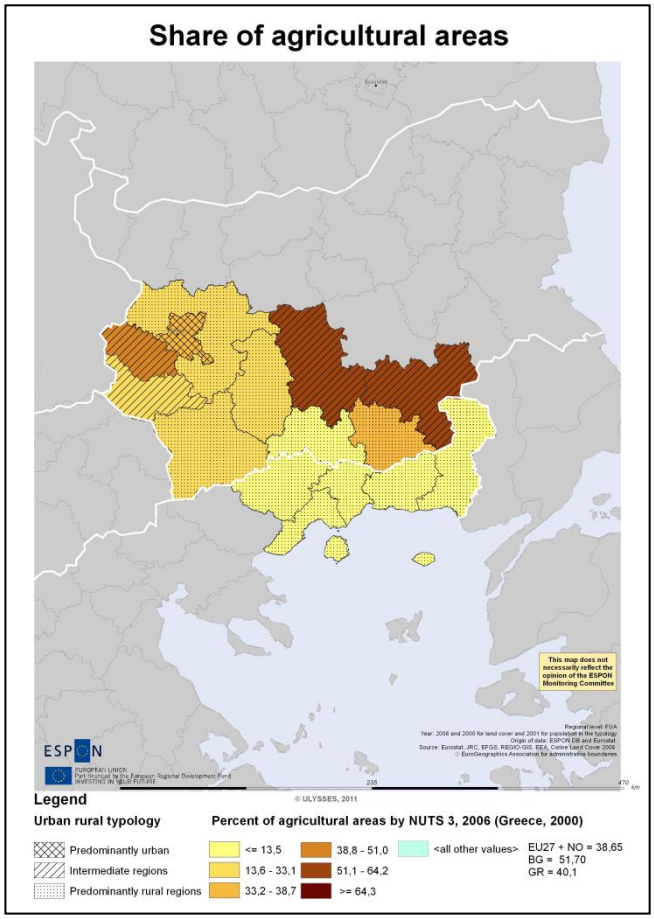

Figure 11. Percentage of agricultural area coverage for the CBA (year 2006).

Present analysis pointed out that the Greece – Bulgaria CBA shows a moderately negative trend in agricultural areas change (-1.35% per year) having a present coverage of 36.3%. Yuzhen Tsentralen (BG42) shows the higher coverage in agricultural areas (40.30%), with a slight negative trend, followed by Anatoliki Makedonia, Thraki (38.62%) and Yugozapaden (30.52%). Anatoliki Makedonia, Thraki loses agricultural land with a significant average annual rate (-4.07%), while Yugozapaden depicts a high positive trend of +5.10% per year. In terms of NUTS3 level units, Plovdiv (BG421), Haskovo (BG422) and Evros (GR111) show the highest 'rurality' behaviour, with agricultural land coverage over 50% of their total area. The highest negative annual trend in agricultural land change is presented by Sofia stolitsa (BG411, -14.11%), followed by Rodopi (GR113, -7.93%). The highest positive trend is shown in Blagoevgrad (BG413, +9.55%).

5.2.4. Urban-Rural Typology

Based on the above parameters (population density; urban – rural population; employment in agriculture, forestry and fishing; produced GVA by the sector of agriculture, forestry and fishing; and land cover and land use), the two main existing urban – rural typologies were followed: a) The Eurostat urban – rural typology, in which regions are classified into three classes: predominantly urban, intermediate and predominantly rural, and b) the ESPON 1.1.2 urban – rural typology, in which regions are classified according to the urban – rural influence and the low – high human intervention.

Eurostat urban-rural typology, classifies Sofia-stolitsa (BG411) as the only 'predominantly urban area' of the CBA. Kyustendil (BG415), Pernik (BG414), Plovdiv (BG412) and Haskovo (BG422) are classified as 'Intermediately Urban Areas', and all remaining regions as 'Predominantly Rural Areas'.

On the other hand, based on ESPON 1.1.2 typology, the whole Anatoliki Makedonia, Thraki (GR11) and the regions of Blagoevgrad (BG413), Smolyan (BG424) and Kardzhali (BG425) are classified as areas of 'Low Urban Influence and Low Human Intervention'. Haskovo (BG422), Pazardzhik (BG423), Sofia (BG412) and Pernik (BG414) are characterized as areas of 'Low Urban Influence and Medium Human Intervention', while Sofia stolitsa (BG411) and Plovdiv (BG412) are considered as areas of 'High Urban Influence and High Human Intervention' (Figure 12).

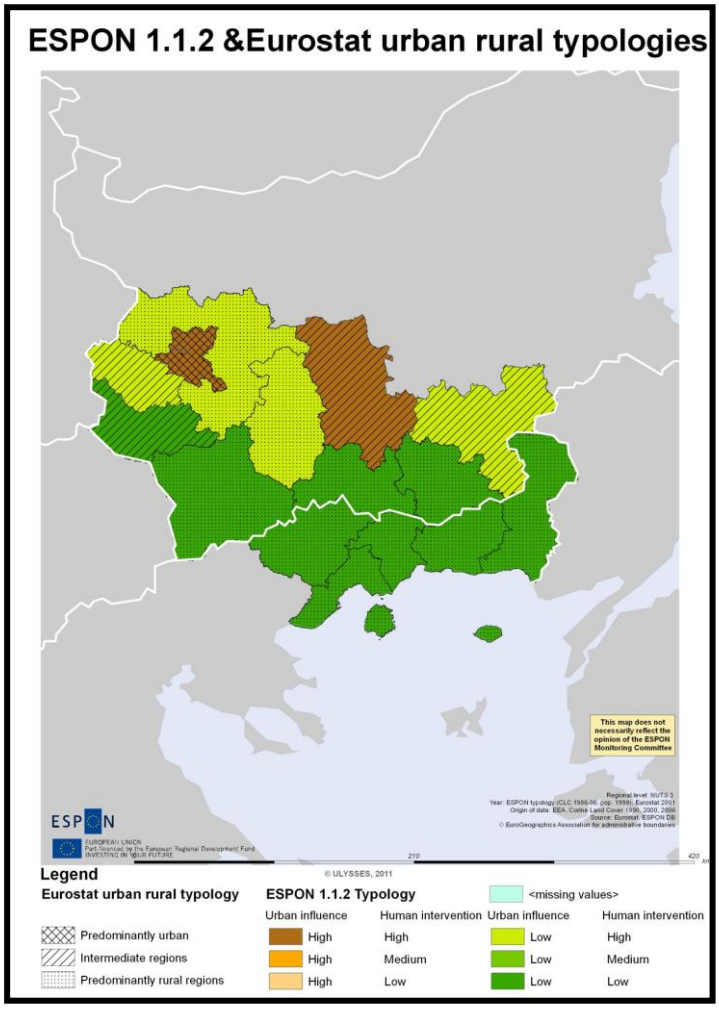

Figure 12. Classification of NUTS3 areas of the Greece – Bulgaria CBA according to the merged Eurostat and ESPON 1.1.2 urban – rural typology.

Chapter 6 – Accessibility & Connectivity Analysis

6.1. Concept and Indicators

Accessibility is the main 'product' of a transport system. While transportation is generally thought of as the way to reach or move something through space, the ability to transport can be defined as accessibility (Black, 2003). In more general terms, accessibility is an important factor for competitiveness of places, determining their economic success (Biehl, 1991; MacKinnon et al., 2008). It is closely related to mobility, economic development, social welfare and environmental impacts. Therefore, accessibility can be considered as a proxy of a set of related (economic, social, environmental) effects of transport infrastructure.

Accessibility determines the locational advantage of an area (i.e. in ESPON a region, a city or a corridor) relative to all areas (including itself). The important role of transport infrastructure (i.e. networks and transport services) for spatial development in its most simplified form implies that areas with better access

to the locations of input materials and markets are expected to be more productive, more competitive and hence more successful than more remote and isolated areas.

The basic indicator used in the present analysis is the Potential Accessibility Index for Road, Rail or Air, determined by two functions: one representing the activities or opportunities to be reached and one representing the effort, time, distance or cost needed to reach them. The basic assumption for its calculation is that the attraction of a destination increases with size and declines with distance or travel time or cost. Therefore, both size and distance of destinations are taken into account. The size of the destination is usually represented by area population or some economic indicator such as total area GDP or total area income. The activity function may be linear or nonlinear. Multimodal accessibility indicators combine several modal accessibility indicators.

The aim of this report is the evaluation of the various accessibility and connectivity levels for each NUTS0, 2 and 3 region of the Greece – Bulgaria Cross-Border Area, and to perform cross-border comparisons estimating the general accessibility levels of the CBA regarding the different modes of transportation. Accessibility and connectivity analysis was performed aiming to determine the general accessibility levels of the Greece – Bulgaria CBA according to the various transportation modes, i.e., road, rail and air, as well as multimodally. Comparisons were taken place between the index of each NUTS3 level unit and the ESPON and CBA average, while the change of the above indices through time was assessed.

6.2. Potential Accessibility by Road

The calculation of the updated road potential accessibility indicators for 2001 and 2006 is based on the detailed GIS database of trans-European transport networks, which cover all countries of the ESPON space and the remaining European countries and includes all modes of transport (RRG GIS database, 2006).

Results showed that the potential accessibility by road of Yugozapaden (BG41) and Yuzhen tsentralen (BG42) (34.38 and 32.56, respectively) appeared significantly higher than that of Anatoliki Makedonia, Thraki (GR11, 21.6). However, this latter area shows a strong improvement in the potential accessibility index between years 2001 and 2006 (from 18.5 to 21.6), due to infrastructure upgrading. Sofia stolitsa (BG411), Plovdiv (BG421) and Haskovo (BG422) present the higher potential accessibility by road indices, while Evros (GR111) and Drama (GR114) depict the lower values. Considering the potential accessibility indices, as related to the Greece – Bulgaria CBA average value, two clusters are formed: the a) *the low accessibility group* consisting of the Anatoliki Makedonia, Thraki areas, together with Smolyan (BG424) and Kardzhali (BG425) with values between 60 and 90 and b) the higher accessibility group, consisting of the remaining areas at the north, north-eastern and north-western parts of the CBA, having accessibility by road values the CBA's mean value.

In terms of the temporal change in the potential accessibility index by road, over the period 2001 – 2006, Kyustendil (BG415) depicts the higher positive index change in potential accessibility by road, Anatoliki Makedonia, Thraki (GR11) together with Blagoevgrad (BG413), Sofia stolitsa (BG411), Sofia (BG412) and Pernik (BG414) show a medium positive index change, while Yuzhen tsentralen region (BG42) shows near zero or even slightly negative standardized index change for the 2001-06 period.

6.3. Potential Accessibility by Rail

For the derivation of the potential accessibility index by rail, the railway network of the RRG database was considered. In addition, new planned railway lines based on the TEN and TINA outline plans and outline plans of national transport ministries and railway authorities, and selected railway links currently closed for operation are also included as well as rail ferries. From this railway database, two model networks were extracted representing the infrastructure and travel time development between 2001 and 2006.

The average potential accessibility by rail of Yugozapaden (BG41) appears slightly higher (18.88) than that of Yuzhen tsentralen (BG42, 16.62) and Anatoliki Makedonia, Thraki (GR11, 15.08). However, as before, the potential accessibility of Anatoliki Makedonia, Thraki shows significant improvement over time, compared to the other two areas. Sofia stolitsa (BG411) and Pernik (BG414) show the highest potential accessibility score, while Evros (GR111), Kardzhali (BG425) and Kyustendil (BG415) demonstrate the lower values (Figure 13).

There exists a cross-border cluster of regions, consisting of Evros (GR111), Rodopi (GR112), Kardzhali (BG425), Smolyan (BG424) and Drama (GR114), with limited potential accessibility by rail indices (<15 standardized according to ESPON average value).

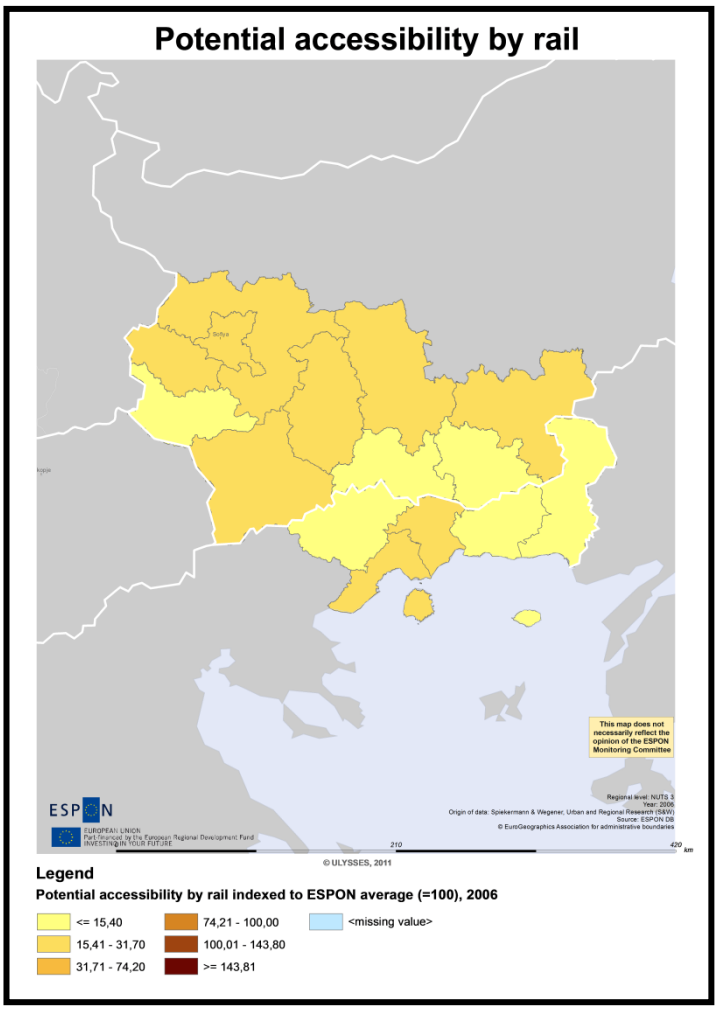

Figure 13. Potential Accessibility by Rail Index of NUTS3 areas of the Greece – Bulgaria CBA, standardized on ESPON space average (=100), for year 2006.

In terms of the temporal change during the 2001 – 2006 period, three clusters occur: a) Anatoliki Makedonia, Thraki high-index-change group, b) the Kardzhali (BG425), Smolyan (BG424), Blagoevgrad (BG413) and Kyustendil (BG415) slightly negative to near zero change group, and c) the remaining NUTS areas of the CBA with strongly negative index change behaviour.

6.4. Potential Accessibility by Air

The RRG world airport database contains about 9,800 airports of international (world-wide), European and regional importance following the airport classification of the Trans-European Transport Network Outline Plan, Section Airports as specified in Decision 1692/96/EC of the European Parliament and of the Council, as well as airports of the so-called TINA networks (TINA = 'Transport infrastructure needs assessment'; TINA Secretariat, 1999; 2002) for the new member states and candidate countries.

There exist four airports within the Greece – Bulgaria CBA (Sofia stolitsa, Plovdiv, Evros and Kavala). The average potential accessibility by air of Yugozapaden (BG41) appears significantly higher (82.54) than that of Anatoliki Makedonia, Thraki (GR11, 46.08) and Yuzhen tsentralen (BG42, 36.66). Moreover, the potential accessibility by air of Yugozapaden (BG41) shows significant improvement (mean 26.44%), in contrast to that of Yuzhen tsentralen (BG42, 17.72%) and Anatoliki Makedonia, Thraki (GR11, 11.58%). Sofia stolitsa (BG411) and Pernik (BG414) show the highest potential accessibility score, while Haskovo (BG422) and Kardzhali (BG425) depict the lower values.

6.5. Multimodal Potential Accessibility

The previously described findings were combined into one indicator showing the multimodal potential accessibility of places by analyzing the joint effect of the three transport modes. The multimodal accessibility of regions may further be used for investigating relationships between accessibility and economic development and between accessibility and migration, issues that are particular in focus in policy documents related to the European territory.

The average multimodal potential accessibility of Yugozapaden (BG41) appears significantly higher (74.1) than that of Anatoliki Makedonia, Thraki (GR11, 42.02) and Yuzhen tsentralen (BG42, 36.66). Moreover, the multimodal potential accessibility of Yugozapaden (BG41) shows significant improvement (mean 25.14%), in contrast to that of Yuzhen tsentralen (BG42, 13.86%) and Anatoliki Makedonia, Thraki (GR11, 11.70%). Sofia stolitsa (BG411), Sofia (BG412) and Pernik (BG414) show the highest multimodal potential accessibility score, while Haskovo (BG422) and Kardzhali (BG425) depict the lower values (Figure 14).

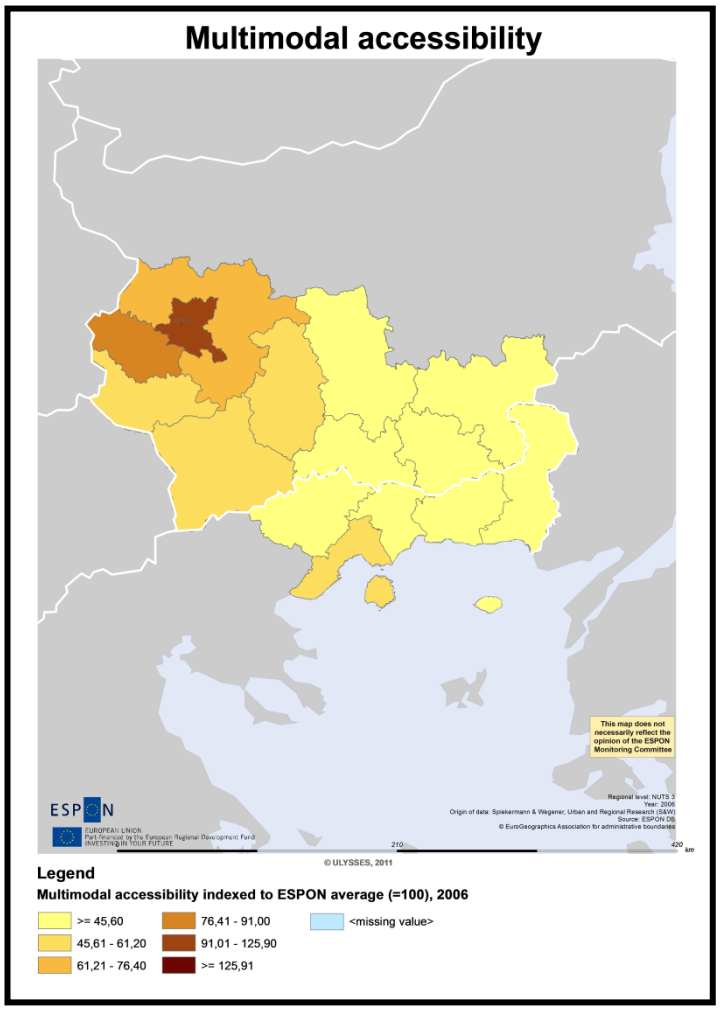

Figure 14. Multimodal Potential Accessibility Index of NUTS3 areas of the Greece – Bulgaria CBA, standardized on ESPON space average (=100), for year 2006.

The temporal variability analysis indicated that Rodopi (GR113) and Kyustendil (BG415) experienced strong accessibility improvement, mostly attributed to rail accessibility upgrade; while for the remaining Yugozapaden areas (BG41) local quality improvement is due to air accessibility change. Relatively intermediate improvement is seen in the remaining Yuzhen tsentralen (BG42), mostly attributed to rail and air accessibility changes. Finally, only Kardzhali (BG425) showed an opposite behaviour, due to negative change in road and rail accessibility indices and the limited air accessibility improvement.

Chapter 7 – Lisbon/Europe 2020 Strategy Analysis

7.1. Concept and Indicators

The territorial dimension of European policy is highlighted in the new document “Gothenburg and Lisbon/Europe 2020: New European strategy” (2010) approved by the European Commission. The aim of this strategy is to help Europe to come out stronger from the crisis and turn the EU into a smart, sustainable and inclusive economy delivering high levels of employment, productivity and social cohesion. Europe 2020 sets out a vision of Europe's social market economy for the 21st century. This strategy sets priorities and specifically, one of them claims for the territorial cohesion:

- Smart growth: developing an economy based on knowledge and innovation,

- Sustainable growth: promoting a more resource efficient, greener and more competitive economy, and
- Inclusive growth: fostering a high-employment economy delivering social and territorial cohesion.

The integral objectives of the Lisbon/Europe 2020 Strategy are leading towards an economy based on knowledge and innovation, with increased investments in human capital, developing social models opposing social exclusion, poverty and ageing, leading towards an economic policy focused on trans-frontier cooperation.

The study of the territorial performance of the Greece – Bulgaria Cross-Border Area considered a list of indicators covering a wide domain of the five most important sectors, as economic background and growth, employment, research and innovation, economic reform and social cohesion.

7.2. Economy and Employment Analysis

Economic and employment analysis considered indices as the GDP, the GDP per capita, the GDP coefficient of deviation and their temporal trends, leading towards an indexing and convergence analysis for the NUTS3 areas of the CBA, compared to the leading in terms of economic performance region (London NUTS2 area).

The total GDP of the Greece – Bulgaria CBA was in 2008 35.4 billion Euros. Yugozapaden (BG41, 16.3 billion Euros) represents approximately 46.2% of this GDP, Anatoliki Makedonia, Thraki (GR11, 9.0 billion Euros) represents the 25.5% while Yuzhen tsentralen (BG42, 4.9 billion Euros) represents almost 14.1% of the CBA. In these figures, the contribution of the Sofia stolitsa GDP was particularly important, raising from 17% in 1997 to 37.5% in 2009. When excluding Sofia stolitsa on this analysis, the CBA's GDP reduces by approximately 48% to 17.15 billion Euros in 2009.

In terms of the temporal GDP variability, over the studied years (1997-2009), Sofia stolitsa (BG411), Pernik (BG414) and Smolyan (BG424) depicted the higher annual mean change in GDP, with values of 19.32%, 17.36% and 13.94%, respectively. Significantly slower GDP growth was reported for the Anatoliki Makedonia, Thraki area (5.13%) and its NUTS3 regions, as Kavala (GR115, 4.44%), Evros (GR111, 4.88%). The Greece – Bulgaria CBA shows a strong mean annual GDP growth of 10.9%, which excluding Sofia stolitsa falls to 7.4%.

Based on the indexed GDP per inhabitant analysis, the Greece – Bulgaria CBA is considered as a 'less developed to very laggard' region, having NUTS3 areas with index ranging between 30-50, 15-30 or even below 15, as compared to Greater London NUTS2 (indexed as 100). The whole Bulgarian NUTS3 areas are falling in this latter category, while only Sofia stolitsa (BG411) and Drama (GR114), Xanthi (GR112) and Rodopi (GR113) are considered as 'laggard regions'. Evros (GR111) and Kavala (GR115) score relatively higher, thus clustered as 'less developed regions', having indices of 31.42 and 30.24, respectively.

To understand better regional disparities in the GDP per capita of the various NUTS regions throughout the Greece – Bulgaria CBA, the coefficient of deviation (CDev) was used. It occurs that Greece shows limited and slowly decreasing regional disparity (CDev 2008: 21.2). Bulgaria on the contrary depicts a strong increasing trend, mostly attributed to the very rapid change of GDP per inhabitant in Sofia stolitsa, as related to the rest of the country (CDev 2008: 44.3). The CBA shows significant regional disparity, with a rapidly converging to ESPON NUTS0 and NUTS3 trend (CDev 2008: 72.3) (Figure 15). Excluding Sofia the coefficient of deviation depicts similar

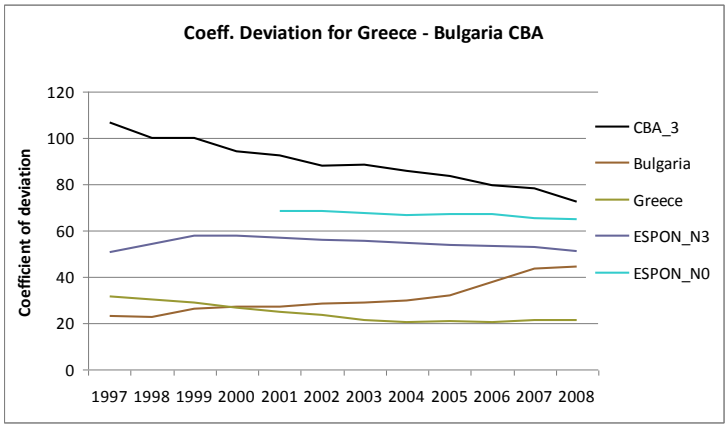

Figure 15. Temporal variability of Coefficient of Deviation for the NUTS3 areas of the Greece – Bulgaria CBA, the NUTS0 areas and the ESPON NUTS0 and NUTS3 space (EU27+CH+NO for the N0 and only EU27 for NUTS 0).

behavior reaching the level of 76.4.

On the other hand, convergence analysis revealed that Kavala (GR115), Xanthi (GR112) and Evros (GR111) have quite similar to the leading region GDP per inhabitant trends, implying that these areas are 'non-converging'. Kyustendil (BG415), Rodopi (GR113) and Drama (GR114) are considered as 'slow converging areas', while Sofia stolitsa (BG411), Pernik (BG414) and Smolyan (BG424) having GDP per inhabitant annual growth rates almost 3-4 times higher than the leading region, are considered as 'steady catching-up areas'.

Employment analysis revealed that employment in the CBA is distributed rather evenly among all NACE economic activities, and the exclusion of Sofia stolitsa produced an almost similar result. A slight employment annual increase (+0.73%) over the last decade was exhibited in the CBA. This increase is mostly fuelled by the strong employment rise in Construction (+6.32%) and the Financial Intermediation and Real Estate sector (+4.05%). Strong employment reduction during the latest decade is seen in Agriculture, Forestry & Fishing sector (-1.19%). The highest employment annual growth rate in the NUTS3 areas is observed in Blagoevgrad (BG413, 19.46%), followed by Smolyan (BG424, 13.94%) (Figure 16).

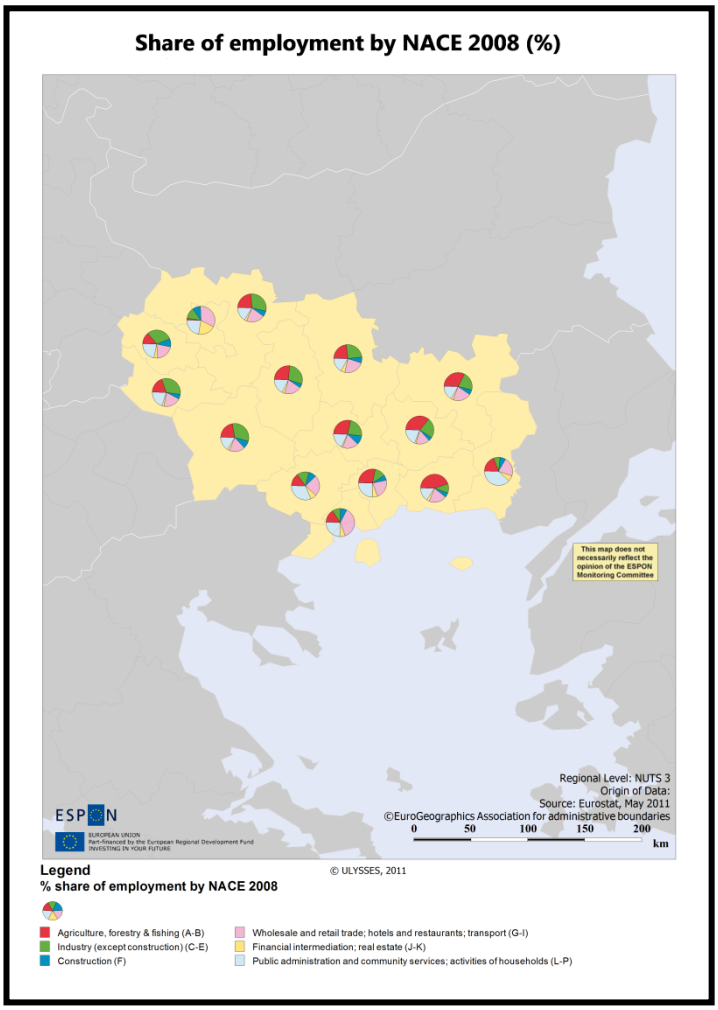

Figure 16. Share of employment by NACE in year 2008 for the NUTS3 areas of the Greece – Bulgaria CBA.

The increase in the annual employment growth rate was lower in the Greece – Bulgaria CBA (+0.73% with Sofia stolitsa and +0.39% without Sofia stolitsa), than that shown by Greece (+1.50%) and Bulgaria (+2.10%). Examining the mean temporal change of employment in all NUTS3 areas of the Greece – Bulgaria CBA, it occurs that Agriculture, Forestry and Fishing showed the higher losses, especially in Pazardzhik (BG423, -11.5%). Kardzhali (BG425) showed growth in this sector (+5.87%). In the Industry sector, employment illustrated the higher positive annual rates in Rodopi (GR113, +4.73%) and Smolyan (BG424, +3.35%), while the highest negative rates were shown in Kavala (GR115, -6.09%) and Drama (GR114, -5.31%).

The GVA of the Greece – Bulgaria CBA in year 2008 from all NACE categories was 25.8 billion euro, with a significant contribution from Sofia stolitsa (42.9%). This GVA appears increased over the latest decade by 169%. The GVA is mostly attributed to the Wholesale and Retail Trade, Tourism and Transport sector (26.8%) and to the Financial Intermediation and Real Estate sector (23.4%) (Figure 17). The temporal change of GVA over the last decade indicated that the primary sector reduced its contribution by 16%, while construction and public administration increased their share by 1.3 and 3.6%, respectively.

7.3. Education, Research and Innovation Analysis

A set of indicators has been identified to examine the CBA's performance in the field of Education, Research and Innovation, such as the share of population with different educational level, the expenditure for R&D at different sectors and regions, the applications for patents to the European Patent Office, etc. All indicators analyzed were determined at NUTS2 level.

Anatoliki Makedonia, Thraki (GR11) exhibits the poorest performance compared with the two neighboring Bulgarian regions. Yugozapaden (BG41) exhibits the best performance among the three regions. Its population percentage with low education is lower than the national and the EU27 averages, while its population percentage of tertiary education is higher than the national and EU27 averages. This is probably due to the fact that the specific region incorporates the wider area of Sofia, the capital of Bulgaria.

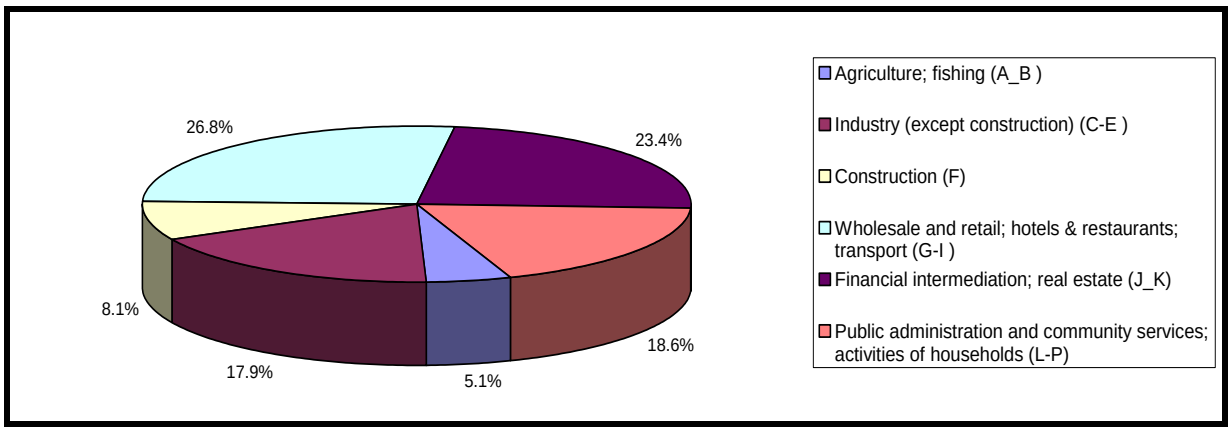

Figure 17. Share first level NACE sectors in the Gross Value Added of the Greece – Bulgaria CBA.

All three regions exhibit significantly lower Total Gross Expenditure on R&D expenditures compared to the EU27 average of 1.85% of GDP. Moreover, all regions under study have lower Business and Higher Education GERD from the EU27 average. Yugozapaden (BG41) demonstrates a clear superiority compared to its neighboring regions, having significantly higher Total, Government and Business GERD. Anatoliki Makedonia, Thraki (GR11) is the leader in Higher Education GERD due to the existence of a major university in its 3 out of 5 NUTS3 unit levels (Figure 18).

Bulgaria and Greece are modest innovators exhibiting a below average performance, and the three NUTS2 regions under study present similar characteristics, demonstrating low innovation performance and weak innovation potential that in terms of the number of patents fall well below the EU27 and the USA averages. For the period (1996-2007) Yuogozapaden (BG41) is the leading region in patents, followed by Anatoliki Makedonia, Thraki (GR11), whereas, considering only year 2007, GR11 presents a rapid increase.

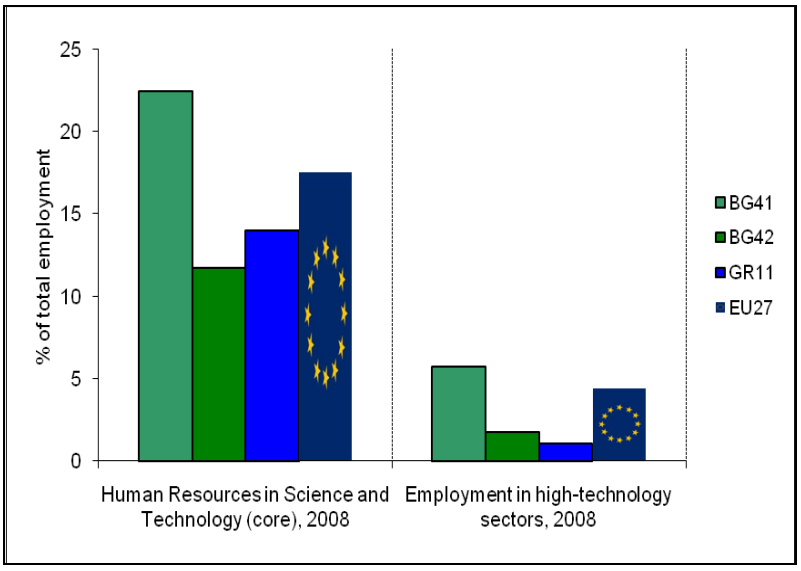

Figure 18. Human Resources in Science and Technology (left) and Employment in High-technology sectors (right).

7.4. Social Cohesion Analysis

Social cohesion is the capacity of a society to ensure the welfare of all its members, minimising disparities and avoiding polarisation (Council of Europe, 2004). It is a fact that presently Europe faces a number of potential threats, setting social cohesion into significant risk. The fight against social exclusion is one of the EU's social policy goals, and the aim is to significantly reduce the number of persons at risk of poverty and social exclusion by 2020.

The selected indicators for this analysis are: a) Unemployment Rate, b) Long-term Unemployment Rate, c) Youth Unemployment Rate, d) Population at Risk of Poverty, and e) Infant Mortality Rate. Statistical data on the social cohesion indicators at NUTS3 level for the Greece – Bulgaria CBA do not exist. Therefore, this analysis will be limited to the available NUTS2 or even NUTS1 data available for the examined region. Furthermore, the available statistical data for each selected parameter refer to variable time periods, ranging between 2008 and 2010.

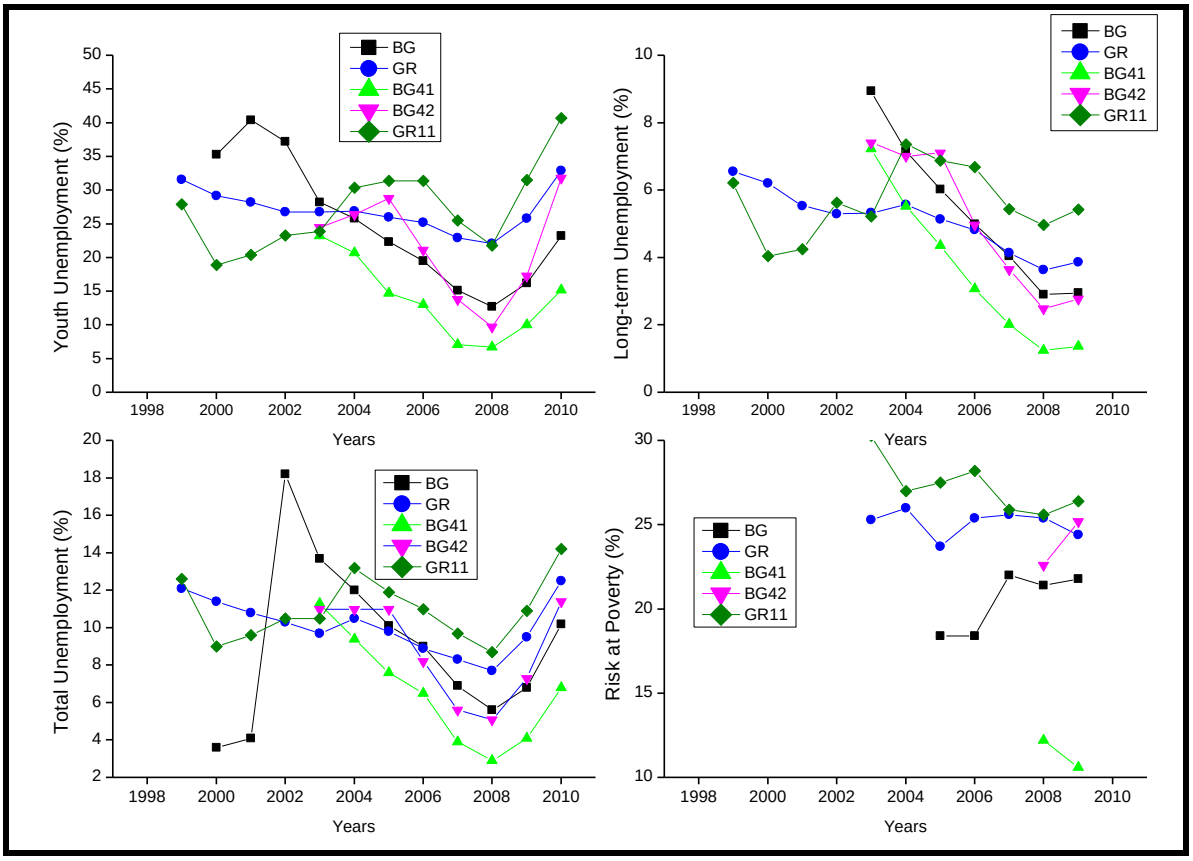

Figure 19. Temporal variability of Social Cohesion Indicators for the NUTS0 and 2 areas of the Greece – Bulgaria CBA.

Results illustrated that the CBA mean unemployment rate for year 2010 (10.8%) appears slightly higher than the mean EU27 value (9.6%) and the national Bulgarian value (10.2%), mostly due to the higher unemployment in Anatoliki Makedonia, Thraki (GR11, 14.2%) and Yuzhen tsentralen (BG42, 11.4%). CBA's mean unemployment rate was lower than the corresponding national Greek value (12.5%). Similarly, Long-term Unemployment in Anatoliki Makedonia, Thraki (GR11) appeared approximately two and four times higher than that in Yuzhen tsentralen (BG42) and Yugozapaden (BG41), respectively, leading to almost similar mean CBA's rate (3.2%) to that of EU27 and the corresponding national values (BG: 3.0%, GR: 3.9%). Youth Unemployment was found at very high levels in Anatoliki Makedonia, Thraki (GR11, 40.7%) and Yuzhen tsentralen (BG42, 31.8%), in relation to Yugozapaden (BG41, 15.2%), producing a much higher CBA rate (29.2%) than the corresponding EU27 value (21%) and the national Bulgarian value (23.2%). The Population at Risk of Poverty Index reached almost 20% in the Greece – Bulgaria CBA, with increased rates in Anatoliki Makedonia, Thraki (GR11, 25.4%) and Yuzhen tsentralen (BG42, 22.6%). This value is comparable to the corresponding national values for Bulgaria (21.4%) and Greece (20.1%). Infant Mortality in the CBA (6.7%) depicted a relatively moderate deviation compared to the correspondent EU27 (4.3%) and the Greek national value (2.7%). Overall, all social cohesion

indicators (total, long-term and youth unemployment) over the period 1999 – 2011 showed a general decreasing trend, until year 2008. After 2008, all indicators increased sharply, returning back to the 1997 levels (Figure 19).

Chapter 8 – Gothenburg Strategy Analysis

8.1. Concept and Indicators

This chapter examines the performance of the Greece – Bulgaria cross-border area in relation to various objectives of the Gothenburg Strategy: e.g. preservation and sustainable use of natural / cultural heritage potentials; sustainable management of main environmental media (soil, air, water etc), effects of climate change (e.g. new natural hazard patterns, natural disasters), renewable energy sources & use of renewable energy sources / increased energy efficiency; potential sources for industrial risks.

The main objective of this analysis is to present - for the specific CBA – the state of the thematic fields closely related with the environmental issues and to understand the influence of the border on the specific issues. A set of indicators has been identified, such as the projected change in number of tropical nights and snow-covered days, wind and solar regional potential, the ambient concentrations of particulate matter and ozone, the NATURA 2000 areas, the soil sealed, etc.

8.2. Climate Change Potential

To analyze the impact of climate change on the EU NUTS-2 regions a vulnerability index was constructed, employing information on the regions vulnerability to droughts and floods, potential effects on agriculture, fisheries and tourism as well as urban and coastal areas, taking into account temperature and precipitation changes.

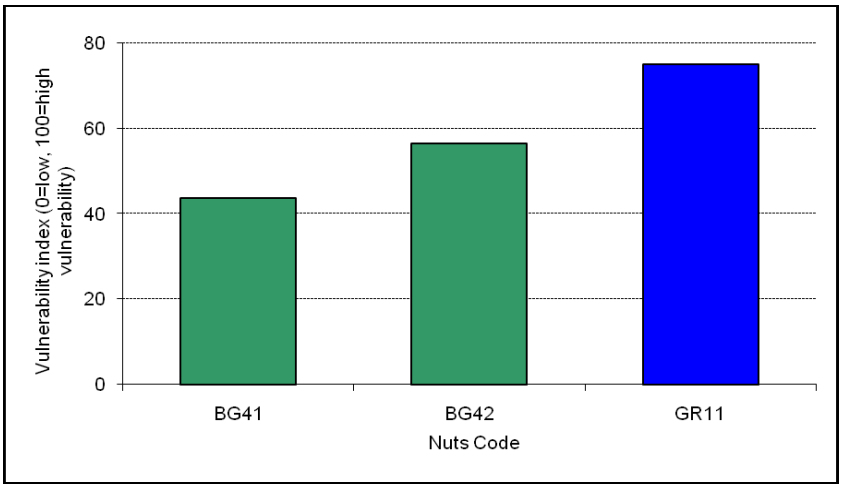

Figure 20. Vulnerability of NUTS2 regions of the Greece – Bulgaria CBA to climate change.

The vulnerability index incorporates issues such as the population percentage affected by river floods; population living below 5 m; population aged 75+, change in tropical nights, Gross Value Added (GVA) in agriculture, fisheries, and tourism, changes in precipitation and temperature, etc. The index ranges between the 0 for low vulnerability to 100 for high vulnerability

All three NUTS2 regions of the Greece – Bulgaria CBA fall into the high vulnerability category, due to their proximity with the Mediterranean and the broader Black Sea area. However, the southern coastal region (Anatoliki Makedonia, Thraki, GR11) is expected to be influenced more from climate change effects, compared to the other two regions in terms of the consequences from a possible climate change (Figure 20).

Specifying further, all five NUTS3 areas of the inland Yugozapaden (BG41) region are estimated to experience significantly less number of days with snow cover per year (30-40 days less), whereas Anatoliki Makedonia, Thraki (GR11) is expected to be influenced least in comparison to the other NUTS2

regions. Those estimations are expected to influence severely the winter tourism at the ski resorts of Yuzhen tsentralen (BG42) and Yugozapaden (BG41) regions.

Further, there is an increasing trend to the number of tropical nights as we move from the northern region (Yugozapaden, BG41) to the southern region (Anatoliki Makedonia, Thraki, GR11).

Concluding, the southern and coastal region of Anatoliki Makedonia, Thraki (GR11) is expected to be influenced more compared to the other two regions, in terms of the consequences from a possible climate change.

8.3. Renewable Resources Potential

Wind and solar power are two forms of renewable energy resources widely applicable in EU. In that aspect, the wind energy potential and the solar energy potential at the Greece-Bulgaria CBA under study, namely GR11, BG41 and BG42 are reported here.

Our analysis indicates that all NUTS3 regions exhibit higher wind energy potential than their respective national averages, but lower than the EU27 average. The predominant NUTS3 regions in terms of wind energy potential are Evros (GR111) and Rodopi (GR113) from GR11 and Kardzhali (BG425) and Haskovo (BG422) from BG42 (Figure 21).

All NUTS3 regions have uniform solar radiation profile and at least 10% higher solar potential than the EU27 average. The performance of the Bulgarian NUTS3 regions matches almost exactly the national average, while the performance of the Greek NUTS3 regions lays approximately 10% below the national Greek average.

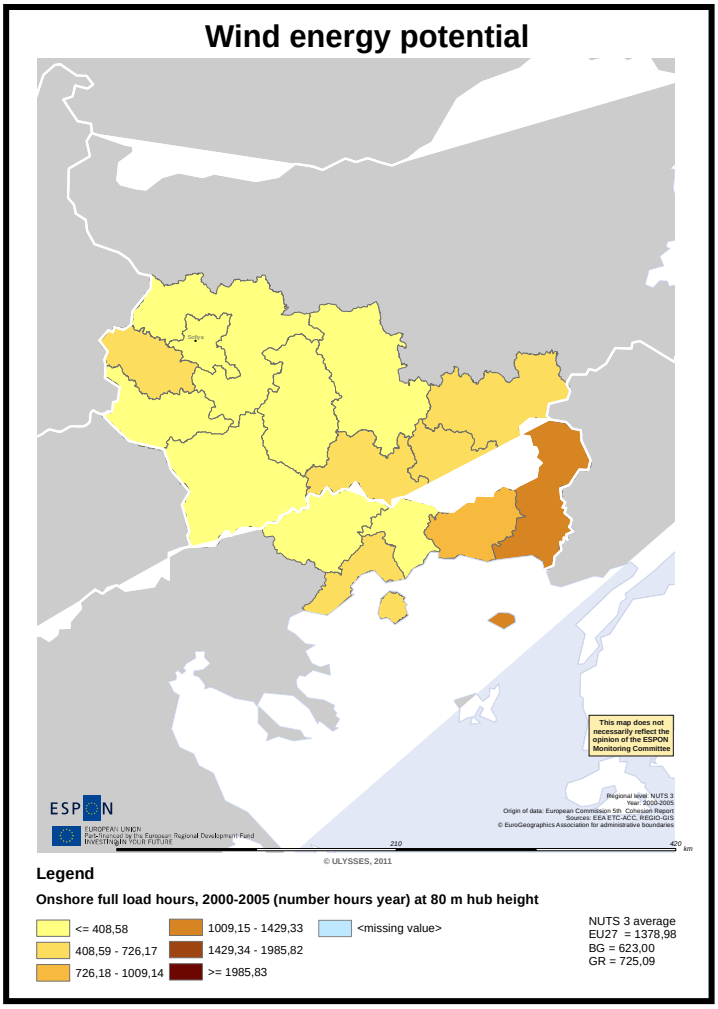

Figure 21. Wind energy potential of the NUTS3 areas of the Greece – Bulgaria CBA for the period 2000-2005.

8.4. Air Quality

In order to assess the quality of the ambient atmospheric conditions at the NUTS2 and NUTS3 regions under study the spatial behavior of two basic air pollutants, i.e Particulate Matter and Ozone Concentrations were examined.

In terms of air quality, PM_{10} concentration levels at all regions were between 10-20 μg/m^3, below the EU environmental limit of 40 μg/m^3 (period 2005-2009), and the updated limit of 20 μg/m^3 (valid from 1/1/2010). Almost all NUTS3 regions of the CBA experience fewer days with ozone concentration exceedance (ozone concentrations >120 μg/m^3) compared to their respective national averages. Further, all NUTS3 regions of the Greece – Bulgaria CBA experience more days with ozone exceedance, than the corresponding EU27 average value. This difference can be attributed to the less sunny days occurring in Central and Northern Europe. Sofia stolitsa exhibited the highest ozone pollution, due to its population industrial activities, and from Anatoliki Makedonia, Thraki region (GR11), only the area of Kavala, due to the existing industrial activities (fertilizers, oil desulfurization, airport, etc.).

8.5. Natural Environment

In this section the share of the Natura 2000 areas, as a percentage of the total area within the 15 NUTS3 regions under study is presented.

The share of Natura 2000 areas at the Bulgarian NUTS3 regions ranged from 13% to 54% and at the Greek NUTS3 regions ranged from 11% to 40%, significantly higher than the EU27 average of 17%. At 8 out of 15 NUTS3 regions the share of Natura 2000 areas is more than double of the corresponding EU27 average. This Natura 2000 share ranges from 13% for the urbanized Sofia (BG411) to 54% for the mountainous Haskovo (BG422). The Greek regions ranged from 11% at the region of Kavala (GR115) to 40% at the region of Evros (GR111) (Figure 22).

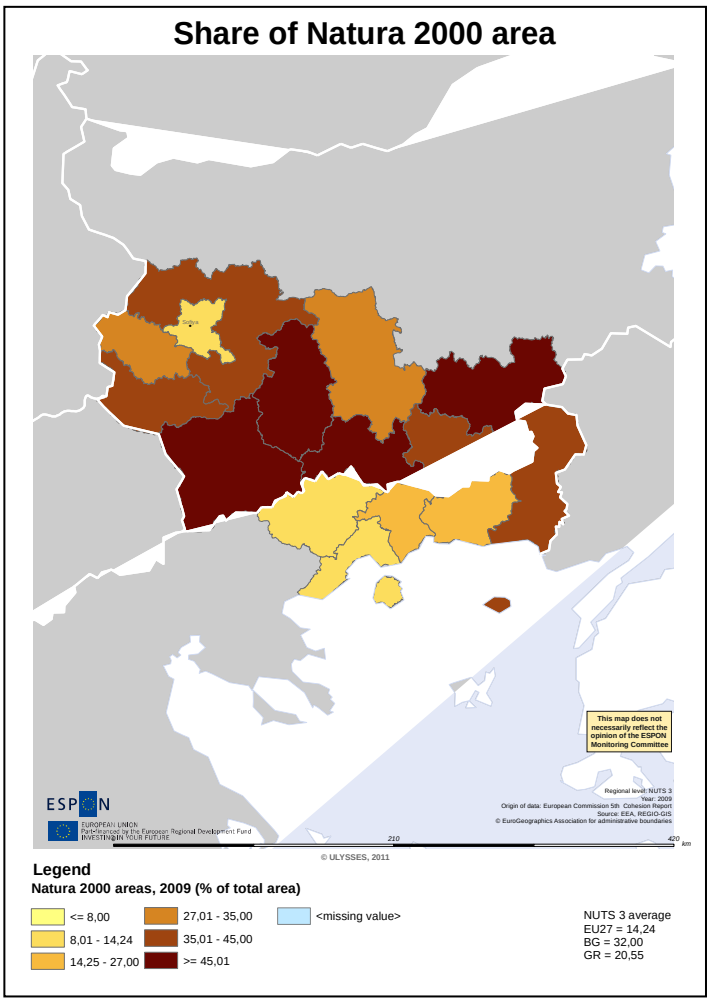

Figure 22. Spatial variation of Natura areas in the Greece – Bulgaria CBA as a share (%) of the total area, for year 2009.

With the exception of Sofia stolitsa (BG411), all other NUTS3 regions have soil sealed percentage approximately 2 to 4 times lower than the EU27 average of 6.7%. Regarding the soil sealed area per inhabitant, the regional Greek average is higher that the regional Bulgarian averages, indicating greater urbanization trend in the Greek region of the CBA. Overall, urbanization is in absolute figures not considered as a problem of major concern, however, there is a trend to augment its severity in the following years should the existing trends be continued.

Finally, the share of the planned investments of Cohesion Policy in environment, for the period 2007-2013, for infrastructure environmental projects is significantly higher for the Bulgarian regions and stands quite higher than the EU27 average. On the other hand, the planned investments of Cohesion Policy in environment, for the period 2007-2013 and for the region Anatoliki Makedonia, Thraki (GR11) appear similar to the EU average.

Chapter 9 – Integrated Territorial Analysis

9.1. Concept and Indicators

Institutional arrangement and governance represent an important factor of territorial performance, including cross-border areas. The hypothesis here is that the performance of cross-border areas is conditioned by institutional structures and governance and that there is a potential of improving the performance via policy actions.

Two sets of indicators were established: one for **territorial profile variables** and one for **territorial performance variables**. The first set considered variables linked to overall territorial characteristics of the different regions, on the themes considered. Polycentricity was excluded at this point, as it makes no sense on a NUTS 3 level at which the analysis was performed. On the other hand, indicators that are

normally associated with the Lisbon/Europe 2020 and Gothenburg objectives at the input level (such as R&D investment, active population with tertiary education and so forth) have also been included, since the differentiation was made between dependent and independent variables and not merely based on thematic categories. The second set considered variables linked to the performance of the regions concerning indicators related to the Lisbon/Europe 2020 and Gothenburg indicators at the output level.

In order to analyse the relations between the territorial profile and the regions performance, two different analyses were performed. Firstly, a factor analysis for each set of indicators and secondly, several multiple linear regressions having as independent variables each factor of the performance indicators and as dependent variables all the factors of the territorial profile.

9.2. Territorial Profile Analysis

Factor analysis on the territorial profile indicators produced eleven factors, having eigenvalues higher than 1 (based on the Kaiser criterion), explaining cumulatively 74.327% of the total system's variance.

Factor 1 has high positive correlations with all the indicators expressing potential accessibility and, to a lesser extent, with the share of employment in the financial intermediation and real estate, the employment in high and medium tech manufacturing activities and with commuting to other regions. It also has a strong negative correlation with the share of employment and GVA in agriculture and fishing. Mapping the spatial distribution of factor scores for Factor 1, it is seen that this factor has its highest values in central European countries, especially in the Ruhr, Belgium and Southern England areas, in a pattern that clearly lines out the 'blue banana'. In the less central regions, the higher values tend to be concentrated around capitals and other major urban agglomerations. Greece – Bulgaria CBA shows very low factor scores in relation to 'centrality' (Figure 23).

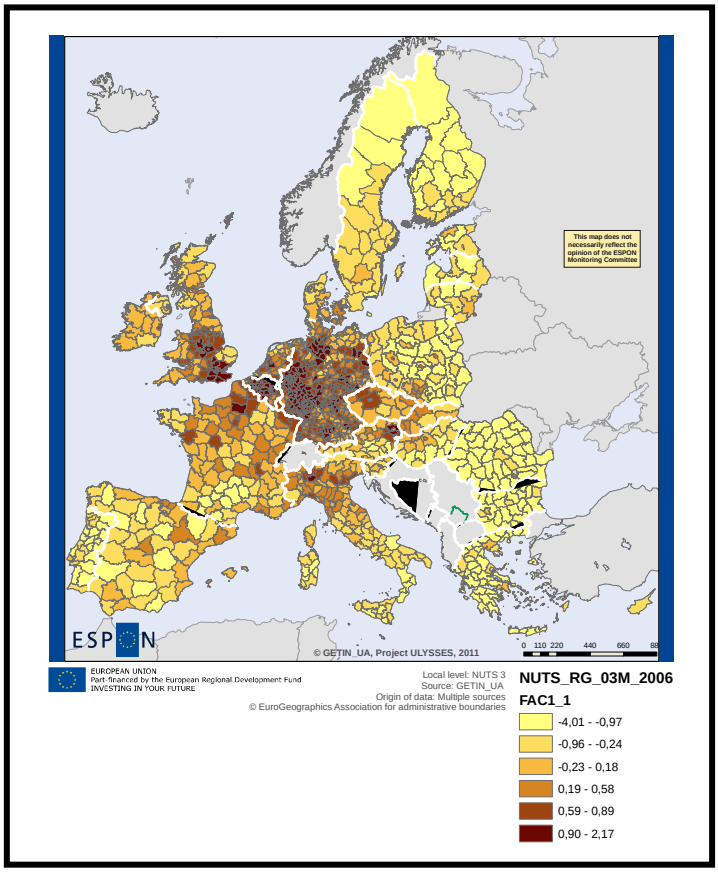

Figure 23. Spatial distribution of rotated factor scores for Factor 1 representing the 'proximity to central urban centres'.

Factor 2 represents the innovation dynamic and the scientific development of each NUTS3 area of the EU27 space. This factor appears mostly related to R&D investment of the different sectors and, to a lesser extent, to EPO patent application and the tertiary educated active population, explaining 8.40% of the total system's variance. Mapping the spatial distribution of factor scores for Factor 2, it is interesting to note that, besides the capital cities, it is possible to identify specific innovation strongholds such as important university towns or high tech industries (Airbus in the Toulouse area, Volkswagen around Wolfsburg, Cambridge or the Silicon Glen). The Scandinavian countries also have a very favourable position in this factor. The Greece – Bulgaria CBA shows relatively low factor scores in relation to 'innovation dynamism'.

Factor 3 appears to represent the proximity of NUTS3 areas to public administration centres, as the indicators positively correlated with this factor are the share of employment and the GVA in public administration, community services and activities of household and the indicators negatively correlated with this factors are the share of employment and the GVA in industry.

This factor explains 8.36% of the total system's variance. The regions with the highest scores of this factor are majorly depressed regions in which, because of their poor economic performance, the public

sector assumes an important position. It is interesting to see that most of the borders NUTS3 areas in Spain and Portugal have very high scores
in this factor, as well as Karelia.

The other cross-border regions seem to be closer to the national patterns. On a different note, this indicator also relates to the different levels of state interventionism, with the Scandinavian countries and France revealing overall high scores (Figure 24). The Bulgarian NUTS3 areas of the Greece – Bulgaria CBA shows relatively low factor scores in relation to the 'public administration' factor. However, all NUTS3 areas of Anatoliki Makedonia, Thraki region show significantly high positive factor scores.

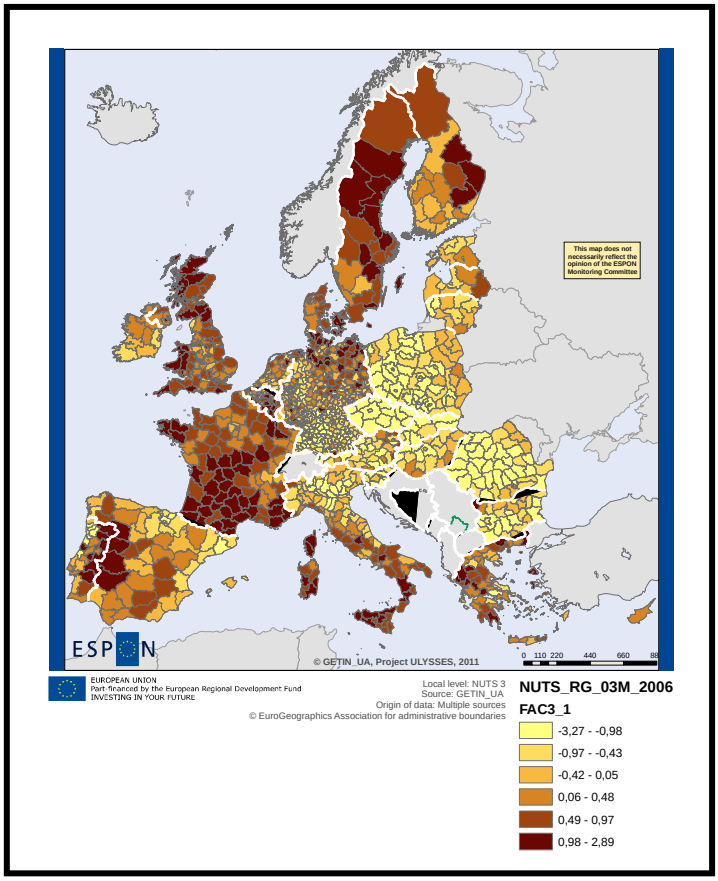

Figure 24. Spatial distribution of rotated factor scores for Factor 3 representing the 'public administration centres'.

Factor 4 seems expressing the demographic dynamism of NUTS3 areas, as the indicators positively correlated with this factor are the young age dependency rate, the crude rate of natural population increase and the total fertility rate. This factor depicts negative correlation to the old age dependency rate parameter. It explains 7.22% of the total system's variance. Mapping the spatial distribution of factor scores, it occurs that the regions with the lowest scores of this factor are in the Mediterranean countries, such as Portugal, Spain and Greece, as well as Germany. On the contrary, the northern parts of France, Ireland, central Great Britain, Scandinavia and eastern Europe are the regions with the highest positive scores. In the Bulgarian NUTS3 areas of the Greece – Bulgaria CBA all NUTS3 areas (with the exception of Xanthi) show negative factor scores in relation to the 'demographic dynamism' factor.

Factor 5 appears related to NUTS3 areas' sensitivity to climate change, as this factor is correlated with the environmental, social and cultural sensitivity indicators. This factor explains 6.91% of the total system's variance. Mapping the spatial distribution of factor scores, it occurs that the highly sensitive to climatic change risks are regions essentially located in coastal areas and other flood prone areas, such as areas close to the Delta of Danube River or Po River. Focusing on the Greece – Bulgaria CBA, it can be seen that most Bulgarian NUTS3 areas show positive factor scores, indicating their relative exposure to climate change. All NUTS3 areas of Anatoliki Makedonia, Thraki show relatively lower climate change risk, when compared to all NUTS3 areas of the EU27 space.

Factor 6 appears related to trade, tourist services and transport, since positively correlated to this factor are indicators as the share of employment and the GVA produced by the wholesale and retail trade, hotels and restaurants and transport sector (NACE G-I). This factor explains 5.92% of the total system's variance. Mapping the spatial distribution of factor scores in Factor 6 it may be noted that many of the regions with the high scores seem to be linked to tourism (as Southern Spain and Portugal, the alpine regions, Paris, Greece, Rome, etc.). Focusing in the Greece – Bulgaria CBA, it can be seen that almost all NUTS3 areas show positive factor score, indicating the high impact of trade, tourism and transport in local economy.

9.3. Territorial Performance Analysis

Factor analysis was applied on the indicators for territorial performance matrix, aiming a) to obtain a small set of variables (preferably uncorrelated) from a large set of variables (most of which are correlated to each other), and b) to create indexes (called factors) with variables that measure similar things. It occurs

that only four factors have eigenvalues higher than 1 (based on the Kaiser criterion). These factors explain cumulatively 72.28% of the total system's variance.

Based on this analysis it occurs that the above territorial profile affects significantly the territorial performance of the CBA. The area suffers from high unemployment (especially in Anatoliki Makedonia, Thraki) and limited economic development, showing a strong convergence tendency in all Bulgarian areas. Territorial performance analysis indicated that these high unemployment levels are strongly related to the low R&D investments, the limited demographic dynamism and the high levels of immigration. Poor economic convergence seems related to the low centrality of the region and the increased public administration sector. Central location appears a more important factor to support economic development of a region, than the R&D investments.

Chapter 10 – Cross-Border Governance Framework

10.1. Territorial Governance and Institutional Performance in CBAs

Cross-border governance in contemporary Europe mostly means cooperation on the *regional* level (in particular Euregios), in many cases complemented by partners on the local level (city networks etc.). The interregional cooperation is embedded within the multi-level governance of the European political system where nation states and the EU are major players.

The analysis of cross-border governance has two main dimensions: a) the structural dimension, meaning that the CBA's governance framework can hardly be influenced by the partners of inter-regional cross-border cooperation, and b) the activity dimension, explaining the intensity and continuity of cross-border cooperation on the regional level. Structural dimension may be identified in terms of the political status and physical status of the border, the institutional status and the language barrier. The activity dimension may be determined in terms of the maturity and historicity of cross-border cooperation, its institutional thickness, the regional cross-border spatial development and the cross-border transport projects.

10.2. Territorial Governance in Greece – Bulgaria CBA

Structural and activity dimension for all six CBAs examined is presented in Figure 25. In terms of structural dimension, the Greece – Bulgaria border seemed to operate as a 'barrier', especially in the period prior 2007 when Bulgaria was not a full EU member. After 2007, cross-border cooperation increased and the border moves rapidly towards an 'interface border-type'.

Indeed, the structural situation in this border region is challenging. Two different languages make up a very serious linguistic barrier. Moreover, the differences between the political systems of Bulgaria as a transformation state on the one side and Greece as an EU member state since 1981 on the other side are considerable. This is true in general, but also with regard to planning traditions. Bulgaria, as a transition state, has a tradition of highly centralised planning procedures in socialist times. During the last two decades, the systems have been reinvented, but it takes time to make the renewed institutions and procedures powerful. It takes even more time, to establish cross-border cooperation that is adapted to the new planning systems. In physical terms, the border between both regions is characterized by a hilly and sometimes mountainous terrain that prohibits

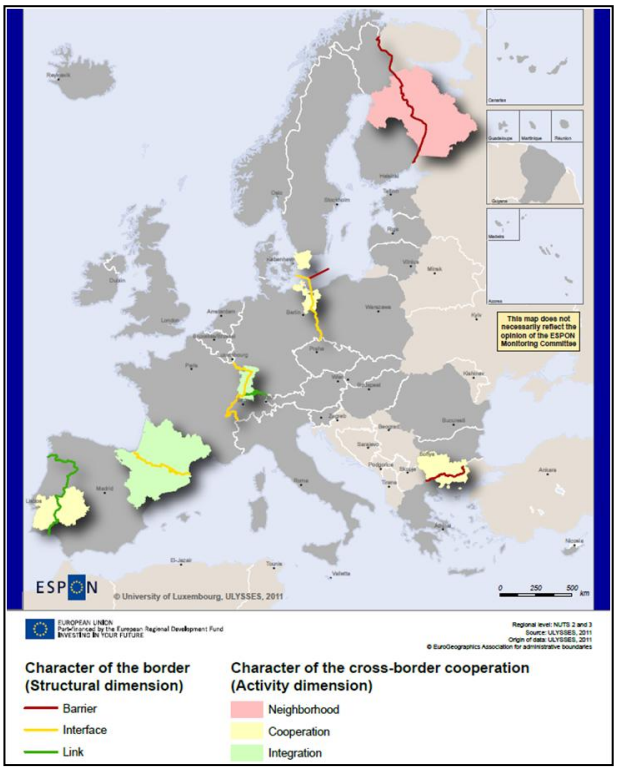

Figure 25. Structural and Activity Dimension of the Uysses CBAs' institutional setting.

cross-border exchange.

In terms of the activity dimension, the three regions act in an 'increased cooperation mode' especially in the field of tourism, transport, trade and environment. Despite the fact that the structural situation is challenging, cross-border cooperation on the regional level does take place, on a technical level even since the 1970s. Given the natural situation of the border region, water management is an issue of high relevance that has led to a large experience of cooperation on this issue. The notion of "Hydro-Diplomacy" (Mylopoulos et al. 2007; Darakas 2002) illustrates, that this technical cooperation is of high importance for the overall political setting.

With regard to institutionalised cross-border cooperation, three Euroregions have been established during the 1990s (Figure 26). Two of them are currently active, whilst in recent years the Euregion Strymon-Strouma has not been very visible. The region has been involved in a series of INTERREG (and Phare) projects and promotes the deepening of cross-border interaction. Despite a series of projects, the cooperation in this region is still in a phase of trust building (Godfried 2009).

On a larger scale, the cross-border cooperation is much reflected in the framework of the Black Sea Economic Cooperation (BSEC) and the Southeast European Cooperative Initiative (SECI). As these institutions are not part of the interregional cooperation, they are not mapped on the institutional mapping above.

Spatial planning has not been a systematic object to cross-border cooperation, yet. This is due also to the fact, that the institutions have not yet reached a level of institutional power to exercise such a long-term task. This has to be seen against the background, that the decentralisation of the planning systems is still going on and very much linked to European incentives (see Godfried, 2009).

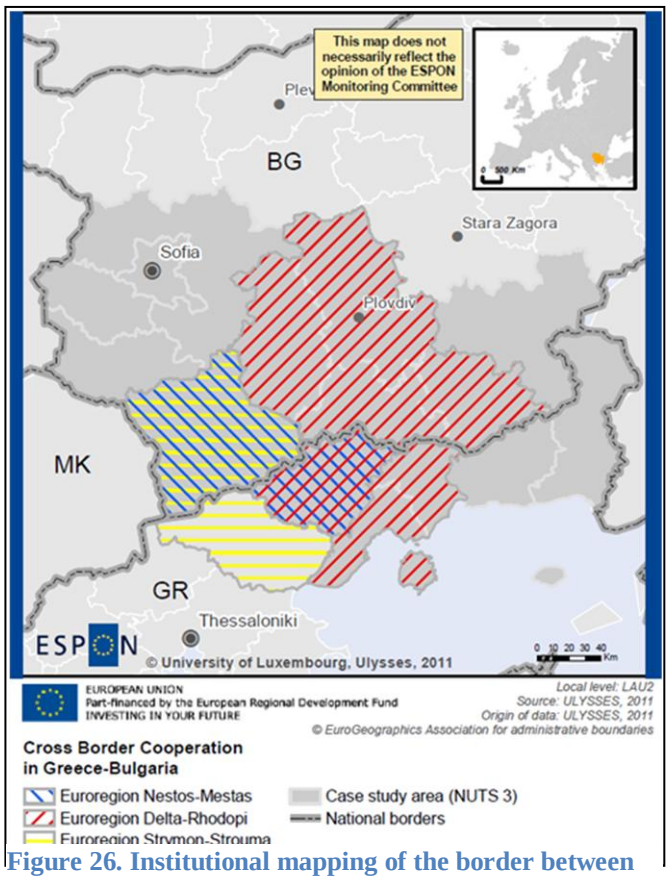

Figure 26. Institutional mapping of the border between Bulgaria and Greece.

With regard to transport, two aspects have to be mentioned: First, a TEN-T priority has already been realised on the axis Sofia – Athens, crossing the border here. Secondly, a series of EU funded projects for regional transport projects have been established. However, a comprehensive regional transport scheme has not yet been developed.

Chapter 11 – Integrated territorial analysis & scenarios

11.1. The SWOT Framework for CBA Integrated Analysis

SWOT is a framework to analyze a territory's current status based on two axes, present/future factor (or internal/external), and positive/negative influence, to decide what action should be taken. Using SWOT Analysis any cross-border area may be analyzed in terms of its current territorial status, leading easily to the definition of the recommended strategies.

In our analysis, SWOT was applied at two consecutive stages:

a) the status-analysis phase, in which the present/internal factors or future/external ones and the factors with positive impact to the achievement of goals or ones with negative impact are determined. Present/internal territorial dimensions and factors include the territorial profiles that have been performed by the project, namely the territorial profile, the territorial performance and the governance context. Future factors include economic trends, population/demography projections, and market circumstances, i.e. all the elements derived from the scenarios analysed by Ulysses and the external driving forces that have been identified by the territorial analysis.

b) the action-decision phase, in which actions are decided after the status analysis is completed. The adopted strategies may be leading to maximize the existing strengths or to mitigate and/or avoid threats, to take advantage of the opportunities by complementing the identified weaknesses, or to face present problems in the view of foreseeable downturns.

The action-decision SWOT phase will be developed in the view of the three main scenarios reported by ESPON 3.2., focusing on the Greece-Bulgaria CBA, as: a) the integrated baseline scenario, explaining the most probable evolution of the European territory, in a situation of no major changes (political or external), b) the Danubian-Europe or cohesion-oriented scenario, in which policies are formulated with the goal of social, economic and territorial cohesion as top priority, and c) the Rhine-Rhone Europe or competitiveness-oriented scenario, in which policies are directed to improve the global competitiveness of the European economy.

The proposed policy list will obviously refer to (and be structured according to) the thematic topics covered by Ulysses as demographic change, polycentric development, urban-rural relationship, accessibility and connectivity and Lisbon and Gothenburg strategies. The proposed array of policies was identified through a joint workshop between the relevant TPG member and the corresponding stakeholder.

11.2. The SWOT Analysis: Present Status-Analysis Phase

11.2.1. CBA's Strengths Analysis

From the present demographic analysis for the period 1997-2009 it became evident that the Greece-Bulgaria CBA and all its NUTS2 regions show a relatively high fertility rate, with a rather positive temporal evolution trend. This is particularly important as demographic studies demonstrated that the declining fertility rates have the greatest role in causing population ageing, as recent population cohorts become smaller than the preceding ones, thus tilting the age distribution towards older ages. Population density in the CBA appears significantly higher than the respective mean value of Bulgaria and Greece, although it is mostly affected by the presence of urban centers, as Sofia stolitsa and Plovdiv. Present population density of the CBA appears of the same order as the mean EU27 and depicts a slight positive trend over time. In terms of population migration, it occurs that some NUTS3 areas depict positive net migration trends during the examined period (1997-2009), although this is not adequate to balance natural population losses. Finally, along the well-established transportation axes (Thessaloniki – Blagoevgrad and Ormenio – Svilengrad), the borderline affects population change positively, thus attracting population near the border, especially from the Greek part.

The urban network of the CBA seems altogether hierarchical in terms of population due to the weight of Sofia metropolitan area. However, if this city is excluded from the analysis, a more polycentric picture emerges, with well-balanced population FUAs population and diminished regional disparities. In parallel, the CBA exhibits a balanced economic activity over its territory, as Sofia exerts a rather weak economic primacy, significantly lower than the corresponding primacy of the more economically active FUAs in Greece and Bulgaria.

The present settlement structure reveals a definite polycentric development pattern, where only the main Bulgarian urban centers are considered as monocentric. Accessibility depicts a rather homogeneous distribution over the CBA. The above may be considered as a 'regional asset', being able to improve CBA's competitive position in the EU. Balanced regional development provides equal quality of life to all CBA's inhabitants on the one hand, and increases the international competitiveness of its larger urban areas on the other.

The Greece – Bulgaria CBA seems characterized as a predominantly rural region of low human influence and low human intervention, as a result of the increased primary sector profile and the rural land cover distribution. The primary sector GVA shows an increasing tendency in time at all Bulgarian NUTS3 areas close to the borderline. As the CBA is rich in natural resources, it has an increased share in natural areas land cover characterization, with several preserved areas as NATURA 2000, animal reserves and national parks.

Road accessibility shows substantial improvement during the period 2001 – 2006 in most NUTS3 parts of the CBA. This is mainly attributed to the construction and completion modern highways (newly opened border-crossings, completion of Egnatia Highway, connection to Pan-European Corridors, connection to PATHE highway, etc.). A marginal improvement in the rail accessibility and a moderate in air accessibility during the period 2001 – 2006 in most NUTS3 parts of the CBA were shown. Air accessibility of the CBA scored above ESPON space average level, with an increased tendency over the 2001-06 period, indicating people's preference in air transport through the main CBA's airports (Sofia, Plovdiv, Alexandroupolis and Kavala). There exists a broad and modern optic fibers telecommunication network at the Greek part of the CBA.

Most Bulgarian NUTS3 areas depict 'slow convergence' to 'steady catching-up' tendency in terms of GDP per inhabitant increase. Employment in the CBA is distributed rather evenly among NACE economic activities, with a slight employment annual increase over the last decade. This increase is mostly fuelled by the strong employment and rise in the construction sector and the financial and real estate sector. The produced GVA of the CBA increased strongly during the latest decade by 169%, mostly attributed to the wholesale and retail trade, tourism and transport sector and the financial and real estate sector. Low and medium education attainment in the CBA is of the order of EU27. The existence of prestigious Universities and research centers in the CBA from both parts of the borderline produces impetus for economic development in the field of innovation.

The CBA is rich in natural resources and biodiversity, natural parks and reserves and shared water and forest resources. Climate change projections show that all Bulgarian NUTS2 regions are expected to depict an increased number of snow cover days, thus promoting winter tourism at the ski resorts of Yuzhen tsentralen and Yugozapaden regions. All NUTS3 regions show a uniform solar radiation profile, having at least 10% higher solar potential than the EU27 average. Air pollution is low to moderate, limited only at urban centers. Most NUTS3 areas have more than double share in Natura 2000 land cover than EU27. Soil sealed share is two to four times lower than the respective EU27 value. The CBA is rich in cultural heritage and monuments, as well as in local traditional heritage.

11.2.2. CBA's Weaknesses Analysis

The Greece-Bulgaria CBA depicts negative population growths in both 5-year periods (1999-2004 and 2005-2009), but with gradually reducing rates (-3.25% and -1.05%, respectively). Population reduction is mostly attributed in all NUTS3 areas to natural causes, i.e., death rates higher than birth rates. Dependency ratios revealed the over-aging problem of the CBA, implying that the young population portion is smaller than that of the old population. The ageing index is significantly higher than the respective mean EU27 value. Along the newly opened border-crossings (Exohi – Hatzidimovo and Thermes – Zlatograd), border effect dynamics are absent and population growth appears mostly related to the population density of these settlements.

In terms of polycentricity, the basic weakness is that although the urban system of the CBA appears rather polycentric, it moves slowly towards a more monocentric pattern over time, due to the movement of rural population to the major urban centers of the CBA. Such development may lead to the peripheralization and polarization within the CBA.

Structural problems in the primary sector seem responsible for the significant reduction in primary sector employment, the produced GVA and the gradual urbanization of natural and agricultural land. There exists a significant population imbalance between urban overpopulated urban centers and rural under-populated peripheral municipalities, remote and mountainous areas. The CBA shows gradual tendency to urbanism, in combination with the abandonment of rural areas.

The potential accessibility by road and rail indices of the CBA scored significantly below ESPON space average. Cross-border transport and accessibility seemed constrained by the mountainous relief, especially in the Rodopi – Kardzhali area.

Based on the indexed GDP per inhabitant analysis, the CBA is considered as 'less developed to very laggard region'. Primary sector employment and produced GVA showed strong reduction over the latest decade. In fact, this sector suffered most heavily in job losses, leading to urbanization and rural areas abandonment. This is linked to population ageing in agriculture and the shift of young people towards non-farming activities. Tertiary education attainment is relatively lower than the EU27 level. All three regions exhibit significantly lower (less than 50%) Total Gross Expenditure on R&D (Total GERD) expenditures compared to the EU27 average. Moreover, all regions under study have lower Business and Higher Education GERD than the EU27 average. Human Resources in R&D and employment in high-technology sectors are significantly lower in the CBA compared to EU27, showing an overall low innovation performance index. The cross-border area experiences high rates of unemployment, long-term unemployment and youth unemployment, with significantly higher rates at the Greek part of the CBA. Limited cross-border cooperation and exchange between universities and research centers from both parts of the border exists.

The CBA seems prone to increased climate change vulnerability, due to its proximity with Mediterranean and Black Sea areas. As a coastal region, the Greek part of the CBA exhibits higher vulnerability to climate change than the adjacent Bulgarian regions. Coastal floods, heat waves and extreme coastal storm waves are expected to influence Anatoliki Makedonia, Thraki region. At the same time, all CBA's NUTS3 regions exhibit higher wind energy potential than their respective national averages, but still lower than the EU27 average.

11.2.3. CBA's Opportunities Analysis

Demographic analysis showed that the basic opportunity for the CBA is the better utilization of the 'borderline factor', in order to attract population at the border area and to promote cross-border exchange. Indeed, in the recent years there is a process of forming a free-trade zone between Bulgaria and Greece, covering the regions of Sofia, Blagoevgrad and Haskovo, the border regions of Bulgaria and the Northern part of Greece. In this zone of cross-border cooperation the trade relations may be characterized as more regular and direct ones, with smaller volumes of transactions but higher frequency of their realization. Considering this trade model between the two countries, it is concluded that the features of economic cooperation may affect the population distribution and shape the demographic potential along the border area.

In terms of polycentricity, the CBA may achieve a more balanced future economic development throughout the CBA territory and a balanced settlement structure favoring transportation networks, infrastructure development and trade.

Urban-rural analysis showed that there is a need for farmers mentality change, focusing in the production of uncommon, traditional and good quality agricultural products, bio-farming products, etc. Seminars and short courses from local Universities and research Centers should initiate this action.

Furthemore, the CBA seems prone to significant improvements in accessibility and connectivity, through the completion of the new designed cross-border motorways and frontier crossing points. For example the completion of the Komotini – Nimfaio – Makaza – Kurdjali crossing point and Xanthi – Ehinos – Eledge – Rudozem and the opening of the fourth, cross-border point of local importance, Kyprinos – Ivailovgrad are currently under implementation. In parallel, the construction of the Komotini-Nymfaia-Haskovo highway (Vertical axis of Egnatia, under construction, part of the Pan-European Corridor IX), the Xanthi–Ehinos–Bulgarian borders highway (Vertical axis of Egnatia, to be included in the projects of the CSF IV) and the Ardanio–Ormenio-Bulgarian borders highway (Vertical axis of Egnatia, part of the Pan-European Corridor IX). Local and limited improvements in the railway network through the Ormenio crossing point have been undertaken. Presently, there is space for potential improvements in the bilateral collaboration towards the use of Alexandroupolis and Kavala sea ports for freight and passenger transport. Finally, the expansion of the existing optic fibers telecommunication network to the Bulgarian part is seen as another potential challenge.

Lisbon strategy analysis illustrated that an increase in the share of educated population may have a positive impact on the GDP. By raising the share of the tertiary-educated population aged 25-34 to 40% it is expected to produce a radical increase in GDP per head. The loss of jobs is related to low or insufficient specialization, whereas the demand for specialized, knowledge-based workforce is increasing. There is an increasing demand for specialized employment in the tourism and 'green' business sector. Similarly, there exists a need for re-valorization and re-orientation of labor force to more competitive sectors of activity. Regional and cross-border development policies should be formulated and applied aiming to promote, encourage and support small and very small enterprises (SMEs), integrating new technologies and ICT tools. There is room for potential investments in energy networks (oil and gas pipelines).

Bilateral cooperation should be fostered in resolving common problems like water management in river Nestos / Mesta and river floods in river Evros. There exists significant potential for investments in renewable energy resources as well as cross-border co-operation on environmental sustainability issues.

11.2.4. CBA's Threats Analysis

It is apparent that the CBA is characterized by an over-aged population, leading to the gradual decline of the potentially active workforce. This is a general EU threat, met globally in developed economies, leading to shortages in skill and labor. There exists limited cross-border cooperation and integration of local economies within the CBA. There is a tendency for increased population flow to urban centers as well as increased immigration flow to other EU countries.

The potential concentration of population and all economic activities in CBA's urban centers and the future monocentric FUAs population and economic development could be seen as a threat based on the polycentric development analysis. Such evolution would directly affect rural areas, leading to gradual depopulation and reduction in the primary sector economic activities.

Transportation and connectivity within the CBA may be threatened due to the reported significant delays and the lack of funding for the completion of cross-border motorways and frontier crossing points. Another important threat is the low integration of broadband communication technologies in remote and rural areas of the CBA. Finally, Illegal and unmonitored immigration transfer within the CBA takes place in the latest years.

Social cohesion indicators exhibited a gradual better performance until 2008, disintegrating sharply after 2008 and returning back to the 1997-levels. Unemployment appears of structural nature, directly related to primary sector abandonment and the concentration of enterprises in areas of high subsidies and low operational and wages cost. There exists a continuing low-level of investments in education, R&D and innovation. There is a sharp deterioration in the market conditions for the local, traditional enterprises, due to the strong competitiveness from the European or multi-national companies. A significant potential threat for the area could be focusing on massive, low standard tourism, leading to adverse social and environmental consequences.

Finally, the CBA may be threatened by environmental deterioration due to climate change impacts and extreme weather events. Water management conflicts as a result of water scarcity and mismanagement are expected to increase in time.

11.3. The SWOT Analysis: Scenarios Status-Analysis Phase

11.3.1. The Integrated Baseline Scenario

The basic challenge for the CBA is the retaining of the favourable demographic patterns and the reversal in the adverse demographic trends. This is particularly important, as the ageing process, already observed by 2000s will be amplified by 2030, despite the revival of fertility rates in some regions. Bulgaria is one of the countries where demographic patterns are expected to worsen. The increase trend in fertility rates is expected to flattened, enhancing over-ageing and labor force shrinking. External migration is expected to increase, although under a more controlled framework, to counterbalance existing demographic patterns. Population ageing and depopulation could reach a critical point in some rural areas of the CBA (Pernik, Kyustendil, Evros, Kavala and Drama). Positive signs may be seen at the

urban centers of Sofia stolitsa, acting as a weak MEGA city for the CBA and at Plovdiv, becoming a regional center in the area, thus inducing the monocentric patterns in the region.

The catching-up process of the Bulgarian NUTS3 regions is expected to continue, while Anatoliki Makedonia, Thraki will exhibit a slow-down trend, following the general behavior noted in all South European countries. Increased economic performance in the CBA could be seen in urban centers as Sofia stolitsa, Plovdiv, Pernik and Haskovo. Near the border, economic growth will fade rapidly, due to the rural orientation of local economy. These rural and mountainous remote parts could become subject to increased marginalization and depopulation. As CAP subsidies follow a downward path, 'experience farming' producing organic, traditional and high quality products and taking advantage of high productivity 'know-how' increases.

Although territorial integration in the CBA deepens, the quality and intensity of inter-firm cross-border co-operation remains at low levels, as presently. Kavala, Xanthi and Drama face the risk of very high declining in industrial activity. Transport flows will be controlled by the general economic conditions and the increasing energy prices. Despite that trend, the network of motorways is expected to expand in the area, improving internal and external connectivity and accessibility in the CBA. However, multi-modal accessibility index by 2030 is now expected to increase significantly, mostly due to the very low level of investments in the railway network. The expected increase in oil prices could boost the diversification process of energy supply systems, favoring the promotion of renewables. Anatoliki Makedonia, Thraki will benefit strongly from this development due to its high solar, wind, hydropower and biomass potentials. Agricultural production will become strongly affected by increased energy prices, increasing the cost of products and eroding local competitiveness. On the other hand, high potentials exist for the production of bio-fuels, bringing new sources of income to farmers.

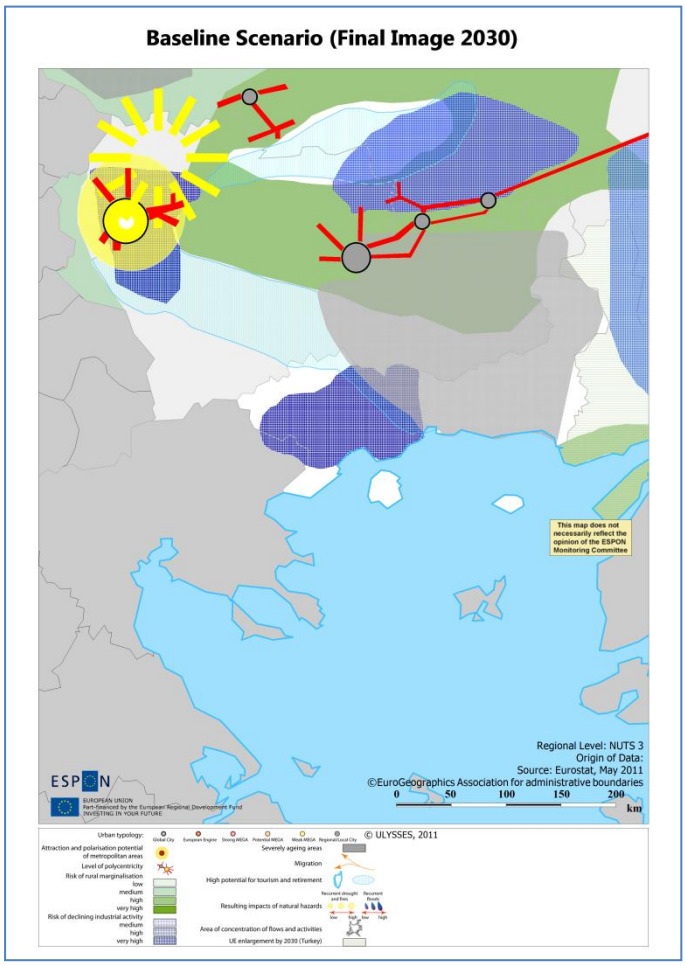

Figure 27. Schematic map of the Greece-Bulgaria CBA in year 2030, according to the baseline scenario.

Environmental problems will be directly linked to climate changes, becoming more profound at the CBA, due to its proximity to the Mediterranean and the Black Sea areas. Water shortage is the main threat for the CBA, increasing the need for imposing irrigation efficient techniques and water pricing. The production of the most water-consuming crops (e.g. cotton, corn) progressively disappears. Precipitation reduction increases the risk for forest fires making landscape management in rural areas more difficult. In Anatoliki Makedonia, Thraki the adverse impacts of groundwater deterioration through salinization and pollution will be enhanced. Tourism and second home construction exerts pressure along the CBA's coastline, at the expense of valuable natural landscapes and wetlands. Biodiversity of natural protected areas declines due to climate change effects, as many elements of the natural landscape are removed.

11.3.2. The Danubian Europe Scenario

The basic effect of this scenario in the demographic field is the adoption of policies oriented towards the revival of fertility rates in most countries. These policies lead to a more balanced demographic structure and population growth in the CBA, reversing depopulation trends. Fertility rates in all NUTS3 areas of the

CBA continue to increase at sharper pace, while external migration becomes more restrictive, diminishing migrants' flows through and in the CBA. On the contrary, illegal migration continues but with declining trend. Although the adopted policies have a more social cohesion-orientation, population median age by 2030 changes slightly from the baseline scenario. This implies that population ageing continues to affect most NUTS3 areas of the CBA. The areas with high potential for tourism and retirement as well as those with severe population ageing remain similar to the baseline scenario.

Public intervention takes place to impose policies towards a more balanced regional development and territorial cohesion. These policies include numerous measures aimed at increasing the competitiveness of the less favored regions and avoiding their marginalisation with regard to globalisation trends. The CBA can benefit from this approach, attracting external investments and enhancing the opportunities for development of its enterprises. Located at the periphery of Europe, the CBA faces several challenges, since under this scenario development appears more diffused, directed towards rural and marginal regions of medium-to-low income. Polycentricity of the CBA is enhanced, as the large urban centers are less-favored compared to the small and medium-sized towns. Thus, support for technological development is concentrated on the less-favored parts of the CBA through ICT infrastructure development, broadband access improvement and strengthening the research, innovation and development poles. The rural CBA's parts are also supported by the CAP, by protecting and regulating agriculture against globalization, leading not only to higher primary sector employment and GVA, but also in reduced chemicals and irrigation water usage.

Transport modes, especially through railway are particularly promoted and modernized, supporting territorial cohesion and balanced regional development. Significant investments in the CBA take place to foster this policy, aiming to reduce travel cost and to increase accessibility within the CBA. As energy prices are expected to rise by 2030, the CBA may benefit from the energy sources diversification need and the development of decentralized energy production and distribution systems. Decentralized energy production supports further farmers income (through biofuels production, wind and solar systems), counterbalancing the decline in a number of traditional weakly competitive agricultural activities. Renewable energy production improves environmental quality and protects the less favored, rural areas of the CBA.

The economic development of the CBA is directly affected by the social-cohesion policies adopted. The rural parts of the CBA exhibit higher growth rates than the urban centers, as a combined result of the enhanced support from RDP and structural funds and the extended development of renewables supporting the decentralized energy supply systems. Significant investments are directed towards water-saving irrigation techniques, desalination plants and the cultivation of less water-demanding crops. Climate change adverse impacts play a lesser role in this scenario, reinforcing tourism development in the CBA. Territorial governance of the CBA is supported by structural funds allowing a strong role to public actors and a stronger to the European Commission.

11.3.3. The Rhine-Rhone Europe Scenario

Based on this scenario, selective immigration is allowed through EU external borders aiming to increase the labor force and to reverse the demographic potential. Specific measures are taken to increase fertility rates (through family protection and fiscal incentive policies) and to increase the retirement age. Despite these measures, median population age in the CBA is expected to increase in 2030 by 2 years, as compared to the baseline scenario. Population ageing at the rural parts of the CBA is expected exacerbate more than the baseline scenario, reaching alarming levels as young and qualified people move to large cities or tourist regions. The demographic potential of the CBA reduces significantly than the baseline scenario, mostly as a result of sharp public spending cuts and the increased flexibility induced in the labor market. Population disparities throughout the CBA are expected to be enhanced to the favor of its main urban centers, as a result of support reduction in rural development. Monocentric size and location patterns for Sofia, Pernik and Plovdiv seem to evolve by 2030, leading to its gradual territorial polarization.

The scenario favors a dynamic labor market, with high cross-border mobility, in which internal migration constraints are abolished and external migration targets on young and highly skillful labor. Cross-border labor exchange could be promoted, especially for highly skilled personnel. The competitiveness orientation of adopted policies leads to the sharp reduction of public expenditure and the privatization of

public services. This will severely affect Anatoliki Makedonia, Thraki region in which the contribution of the public sector in the produced GDP is significant. On the contrary, intra-Mediterranean and global trade will rise, providing significant advantage to the port-cities of Alexandroupolis and Kavala, favoring the development of parallel service functions.

CAP and structural funds are completely reformed, and their resources are directed towards R&D, technological development, ICT, education and training. Such direction will directly affect CBA's rural areas, promoting rural depopulation and further primary sector GVA reduction. Agricultural productivity will further decline as a result of sustained drought, especially in non-irrigated areas. This may lead further into increased cities and agglomerations concentration and into growing cross-border labor force migration. In non-irrigated areas, agriculture will give space to solar energy production, boosted by the increase in energy prices, while in the irrigated land along the rivers Nestos/Mesta and Evros/Maritsa agriculture will intensify, allowing local economic diversification.

The economic performance of the CBA seems worse than that under the baseline scenario, due to the significantly weaker cohesion-oriented structural support, the reduced CAP funds and under the pressures of increased globalization. CBA's social cohesion indices deteriorate fast, as unemployment, long-term and youth unemployment rises. As intra-national economic disparities rise, the gap for Anatoliki Makedonia, Thraki and Yutsen tsentralen regions with their national average indices steadily increases. Tourism is favored, although transportation costs increase and climatic conditions are worsen. Small and medium sized towns specialized in residential economy, tourism, recreation, cultural activities, health care etc. have remained attractive and have therefore expanded. At institutional level, cross-border co-operation is enhanced since all previous barriers are abolished, allowing the inter-firm collaboration and promoting the bilateral trade and tourism and transport services.

Chapter 12 – Suggested Strategies

12.1. The EU Strategic Policy Framework

The provision of policy alternatives or policy options are an important part of all ESPON projects as ESPON is supposed to be a "policy-oriented research" program. For this purpose, a comprehensive review on the EU policy documents emphasizing on its territorial dimension was needed, focusing on:

1. The Lisbon Treaty, introducing the territorial cohesion concept as a fundamental aim of the EU, alongside with social and economic cohesion,
2. The Territorial Agenda 2020, providing strategic orientations for territorial development, fostering integration of territorial dimension within different policies through all governance levels, and
3. The EU 2020 as the current key-reference strategy for the next 10 years, introducing smart growth, inclusive growth and sustainable growth as policy alternatives.

12.2. The CBA Confronting its Main Challenges

The main future challenges for the Greece-Bulgaria CBA were explored, following the thematic topics covered by Ulysses as demographic change, polycentric development, urban-rural relationship, accessibility and connectivity and Lisbon and Gothenburg strategies.

In terms of demographic changes the challenges identified in the CBA were to retain the existing favorable demographic trends, (e.g., the increased fertility rates in all NUTS3 areas), and to reverse the negative demographic trends, as population ageing and rural depopulation.

The CBA should preserve its balanced and polycentric population distribution throughout its space by promoting territorial cohesion and encouraging territorial competitiveness, especially at the near-border areas. An urban network of centers located on an east-to-west orientation (Blagoevgrad and Haskovo in Bulgaria and Kavala, Xanthi, Komotini and Alexandroupolis in Greece) could be better served by the development of an internal secondary medium-sized cluster comprised of Petrich, Smolyan, Kardzhali, Svilengrad, Drama, Stavroupolis and Orestias.

The rural and sparsely-populated character of the area should be preserved placing efforts to achieve urban-rural synergies and to integrate the development of small and medium-sized cities within the rural space in the CBA. Primary production sector should be supported and the flux of people from villages to cities should be reversed, especially at the rural near-border areas, in both Greece and Bulgaria.

The improvement of cross-border transport connectivity through the construction of the planned motorway axes could reduce the distances for access in goods and services and allow the better integration of the labor market. In parallel, the upgrading of the existing railway network and its connection to the ports of Alexandroupolis and Kavala could stimulate growth in the CBA creating new potentials. The telecommunication network in the CBA should be improved and the IT should be promoted to encourage more flexible work patterns.

The protection and exploitation of the common water and forest resources constitute the main priorities for cross-border co-operation. Cultural and educational collaboration could also stimulate cross-border exchange. It occurred that there is a need to facilitate the better utilization of local development potentials, and to promote education, R&D and innovation within the CBA. The bilateral inter-firm co-operation in the quest for new markets and the integration of the labor market within the CBA could promote a more balanced economic development. The CBA should confront the present economic restructuring, leading to the increased role of private sector, in order to reduce the existing spatial economic disparities. Especially at the Greek part, the present and future reduction in construction and public administration sectors should be counterbalanced by investments in tourism, renewable energy and 'experience farming'. Tertiary education attainment levels should be improved in all NUTS2 regions of the CBA and cross-border collaboration between universities and research centers should be promoted.

Finally, the CBA is confronted with the need to successfully mitigate the potential environmental and climate change impacts, especially at its coastal part, and promote regional adaptation strategies. In terms of cross-border governance and institutional framework, the main challenge is the increase of cross-border co-operation, aiming towards a more balanced territorial development.

12.3. Suggested Policy Options to Improve CBA's Performance

For demographic improvement, it seems important to exercise policies to improve family potentials by improving the family childcare facilities at the urban centres of the CBA, to introduce flexible work forms using new technologies and to enhance cross-border health care covering especially the borderline area. The introduction of young people into the labour market through full-, part- and shelf-employment should be encouraged, especially at the rural and more remote parts of the CBA.

Polycentric development in the CBA could be promoted by reinforcing its existing balanced structure through the quality of life improvements in small and medium-sized cities of the territory. The transport infrastructure and the public networks between these small and medium-sized cities should be improved. Cross-border cooperation could increase the flux of products through the main perpendicular to the border transportation axes, linking urban centres from the Mediterranean to the Balkans and vice versa.

Rural areas could be revitalised by promoting local and traditional farm products, organic farming and eco-tourism. Mountainous and semi-mountainous areas should gain their energy independence, focusing on renewable energy production, through either solar parks or wind farms. The sustainable forest management and the agricultural production of energy crops could improve the primary sector's performance in employment and GVA.

In spite of CBA's low inter-connection level, the passage of the Trans-European road networks, and the passage of the Trans-European natural gas network, could advance and reinforce CBA's role, offering greater opportunities for economic and social mobilization and development. Investments in the improvement and expansion of the telecommunication network could foster cross-border business cooperation and allow the creation of multi-sectoral information networks employing modern technology.

Cross-border trade and the provision of services should be intensified, obstacles in the legal workforce mobility should be removed, labor market legislation over the CBA should be gradually harmonized and cross-border exchanges in the field of research, education and vocational training should be promoted. Cross-border health care provisions should be introduced for the citizens living at the border areas.

All economic activities especially at the rural and environmentally-sensitive CBA parts should diminish their 'environmental footprint', intensive agriculture, forestry and mass tourism should be penalized and living quality standards should be harmonized over the CBA. Climate change risks as water shortage, forest fires, floods and animal stock diseases should be confronted in an integrated and combined manner involving authorities from both sides of the border. Local traditions and cultural exchanges should be promoted.

More specific policy options could include:

a) The CBA as an Energy and Transport Cross-Road

This policy set views the CBA and its development through a cross-road of transport axes and energy pipelines, transferring people, freight and gas from the Mediterranean and the Black Sea, via the ports of Kavala and Alexandroupolis, to the East and Central European mainland. Such policy option would re-define the CBA's 'center of influence', transforming the area as the main corridor connecting the EU with the western Balkans, the Black Sea and the Mediterranean countries. The CBA could develop its infrastructure to the direction of a 'trade and energy node', increasing the trend for higher quality products and services and promoting 'satellite' businesses in all sectors.

b) The CBA as an Agro-tourism center

The CBA should maximize the exploitation of its remarkably rich natural and cultural resources, aiming to promote an agro-touristic development model. The avoidance of massive, low quality tourism would increase employment at the remote and rural parts of the CBA, would enhance environmental protection and sustainability and would diversify the tourist product throughout the year, by promoting as 'ultimate touristic destinations' the Greek coastline during the summer and the ski resorts of Bulgaria in the winter. In that sense, small-sized tourism enterprises of the CBA could be organized into structured clusters, continuously networked and interacted with other economy sectors.

c) The CBA as an R&D corner-stone

The CBA should exploit the high level of human resources activating in the area and attempt to maximize their potential for R&D penetration in the Balkans, the Black Sea countries and the Mediterranean Sea space. This policy option could enhance synergies on both sides of the borderline, promoting the exchange of knowledge and innovation across the borders and spreading technological achievements to local SMEs. Universities and research institutes of the CBA could harmonize their educational processes through the promotion in the transfer of students and staff, and expand their cooperation aiming to attract high-level EU research grants.

Chapter 13 – General Conclusions

13.1. Methodological Flow Chart

The present report comprises a multi-scale and multi-thematic analysis to assess territorial socioeconomic dynamics and performances of the Greece – Bulgaria Cross-Border Area (CBA) and to identify existing territorial drivers and profiles. The main topics covered by the report follow TA2020, placing emphasis on demographic development, polycentricity, urban-rural relationships, levels of accessibility and connectivity and the performance of the CBA according to the Lisbon/Europe 2020 and Gothenburg objectives. Additionally, a comprehensive cross-border institutional performance analysis was carried out for the Greece-Bulgaria CBA, focusing on the structural and activity dimension of the CBA. This integrated study was followed by a two-phase SWOT analysis that included the status-analysis phase and the action-decision phase. Further, for each identified challenge related to the studied topics, a proposed potential strategy was introduced.

An extensive database for the Greece-Bulgaria CBA at NUTS0, 2 and 3 level was built, covering statistical parameters regarding the above topics. Continuous datasets for the period 1999-2009 existed

for almost all parameters, making the relevant to the trends of the previous decade, but being unable to follow current developments, as the impact of the economic crisis in Greece.

Throughout the project, continuous participation and consultation with the CBA's stakeholder (Regional Authority of Anatoliki Makedonia, Thraki) and the local AEBR representative was achieved. Project results obtained from WP2.2 and 2.3 were presented at the South-Eastern Cluster Group Meeting of AEBR in Komotini on 7th November 2011. Participants' comments were integrated in the report at that stage of the project. The identified challenges and the respective proposed potential strategies were discussed with the stakeholder's and AEBR's representatives, aiming to validate the above described process.

13.2. Main Project Findings

As the Greece-Bulgaria CBA is located at Europe's periphery, it suffers from economic under-performance, especially at its southern and remote and rural parts, leading gradually to its de-population and over-ageing. Border crossing points could reverse this negative outlook, revitalizing population patterns and economic activity near the borderline. The area retains its main rural character, having dispersed urban centers were economic activity and population concentrates. The polycentric demographic and economic character of the region could be seen as an asset, needing further exploitation through the expansion of existing connectivity networks. Trade, tourism and transport seem to be the main economic sectors supporting local CBA's economy, followed by subsequent reduction in construction and services sectors. The area underperforms in all social cohesion indices, although they showed a gradual increasing tendency up to 2008. Thereafter, a sharp decline was noted, increasing unemployment in most economic sectors. R&D investments and innovation orientation appear bellow average, having low contribution to CBA's economic growth. Climate change factors and its related environmental risks are expected to affect the area in the near future.

Overall, the area suffers from high unemployment, especially at its southern parts, and limited economic development, showing spatial disparities due to the stronger Bulgarian convergence tendency. The observed high unemployment levels are strongly related to the low R&D investments, the limited demographic dynamism and the high levels of immigration.

Territorial governance analysis indicated that the borderline is gradually transferred from a 'barrier' to an 'interface' border-type. The Bulgarian full EU accession and the political transformation procedure appears to counter-balance the very serious linguistic barrier across the border. Presently, the CBA acts at an 'increased cooperation mode', especially in the field of tourism, trade and environment.

SWOT analysis aimed to identify the main CBA's challenges for each examined topic. These are summarized as:

- the challenge to reverse the present negative demographic trends, focusing on over-ageing and rural depopulation,
- the challenge to promote territorial cohesion and encourage territorial competitiveness at the near-border zone, utilizing cross-border transportation axes as a tool of territorial integration and expansion,
- the challenge to achieve urban-rural synergies, adverting rural depopulation by promoting renewable energy investments, eco-tourism and experience farming.
- the challenge to improve economic performance by attracting external large-scale investments and promoting the bilateral inter-firm collaboration of SMEs,
- the challenge to integrate the labor market, harmonizing the present disparities, by removing existing obstacles in legal workforce mobility.
- the challenge to protect the rich and diverse CBA's environmental resources, reducing the footprint of human activities and introducing policies to confront the future climate change risks.

Following the integrated baseline scenario, the basic challenge is the retaining of the favorable demographic patterns and the reversal in the adverse demographic trends. Under this view, the demographic patterns will be worsen, thus over-ageing will be counter-balanced by external migration to advert labor force shrinking. Population ageing and depopulation could reach a critical point in some rural

areas of the CBA (Pernik, Kyustendil, Evros, Kavala and Drama), while positive trends may be seen at the urban centers, as Sofia stolitsa and Plodviv. The catching-up process of the Bulgarian part is expected to continue, while the Greek site will exhibit a slow-downward trend. Especially, Kavala, Xanthi and Drama could face the risk of very high declining in industrial activity. The expected increase in energy costs could boost the diversification process of energy supply systems, favoring the promotion of renewables. Anatoliki Makedonia, Thraki could benefit strongly from this development due to its high solar, wind, hydropower and biomass potentials. Environmenta risks increase while biodiversity declines under climate change effects.

Under the Danubian scenario, a more balanced demographic structure and population growth in the CBA is achieved. Balanced regional development policies promote territorial cohesion supporting infrastructure and technological development at the rural, less-favored areas. Polycentricity is enhanced, while transport modes are particularly promoted and modernized increasing CBA's accessibility. Renewable energy production improves environmental quality and protects the less favored rural areas of the CBA, favoring higher growth rates in these regions. Territorial governance is supported by structural funds, while climate change adverse impacts play a less significant role.

The Rhine-Rhone scenario, emphasizing on regional competitiveness increases rural depopulation while exacerbates over-ageing. The CBA adopts a monocentric behavior, leading to a gradual territorial polarization at the urban centers of Sofia, Plovdiv and Pernik. Cross-border highly-skilled labor exchange seems promoted and public expenditure exhibits a sharp decline. The expected rise of global trade favors the coastal port-cities of the CBA. At institutional level, cross-border co-operation seems enhanced since all previous barriers are abolished.

A set of policy options was proposed, in direct collaboration with the stakeholder, aiming to lead towards demographic improvement, polycentric stabilization, rural areas revitalization, inter-connection networks expansion and cross-border exchanges in the field of research and innovation. Specific policy implications involve the transfer of the CBA as a modern energy and transport cross-road, the development of the CBA into a diverse agro-touristic center for the Balkans, the Black Sea and the Mediterranean and human resources exploitation towards an R&D corner-stone of the broader region.

13.3. Further Analytical Work and Research

The need for the establishment of a local CBA Observatory dedicated to collect recent datasets at lower spatial and temporal scale appears as obvious. The Association of European Border Regions (AEBR) could play a vital role in the organization and implementation of such Observatory, interlinked in a network with other similar cross-border institutions.

This local CBA Observatory is particularly important as the area currently performs in a transitional state, changing from a 'barrier-type' into an 'interface-type' border. This transition needs closer and continuous monitoring from both sides of the border, to enhance collaboration and accelerate wherever possible the transition processes. Local Joint ESPON-AEBR Observatories could be established to monitor the harmonization and adaptation processes and provide 'know-how' to both parts. This way local data could be better integrated in the national and international (Espon, Eurostat, OECD) databases.

References

Bengs, C., et al. (2006). ESPON 1.1.2. Urban – rural relations in Europe. (Centre for Urban and Regional Studies. Helsinki University of Technology/ESPON Monitoring Committee; http://www.espon.eu).

Biehl, D. (1991). The role of infrastructure in regional development. In: Infrastructure and Regional Development. Pion. London. pp. 9–35.

Black, W.R. (2003). Transportation: A Geographical Analysis. The Guilford Press. New York.

Council of Europe (2004). A new strategy for Social Cohesion. Approved by the Committee of Ministers, 31/3/2004.

Darakas, E. (2002). The transboundary River Nestos and its water quality assessment: cross-border cooperation between Greece and Bulgaria. Environmentalist 22, 367-375.

EU Territorial Agenda (2007). Territorial Agenda of the European Union: Towards a More Competitive and Sustainable Europe of Diverse Regions — Agreed at the Occasion of the Informal Ministerial Meeting on Urban Development and Territorial Cohesion on 24/25 May, Leipzig, Federal Republic of Germany.

EU Territorial Agenda 2020 (2011). Territorial Agenda of the European Union 2020 - Towards an Inclusive, Smart and Sustainable Europe of Diverse Regions — Agreed at the Informal Ministerial Meeting of Ministers Responsible for Spatial Planning and Territorial Development on 19th May, Hungary: Gödöllő.

Godfried, S. (2009). On track with Thrace: Exploring cross-border cooperation in the EU's south-eastern external borders. MSc Thesis, University of Twente, 128 p.

MacKinnon, D., Pirie, G., Gather, M. (2008). Transport and economic development. In: Knowles, R., Shaw, J., Docherty, I. (Eds.). Transport Geographies: Mobilities. Flows and Spaces. Blackwell Publishing. Oxford. pp. 10–28.

Mylopoulos, Y., Kolokytha, E., Kampragou, E., Vagiona, D. (2007). A Combined Methodology for Transboundary River Basin Management in Europe. Application in The Nestos–Mesta Catchment Area. Water Resources Management 22(8), 1101-1112.

Nordregio et al. (2004): ESPON 1.1.1. Potentials for polycentric development in Europe (Stockholm/Luxembourg: Nordregio/ESPON Monitoring Committee; http://www.espon.eu).

Redding, S.J., Sturm, D.M. (2008). The Costs of Remoteness: Evidence from German Division and Reunification. American Economic Review 98:5, 1766–1797.

RRG – RRG Spatial Planning and Geoinformation (2006). RRG GIS Database. http://www.brrg.de/database.php?language=de. Oldenburg/H.: RRG.

Shürmann, C., Spiekermann, K., Wegener, M. (1997). Accessibility Indicators. Berichte aus dem Institute für Raumplanung 39. Universität Dortmund.

Spiekermann, K., Wegener. M. (2006). The role of transport infrastructure for regional development in southeast Europe. SEER SouthEast Europe Review for Labour and Social Affairs. issue: 01/2006.

Glossary

Ageing Index: the number of people aged 65 and over per 100 youths under age 15.

CBA: Abbreviation for Cross Border Area, representing the cross-border area along the land border between.

FUA: Abbreviation for Functional Urban Area, namely the municipality (or a cluster of municipalities forming an urban agglomeration) and its related labour basin.

Gross Added Value: A measure of the value of goods and services produced in an area, industry or sector of the economy.

NUTS: Abbreviation of the Nomenclature of Units for Territorial Statistics. It represents a 'geocode standard' for referencing the subdivisions of EU space for statistical purposes.

NUTS 1: First level definition of the EU space, corresponding to countries.

NUTS 2: Second level definition of the EU space, corresponding to regions (peripheries for Greece and planning regions for Bulgaria).

NUTS 3: Third level definition of the EU space, corresponding to districts (prefectures for Greece and oblasts for Bulgaria).

NUTS 4: Fourth level definition of the EU space, corresponding to municipalities.

Population Growth: Represents the change of total population over a certain time period.

Population Density: Represents a key geographic parameter expressing the total population per unit area, usually per sq km.

Total Dependency Ratio: Represents the ratio of the combined youth and senior population to the working-age population.

Total Fertility Rate: Represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates.

ANNEX I – The Greece – Bulgaria CBA, excluding Sofia's impact

In this Annex a similar to previous analysis was carried out, in which the impact of Sofia as the Bulgarian capital, was excluded. This means that in the analysis the Region BG41 (Yugozapaden) was consisting only of three NUTS3 areas: Blagoevgrad (BG413), Pernik (BG414) and Kyustendil (BG415). All other NUTS2 areas of the CBA remained the same. In case some indicators were only provided on a NUTS2 areal basis, then these indicators were used but special consideration was taken.

General Overview of the CBA – excluding Sofia

The Greece (GR) – Bulgaria (BG) Cross-Border Area (CBA) is defined by the 494 km borderline length between the two countries. The Greece – Bulgaria CBA is located at the north-eastern part of Greece and the southern part of Bulgaria. It comprises of three NUTS2 administrative regions:

- Yugozapaden, (BG41), excluding Sofia (stolitsa) (BG411) and Sofia (BG412)
- Yuzhen tsentralen (BG42), and
- Anatoliki Makedonia, Thraki (GR11),

Each NUTS2-level is further divided into a number of NUTS3 level administrative districts (Table 1): 3 and 5 NUTS3 administrative districts (oblasts) in Yugozapaden (BG41) and Yuzhen tsentralen (BG42) regions, respectively, and 5 NUTS3 administrative districts (prefectures) in Anatoliki Makedonia, Thraki (GR11).

Table 1. Administrative levels of Greece – Bulgaria CBA.

	CODE	NUTS-ID
Bulgaria	BG	NUTS1
Yugozapaden	BG41	NUTS2
Blagoevgrad	BG413	NUTS3
Pernik	BG414	NUTS3
Kyustendil	BG415	NUTS3
Yuzhen tsentralen	BG42	NUTS2
Plovdiv	BG421	NUTS3
Haskovo	BG422	NUTS3
Pazardzhik	BG423	NUTS3
Smolyan	BG424	NUTS3
Kardzhali	BG425	NUTS3
Greece	GR	NUTS1
Anatoliki Makedonia, Thraki	GR11	NUTS2
Evros	GR111	NUTS3
Xanthi	GR112	NUTS3
Rodopi	GR113	NUTS3
Drama	GR114	NUTS3
Kavala	GR115	NUTS3

The Greece – Bulgaria Cross-Border Area (when excluding Sofia) occupies a total area of 48,417.30 sq km. Anatoliki Makedonia, Thraki (GR11) covers an area of 14,157.0 sq km (i.e., 43.07%) of Greece, while Yugozapaden (BG41) and Yuzhen tsentralen (BG42) regions occupy in total 34,260.30 sq km (i.e., 30.86%) of Bulgaria.

At NUTS2 level, Yuzhen tsentralen represents 46.19% of the CBA's total area (excluding Sofia), Yugozapaden the 24.57% while Anatoliki Makedonia, Thraki 29.24%. Blagoevgrad (BG413) and Plovdiv (BG421) are the largest NUTS3 level units of the CBA, occupying 7,062.3 sq km and 5,972.9 sq km, respectively. Xanthi (GR112) and Kavala (GR115) are the smallest NUTS3 level units of the CBA, covering 1,793.0 sq km and 2,111.0 sq km, respectively.

Komotini, the administrative centre of Anatoliki Makedonia, Thraki is located approximately 746 km to the north-east of Athens, the capital of Greece. On the other hand, the capital of Bulgaria, Sofia, is part of the Greece – Bulgaria CBA, located at its north-western part. Excluding Sofia, Blagoevgrad is considered as the administrative centre for Yugozapaden region, while Plovdiv, the administrative centre for the Yuzhen tsentralen region, is located 131 km to the south-east of Sofia.

Over the latest decades, the studied area has developed significant cross-border co-operation within the framework of INTERREG Programs.

Chapter A3 – Demographic Analysis

3.1. Concept and Indicators

Demographic Analysis of the Greece – Bulgaria CBA aims to identify the behavior of the cross-border region in terms of population spatial distribution and temporal dynamics. The main objective is to understand the influence of the border on the settlement and population patterns of the CBA.

For the purposes of present analysis, the performance of the NUTS3 regions of the CBA was examined in terms of indicators, as the CBA's total population; the population growth; the population density; the total and partial dependency rates; the ageing index; and the fertility rates, covering the period 1999-2009. The demographic potential, i.e., the effect of the Greece-Bulgaria borders on the patterns of settlement, was analyzed at the NUTS4 unit level.

3.2. Demographic Dynamics in the Greece – Bulgaria CBA

The total population in 2009 of the Greece – Bulgaria CBA (excluding Sofia) was 3,007,485 inhabitants. This population represented approximately 0.60% of the total EU27 population (499,705,496 inhabitants in 2009). Further, CBA's population represented 39.54% of the total population of Bulgaria (7,606,551 inhabitants) and 26.71% of the total population of Greece (11,260,402 inhabitants). Plovdiv (BG421) and Blagoevgrad (BG413) are the NUTS3 areas with the higher contribution to the total population of the CBA. Drama (GR114) and Xanthi (GR112) are the NUTS3 areas with the lowest total population in the CBA.

The major result produced by the analysis, is that over the latest decade, the total population of the CBA shows a significant decrease by approximately 7.14%, with the highest negative trend shown in the Yuzhen tsentralen area. Indeed, Kyustendil (BG415), Smolyan (BG424) and Haskovo (BG422) are the areas with the highest negative population change rates. Based on this trend, the total population of the CBA in 2020 will be diminished at the level of 2,523,090 inhabitants. Xanthi (GR113) is the only NUTS3 areas of the CBA depicting positive population growth rates, even higher than the mean EU27 growth rate. This population increase in Xanthi (GR113) is attributed mostly to natural increase factors. Natural causes appear also responsible for the population reduction shown in Plodviv (BG421), Drama (GR114) and Kavala (GR115) areas. In the remaining NUTS3 unit levels of the Greece – Bulgaria CBA, population decrease is due to both natural causes and out-migration.

The mean fertility rate of the Greece-Bulgaria CBA is 1.48, equal to the corresponding rate of Bulgaria and slightly lower to that of Greece (1.51), but significantly lower than the EU27 rate (1.60). Fertility rate temporal evolution depicts a gradual increase in all regions of the CBA. Anatoliki Makedonia, Thraki exhibits the higher fertility rate value (1.61), but the highest fertility rate increase over the latest decade was observed firstly for Yugozapaden (30.48%), then for Yuzhen tsentralen (19.83%) and lastly for Anatoliki Makedonia, Thraki (12.59%).

Population density in the CBA when excluding Sofia is 54.6 inhabitants per sq km, appearing significantly lower than the mean national value of Bulgaria (68.7 inhabitants per sq km) and Greece (85.9 inhabitants per sq km), and almost half of the EU27 mean value (116 inhabitants per sq km). In all NUTS3 level units, population density appears mostly affected by the existence of urban centres in some regions in Bulgaria, as Plovdiv (BG421) with population density of 118.0 inhabitants per sq km.

The child dependency ratios in all NUTS3 level units were found consistently lower than the aged dependency ratios. This expresses the fact that the young population of the CBA represents a smaller portion of the total population than the aged population of the CBA. Such increasing proportions of aged persons have been accompanied, in both countries, by steady declines in the proportion of young persons.

In the CBA, the most over-aged populations are found in Drama (GR114), Evros (GR111), Kavala (GR115), Pernik (BG414), and Kyustendil (BG415). In fact, Xanthi (GR112) is the only NUTS3 area of the CBA having higher child dependency ratio than the corresponding aged dependency ratio. The ageing index of the CBA was computed as 139, at the level of national Bulgarian and Greek corresponding values (130 and 131, respectively), but significantly higher than mean EU27 value (110).

3.3. Border Effect for the Greece – Bulgaria CBA

In general, border regions tend to be disadvantaged economically and with regard to population growth and density. However, the enlargement of the European Union (EU) may create positive border effects in cities or regions located close to the national borders, as they are especially confronted with changes in market access, whereas the border effect for cities or regions further away from the border appears more subdued. This positive integration effect declines with distance, is about the same for new and old members, and is more important for large cities and regions (Redding and Sturm, 2008).

In the case of Greece – Bulgaria CBA, the border effect on demography was examined at NUTS4 level units, for cities located at a close distance to the border (maximum road distance of 70 km), in view of the fact that Bulgaria became a full EU member on 1/1/2007. In this analysis, NUTS4 regions were considered as located along the main transport axes along which road distances were determined. Four road axes were considered, the two main border crossing points[3]: a) the Strymon road axis (Thessaloniki – Blagoevgrad), part of Pan-European Corridor IV, and b) the Ardanio – Ormenio – Svilengrad axis (vertical Egnatia axis and part of the Pan-European Corridor IX), together with two newer crossing points: c) the Drama - Exohi – Hadzhidimovo axis constructed in 2005, and d) the Xanthi - Thermes – Zlatograd axis opened in 2009.

The Komotini – Nimfaia – Kurdjali axis has not been completed yet; therefore the interaction between Komotini and Haskovo is limited.

Results showed that along the well-established transport axes of Ormenio – Svilengrad and Exohi – Hadzhidimovo, the border affects population change positively, thus attracting population. Population growth was positive from the Greek side along these axes, turning to slightly negative towards the Bulgarian side. As the distance to border increases, population growth becomes strongly negative, indicating the positive border effect. On the contrary, along the newly opened crossings, these dynamics are absent and population growth appears mostly related to the population density of these settlements.

Chapter A4 – Polycentric Development

4.1. Concept and Indicators

The concept of polycentricity plays a fundamental role in European regional policy and constitutes a priority for spatial development in Europe. Polycentricity can contribute to the economic, social and territorial cohesion, which constitutes one of the objectives of the Lisbon Treaty, as well as to the economic competitiveness, social justice and sustainable development. Especially for South-Eastern Europe, it is strongly believed that the existing or emerging polycentric structures should be strengthened by improving the accessibility of medium-sized centres and counterbalancing the reduced accessibility of rural and isolated regions (Spiekermann and Wegener, 2006).

Based on ESPON 1.1.1 Project (Nordregio, et al., 2004), polycentricity has a twofold feature: a) Morphological polycentricity, laying out the distribution of urban areas in a given territory, and b) Relational polycentricity, based on the networks of flows and cooperation between urban areas at different scales/levels. Both elements are strongly linked: relations between cities are crucial for polycentricity, as nodes without relations would not form a polycentric system.

[3] The road axes have been defined as follows:

e) The Strymon Axis: Petrich, Sandanski, Kresna, Simitli, Blagoevgrad.
f) The Ardanio-Ormenio-Svilengrad Axis: Didimotiho, Orestiada, Vissa, Haskovo, Harmanli, Simeonovgrad, Svilengrad, Madzharovo, Ljubimec, Ivaylovgrad, Dimitrovgrad.
g) The Drama-Exohi-Hadzhidimovo Axis: Sitagroi, Prosotsani, Kato Nevrokopi, Dospat, Devin, Borino, Yakoruda, Belitsa, Razlog, Bansko, Gotse Delchev, Satovcha, Hadzhidimovo.
h) The Thermes-Zlatograd Axis: Stavroupolis, Xanthi, Miki, Chepelare, Smolyan, Rudozem, Nedelino, Madan, Zlatograd, Banite.

The main aim of this chapter is to identify tendencies in the structure of the city network in the Greece – Bulgaria Cross-Border Area (CBA) and compare the urban network density to that in the non-border regions. Further, to examine the deviation of urban centres in the CBA from the rank-size distribution of EU27 and determine the impact of urban centres distribution on commuting patterns. The basic indicators in this analysis involve: a) the size polycentricity index, with four sub-indicators (the slope of the regression line of the rank-size distribution of population in the FUAs, the primacy rates in terms of the population distribution in the FUAs, the slope of the regression line of the rank-size distribution of GDP in the FUAs and the primacy rates in terms of the GDP in the FUAs; b) the location index, expressed as the Gini coefficient of the size of the Thiessen polygons around each FUA; c) the connectivity index with two sub-indicators, with two sub-indicators (the slope of the regression line between the accessibility and the FUAs population and the Gini coefficient of the accessibility of the FUAs).

4.2. Cross-border polycentricity in the Greece-Bulgaria CBA

Polycentricity analysis was performed on Functional Urban Areas (FUAs) dataset of population and GDP, aiming to obtain the CBA's population and GDP primacy rates. Analysis of location, accessibility and connectivity indices of each FUA was also taken place. An aggregated polycentricity index was derived based on the weighted values of the above indices.

Excluding Sofia (stolitsa), overall, fifteen Functional Urban Areas (FUAs) exist in the Greece – Bulgaria CBA[4], with Plovdiv being the main urban center of the CBA. Plovdiv (BG421) and Haskovo (BG422) have 2 FUAs representing 68.7% and 59.4% of their NUTS3 level unit population within these FUAs. The rest CBA appears well-balanced with almost equal total population (70,000 - 90,000 inhabitants) in FUAs.

4.2.1. Size Polycentricity Index

Characteristic for polycentric urban systems is that cities often tend to be relatively similar-sized. For the FUAs population, a linear regression of the absolute value of the size of each city and of the corresponding location of the city in the size rating is performed. The performance of a linear regression between the population of the FUAs and their location in the aforementioned classification results in the indicator "primacy rate", which expresses the degree of primacy of the FUA with the highest population (in this case Plovdiv). Population primacy rate of the CBA was calculated at 3.56 in 2001 and at 1.76 in 2006, implying that population primacy of Plovdiv FUA in relation to the rest of the FUAs of the CBA gradually decreases over time. This finding suggests that the system moves towards more polycentric patterns over time.

By solving the produced regression equation, it was derived that based on the population distribution of the CBA, the population of Plovdiv should be approximately at the level of 123,114 inhabitants in 2001 and 245,714 inhabitants in 2006, to achieve polycentricity. Moreover, based on the distribution of cities in relation to the regression line of 2001, it occurs that Haskovo, Kavala and Blagoevgrad are over-represented, while the medium-sized cities of the CBA (Alexandroupolis, Asenovgrad and Karzdhali) are under-represented. The situation changes for the 2006 regression, as Pernik, Haskovo and Kavala appear under-represented by the FUAs distribution in the CBA.

The CBA appears slightly more polycentric than Greece and Bulgaria, but more monocentric than other Greek NUTS1 areas as Voreia Ellada (GR1) and Kentriki Ellada (GR2). The primacy of the biggest city over the rest FUAs of the CBA (Plovdiv) is moderate and definitely lower than the corresponding primacy of Athens and Thessaloniki over the rest FUAs of Greece and Voreia Ellada, respectively. However, the primacy of Plovdiv in the CBA territory appears higher than the corresponding primacy of Sofia in Bulgaria, of Athens in Kentriki Ellada and of Irakleion in N. Aigaiou – Kriti. The change in the slope of this regression line shows a significant increase (from -0.029 to -0.614), meaning that the system moves slowly towards a more polycentric pattern. This trend is mainly due to the population redistribution over the CBA, as Plovdiv decreases in population and some CBA's cities exhibit a considerable population, especially in the Greek FUAs with relatively small size.

The Gross Domestic Product (GDP) was used to express the FUAs size of the markets. GDP per inhabitant data for all European FUAs for year 2006 was provided by Eurostat. The values of this parameter were multiplied by the 2006 FUAs population to derive the 2006 FUAs GDP. It occurs that the FUAs of the Greece

[4] The FUAs of the CBA are: Sofia, Blagoevgrad, Petrich, Pernik, Kyustendil, Plovdiv, Asenovgrad, Haskovo, Dimitrovgrad, Pazardzhik, Kardzhali, Alexandroupolis, Xanthi, Komotini, Drama, Kavala.

– Bulgaria CBA (excluding Sofia) produce a GDP of 7.3 billion Euros. The highest GDP is produced in the FUA of Plovdiv (1.3 billion Euros), followed by the GDP of Kavala (1.3 billion Euros). FUAs with the lower GDPs are Kardzhali (88.5 million Euros), Dimitrovgrad (124.5 million Euros) and Kyustendil (140.5 million Euros).

The GDP primacy rate of the CBA was found at 0.08 in 2006, meaning that Plovdiv excels an extremely weak economic primacy over the rest of the FUAs of the Greece – Bulgaria CBA. This suggests a balanced economic growth distribution of FUAs over the CBA territory. The economic primacy of the city appears significantly lower than the corresponding primacy of the more economically active FUAs in Greece, Bulgaria and the NUTS1 unit levels of Greece. Overall, the fact that the GDP rank-size distribution is similar to that of population proves the general principle that 'largest cities are most likely to be most economically successful' (ESPON, 2005).

Comparative results of the polycentricity size indicators for Greece – Bulgaria CBA and the respective NUTS0 and NUTS1 revealed that in terms of population distribution the CBA appears as a rather polycentric area, with relatively mild slope of the regression line. The CBA appears slightly more polycentric than Greece and Bulgaria, but more monocentric than other Greek NUTS1 areas as Voreia Ellada (GR1) and Kentriki Ellada (GR2). The primacy of the biggest city over the rest FUAs of the CBA (Plovdiv) is very low and definitely lower than the corresponding primacy of Athens and Thessaloniki over the rest FUAs of Greece and Voreia Ellada, respectively.

4.2.2. Location Polycentricity Index

This index examines the distribution of cities over the territory, by sub-dividing the territory into service areas in a manner that each point of the territory is allocated to the nearest centre. The method utilises the Thiessen polygons to define individual areas of influence around each of a set of points. In this way the area served by each centre can be measured. Such area of influence represents the PUSH (Potential Urban Strategic Horizon) areas, including all municipalities of which at least 10% of the area can be reached within 45 minutes from each FUA centre by car. As a measure of the inequality of the size of service areas the Gini coefficient of inequality was used.

It occurs from the Location Index analysis that Kavala, Drama and Xanthi are the PUSH areas with the higher number of municipalities assigned in them, using the full-area and the 50% criterion. When the 5% criterion is used, then Drama, Kavala and Plovdiv are the PUSH areas with the higher number of municipalities assigned in them.

The mean PUSH population in the CBA (excluding Sofia) is 461,134 inhabitants. Pernik and Asenovgrad are the biggest in terms of population PUSH areas. Orestias, Alexandroupolis and Kyustendil are the lower in population PUSH areas. PUSH territories show a mean overlap of 74% with adjacent PUSH areas. The mean settlement area for each PUSH covers 182 km^2, with the highest settlement area in Pernik (495.00 km^2) and the lowest in Alexandroupolis (37.31 km^2). Settlements cover on average 3.38% of the PUSH areas in the CBA.

Location Index analysis reveals that the settlement structure in the Greece – Bulgaria CBA is considered as polycentric for most PUSH areas, while only Pernik, Plovdiv, Asenovgrad and Pazardzhik are considered as monocentric. A mean Gini Coefficient of 0.51 reveals the moderate polarization in the distribution of settlements in the PUSH areas of the CBA. Increased polarization is shown in the PUSH area of Pernik (Gini = 0.7370). The Area Concentration Index (ACI) was developed and applied, taking account both the size of the settlement areas and their relative location against each other. Again, the highest ACI was calculated in Pernik and the lowest in Orestias, Kavala and Drama.

4.2.3. Connectivity Polycentricity Index

The connectivity of the FUAs constitutes one of the central factors of polycentrism. Based on ESPON 1.1.1 it occurs that in a polycentric system, both small and large FUAs have good accessibility. The more accessible lower-level centres are compared to the primary city, the less monocentric is the urban system. To measure the actual interactions, accessibility was considered by the area covered by the 45-minutes isochrones, i.e., the area that can be reached from the respective FUA centre in 45 minutes, travelling by car with a mean travel speed (Shürmann et al., 1997).

Accessibility Index analysis illustrates that Plovdiv and Pernik are the FUAs with the higher accessibility of the CBA, while Orestias with the lower. Most FUAs in the CBA depict a relatively low change in accessibility over time, attributed to the limited FUAs population change. Accessibility primacy rate of Plovdiv was computed at 3.85, indicating a relatively low degree of primacy over the remaining CBA. Similarly, the Gini coefficient of accessibility (0.24) indicates a rather homogeneous distribution of accessibility throughout the Greece – Bulgaria CBA.

4.2.4. Combined Polycentricity Index

Using the above determined partial polycentricity indices, namely the Size Index, the Location Index and the Connectivity Index; a combined Polycentricity Index can be derived.

The Greece – Bulgaria CBA combined Polycentricity Index appears significantly higher than the corresponding value for Greece and slightly lower than that of Bulgaria. The CBA obtained the lower Location Index probably due to the inequality in the FUAs service areas. Connectivity Index was found at very high levels, significantly elevated than Bulgaria, Greece and the Greek NUTS1 examined areas. Finally, the combined Polycentricity Index shows relatively increased level, at quite similar level with the examined NUTS0 and NUTS1 areas.

Chapter A5 – Urban – Rural Relationships

5.1. Concept and Indicators

ESPON Project 1.1.2 defined the ‘urban’ and ‘rural’ space in Europe, examined their structural and functional inter-relationships and analyzed the EU policies affecting these relations (Bengs et al., 2006). With regard to the definition of a rural area in the EU, it is a territorial unit that has “a) population density up to 100 persons per km^2, or share of agriculture equal or twice higher that the Community average for any year after 1985; b) average unemployment for the last three years higher than the community average, or a reduction of population after 1985”.

The elaborated typology produced by ESPON 1.1.2 is based on the idea of two main dimensions, that is, the *degree of urban influence* on the one hand, and the *degree of human intervention* on the other hand. In determining degree of *urban influence*, two factors were taken into account: population density and status of the leading urban centre of the region. Only two classes were defined, i.e. *high urban influence*, and *low urban influence*. In terms of the *degree of human intervention* three classes were defined: *High human intervention* corresponding to the situation where the share of artificial surfaces (and possibly one of the two other land cover categories) is above European average, *medium human intervention* equals the cases where the share of agricultural land (and possibly the share of residual land cover) is above European average, and *low human intervention* concerns all cases where only the share of residual land cover is above European average.

5.2. Urban-rural relations in the Greece – Bulgaria CBA

Urban-rural relationships of the Greece – Bulgaria CBA were examined in terms of population density, urban-to-rural population shares, employment and GVA in the primary sector and land type coverage.

5.2.1. Population Density

The mean population density of the CBA (54.6 inhabitants per sq km) was found lower than the mean value of Bulgaria and Greece and significantly lower than the mean EU27 corresponding value. This indicates that the status of urban influence in the CBA is considered as rather low.

In most NUTS3 regions, population density depicted a decreasing trend over the last decade. Linear population density projections showed that by year 2020 most NUTS3 level units are expected to be characterised as ‘strongly rural areas’ (having population density below 50 inh per sq km), thus experiencing strong depopulation. Plovdiv is the only ‘moderately urban area’ of the CBA.

5.2.2. Urban-Rural Population and GVA Analysis

Urban-to-rural population analysis showed that that the level of urbanism for Bulgaria and Greece is relatively high and quite similar (71.41% and 72.79%, respectively). In terms of NUTS2 areas, Yugozapaden (BG41) shows the stronger urbanism proportion, with 63% of total population living in urban areas. Yuzhen Tsentralen (BG42) region shows significantly lower urban population proportion (66.46%), with Plovdiv (BG421) having the higher urban population percentage (74.45%) and Kardzhali (BG425) being a relatively rural area with urban population percentage of 41.79%. Finally, Anatoliki Makedonia, Thraki (GR11) is a NUTS3 region with almost balanced 'urban-to-rural' population (59.11%). Drama (GR114) and Kavala (GR115) present the higher urban population proportions (63.08% and 62.77%, respectively). Rodopi (GR113) appears as the most rural NUTS3 area of the region, having the 51.43% of its total population living in urban centers. Temporal analysis revealed that over the last five years a gradual increase in urbanism has occurred, as urban population increased by 0.23% per year in Yugozapaden (BG41) and by 0.42% per year in Yuzhen Tsentralen (BG42).

Present analysis revealed that the primary sector employment in the Greece – Bulgaria CBA (excluding Sofia) seems to be characterized by an increased 'level of ruralism', as approximately 25.13% of the economically active population is employed in the agriculture, forestry and fishing sector. This increased primary sector employment appears mostly affected by the high employment in Yuzhen tsentralen (BG42), where almost 27% of the total economically active population is employed in this sector. In Anatoliki Makedonia, Thraki (GR11) this percentage reduces to approximately 25%, while in Yugozapaden (BG41) rural employment is reduced to 18.6%. Rural employment over the last decade shows a gradual reduction trend of 0.64% per year; in Anatoliki Makedonia, Thraki this reduction is the highest, reaching 3.5% per year.

The produced GVA in the agriculture, forestry and fishing sector of the CBA (excluding Sofia) was of the order of 1.2 billion Euros in 2008. Plovdiv (BG421), Blagoevgrad (BG413), Evros (GR111) and Kardzhali (BG425) are producing the higher GVA in the CBA. In fact, all Bulgarian areas located closely to the Greece – Bulgaria borderline depict the higher percentages (>10%) in GVA production from primary sector activities. GVA's temporal variability depicts an increasing tendency through time in Bulgarian areas (>10%), especially those close to the borderline. All Greek areas show a strong opposite effect, following well the national trend (from -7 to -10%). As a result the CBA's GVA by 2020 seems to remain unchanged. A cluster of areas (Pazardzhik, BG423; Blagoevgrad, BG413; Smolyan, BG424; Drama, GR114 and Xanthi, GR112) show almost equal behaviour in their annual primary production sector GVA change (from -7 to -10%).

5.2.3. Land Coverage

Land cover is here taken as an indicator of degree of human intervention. Harmonised data of land cover are made available by the CORINE dataset. In this data set, the total land cover is divided into three main categories: artificial surfaces, agricultural land and a residual group. Artificial surfaces consist of urban fabric, industrial, commercial and transport units, mine, dump and construction sites, and artificial, non-agricultural vegetated areas. Agricultural areas include arable land, permanent crops, pasture and heterogeneous agricultural areas. The residual group is composed by forest and semi-natural areas (forests, scrub and/or herbaceous vegetation associations, open spaces with little or no vegetation), wetlands (inland wetlands, maritime wetlands), and water bodies (inland waters, maritime waters).

The European average of artificial surfaces was 3.48% of the total land cover. The corresponding figure for agricultural land was 50.36% and for the residual group it was 46.16%.

Present analysis pointed out that the Greece – Bulgaria CBA (excluding Sofia) shows a rather slight positive trend in agricultural areas change (+0.06% per year) having a present coverage of 36.3%. Yuzhen Tsentralen (BG42) shows the higher coverage in agricultural areas (40.30%), with a slight negative trend, followed by Anatoliki Makedonia, Thraki (38.62%) and Yugozapaden (32.82%). Anatoliki Makedonia, Thraki loses agricultural land with a significant average annual rate (-4.07%), while Yugozapaden (excluding Sofia) depicts a high positive trend of +7.90% per year. In terms of NUTS3 level units, Plovdiv (BG421), Haskovo (BG422) and Evros (GR111) show the highest 'rurality' behaviour, with agricultural land coverage over 50% of their total area. The highest negative annual trend in agricultural land change is presented by Rodopi (GR113, -7.93%) followed by Xanthi (GR112, -5.74%). The highest positive trend is shown in Blagoevgrad (BG413, +9.55%).

5.2.4. Urban-Rural Typology

Based on the above parameters (population density; urban – rural population; employment in agriculture, forestry and fishing; produced GVA by the sector of agriculture, forestry and fishing; and land cover and land use), the two main existing urban – rural typologies were followed: a) The Eurostat urban – rural typology, in which regions are classified into three classes: predominantly urban, intermediate and predominantly rural, and b) the ESPON 1.1.2 urban – rural typology, in which regions are classified according to the urban – rural influence and the low – high human intervention.

Eurostat urban-rural typology, classifies Kyustendil (BG415), Pernik (BG414), Plovdiv (BG412) and Haskovo (BG422) as 'Intermediately Urban Areas', and all remaining regions as 'Predominantly Rural Areas'.

On the other hand, based on ESPON 1.1.2 typology, the whole Anatoliki Makedonia, Thraki (GR11) and the regions of Blagoevgrad (BG413), Smolyan (BG424) and Kardzhali (BG425) are classified as areas of 'Low Urban Influence and Low Human Intervention'. Haskovo (BG422), Pazardzhik (BG423), Sofia (BG412) and Pernik (BG414) are characterized as areas of 'Low Urban Influence and Medium Human Intervention', while Plovdiv (BG412) is considered as an area of 'High Urban Influence and High Human Intervention'.

Chapter A6 – Accessibility & Connectivity Analysis

6.1. Concept and Indicators

Accessibility is the main 'product' of a transport system. While transportation is generally thought of as the way to reach or move something through space, the ability to transport can be defined as accessibility (Black, 2003). In more general terms, accessibility is an important factor for competitiveness of places, determining their economic success (Biehl, 1991; MacKinnon et al., 2008). It is closely related to mobility, economic development, social welfare and environmental impacts. Therefore, accessibility can be considered as a proxy of a set of related (economic, social, environmental) effects of transport infrastructure.

Accessibility determines the locational advantage of an area (i.e. in ESPON a region, a city or a corridor) relative to all areas (including itself). The important role of transport infrastructure (i.e. networks and transport services) for spatial development in its most simplified form implies that areas with better access to the locations of input materials and markets are expected to be more productive, more competitive and hence more successful than more remote and isolated areas.

The basic indicator used in the present analysis is the Potential Accessibility Index for Road, Rail or Air, determined by two functions: one representing the activities or opportunities to be reached and one representing the effort, time, distance or cost needed to reach them. The basic assumption for its calculation is that the attraction of a destination increases with size and declines with distance or travel time or cost. Therefore, both size and distance of destinations are taken into account. The size of the destination is usually represented by area population or some economic indicator such as total area GDP or total area income. The activity function may be linear or nonlinear. Multimodal accessibility indicators combine several modal accessibility indicators.

The aim of this report is the evaluation of the various accessibility and connectivity levels for each NUTS0, 2 and 3 region of the Greece – Bulgaria Cross-Border Area, and to perform cross-border comparisons estimating the general accessibility levels of the CBA regarding the different modes of transportation. Accessibility and connectivity analysis was performed aiming to determine the general accessibility levels of the Greece – Bulgaria CBA according to the various transportation modes, i.e., road, rail and air, as well as multimodally. Comparisons were taken place between the index of each NUTS3 level unit and the ESPON and CBA average, while the change of the above indices through time was assessed.

6.2. Potential Accessibility by Road

The calculation of the updated road potential accessibility indicators for 2001 and 2006 is based on the detailed GIS database of trans-European transport networks, which cover all countries of the ESPON space and the remaining European countries and includes all modes of transport (RRG GIS database, 2006).

Results showed that the potential accessibility by road of Yugozapaden (BG41) and Yuzhen tsentralen (BG42) (32.63 and 32.56, respectively) appeared significantly higher than that of Anatoliki Makedonia, Thraki (GR11, 21.6). However, this latter area shows a strong improvement in the potential accessibility index between years 2001 and 2006 (from 18.5 to 21.6), due to infrastructure upgrading. Plovdiv (BG421), Haskovo (BG422) and Pernik (BG414) present the higher potential accessibility by road indices, while Evros (GR111) and Drama (GR114) depict the lower values. Considering the potential accessibility indices, as related to the Greece – Bulgaria CBA average value, two clusters are formed: the a) *the low accessibility group* consisting of the Anatoliki Makedonia, Thraki areas, together with Smolyan (BG424) and Kardzhali (BG425) with values between 60 and 90 and b) the higher accessibility group, consisting of the remaining areas at the north, north-eastern and north-western parts of the CBA, having accessibility by road values the CBA's mean value.

In terms of the temporal change in the potential accessibility index by road, over the period 2001 – 2006, Kyustendil (BG415) depicts the higher positive index change in potential accessibility by road, Anatoliki Makedonia, Thraki (GR11) together with Blagoevgrad (BG413) and Pernik (BG414) show a medium positive index change, while Yuzhen tsentralen region (BG42) shows near zero or even slightly negative standardized index change for the 2001-06 period.

6.3. Potential Accessibility by Rail

For the derivation of the potential accessibility index by rail, the railway network of the RRG database was considered. In addition, new planned railway lines based on the TEN and TINA outline plans and outline plans of national transport ministries and railway authorities, and selected railway links currently closed for operation are also included as well as rail ferries. From this railway database, two model networks were extracted representing the infrastructure and travel time development between 2001 and 2006.

The average potential accessibility by rail of Yugozapaden (BG41) appears slightly higher (17.56) than that of Yuzhen tsentralen (BG42, 16.62) and Anatoliki Makedonia, Thraki (GR11, 15.08). However, as before, the potential accessibility of Anatoliki Makedonia, Thraki shows significant improvement over time, compared to the other two areas. Pernik (BG414) and Plovdiv (BG421) show the highest potential accessibility score, while Evros (GR111), Kardzhali (BG425) and Kyustendil (BG415) demonstrate the lower values.

A cross-border cluster of regions seems to be formed, consisting of Evros (GR111), Rodopi (GR112), Kardzhali (BG425), Smolyan (BG424) and Drama (GR114), with limited potential accessibility by rail indices (<15 standardized according to ESPON average value).

In terms of the temporal change during the 2001 – 2006 period, three clusters occur: a) Anatoliki Makedonia, Thraki high-index-change group, b) the Kardzhali (BG425), Smolyan (BG424), Blagoevgrad (BG413) and Kyustendil (BG415) slightly negative to near zero change group, and c) the remaining NUTS areas of the CBA with strongly negative index change behaviour.

6.4. Potential Accessibility by Air

The RRG world airport database contains about 9,800 airports of international (world-wide), European and regional importance following the airport classification of the Trans-European Transport Network Outline Plan, Section Airports as specified in Decision 1692/96/EC of the European Parliament and of the Council, as well as airports of the so-called TINA networks (TINA = 'Transport infrastructure needs assessment'; TINA Secretariat, 1999; 2002) for the new member states and candidate countries.

There exist four airports within the Greece – Bulgaria CBA (Sofia stolitsa, Plovdiv, Evros and Kavala). The average potential accessibility by air of Yugozapaden (BG41) appears significantly higher (71.30) than that of Anatoliki Makedonia, Thraki (GR11, 46.08) and Yuzhen tsentralen (BG42, 36.66). Moreover, the potential accessibility by air of Yuzhen tsentralen (BG42, +17.72%) and Yugozapaden (BG41, +16.43%) show significant improvement, in contrast to that of Anatoliki Makedonia, Thraki (GR11, +11.58%). Pernik (BG414) shows the highest potential accessibility score, while Haskovo (BG422) and Kardzhali (BG425) depict the lower values.

6.5. Multimodal Potential Accessibility

The previously described findings were combined into one indicator showing the multimodal potential accessibility of places by analyzing the joint effect of the three transport modes. The multimodal accessibility of regions may further be used for investigating relationships between accessibility and economic development and between accessibility and migration, issues that are particular in focus in policy documents related to the European territory.

The average multimodal potential accessibility of Yugozapaden (BG41) appears significantly higher (64.5) than that of Anatoliki Makedonia, Thraki (GR11, 42.02) and Yuzhen tsentralen (BG42, 36.66). Moreover, the multimodal potential accessibility of Yugozapaden (BG41) shows significant improvement (mean 14.56%), in contrast to that of Yuzhen tsentralen (BG42, 13.86%) and Anatoliki Makedonia, Thraki (GR11, 11.70%). Pernik (BG414) and Kyustendil (BG415) show the highest multimodal potential accessibility score, while Haskovo (BG422) and Kardzhali (BG425) depict the lower values.

The temporal variability analysis indicated that Rodopi (GR113) and Kyustendil (BG415) experienced strong accessibility improvement, mostly attributed to rail accessibility upgrade; while for the remaining Yugozapaden areas (BG41) local quality improvement is due to air accessibility change. Relatively intermediate improvement is seen in the remaining Yuzhen tsentralen (BG42), mostly attributed to rail and air accessibility changes. Finally, only Kardzhali (BG425) showed an opposite behavior, due to negative change in road and rail accessibility indices and the limited air accessibility improvement.

Chapter A7 – Lisbon/Europe 2020 Strategy Analysis

7.1. Concept and Indicators

The territorial dimension of European policy is highlighted in the new document “Gothenburg and Lisbon/Europe 2020: New European strategy” (2010) approved by the European Commission. The aim of this strategy is to help Europe to come out stronger from the crisis and turn the EU into a smart, sustainable and inclusive economy delivering high levels of employment, productivity and social cohesion. Europe 2020 sets out a vision of Europe's social market economy for the 21st century. This strategy sets priorities and specifically, one of them claims for the territorial cohesion:

- Smart growth: developing an economy based on knowledge and innovation,
- Sustainable growth: promoting a more resource efficient, greener and more competitive economy, and
- Inclusive growth: fostering a high-employment economy delivering social and territorial cohesion.

The integral objectives of the Lisbon/Europe 2020 Strategy are leading towards an economy based on knowledge and innovation, with increased investments in human capital, developing social models opposing social exclusion, poverty and ageing, leading towards an economic policy focused on trans-frontier cooperation.

The study of the territorial performance of the Greece – Bulgaria Cross-Border Area considered a list of indicators covering a wide domain of the five most important sectors, as economic background and growth, employment, research and innovation, economic reform and social cohesion.

7.2. Economy and Employment Analysis

Economic and employment analysis considered indices as the GDP, the GDP per capita, the GDP coefficient of deviation and their temporal trends, leading towards an indexing and convergence analysis for the NUTS3 areas of the CBA, compared to the leading in terms of economic performance region (London NUTS2 area).

The total GDP of the Greece – Bulgaria CBA (excluding Sofia) was in 2008 16.2 billion Euros. Yugozapaden (BG41 excluding Sofia, 2.17 billion Euros) represents approximately 13.4% of this GDP, Anatoliki Makedonia, Thraki (GR11, 9.0 billion Euros) represents the 55.7% while Yuzhen tsentralen (BG42, 4.9 billion Euros) represents almost 30.8% of the CBA. In terms of the temporal GDP variability, over the studied years (1997-2009), Pernik (BG414) and Smolyan (BG424) depicted the higher annual mean change in GDP, with values of 19.32%, 17.36% and 13.94%, respectively. Significantly slower GDP growth was reported for the

Anatoliki Makedonia, Thraki area (5.13%) and its NUTS3 regions, as Kavala (GR115, 4.44%), Evros (GR111, 4.88%). The Greece – Bulgaria CBA (excluding Sofia) shows a strong mean annual GDP growth of 7.4%.

Based on the indexed GDP per inhabitant analysis, the Greece – Bulgaria CBA is considered as a 'less developed to very laggard' region, having NUTS3 areas with index ranging between 30-50, 15-30 or even below 15, as compared to Greater London NUTS2 (indexed as 100). The whole Bulgarian NUTS3 areas are falling in this latter category, while only Drama (GR114), Xanthi (GR112) and Rodopi (GR113) are considered as 'laggard regions'. Evros (GR111) and Kavala (GR115) score relatively higher, thus clustered as 'less developed regions', having indices of 31.42 and 30.24, respectively.

To understand better regional disparities in the GDP per capita of the various NUTS regions throughout the Greece – Bulgaria CBA, the coefficient of deviation (CDev) was used. It occurs that Greece shows limited and slowly decreasing regional disparity (CDev 2008: 21.2). Bulgaria on the contrary depicts a strong increasing trend, mostly attributed to the very rapid change of GDP per inhabitant in Sofia stolitsa, as related to the rest of the country (CDev 2008: 44.3). The CBA (excluding Sofia) shows significant regional disparity, with a rapidly converging to ESPON NUTS0 and NUTS3 trend (CDev 2008: 76.4).

On the other hand, convergence analysis revealed that Kavala (GR115), Xanthi (GR112) and Evros (GR111) have quite similar to the leading region GDP per inhabitant trends, implying that these areas are 'non-converging'. Kyustendil (BG415), Rodopi (GR113) and Drama (GR114) are considered as 'slow converging areas', while Pernik (BG414) and Smolyan (BG424) having GDP per inhabitant annual growth rates almost 3-4 times higher than the leading region, are considered as 'steady catching-up areas'.

Employment analysis revealed that employment in the CBA (excluding Sofia) is distributed rather evenly among all NACE economic activities. A slight employment annual increase (+0.73%) over the last decade was exhibited in the CBA. This increase is mostly fuelled by the strong employment rise in Construction (+6.32%) and the Financial Intermediation and Real Estate sector (+4.05%). Strong employment reduction during the latest decade is seen in Agriculture, Forestry & Fishing sector (-1.19%). The highest employment annual growth rate in the NUTS3 areas is observed in Blagoevgrad (BG413, 19.46%), followed by Smolyan (BG424, 13.94%).

The increase in the annual employment growth rate was lower in the Greece – Bulgaria CBA (+0.39% without Sofia stolitsa), than that shown by Greece (+1.50%) and Bulgaria (+2.10%). Examining the mean temporal change of employment in all NUTS3 areas of the Greece – Bulgaria CBA, it occurs that Agriculture, Forestry and Fishing showed the higher losses, especially in Pazardzhik (BG423, -11.5%). Kardzhali (BG425) showed growth in this sector (+5.87%). In the Industry sector, employment illustrated the higher positive annual rates in Rhodopi (GR113, +4.73%) and Smolyan (BG424, +3.35%), while the highest negative rates were shown in Kavala (GR115, -6.09%) and Drama (GR114, -5.31%).

The GVA of the Greece – Bulgaria CBA (excluding Sofia) in year 2008 from all NACE categories was 13.9 billion euro, with significant contribution from Evros (GR111, 2,097 billion euros) and Plovdiv (BG421, 2,046 billion euros). This GVA appears increased over the latest decade by 122%. The GVA is mostly attributed to the Industrial Sector (23.6%), the Public Administration sector (20.58%), the Wholesale and Retail Trade, Tourism and Transport sector (20.5%) and to the Financial Intermediation and Real Estate sector (15.9%). The temporal change of GVA over the last decade indicated that the primary sector reduced its contribution by 17%, while construction and public administration increased their share by 1.7 and 4%, respectively.

7.3. Education, Research and Innovation Analysis

A set of indicators has been identified to examine the CBA's performance in the field of Education, Research and Innovation, such as the share of population with different educational level, the expenditure for R&D at different sectors and regions, the applications for patents to the European Patent Office, etc. All indicators analyzed were determined at NUTS2 level.

Anatoliki Makedonia, Thraki (GR11) exhibits the poorest performance compared with the two neighboring Bulgarian regions. Yugozapaden (BG41) exhibits the best performance among the three regions. Its population percentage with low education is lower than the national and the EU27 averages, while its

population percentage of tertiary education is higher than the national and EU27 averages. This is probably due to the fact that the specific region incorporates the wider area of Sofia, the capital of Bulgaria.

All three regions exhibit significantly lower Total Gross Expenditure on R&D expenditures compared to the EU27 average of 1.85% of GDP. Moreover, all regions under study have lower Business and Higher Education GERD from the EU27 average. Yugozapaden (BG41) demonstrates a clear superiority compared to its neighboring regions, having significantly higher Total, Government and Business GERD. Anatoliki Makedonia, Thraki (GR11) is the leader in Higher Education GERD due to the existence of a major university in its 3 out of 5 NUTS3 unit levels.

Bulgaria and Greece are modest innovators exhibiting a below average performance, and the three NUTS2 regions under study present similar characteristics, demonstrating low innovation performance and weak innovation potential that in terms of the number of patents fall well below the EU27 and the USA averages. For the period (1996-2007) Yuogozapaden (BG41) is the leading region in patents, followed by Anatoliki Makedonia, Thraki (GR11), whereas, considering only year 2007, GR11 presents a rapid increase.

7.4. Social Cohesion Analysis

Social cohesion is the capacity of a society to ensure the welfare of all its members, minimising disparities and avoiding polarisation (Council of Europe, 2004). It is a fact that presently Europe faces a number of potential threats, setting social cohesion into significant risk. The fight against social exclusion is one of the EU's social policy goals, and the aim is to significantly reduce the number of persons at risk of poverty and social exclusion by 2020.

The selected indicators for this analysis are: a) Unemployment Rate, b) Long-term Unemployment Rate, c) Youth Unemployment Rate, d) Population at Risk of Poverty, and e) Infant Mortality Rate. Statistical data on the social cohesion indicators at NUTS3 level for the Greece – Bulgaria CBA do not exist. Therefore, this analysis will be limited to the available NUTS2 or even NUTS1 data available for the examined region. Furthermore, the available statistical data for each selected parameter refer to variable time periods, ranging between 2008 and 2010.

Results illustrated that the CBA mean unemployment rate for year 2010 (10.8%) appears slightly higher than the mean EU27 value (9.6%), mostly due to the higher unemployment in Anatoliki Makedonia, Thraki (GR11, 14.2%) and Yuzhen tsentralen (BG42, 11.4%). Similarly, Long-term Unemployment in Anatoliki Makedonia, Thraki (GR11) appeared approximately two and four times higher than that in Yuzhen tsentralen (BG42) and Yugozapaden (BG41), respectively, leading to almost similar mean CBA's rate (3.2%) to that of EU27. Youth Unemployment was found at very high levels in Anatoliki Makedonia, Thraki (GR11, 40.7%) and Yuzhen tsentralen (BG42, 31.8%), in relation to Yugozapaden (BG41, 15.2%), producing a much higher CBA rate (29.2%) than the corresponding EU27 value (21%). The Population at Risk of Poverty Index reached almost 20% in the Greece – Bulgaria CBA, with increased rates in Anatoliki Makedonia, Thraki (GR11, 25.4%) and Yuzhen tsentralen (BG42, 22.6%). Infant Mortality in the CBA (6.7%) depicted a relatively moderate deviation compared to the correspondent EU27 (4.3%). All social cohesion indicators (total, long-term and youth unemployment) over the period 1999 – 2011 showed a general decreasing trend, until year 2008. After 2008, all indicators increased sharply, returning back to the 1997 levels.

Chapter A8 – Gothenburg Strategy Analysis

8.1. Concept and Indicators

This chapter examines the performance of the Greece – Bulgaria cross-border area in relation to various objectives of the Gothenburg Strategy: e.g. preservation and sustainable use of natural / cultural heritage potentials; sustainable management of main environmental media (soil, air, water etc), effects of climate change (e.g. new natural hazard patterns, natural disasters), renewable energy sources & use of renewable energy sources / increased energy efficiency; potential sources for industrial risks.

The main objective of this analysis is to present - for the specific CBA – the state of the thematic fields closely related with the environmental issues and to understand the influence of the border on the specific issues. A set of indicators has been identified, such as the projected change in number of tropical nights and snow-covered days, wind and solar regional potential, the ambient concentrations of particulate matter and ozone, the NATURA 2000 areas, the soil sealed, etc.

8.2. Climate Change Potential

To analyze the impact of climate change on the EU NUTS-2 regions a vulnerability index was constructed, employing information on the regions vulnerability to droughts and floods, potential effects on agriculture, fisheries and tourism as well as urban and coastal areas, taking into account temperature and precipitation changes.

The vulnerability index incorporates issues such as the population percentage affected by river floods; population living below 5 m; population aged 75+, change in tropical nights, Gross Value Added (GVA) in agriculture, fisheries, and tourism, changes in precipitation and temperature, etc. The index ranges between the 0 for low vulnerability to 100 for high vulnerability

All three NUTS2 regions of the Greece – Bulgaria CBA fall into the high vulnerability category, due to their proximity with the Mediterranean and the broader Black Sea area. However, the southern coastal region (Anatoliki Makedonia, Thraki, GR11) is expected to be influenced more from climate change effects, compared to the other two regions in terms of the consequences from a possible climate change.

Specifying further, all five NUTS3 areas of the inland Yugozapaden (BG41) region are estimated to experience significantly less number of days with snow cover per year (30-40 days less), whereas Anatoliki Makedonia, Thraki (GR11) is expected to be influenced least in comparison to the other NUTS2 regions. Those estimations are expected to influence severely the winter tourism at the ski resorts of Yuzhen tsentralen (BG42) and Yugozapaden (BG41) regions.

Further, there is an increasing trend to the number of tropical nights as we move from the northern region (Yugozapaden, BG41) to the southern region (Anatoliki Makedonia, Thraki, GR11).

Concluding, the southern and coastal region of Anatoliki Makedonia, Thraki (GR11) is expected to be influenced more compared to the other two regions, in terms of the consequences from a possible climate change.

8.3. Renewable Resources Potential

Wind and solar power are two forms of renewable energy resources widely applicable in EU. In that aspect, the wind energy potential and the solar energy potential at the Greece-Bulgaria CBA under study, namely GR11, BG41 and BG42 are reported here.

Our analysis indicates that all NUTS3 regions exhibit higher wind energy potential than their respective national averages, but lower than the EU27 average. The predominant NUTS3 regions in terms of wind energy potential are Evros (GR111) and Rodopi (GR113) from GR11 and Kardzhali (BG425) and Haskovo (BG422) from BG42.

All NUTS3 regions have uniform solar radiation profile and at least 10% higher solar potential than the EU27 average. The performance of the Bulgarian NUTS3 regions matches almost exactly the national average, while the performance of the Greek NUTS3 regions lays approximately 10% below the national Greek average.

8.4. Air Quality

In order to assess the quality of the ambient atmospheric conditions at the NUTS2 and NUTS3 regions under study the spatial behavior of two basic air pollutants, i.e Particulate Matter and Ozone Concentrations were examined.

In terms of air quality, PM_{10} concentration levels at all regions were between 10-20 μg/m^3, below the EU environmental limit of 40 μg/m^3 (period 2005-2009), and the updated limit of 20 μg/m^3 (valid from 1/1/2010).

Almost all NUTS3 regions of the CBA experience fewer days with ozone concentration exceedance (ozone concentrations >120 μg/m^3) compared to their respective national averages. Further, all NUTS3 regions of the Greece – Bulgaria CBA experience more days with ozone exceedance, than the corresponding EU27 average value. This difference can be attributed to the less sunny days occurring in Central and Northern Europe. Rodopi (GR113), Xanthi (GR122) and Haskovo (BG422) exhibited the highest ozone concentration levels exceedance with 23, 22 and 20 days per year.

8.5. Natural Environment

In this section the share of the Natura 2000 areas, as a percentage of the total area within the 13 NUTS3 regions under study is presented.

The share of Natura 2000 areas at the Bulgarian NUTS3 regions ranged from 28% to 54% and at the Greek NUTS3 regions ranged from 11% to 40%, significantly higher than the EU27 average of 17%. At 8 out of 13 NUTS3 regions the share of Natura 2000 areas is more than double of the corresponding EU27 average. This Natura 2000 share ranges from 28% for the rather urbanized Pernik (BG414) to 54% for the mountainous Haskovo (BG422). The Greek regions ranged from 11% at the region of Kavala (GR115) to 40% at the region of Evros (GR111).

Furthermore, all NUTS3 regions have soil sealed percentage approximately 2 to 4 times lower than the EU27 average of 6.7%. Regarding the soil sealed area per inhabitant, the regional Greek average is higher that the regional Bulgarian averages, indicating greater urbanization trend in the Greek region of the CBA. Overall, urbanization is in absolute figures not considered as a problem of major concern, however, there is a trend to augment its severity in the following years should the existing trends be continued.

Finally, the share of the planned investments of Cohesion Policy in environment, for the period 2007-2013, for infrastructure environmental projects is significantly higher for the Bulgarian regions and stands quite higher than the EU27 average. On the other hand, the planned investments of Cohesion Policy in environment, for the period 2007-2013 and for the region Anatoliki Makedonia, Thraki (GR11) appear similar to the EU average.

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The ESPON 2013 Programme is part-financed by the European Regional Development Fund, the EU Member States and the Partner States Iceland, Liechtenstein, Norway and Switzerland. It shall support policy development in relation to the aim of territorial cohesion and a harmonious development of the European territory.