Accessibility of the Baltic Sea Region
Past and future dynamics

Research report

This report has been written by Spiekermann & Wegener Urban and Regional Research on the behalf of VASAB Secretariat at Latvian State Regional Development Agency

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1 Introduction

The quality of transport infrastructure and services is considered a decisive factor for the development of cities and regions. Central term related to this is accessibility which is, however, a multifaceted concept. Accessibility can be a location factor for economic activities as well as factor for quality of life of the population. Accessibility can thus be understood as important "product“ of the transport system for territorial development at all spatial scales. Accessibility indicators reflect the opportunities regions in Europe can enjoy from the existence of transport infrastructure and services linking them to activities of interest. In consequence, accessibility has become a key concept for territorial development. The provision of favourite accessibility conditions to people and economic actors is thus a core element of almost all policy documents on territorial development at the European level.

The situation and possible strategies for the improvement of accessibility and connectivity of the Baltic Sea Region (BSR) has therefore been also a topic of strategic political documents in the region for decades. In particular VASAB (Vision and Strategies around the Baltic Sea), the intergovernmental network of 11 countries promoting cooperation on spatial planning and development in the BSR, has addressed accessibility since its first vision of the early 1990s.

- In the first VASAB vision of 1994, the notion of "strings" was used to emphasise the importance of effective and sustainable links between cites (VASAB, 1994). The vision was that the mobility networks in the BSR should facilitate environmental friendly transport and that they should provide conditions for effective integration within the BSR and with the world.
- The VASAB 2010 Plus Spatial Development Action Programme of 2001(VASAB, 2001a) confirmed the need to promote environment friendly modes of transport and links this also with the development of spatial structures enabling higher use of public transport. The vision document pointed to the quality of transport infrastructure in some parts of the BSR as a bottleneck to regional development that has to be overcome by the integration of transnational infrastructure concepts with corridor improvements relevant for regional development and for effective integration across the BSR and across the whole of Europe. Here, the transnational transport links important for cross-BSR and cross-Europe integration form one of six key themes of the spatial development action programme. The role of maritime transport also for spatial development on land was highlighted with the promotion of the functionality of ports as transport nodes as strategy.
- The current VASAB Long Term Perspective for the Territorial Development of the Baltic Sea Region (VASAB, 2010) concentrates on issues which require transnational solutions. The improvement of external and internal accessibility is a key topic besides urban networking, urban-rural cooperation and maritime spatial planning. In this context it also calls to overcome territorial disparities and socio-economic divides between parts of the BSR.
- The VASAB Tallinn Declaration of the Ministers Responsible for Spatial Planning and Development of the BSR (VASAB, 2014) underlines that connectivity and accessibility in the Baltic Sea Region, links between the Region and Europe’s core areas, and between the Region and other neighbouring regions are amongst the key development issues in the Baltic Sea Region. The key challenge for the countries and regions is to interconnect Trans-European, national and regional intermodal transport networks in the best way possible. The declaration asks the Committee on Spatial Planning and Development of the BSR (CSPD/BSR) to observe closely the regional effects of the European transport infrastructure and to support actions and projects, using the potential of Trans-European Transport Networks (TEN-T) for regional development and improving their connectivity to regional transport networks, in order to promote territorial integration and cohesion.

A precondition for successful actions for the achievement of the territorial development objectives of VASAB is good knowledge of the situation including the recent development and possible future changes. Besides using the monitoring system developed by the ESPON Baltic Sea Region Territorial Monitoring System (BSR-TeMo) project (ESPON, 2014), VASAB CSPD/BSR agreed to regularly produce information about territorial evidence on territorial structures and development trends of the BSR to be distributed to national level officials, stakeholders and EUSBSR actors. The first publication in the planned series was devoted to the "Development of cities in the BSR" (VASAB, 2016) based on a background study (Līviņa et al., 2016). the second topic selected for the publication series is "Accessibility of the Baltic Sea Region".

The report presented here is the background study for the forthcoming VASAB publication on "Accessibility of the Baltic Sea Region". At the beginning of the Report, demographic and transport-related factors were briefly described. Main report commences with an analysis of the accessibility situation of the BSR and its recent development by transport mode by using the standard indicator of accessibility potential (Chapter 2). This will be followed by a more specific analysis looking at the accessibility of opportunities such as jobs and services in regional centres (Chapter 3). Maritime accessibility is treated in Chapter 4, external accessibility in Chapter 5. The possible future changes of accessibility potential induced by the Trans-European Transport Network (TEN-T) are addressed in Chapter 6. The relationship between accessibility and regional economic performance and the possible impacts of the development of major transport infrastructure in the BSR is subject of Chapter 7. Policy related conclusions from the findings will be given in Chapter 8. The Annex of this report contains some more detailed methodological explanation of the accessibility indicators of the potential type (A1) and more detailed maps on individual ports for maritime accessibility (A2).

The spatial scope of the report covers the area of VASAB, i.e. it includes Belarus, Denmark, Estonia, Finland, Germany (BSR parts only), Latvia, Lithuania, Norway, Poland, Russia (BSR parts only) and Sweden. Thus, in the case of Russia and Germany, it does not apply to the entire territories of these countries. At the same time, some detailed results are presented for parts of the macro region only (zoom-in studies for Finland, the Baltic States, and in particular for Poland). This is mainly due to the availability of in-depth databases and the results of previous research (including ESPON TRACC and evaluation studies of the Polish Ministry of Investment and Development). Some accessibility indicators (such as accessibility to jobs, access to services of general interests) require ideally LAU1 or LAU2 level. Data in such a resolution are available only in cases of some countries of the BSR. In addition, a more detailed discussion of the transport situation in Poland has its justification in: a) the scale of new transport investments in this country; b) a transit location for many Baltic relations; c) access to detailed lists of investments planned to be implemented by 2023 (for the entire macro region it was only possible to rely on the target TEN-T network, which probably will not be established in the current EU financial perspective).

2 Accessibility potential in the BSR 2006-2016

One of the key accessibility concepts widely taken up is accessibility potential. In the ESPON Programme, accessibility potential indicators have become one of the standard indicator types for describing the situation and trends of territorial development and cohesion. Already in the ESPON 2006 Programme, indicators of this type were calculated in the ESPON 1.2.1 Project on “Transport Services and Networks: Territorial Trends and Basic Supply of Infrastructure for Territorial Cohesion” 2002-2004 (Mathis et al., 2005), and updated several times in the more recent ESPON programmes. The ESPON TRACC project on “Transport Accessibility at Regional/Local Scale and Patterns in Europe” provided an overview on a wide set of accessibility indicators for Europe, but confirmed also the explanatory importance of the potential type indicators (Spiekermann et al., 2015).

These accessibility potential indicators have also been selected as key indicators in various ESPON projects on territorial monitoring (for instance, ESPON INTERCO, ESPON BSR-TeMo, ESPON ATLAS). Also beyond ESPON they became headline indicators, for instance in the Cohesion Reports of the European Commission and various other policy documents at European, national or regional levels. But also in the context of the BSR, accessibility potential played a primary role, for instance in the background document for VASAB 2010+ (VASAB, 2001b) and its analytical base (Hanell et al., 2000), in the preparation of the BSR Transnational Programme 2007-2013 (Schürmann and Spiekermann, 2006) or in assessing the degree of Nordic peripherality in Europe (Spiekermann and Aalbu, 2004).

The concept of accessibility potential is based on the assumption that the attraction of a destination increases with size, and declines with distance, travel time or cost. For the analysis presented in this chapter, destination size is represented by regional population, the impedance by travel time. In this way, accessibility potential to population can be seen as an indicator for the size of market areas for suppliers of goods and services and thus as an indicator showing the competitive position of regions. The accessibility potential indicators are presented as index values, i.e. the BSR average accessibility is always set to 100 and all regional indicator values are standardised using this average. Some methodological detail on measuring accessibility potential is given in Annex A1 of this report.

2.1 The context of past accessibility changes

Changes of accessibility over time are related to many other factors. Before presenting the changes in accessibility for the last ten years, two of the most important influential factors are discussed in this chapter, demographic changes and the development of the transport market.

2.1.1 Demographic changes

Accessibility potential as used in this study has as indicator to describe the attractiveness of the destination the population of all other regions in Europe. However, as this is changing over time as well, accessibility potential might change solely on changing population without any changes in the transport system. To demonstrate that population change has a significant impact on accessibility potential of the BSR regions, we start here with discussing the population changes for the period in time considered.

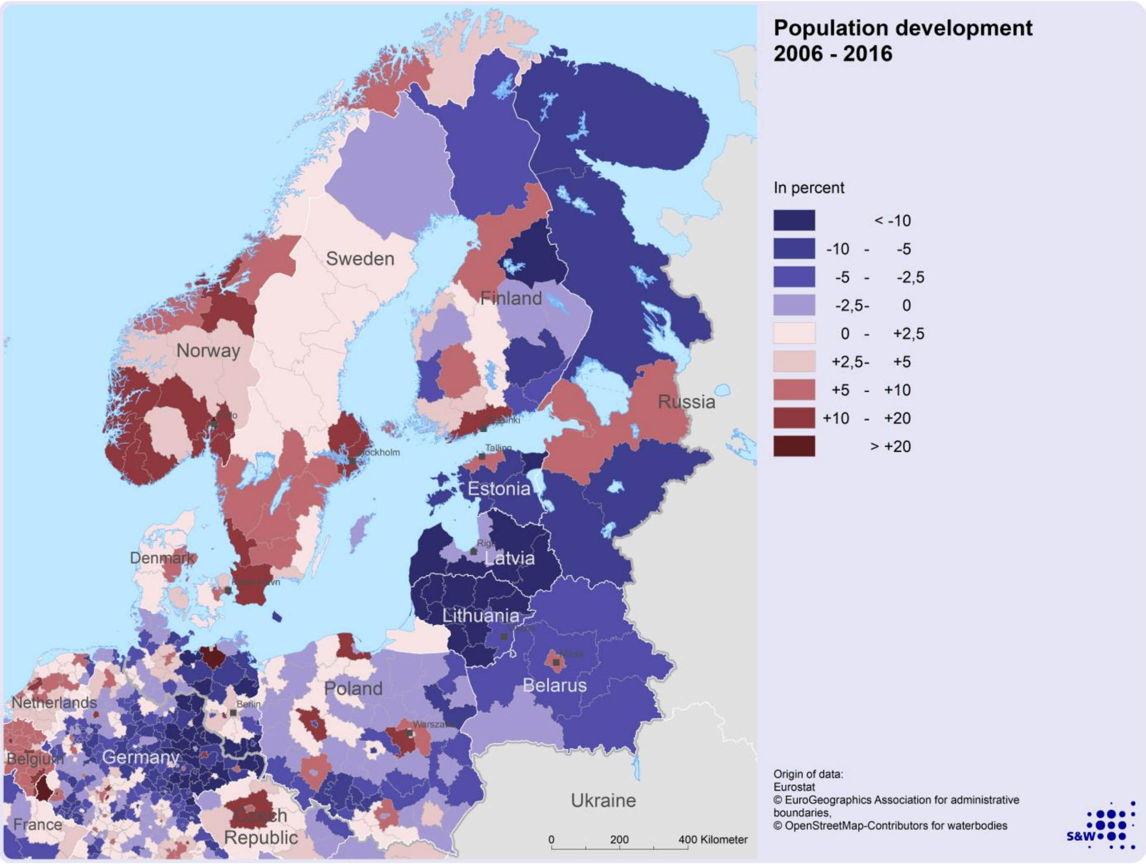

Figure 2.1 Population development, 2006-2016.

Changes in the population distribution in the BSR macro region in the period 2006-2016 were significant (Figure 2.1). A substantial population increase took place in southern Sweden, Finland Norway and Denmark, as well as in the Saint Petersburg region. In Poland, there was a clear concentration of the population in the vicinity of the five largest centres (the so-called "Big Five"): Warsaw, Gdańsk, Poznań, Kraków and Wrocław. It results from the intense migration to these cities from the peripheries and from massive suburbanisation. The same process can be observed in the surroundings of Tallinn, Helsinki and Minsk. In Lithuania and Latvia, the better situation of suburban zones of Vilnius and Riga is expressed only in the less negative population balance. In general, most of the south-eastern part of the Baltic Sea macro region (Lithuania, Latvia, Estonia, Belarus, Eastern Poland, part of Russia and eastern Finland and north-eastern Germany) are characterised by rapid population loss during the last ten years. In the new EU member states, it is caused by parallel migration to the largest cities and abroad. In Russia and in Belarus, internal directions were important for the largest centres (Moscow, St. Petersburg, Minsk). The concentration of people in major metropolises also occurs in the Nordic countries.

The processes indicate the growing differentiation of the macro region with respect to the demographic situation. It takes place in two dimensions: a) east-west; and b) peripheries - the largest centres. The scale and speed of changes cause that they affect the indicators of spatial accessibility. Over a period of 10 years, the population of some areas increased by over 20 % (Skåne, southern Norway, the Stockholm region, suburbs of Gdansk, Poznań, Warsaw and Helsinki) At the same time, the population of most units in Lithuania, Latvia and Mecklenburg fell by more than 10 %. If new transport investments were not implemented in 2006-2016, demographic changes would probably have caused a noticeable decrease in the level of accessibility potential in the eastern part of the macro region. This should also be considered in the context of changes in the demographic structure (aging process). Thus, in many regions, the importance of public transport in accessing basic public services increases, so the real accessibility may be lower there than the actual indicators show.

2.1.2 Past transport infrastructure development

This section gives a brief overview on major transport infrastructure developments in the BSR for the last ten to fifteen years for road, rail and air transport.

Road

In some countries of the BSR, the motorway network was already widely developed by 2006 (Table 2.1). Since then, road infrastructure development was devoted to closing gaps in the network and to increase capacity on existing motorways by adding additional lanes. This is particular true for Germany with about 100 km new motorways in the BSR (in Schleswig-Holstein and Mecklenburg-Vorpommern); or for Denmark with an extension of the motorway network from by about 200 km since 2005 with a few new sections on Jutland and capacity increases in the Copenhagen region.

In the other Nordic countries, the motorway network was extended more substantially. In Norway with about 260 km of motorways in 2005, another 200 km, sections along the north-south axis and between Oslo and Bergen, were put in operation since. In Sweden, more than 400 km of new motorways were added to the 1,700 km existing in 2005 which included the closing of existing gaps in southern Sweden between Malmoe, Gothenburg and Stockholm as well as network extensions to the northern parts of the country. In Finland, the motorway network extension was about 200 km leading to roughly 900 km of motorways at the end of 2016. In the Nordic countries national roads have an important role for the connectivity of regions and cities: Lower densities and lower traffic volumes do not require motorway standards here; something which is also true for several parts of the Baltic States.

In the Baltic States, Latvia has no classified motorway network, but a network of about 1,700 km of main roads, most of which are dual carriageways. Lithuania has more than 300 km of classified motorways, however, there was no substantial extension during the period up to 2016 considered, but 35 km of the A5 motorway between Kaunas and the border to Poland were recently opened.. Estonia extended the motorway lengths from 100 km in 2005 by almost 50 km. In all three Baltic States as well as in Russia and Belarus quality and capacity of national roads was significantly improved.

Poland is the country that has invested heavily in motorways. The network length was tripled compared to 2005. Since, more than 1,000 km of motorways were put into operation between 2005 and 2016. In addition, during the last two years roughly 500 km of motorways were put into operation, up to 200 km will be opened during the next two or three years. The new sections opened are part of the evolution of the Polish motorway network that links all larger agglomerations and provides links to the neighbouring countries.

Table 2.1 Length of the motorway network in EU member states of the BSR

Year	DK	DE*	EE	FI	LV	LT	NO	PL	SE
2005 (km)	1,032	2,051	99	693	-	** 309	264	552	1,700
2016 (km)	1,255	2,155	145	890	-	314	392	1,640	2,118
Change (km)	223	104	46	197	-	5	128	1,088	418

Source: Eurostat (2018), BMVI (2017) *BSR part only ** data for 2010

Rail

The development of the rail infrastructure in the BSR was very different in the different countries. In some countries, such as Finland, Lithuania and the BSR parts of Germany there was an increase in the length of the railway network in actual use. However, all other countries saw a decrease of the railway network in operation. This was most severe in Latvia where about 400 km were taken out of use, some of them cross-border links to neighbouring countries with the consequence of rather radial, Riga centred network structure. And also Poland saw a significant reduction of railway lines in use; more than 1,000 km rail lines were not in operation in 2016 that were still in operation ten years earlier.

The rate of electrification of railway lines which might be used as an indication of future-oriented past investments in the infrastructure is very distinct from country to country. Whereas it is very high in Sweden with about 75 % as well as in Norway and Poland (both around 64 %) and followed with only slightly more than 50 % by Germany (whole country), electrification of railway tracks is comparatively low in Denmark (25 %) and rather low in the three Baltic States in which only the urban commuter lines are electrified. The percentages of electrified lines are ranging there from about 14 % in Estonia and Latvia down to only 6 % in Lithuania. No comprehensive information does exist on modernisation of railway lines. However, it can be expected that both processes modernisation of some parts and decapitalisation of other parts of the rail infrastructure took place in most BSR countries.

Table 2.2 Length of the railway lines in use in EU member states of the BSR

Year	DK	DE*	EE	FI	LV	LT	NO	PL	SE
2005 (km)	2,646	* 6,657	968	5.732	2.270	1.771	4.114	19.507	11.017
2016 (km)	2.539	* 6,760	918	5.926	1.860	1.911	3.895	18.429	10.882
Change (km)	-107	* +103	-50	+194	-410	+140	-219	-1078	-135
% electrified in 2016	24.5	** 52.8	14.4	55.2	13.5	6.4	63.1	64.0	75.2

Source: Eurostat (2018), Destatis (2018) *BSR part only ** Germany

High-speed rail has introduced a new level of service in rail transport in Europe and have very much influenced gains in accessibility potential in the regions and cities served. However, high-speed rail infrastructure is not a dominant feature of the BSR. Eurostat's transport statistic (2018) defines high-speed rail sections as those on which trains can go faster than 250 km/h at some points during the journey. According to this definition, the list for EU countries contains only 234 km high-speed line in Poland since 2015 (rail link Warsaw - Kraków/Katowice) and in Denmark 56 km for the link from Copenhagen to Ringsted to be in operation from 2019 onwards.

However, there is no overall definition of high-speed rail. Even in the same publication, Eurostat when looking at high-speed rail operation is defining high-speed rail transport as rail operations with rolling stock able to run up to 200 km/h. And this kind of high-speed rail operation which has clear effects on accessibility by rail has been developed more widely in the BSR.

In Norway, the Gardermobanen linking Oslo via its airport to Eidsvoll is already in operation since 1998 and allows speeds up to 210 km/h. It is mainly used for linking the airport to the capital and for train services going further north. Sweden has several rail section which allow speeds up to 200 km/h. These are particularly located in the south of the country linking Malmoe, Gothenburg and Stockholm, But since 2010, several parts of the Botniabanan from Stockholm via Uppsala towards Umea allows for such speeds. Most of the infrastructure of these lines is suitable for speeds up to 250 km/h, but still lacks appropriate signalling system and rolling stock. Finland has two fast lines linking Helsinki with Turku and Seinäjoki with speeds of up to 200 km/h and the line from Helsinki to Lathi with up to 220 km/h and then eastwards to the Russian border with up to 200 km/h.

In the BSR part of Russia significant progress in improving the accessibility of high-speed rail transport for residents of St Petersburg, the Republic of Karelia, Leningrad and Novgorod regions was made through increased transport connectivity between these regions of Russia including links between cities and rural areas on the one hand, and between St Petersburg, Leningrad Region and Finland, on the other. Since the end of 2009 regular high-speed rail services have been in operation on the route St Petersburg – Moscow. Some of the trains have intermediate stops at two stations in the Novgorod Region. One year later, a regular high-speed rail service began on the route St Petersburg – Helsinki with a journey time of about three and a half hours. In the period 2011-2016 about 2.3 million passengers used this high-speed rail service. Regional high-speed trains started operation in 2013 on the route St Petersburg – Bologoe (Tver Region) with intermediate stops in the Leningrad and Novgorod regions, the route St Petersburg – Veliky Novgorod and several routes from St Petersburg to the most important district centres of the Leningrad Region (Volkhov, Gatchina, Luga, etc). Since 2017, regional high-speed trains began to run on the route St Petersburg – Petrozavodsk in the Republic of Karelia.

In Poland, several sections of the main railway network were upgraded to allow speeds of up to at least 200 km/h. This includes the Central Rail Line linking Warsaw with Katowice and Kraków which reduces the rail travel time between Warsaw and Krakow to 2:20 hours, and the line from Warsaw to Gdańsk and Gdynia which decreases travel times between Gdansk and the capital city down to less than three hours. In Germany, most important inside the BSR are the link between Berlin and Hamburg upgraded by 2004, operated at speeds up to 230 km/h since and providing a travel time between the two cities of around 100 minutes, and the links from Berlin and Hamburg to other parts of Germany which have gradually transferred to high-speed during the last two decades.

However, the overwhelming part of the rail infrastructure in the BSR does not allow such operating speeds on the network. Quite the opposite, non-modernised tracks, outdated signalling techniques and rolling stock lead to slow and often unreliable train services. Something that often happens along, but is not limited to secondary rail line.

Air transport

Air transport has substantially increased in the BSR during the last fifteen years. This was a combination of two factors, the continued penetration of the air market by low cost carriers and the investments in airport capacities in several capitals and other larger cities in the BSR. Examples for recent investments in airport capacities are modernisation investments and new terminals at the Warsaw Chopin Airport, at Riga International Airport, at Lennart Meri Tallinn Airport, at Helsinki airport, Stockholm Arlanda airport or Hamburg airport. Helsinki and Stockholm airports got also additional runways. The new Oslo Gardermoen airport was put in operation in 1998. Copenhagen Airport, Kastrup was steadily expanded during the last decades and got an additional terminal for low cost carriers in 2010.

In the BSR area of Russia, the residents and visitors of St Petersburg, Leningrad and Kaliningrad regions benefitted of large-scale reconstructions of the airport complexes in St Petersburg (Pulkovo airport) and Kaliningrad (Airport «Khrabrovo»). The new airport terminal in St Petersburg began operating in 2015. At the airport in Kaliningrad, the first phase of the works was completed in 2007, the second with the new airport terminal in 2017. As a result, the geography of flights and the number of passengers served were clearly expanded.

There are also several secondary airports beyond the ones of the capitals that saw modernisations and capacity increases for handling more passengers and freight since the beginning of the millennium. Those airports are frequently served by low cost carriers. Important examples are Gdańsk Lech Wałęsa Airport, Kraków John Paul II International Airport and Katowice International Airport in Poland.

Originally planned to open in the year 2011, but still not in operation is the new Berlin airport which would have significantly increased air capacity and connectivity of German's capital.

2.1.3 Changes in the transport market

Changes in transport accessibility related to new investments are a response to the situation on the transport market. Figure 2.2 shows the dynamics of road cargo transport in the BSR countries in 2005-2016. Major changes in this area took place mainly at the beginning of the analysed period. There was an increase in transport connected with the enlargement of the European Union, and then the collapse in 2008-2009 related to the economic crisis. The only country in which the breakdown has not occurred was Poland, which can be related to the size of the internal market and the rapid entry of Polish road carriers into the Western European markets. After 2012, the volume of transport stabilised in most of the BSR countries. The exception is Lithuania, where transport has been systematically growing since 2009. Also in this case, the causes should be sought in the growing participation of Lithuanian operators in European transport, especially in transit from Russia. Since 2013, Sweden has also been experiencing high transport dynamics. In Denmark and Finland, the volume of goods transported on roads in 2016 was lower than in 2005. This may be the result of positive modal changes.

The dynamics of road transport cannot be treated as an effect of improving transport accessibility. It is rather one of its indirect causes. The large scale of growth in Poland and the Baltic States (including the scale of transit from Eastern Europe) caused significant increases in the number of HGV (heavy goods vehicles), and thus the demand for new infrastructure. The development of the TEN-T Baltic-North Sea Corridor (including in particular the construction of Via Baltica) is seen as the answer to this demand.

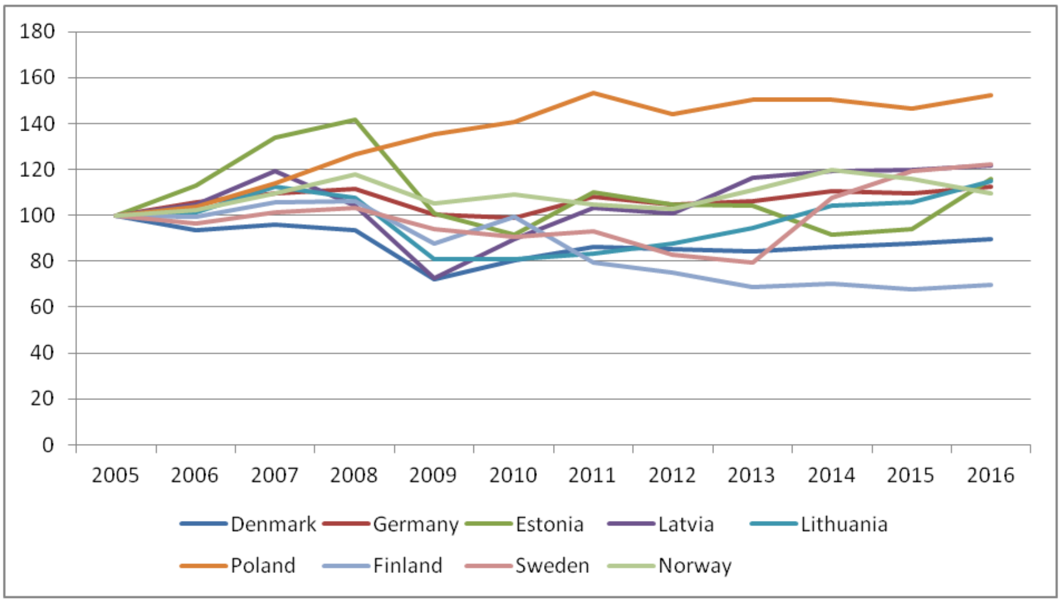

Figure 2.2. Dynamics of road cargo transport in the BSR countries (2005-2016); Data source: EUROSTAT

In the case of rail transport (Figure 2.3), the scale of changes in the period considered was generally lower. Also in this case, the effect of the 2008 crisis is visible. However, the enlargement of the European Union itself is much less marked. The overall increase in transport in the new member states was mostly taken over by road transport. Also in subsequent years, the increase in the volume of transported cargo occurred mainly in the Scandinavian countries (especially in Norway and Denmark), and in the beginning also in Germany. This confirms the hypothesis about favourable modal changes, which might have been the effect of railway investments. Rail transport continued to decrease in Poland and the Baltic States. In Estonia, we can talk about their total collapse

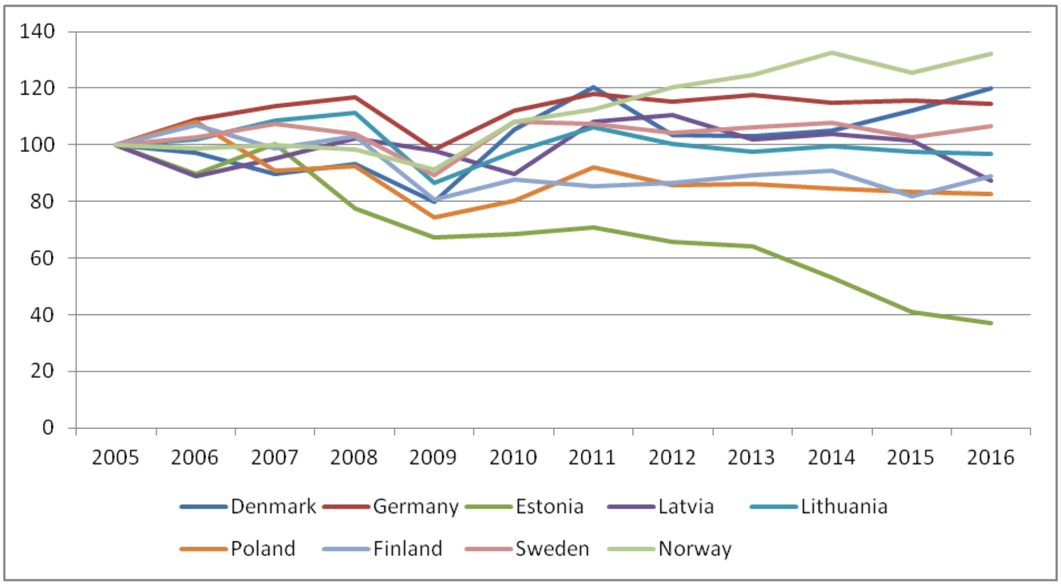

Figure 2.3. Dynamics of rail cargo transport in the BSR countries (2005-2016); Source: EUROSTAT

There are various stages of development of the transport market in the BSR countries. In Germany and the Nordic countries the development of infrastructure and the improvement of railway accessibility can be seen as one of the factors of favourable changes of the modal structure towards a more environmentally friendly railway transport. In Poland and the Baltic countries, the negative dynamics of transport probably has an indirect impact on the delay of railway investments relative to roads.

For accessibility by rail in Europe, the development of high-speed rail services is an important element. For the BSR, Eurostat (2018) lists only three countries (Sweden, Poland and Germany) that have high-speed rail transport. This is defined as all traffic with high-speed rolling stock (incl. tilting trains able to run 200 km/h) and does not necessarily require high-speed infrastructure. In Sweden, 3.48billion high-speed rail passenger km (pkm) are recorded for the year 2016 which is a share of 27.2 percent of all rail pkm. For Poland, 1.44 billion pkm high-speed rail travel make a share of 7.5 % of ail rail pkm. In Germany as a whole, high-speed rail passenger km have a share of 28.4 percent of total rail passenger km; no information can be extracted for the share of the BSR part of Germany in high-speed rail travel which is mainly the connection between Hamburg and Berlin.

The image of changes in passenger transport can be demonstrated by the level of car ownership (Figure 2.4). In Sweden, Denmark and Germany it is stabilised on high levels and did not undergo major changes after 2005. Growth in Norway can be related to heavily supported development of

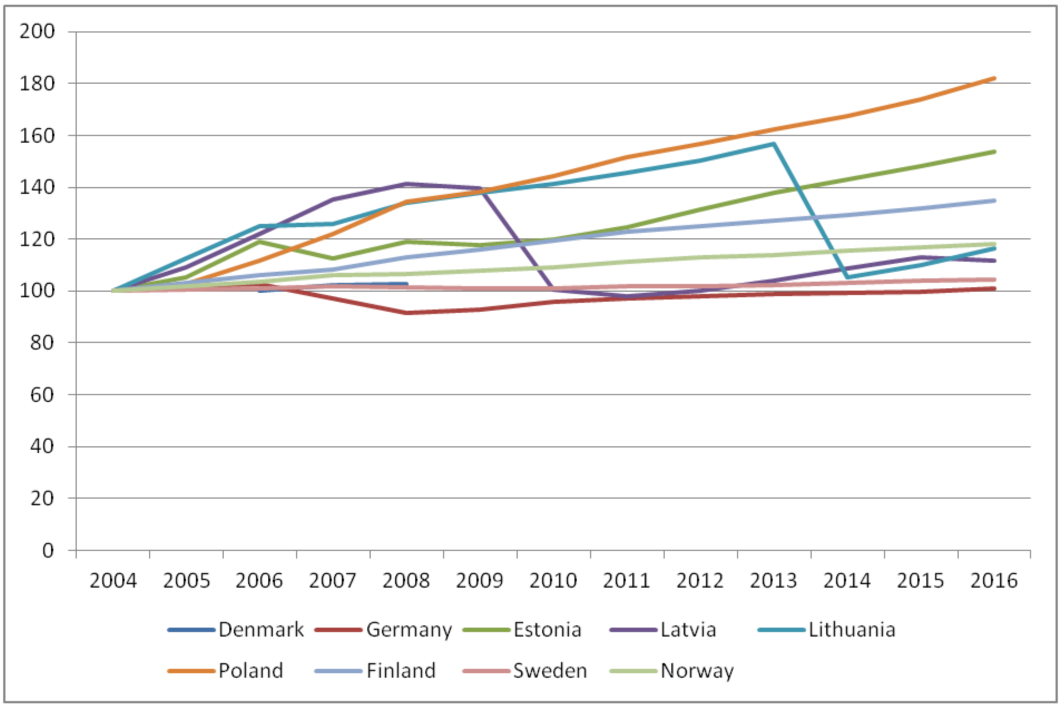

Figure 2.4. Dynamics of car ownership in the BSR countries (2004-2016); Source: EUROSTAT.

electric vehicles. In the Baltic States, statistics related to the level of motorisation underwent verification during the period under consideration. Nevertheless, it can be assumed that just like in Poland, the number of private passenger cars in these countries is constantly growing. In Poland, this increase is still linear, and the level has almost doubled since 2005. This is related to liberal regulations regarding the import of used cars from Western Europe.

The quality of public transport in peripheral areas and mass suburbanisation in the vicinity of the largest urban centres are also important. In both cases, the use of cars becomes a pre-condition for economic activity. In this context, accessibility in road transport can be seen as a determinant of the position on the labour market and an indicator of overall quality of life. Mass motorisation also creates pressure on the development of road infrastructure and is an indirect cause of some actions improving the level of accessibility.

In all BSR countries in the years 2005-2016 there was a dynamic growth of air traffic, and thus the demand for infrastructure for this mode of transport (Figure 2.5). It has to be associated with the expansion of low cost airlines that has spread all over Europe. However, the growth rate was higher in the new member states, especially in Poland, Lithuania and Latvia. It can also be connected with the migration to Western Europe and the improvement of the standard of living and related growth of tourist trips.

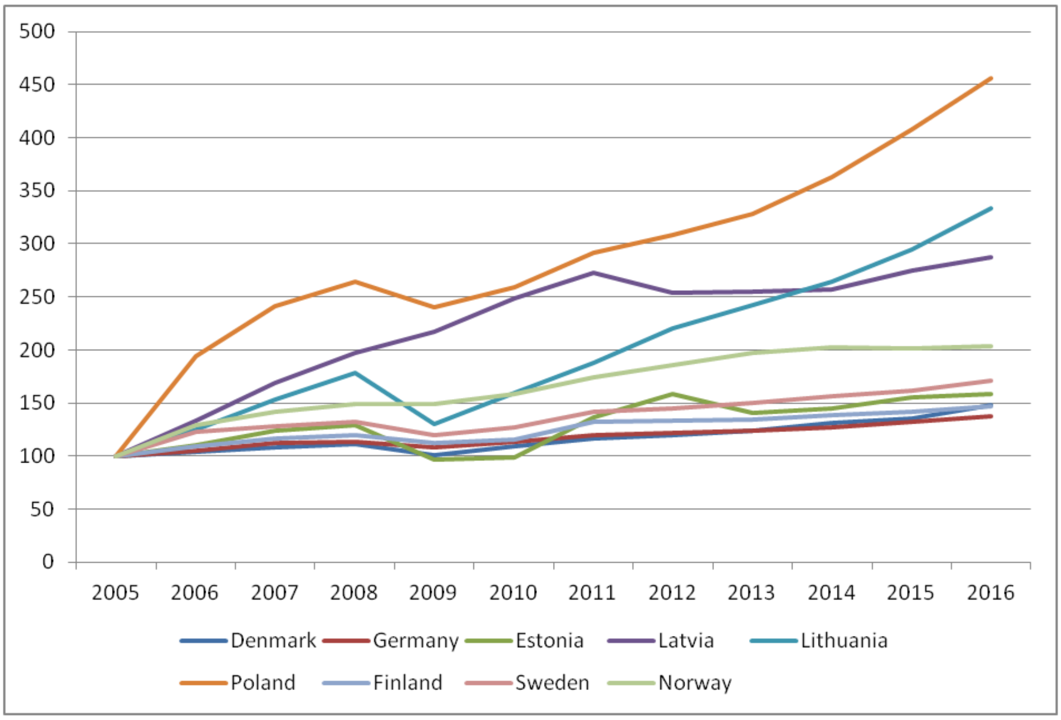

Figure 2.5. Dynamics of air passenger transport in the BSR countries (2005-2016); data source: EUROSTAT.

2.2 Accessibility potential by road

The level of accessibility potential by road in the Baltic Sea Region (Figure 2.6) is highest in the German regions and decreases in North-East direction, as one moves away from the demographic-economic core of the EU (the so-called Pentagon). The demographic potentials of the largest urban regions of the BSR apart from Germany (Stockholm, Copenhagen, Warsaw) only to a little extent balance or compensate this decrease. The exception is Sankt Petersburg which distinguishes itself by a very large demographic mass. However, its impact on a general level of accessibility of the region is restricted by a low permeability of borders between EU countries and Russia. The area of relatively better accessibility extends from Germany further toward eastern direction in central Poland, primarily due to recent investments in road infrastructure along the Warsaw-Berlin corridor.

At the same time, in the northern Polish belt adjoining the Baltic Sea, there is an abrupt decrease of accessibility, which takes place just several dozen kilometres from the German-Polish border. It results from the lack of up-to-date, modern linear infrastructure running along the coast (the so-called Via Hanseatica). The low population density in the zone between Szczecin and Gdańsk also has some significance. Also worth noting is the spatial structure of the higher accessibility zone in the area of Sweden. It refers to the Malmo/Goteborg - Stockholm motorway, while, on the other hand, the south-eastern regions of Sweden along the western coast of the Baltic Sea have clearly less good accessibility. Again, this can be related to the relatively lower population density of this region. In addition, the low frequency of ferry connections between southern Sweden and northern Poland means that the regions of both countries do not noticeably increase their accessibility as a result of the trans-Baltic neighbourhood. Medium-sized centres concentrating the population in the coastal zone of both countries are mutually poorly accessible in road.

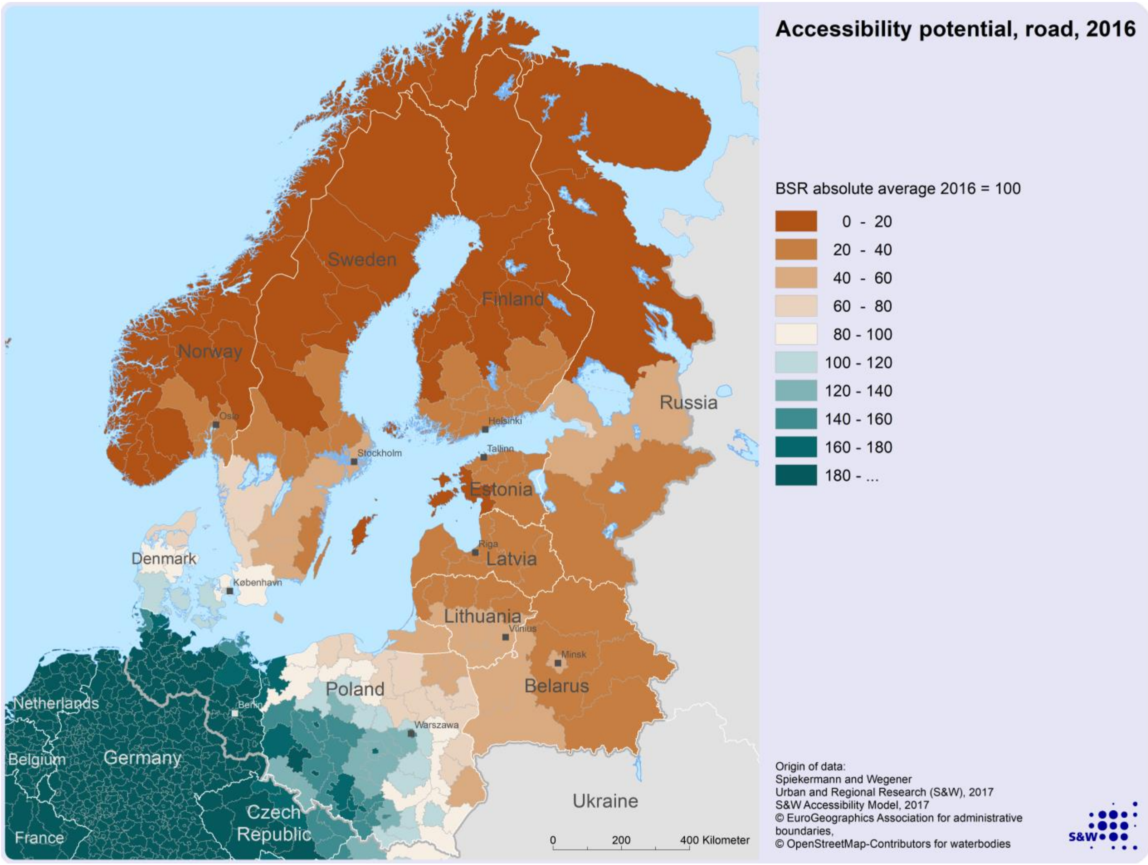

Figure 2.6 Accessibility potential, road, 2016.

All other regions of the BSR have a rather low accessibility potential by road which is less than half of the BSR average accessibility, in the far northern regions even less than a fifth of the BSR average. Also, all Baltic islands are characterised by relatively low accessibility.

In order to compare the different levels of accessibility in a more aggregate way, Figure 2.7 gives accessibility potential by road for the BSR countries differentiated by the urban-rural typology of the European Commission (Dijkstra and Poelman, 2011) no differentiation is defined for Belarus and Russia). The general differences in the level of road accessibility between the countries of the BSR are significant. Germany's (BSR part only) and Poland's average road accessibilities are clearly above the BSR average, Denmark's is about average, all other countries are clearly below average, of these the Russian BSR regions have the highest accessibility by road. For the countries with higher accessibility, this is mainly due to the location of these countries, and in the case of Germany due to the well-developed motorways network. Differences between indicator values for other countries are smaller. In the case of Sweden, Norway and Finland, however, they are the average value between the well-accessible south and the far-distant northern frontiers of the Scandinavian Peninsula.

In the BSR as a whole, urban regions have higher accessibility potential by road than other regional types. This is particular true for the BSR area of Germany, Poland and Finland. In Poland, the reason is better accessibility in the western part of the country, which is characterised by a higher level of urbanisation. Another explanation may be that countries with a generally higher level of accessibility and a larger geographical area are characterised by a greater polarisation at the same time. The other countries show a more balanced picture of road accessibility between urban and rural regions. Lowest road accessibility in the BSR is to be found in the rural regions of Finland and Norway.

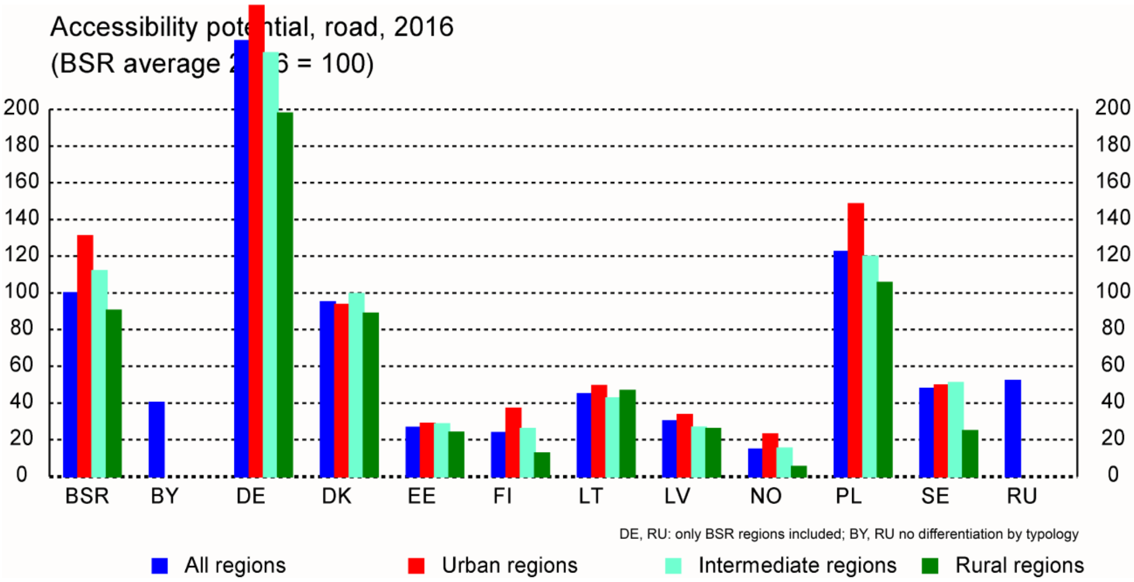

Figure 2.7 Accessibility potential by country and urban-rural typology, road, 2016.

There are two basic possibilities to look at changes of accessibility over time. The one is to analyse the relative changes, the other one is to use absolute changes. Both approaches might yield different results as one region might perform in different ways depending on the way the change is looked at. Therefore, relative and absolute changes are considered here.

In the years 2006-2014, higher relative improvements of up to 50 percent of the initial value of road accessibility took place in particular in Poland, Sweden and Norway, and somewhat less also in Finland, Belarus, Lithuania and Kaliningrad Oblast, due to road investments made by those countries (Figure 2.8). The relative changes were of moderate character in the regions that already enjoyed high road accessibility (BSR part of Germany, Denmark), however, the most insignificant changes were noted in the regions that had a very poor accessibility (Russia, East Belarus, Latvia, northern regions of Finland, Sweden and Norway). In some parts of the latter mentioned regions, there occurred even a drop in the value of accessibility index, which can be explained by depopulation processes.

Looking at absolute changes of accessibility potential by road, the pattern of regions benefitting most is somewhat different (Figure 2.9). The higher relative gains in northern and eastern regions of the BSR are not visible anymore; the stronger relative gain is an outcome of the low initial values. Nevertheless, the relative gains in those regions show effects of transport infrastructure investments. Highest absolute gains are to be found in Polish regions followed by many regions in the BSR area of Germany and partly in Denmark. Here, massive road infrastructure investments linking areas with high population figures led to a clear absolute increase in road accessibility.

This spatial pattern of higher and lower absolute gains in accessibility is confirmed when aggregating the changes to countries and regional types (Figure 2.10). The BSR as a whole has increased its average accessibility in 2016 by about 12 index points of its 2006 average level. Highest gains occurred in Poland with an increase of slightly more than 20 index points, followed by the German parts of the BSR with an increase of 13 index points. The road accessibility gain of all other countries was below BSR average. Out of this group of countries, Denmark and Sweden performed best, whereas all other countries saw absolute accessibility gains of less than five index points. In the best performing countries, Poland and BSR parts of Germany, urban regions had highest increases of road accessibility. In the other countries, higher benefits of urban regions occurred mainly in Norway, whereas in Denmark and Lithuania rural regions gained most.

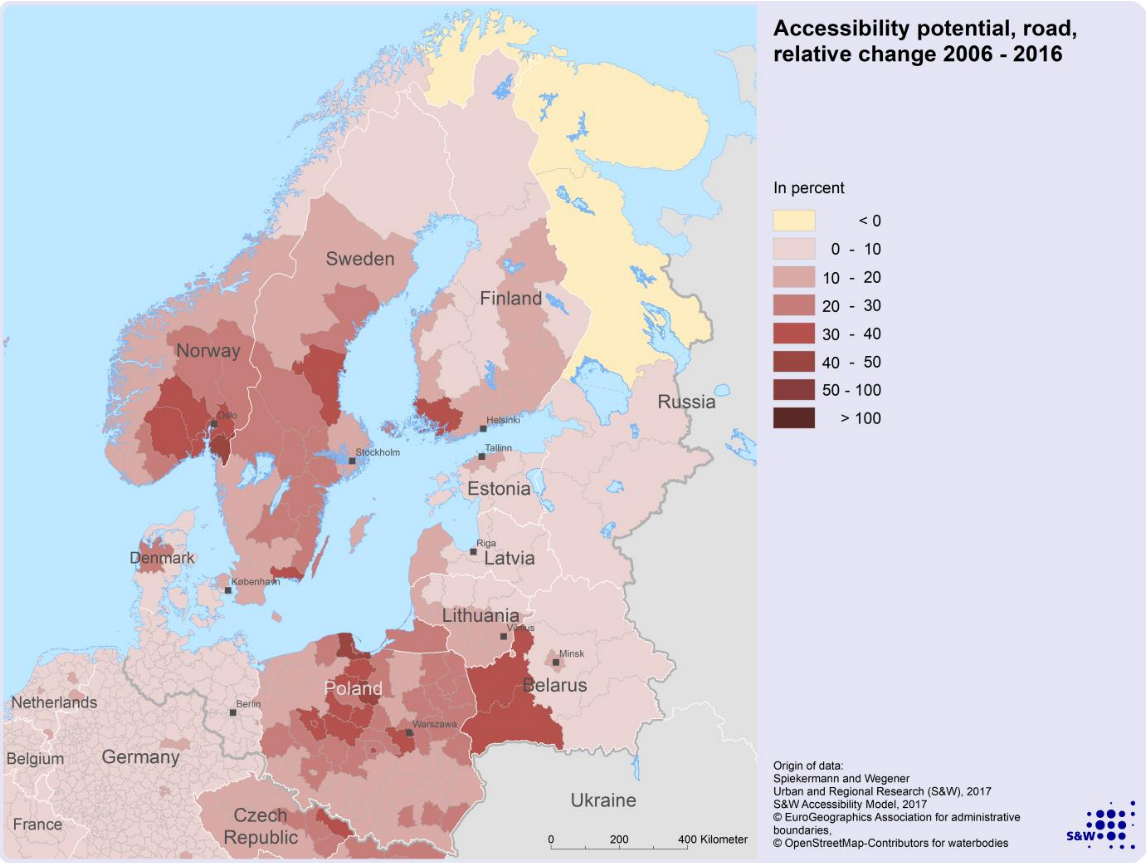

Figure 2.8 Accessibility potential, road, relative change 2006-2016.

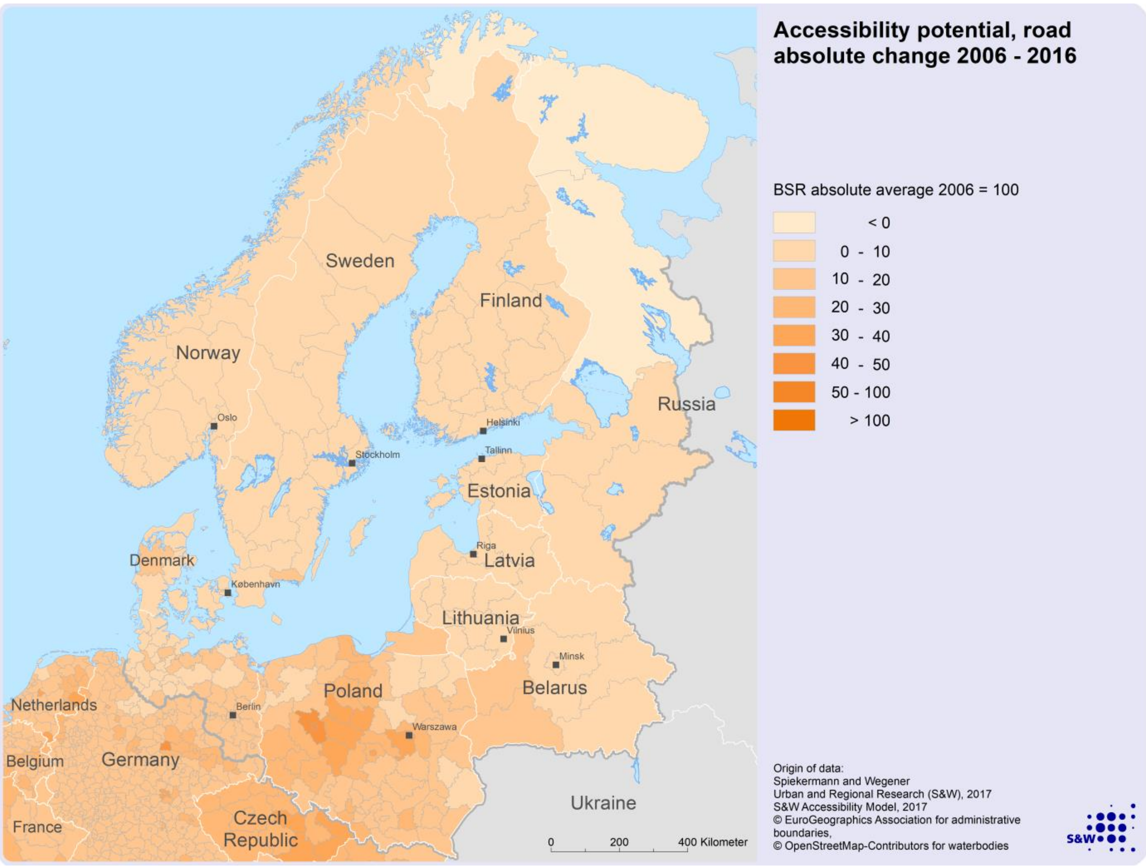

Figure 2.9 Accessibility potential, road, absolute change 2006-2016.

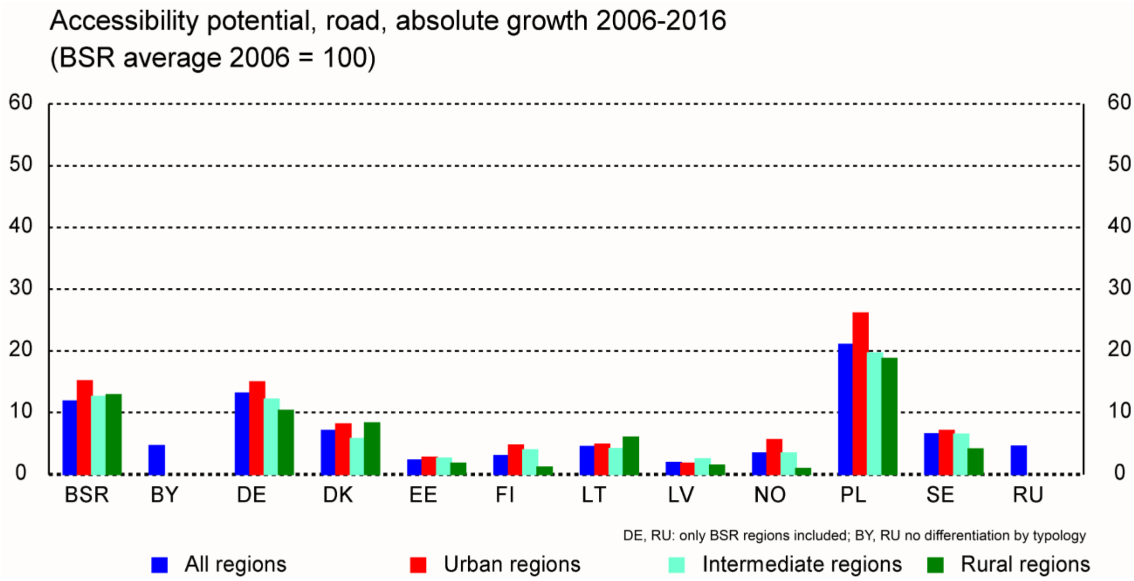

Figure 2.10 Accessibility potential by country and urban-rural typology, road, absolute change 2006-2016.

In general, the effect of relative and absolute improvements in road accessibility was of lower significance towards eastern and northern directions. The above described changes may indicate that there was an increase in disparities between the best and the least accessible regions within the BSR. However, Poland may serve as an example in which a country can improve its accessibility by huge investments in its high-level road network. The effect of large investment programs is greater if (as in the case of Poland) they are implemented in the vicinity of well-developed transport systems of the European Union core.

The classical concentric structure of accessibility potential by road in Europe with highest values in the Benelux countries and western parts of Germany was somewhat modified in the BSR primarily by investments within the transport corridors Hamburg-Copenhagen-Oresund bridge-Stockholm and Berlin-Warsaw. The distribution of zones in which accessibility has improved indicates that the investments were very important in very specific sections. These include, for example, the central fragment of the Polish A2 motorway between Łódź and Warsaw. At both ends, characteristic "service zones" have been formed that collect a lot of shortest pathways between places in the BSR. This proves that it is possible to identify other sections, the modernisation or construction of which may in future have a key impact on the transport integration of the BSR.

2.3 Accessibility potential by rail

Regarding accessibility potential by rail, the overall pattern of regions in the BSR with higher and lower index values corresponds to that of road (Figure 2.11). Again, the regions with the highest rail accessibility in Europe are in the Benelux countries, northern France and western Germany. Highest rail accessibility within the BSR do have the regions of Germany belonging to this macro region. Most regions of Poland (up to the Vistula line) and Denmark and due to the Oresund bridge even the region of Scania in Sweden do have rail accessibility values above the BSR average, i.e. the area of above BSR average accessibility is somewhat larger than for road. Rail accessibility then decreases steadily towards the northern and eastern regions of the BSR. However, in the case of railway accessibility potential the small- and large-scale disparities within the BSR might be even bigger than for road accessibility. For instance, an abrupt decrease in rail accessibility takes place at the German borders (with Denmark and Poland).

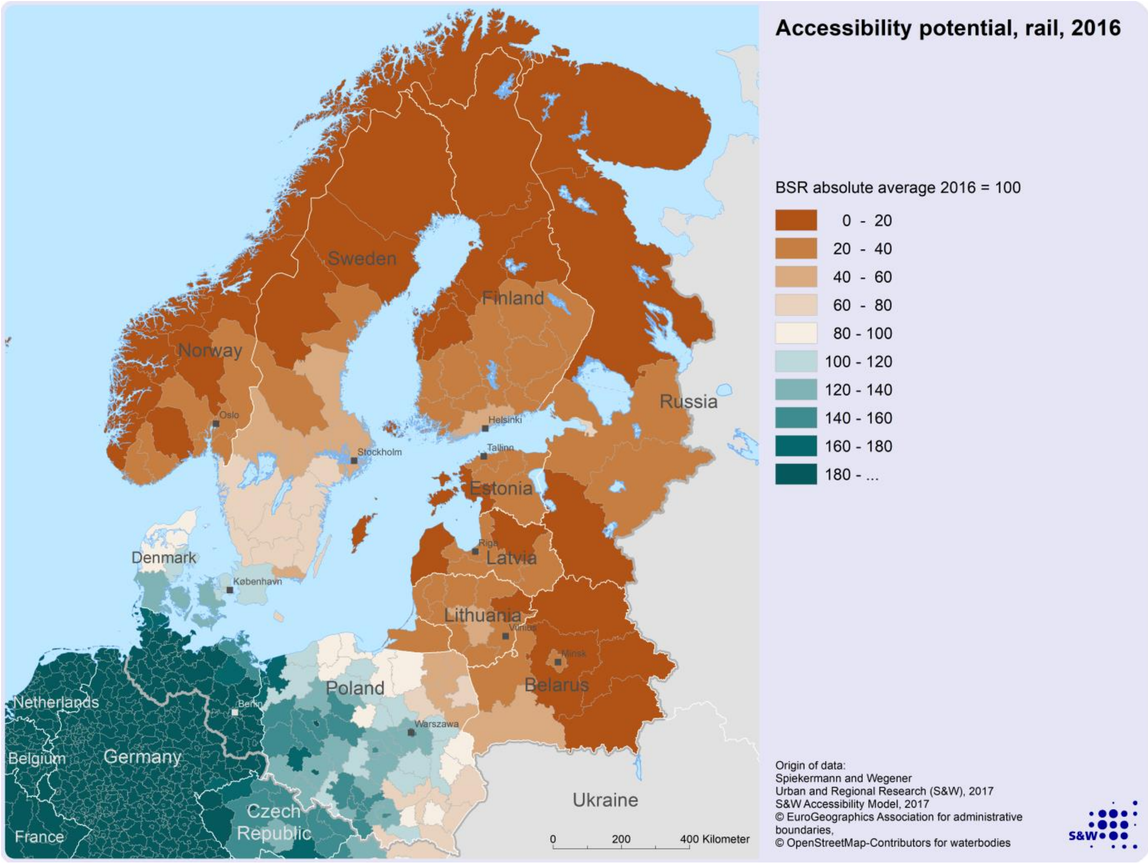

Figure 2.11 Accessibility potential, rail, 2016.

Also for rail, differences in accessibility between countries of the BSR are significant (Fig. 2.12). Again, highest rates are recorded by the BSR regions of Germany, followed by Poland and Denmark, all above BSR average. The average values of Sweden and the Russian BSR regions are clearly higher than those of the other countries. In the BSR as a whole and in most countries, the urban regions have higher rail accessibility than rural regions; the differences are highest for the BSR regions of Germany and for Poland, i.e. countries with highest rail accessibility. However, in Denmark as a country with above BSR average rail accessibility, the situation is much more balanced between the different region types. This is also the case in Lithuania, Latvia and Estonia, but on a rather low overall level of rail accessibility. Larger internal polarisation is also visible in the Nordic countries, especially in Norway and Finland, where the far north rural regions have lowest rail accessibility. Rail accessibility depends not only on the quality of the network, but also on its existence and density. The low rail accessibility in the Baltic States and Poland is related to the regression of the railway network after 1989. In Poland, length of railway lines decreased from 24.4 to 19.1 ths. km between 1989 and 2004 (Taylor 2007). This was an effect of a gradual decapitalisation and, as a result, a weakening of rail transport competitiveness relative to road.

During the past ten years, relative improvements in rail accessibility took place mainly in the Nordic countries due to the modernisation and upgrading of railways lines in Sweden, Norway and Finland and in Russian BSR regions in particular through the high-speed connections of St. Petersburg (Figure 2.13). Of significance was also the increase in speed of railway travelling in the Malmo-Stockholm line. Relative rail accessibility gains occurred also in regions of the three Baltic States and of Poland and Germany. However, it has to be remembered that, to some degree, the relative growth was an effect of a "low base" (low rail accessibility in the previous years). Outside the BSR, in parts of Germany, Belgium and the Netherlands, high relative growth is visible in regions that already had highest rail accessibility in Europe.

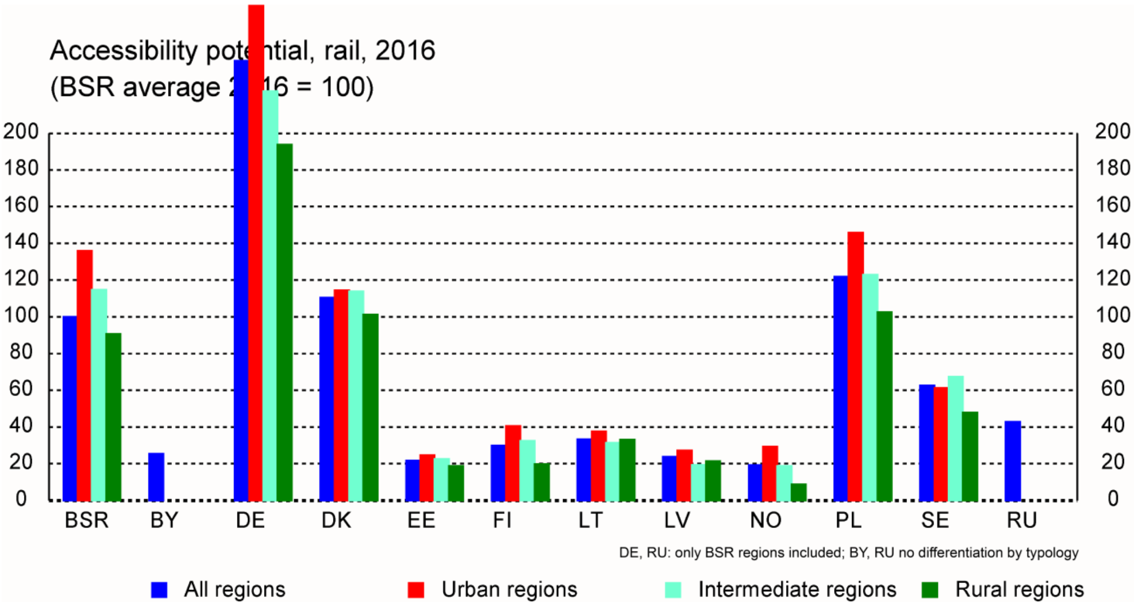

Figure 2.12 Accessibility potential by country and urban-rural typology, rail, 2016.

Belarus and some regions of eastern Poland, Lithuania, Latvia and Russia noted even a decrease in the level of rail accessibility during the period considered. This is the cumulative effect of depopulation and decapitalisation of the railway network. The important barrier is the difference between the European and Eastern European gauge of railway tracks, meaning that railway investments in Poland did not translate into improved accessibility in the former USSR countries (including the Baltic republics), as it was the case in road transport.

As for road, the spatial pattern of absolute changes of accessibility potential by rail is somewhat different (Figure 2.14). In the Nordic countries, increases are visible in southern Finland and in the corridor from Stockholm to Copenhagen as well as in other parts of Denmark. Clear growth in absolute index values occurred also in Poland, mostly in central and southern parts. The German regions of the BSR had even higher gains, the metropolitan region of Hamburg saw highest growth of rail accessibility within the BSR. However, as the high relative growth of regions outside the BSR already indicated, rail accessibility grew much stronger in the non-BSR regions of Germany, and in the Benelux countries and in France.

On average, rail accessibility in the BSR grew by 10 index points of the 2006 average (Figure 2.15). However, the changes during the ten years since then were rather heterogeneous across the BSR. On the one hand, the regions of Germany belonging to the BSR experienced a growth in accessibility potential by rail of about 25 index points, Denmark's regions 15 and Poland's 12. Sweden and Finland saw a growth of almost ten index points, i.e. at about BSR average, Russian BSR regions grew about seven index points. Growth of rail accessibility in Estonia, Latvia and Norway was rather modest; Belarus and Lithuania experienced even a slight reduction. This is partly due to the fact that positive accessibility effects of investments in rail infrastructure, if happened at all in some of those countries, were outbalanced by population decline. The result of those two factors are only modest growth or even decline of accessibility when measured as accessibility potential as it is done in the main parts of this study. In the BSR as a whole, urban regions benefitted most of the growth in accessibility potential by rail while rural regions experienced lower gains. The more favourable development of the urban regions is because the urban regions in the more strongly growing countries, in particular in the BSR regions of Germany, Poland and Finland, gained much more than the other regional types in those countries. However, in Denmark, which had also a clear increase in rail accessibility, the growth was more evenly distributed across urban, intermediate and rural regions. The same is also true for Sweden.

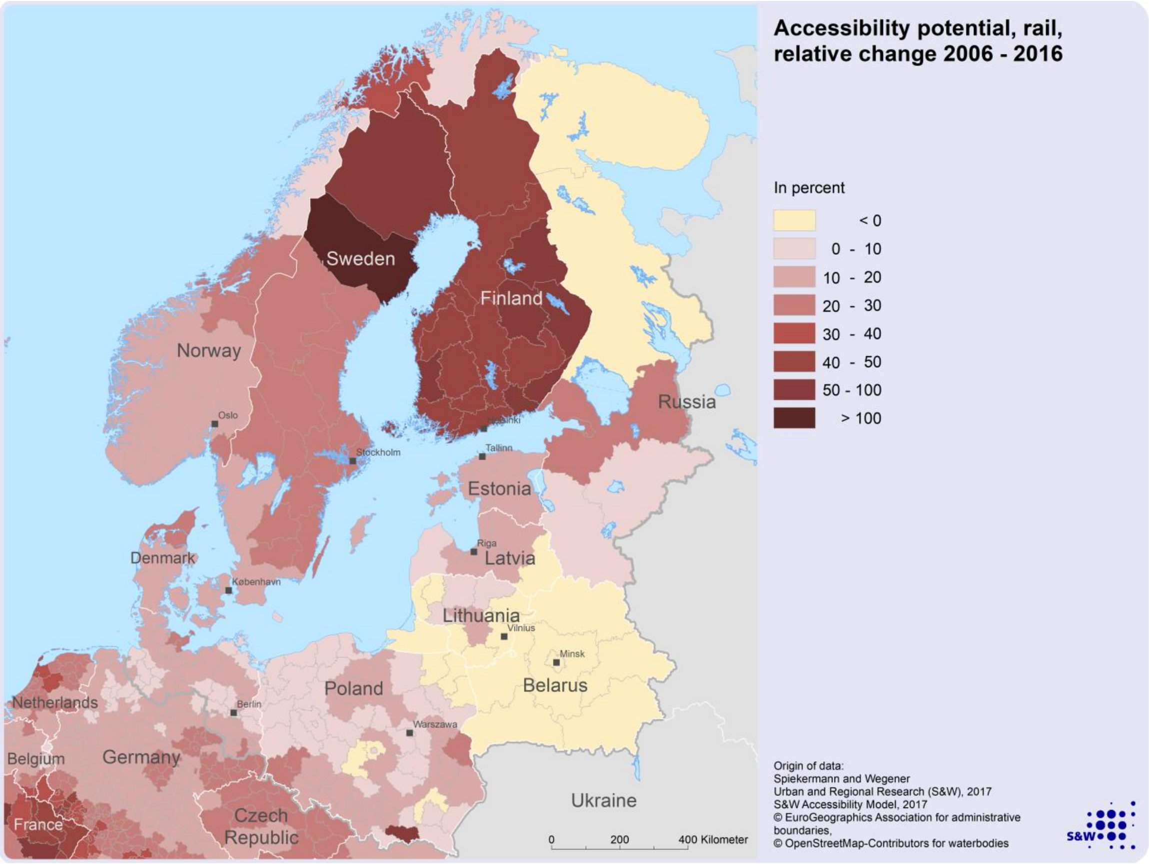

Figure 2.13 Accessibility potential, rail, relative change 2006-2016.

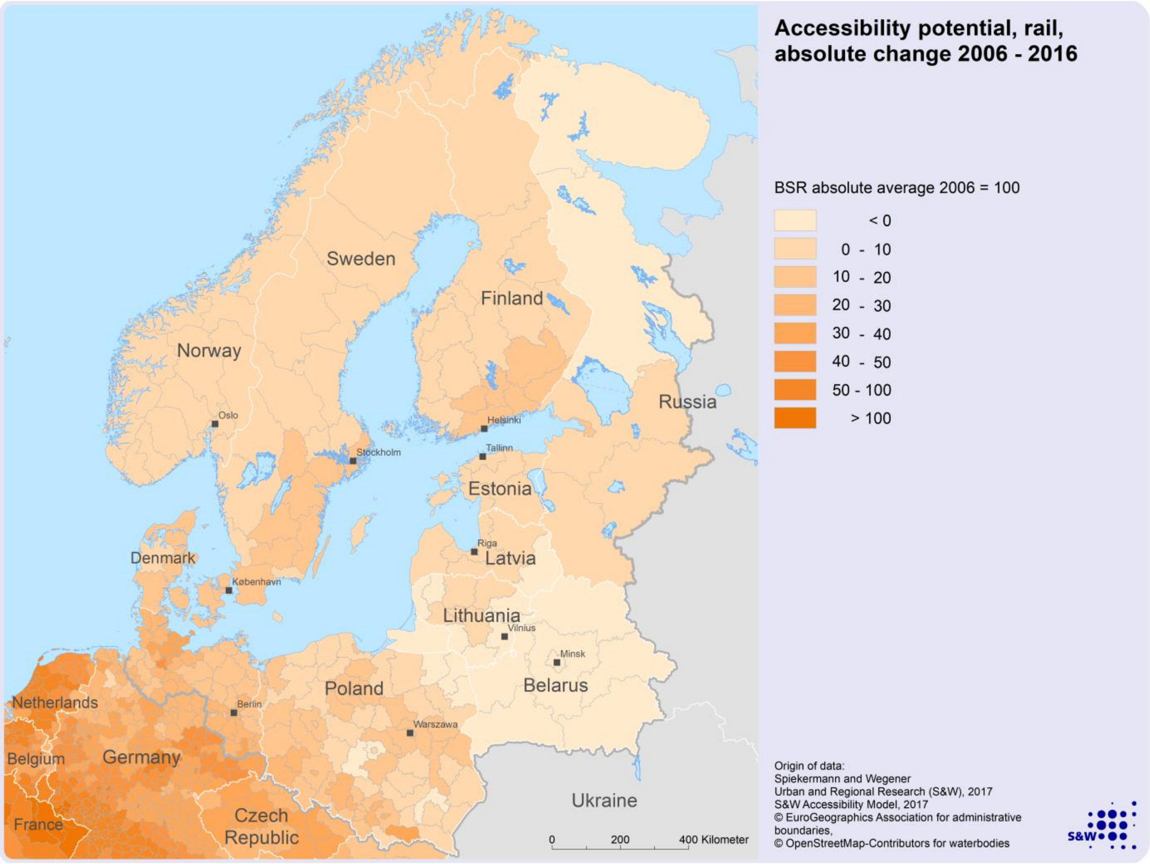

Figure 2.14 Accessibility potential, rail, absolute change 2006-2016.

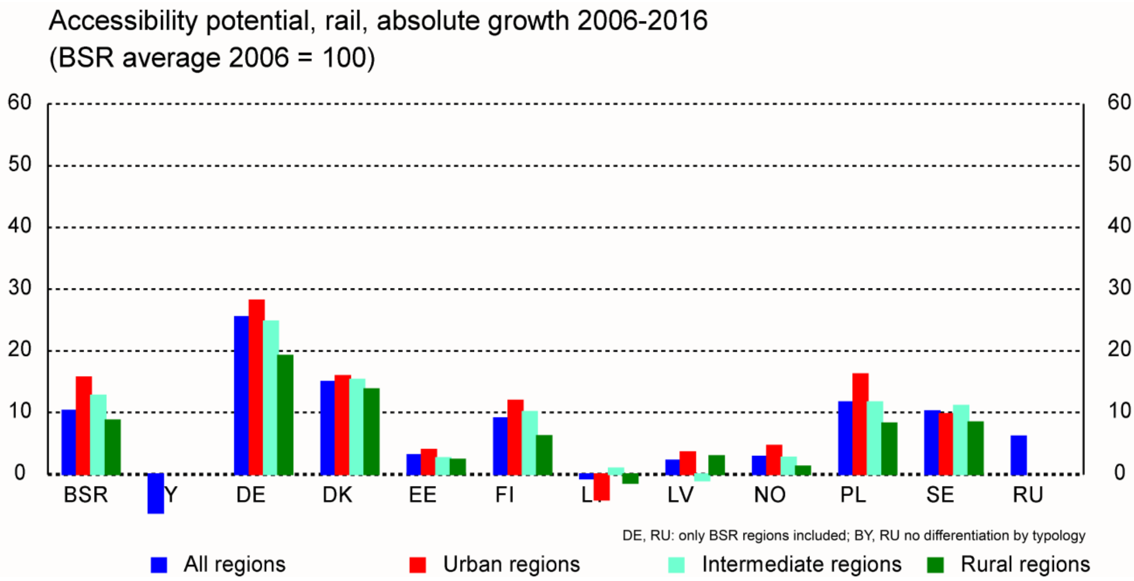

Figure 2.15 Accessibility potential by country and urban-rural typology, rail, absolute change 2006-2016.

2.4 Accessibility potential by air

Accessibility in air transport is conditioned by the location of airports, by their accessibility through land transport modes and by the flight services offered. The resulting spatial pattern of accessibility potential by air is very distinct from the patterns for road and rail (Figure 2.16). The clear centre-periphery continuum of the land modes is replaced by a mosaic of highly accessible regions surrounded by regions with much lower air accessibility. All countries have at least one region which has a accessibility potential by air which is clearly above the BSR average. In all countries the capital region having an international airport belongs to this highly accessible group of regions in the BSR. In Finland, in the Russian regions belonging to the BSR, in Estonia, in Latvia, in Lithuania and in Belarus, the capital airport, respective St. Petersburg's airport, is the only airport offering above average accessibility. In the other countries, the capital airport offers highest accessibility, but there are also other airports offering above BSR-average air accessibility such as Bergen in Norway, Aalborg in Denmark or Hamburg in Germany. Poland has even several cities such as Gdansk, Poznan, Wroclaw or Krakow that offer above average accessibility.

However, it can also be seen that the area benefitting in terms of air accessibility from good air connectivity is rather confined to the surrounding of the individual airports. That means that regions with comparatively low air accessibility can be found in all countries of the BSR. Even in Germany, the regions between Hamburg, Hannover and Berlin airports and all other regions in Mecklenburg-Vorpommern have air accessibility clearly below the BSR average. Such a pattern of high and low air accessibility is visible in all countries. However, differences are clearer pronounced in the three Baltic States and Belarus and Russia than in Poland and in the Nordic countries. The latter are remarkably as the northern regions' air accessibility is not as much below the average as their road and rail accessibility; an outcome of the substantial number of regional airports mainly served by flight connections to the capitals of the countries.

In contrast to the accessibility in road and rail transport, indicators in air accessibility reach similar values in all countries (Figure 2.17). Only Denmark and the BSR regions of Germany are clearly higher due to their international airport hubs. The main differences in the BSR are not between

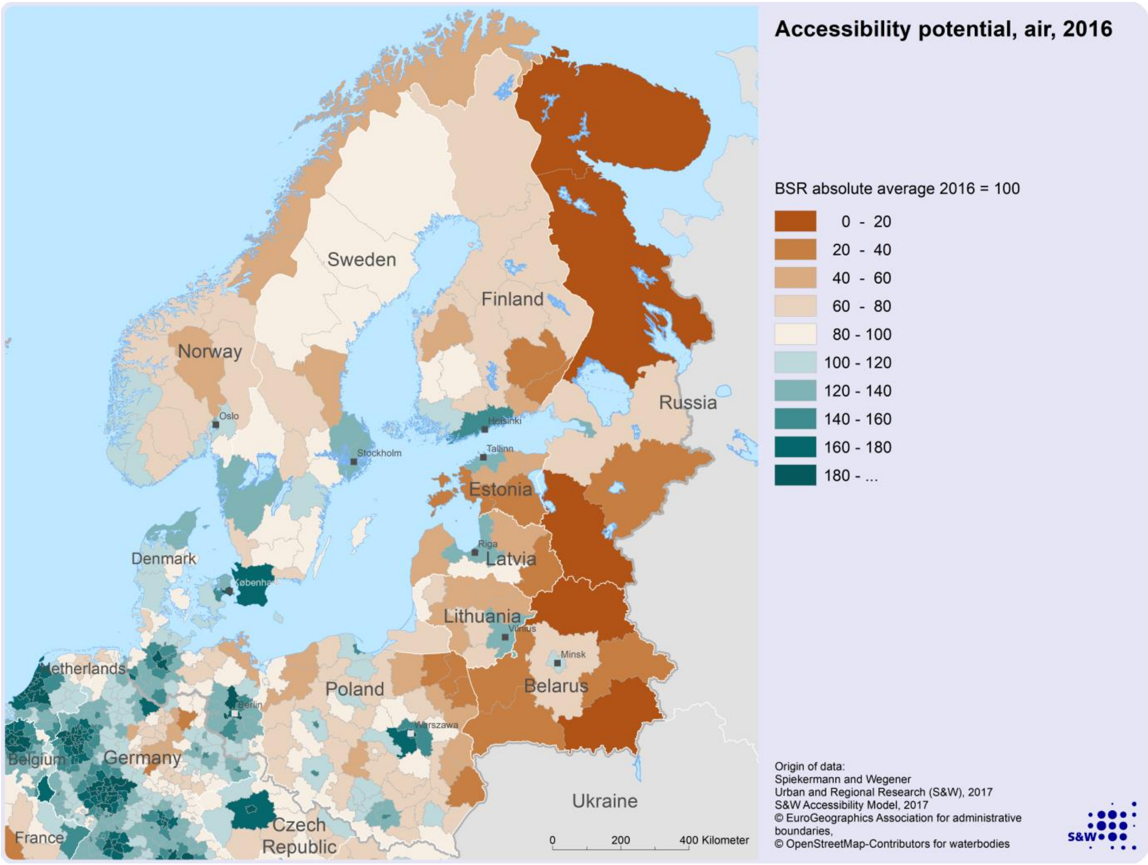

Figure 2.16 Accessibility potential, air, 2016.

countries but between urban regions and rural regions. This is true for the BSR as a whole but also for each individual country. Urbanised regions are better accessible in all countries of the BSR. This proves that air transport is an important factor balancing the level of multimodal accessibility in the Baltic Sea Region on the national scale. At the same time, it polarises regional spatial systems by favouring metropolises served by international airports.

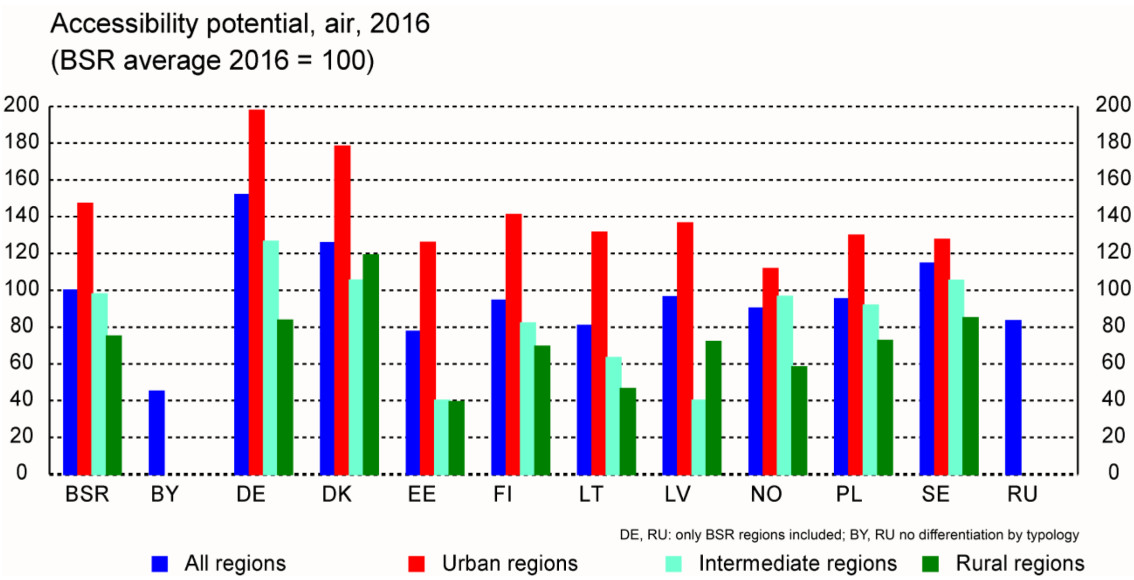

Figure 2.17 Accessibility potential by country and urban-rural typology, air, 2016.

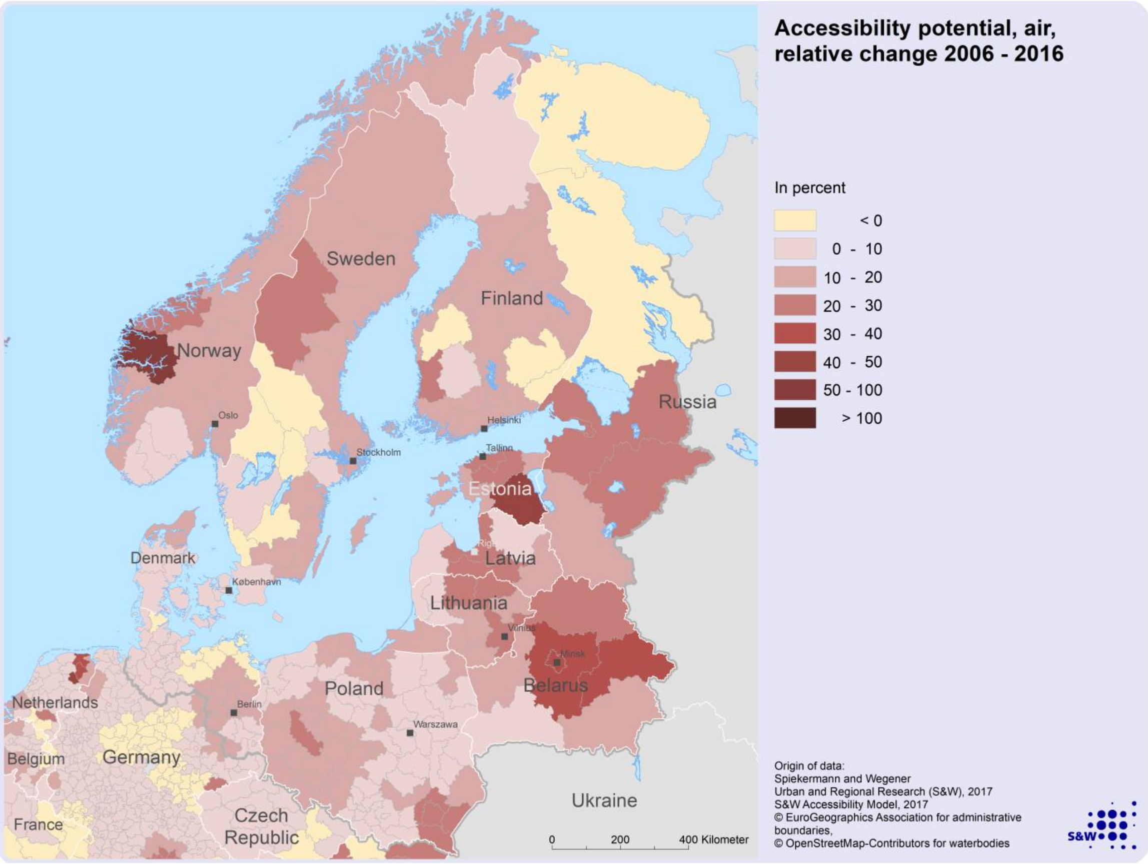

Figure 2.18 Accessibility potential, air, relative change 2006-2016.

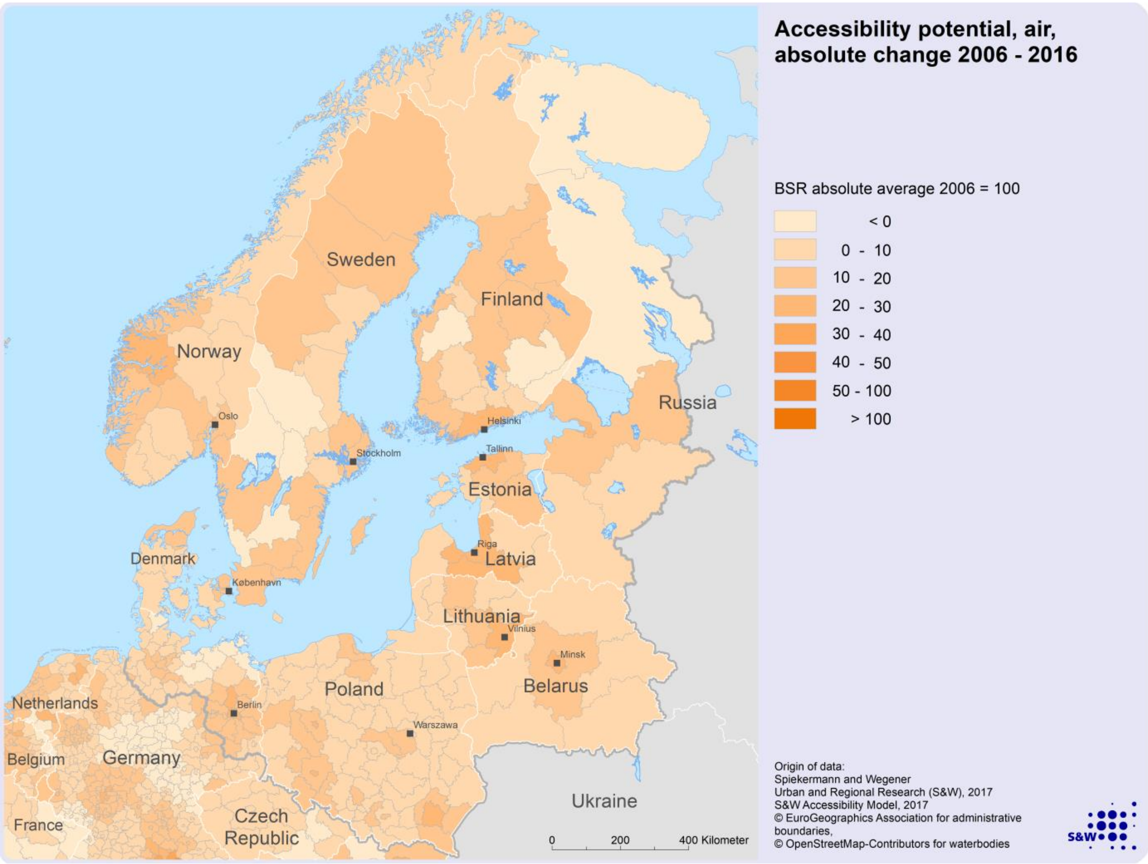

Figure 2.19 Accessibility potential, air, absolute change 2006-2016.

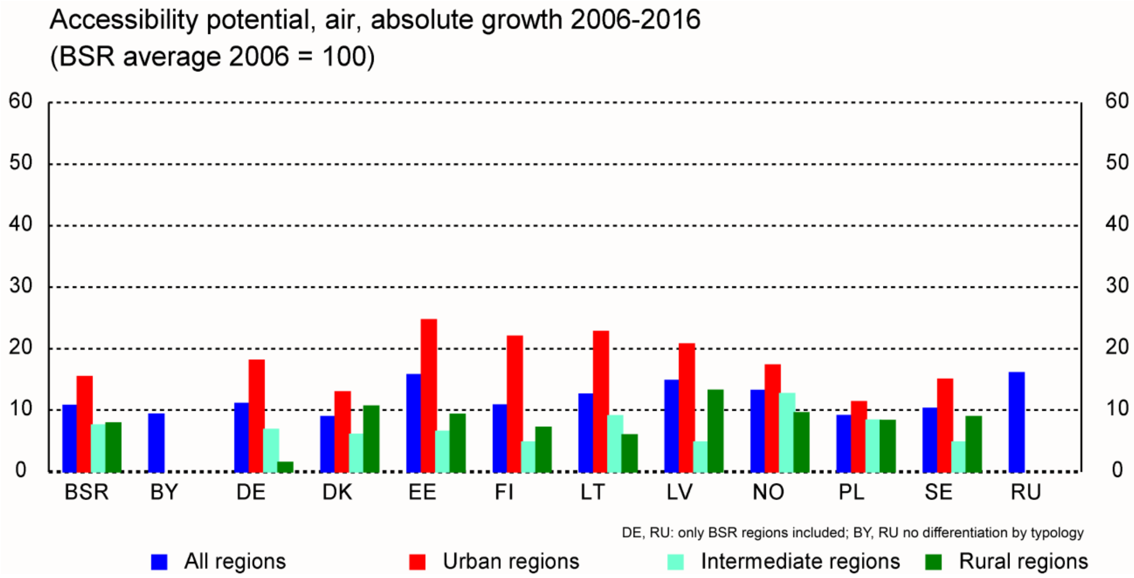

Figure 2.20 Accessibility potential by country and urban-rural typology, air, absolute change 2006-2016.

Figures 2.18 and 2.19 demonstrate that the years 2006-2016 were the period of a spectacular growth in the level of air accessibility throughout all "new" EU member states through the construction of new airports, modernisation of existing facilities and expansion of low-cost carriers, and also in Russia and Belarus. Relatively, the most significant growth in accessibility was noted in the three Baltic States, in the western and southern parts of Poland, in Belarus and Russia and in a few regions in Norway and Finland. (Figure 2.18). However, the combined working of reduced flight services in some regional airports and sometimes shrinking of population led also to negative changes in air accessibility in regions of Germany, Sweden, Finland and Russia. The absolute growth in air accessibility follows more or less that of the relative changes (Figure 2.19).

In the country by country comparison of absolute growth of air accessibility, the Russian BSR regions, the three Baltic States of Estonia, Latvia and Lithuania and Norway experienced the strongest push (Figure 2.20). This was possible because mainly the urban region, i.e. the capital regions of those countries and St. Petersburg gained through the improved facilities and connections of their airports. The growth of Danish and German BSR regions was much less: As those regions have the highest absolute values, there is a tendency of a more balanced pattern of air accessibility in the BSR. Some areas have improved air accessibility due to their location near modernised airports in neighbouring countries. This applies, for example, to northern Lithuania (the airport of Riga) and north-eastern Poland (Lithuanian airports in Vilnius and Kaunas).

2.5 Accessibility potential, multimodal

Accessibility potential multimodal is an aggregate indicator composed of road, rail and air accessibility. As the accessibility potential indicators are specified in a way that they reflect Europe-wide accessibility more than local or regional, multimodal accessibility is mainly, but not solely determined by air accessibility. Consequently, the overall spatial pattern of multimodal accessibility (Figure 2.21) is somehow comparable to that of air accessibility. But there are some important differences. Overall, the regions that have high air accessibility do also have high multimodal accessibility. These are mainly the capital regions of almost all countries. However, due to low road and rail accessibility, the Minsk and St. Petersburg regions are now below the BSR average. On the other hand, favourable conditions for road and rail accessibility might compensate for low air accessibility. This is the case for many BSR regions in Germany which have clearly below air

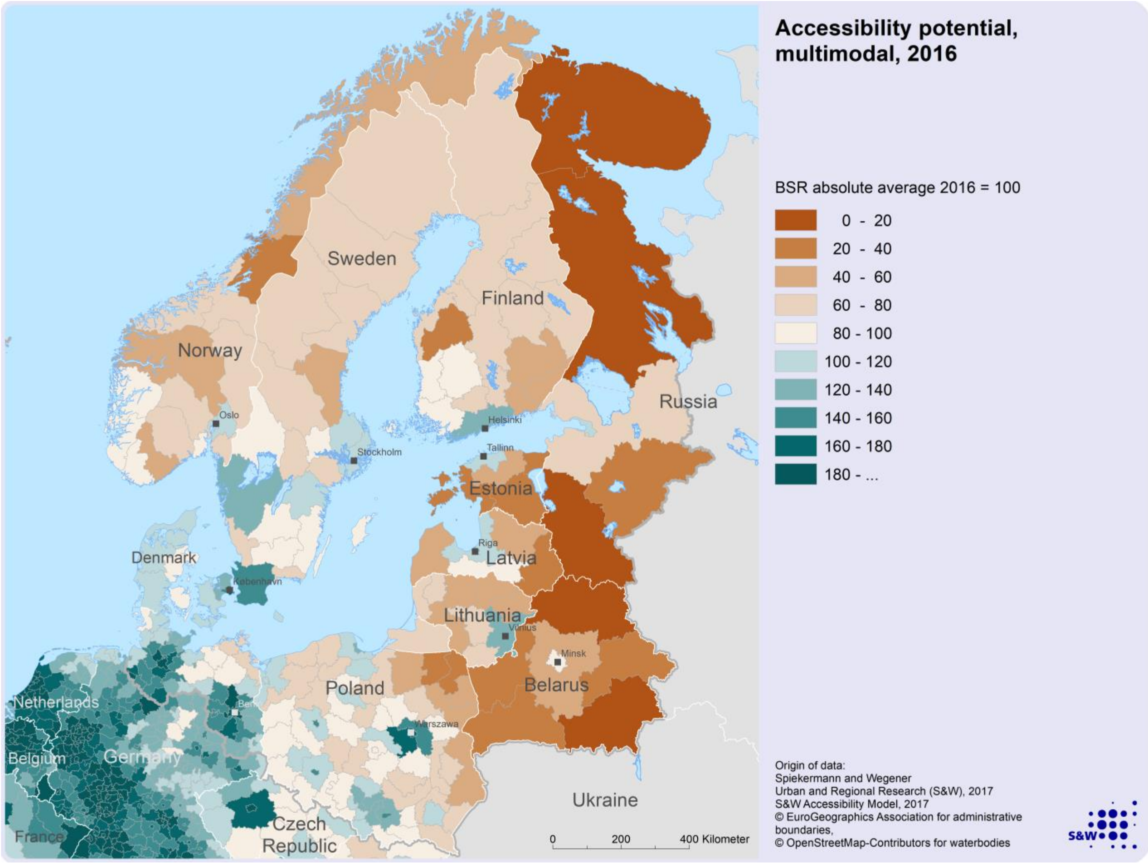

Figure 2.21 Accessibility potential, multimodal, 2016.

accessibility, but clearly above multimodal accessibility. In other regions, in particular the northern regions in the Nordic countries, relatively good air accessibility compensates for the rather low degrees of road and rail accessibility.

The aggregation of multimodal accessibility by country shows the highest values for the BSR regions of Germany followed by Denmark; then Sweden and Poland which have average multi-modal accessibility corresponding to the BSR average (Figure 2.22). All other countries, except

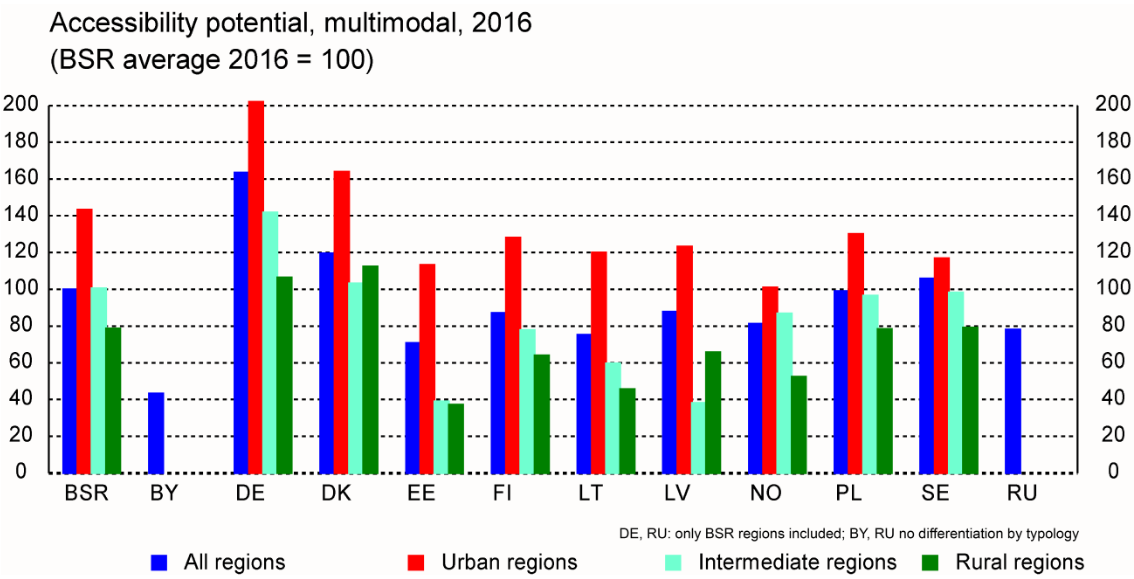

Figure 2.22 Accessibility potential by country and urban-rural typology, multimodal, 2016.

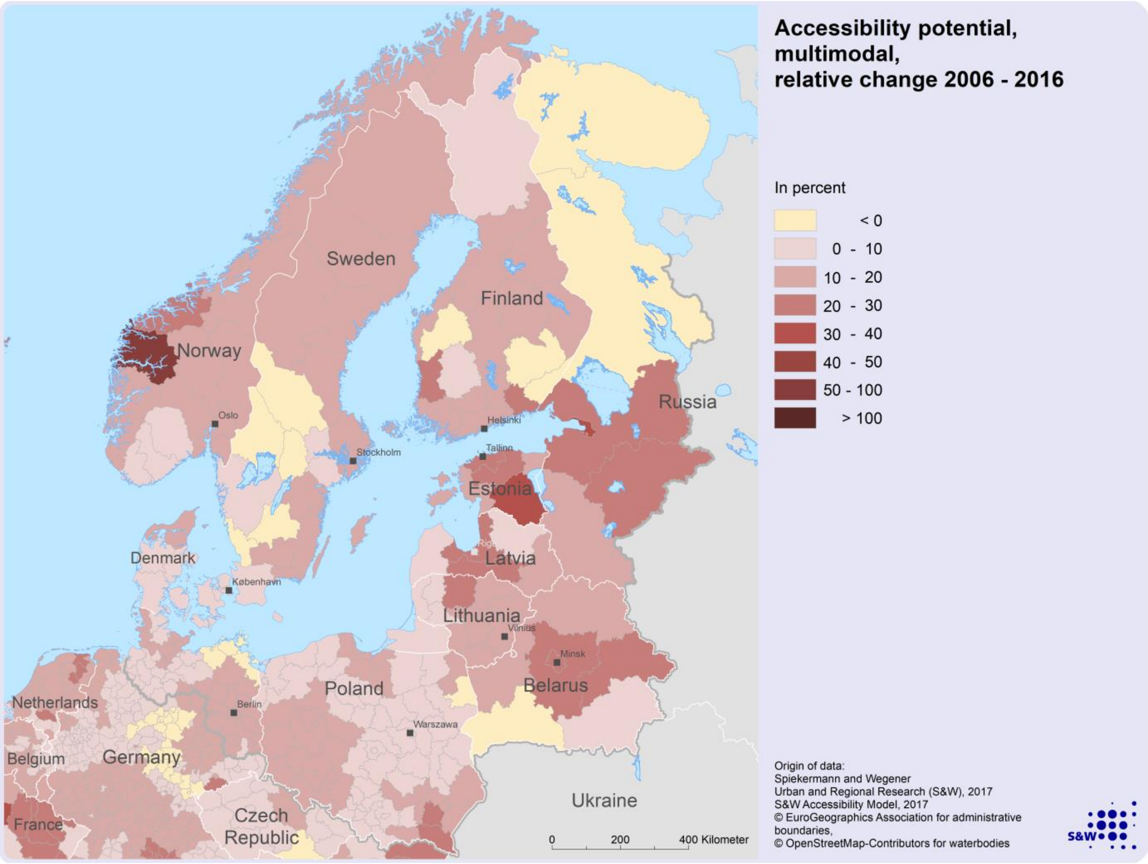

Figure 2.23 Accessibility potential, multimodal, relative change 2006-2016.

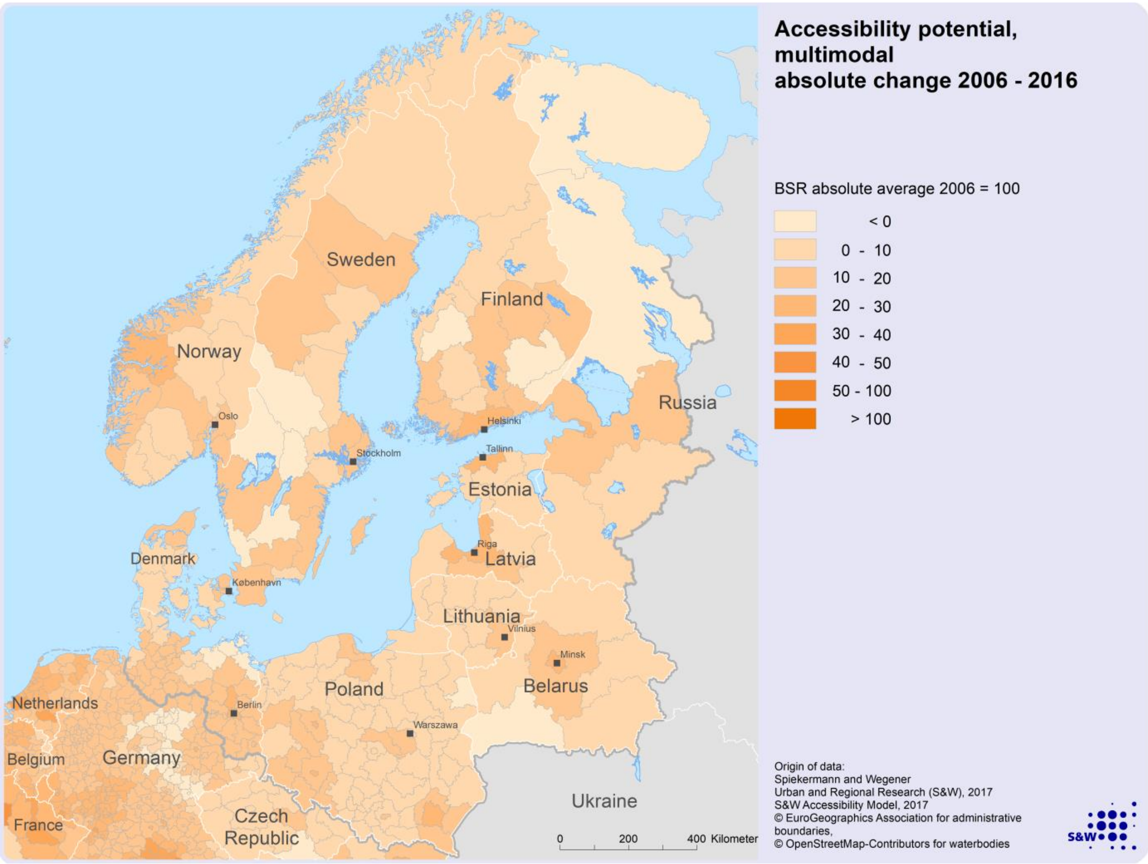

Figure 2.24 Accessibility potential, multimodal, absolute change 2006-2016.

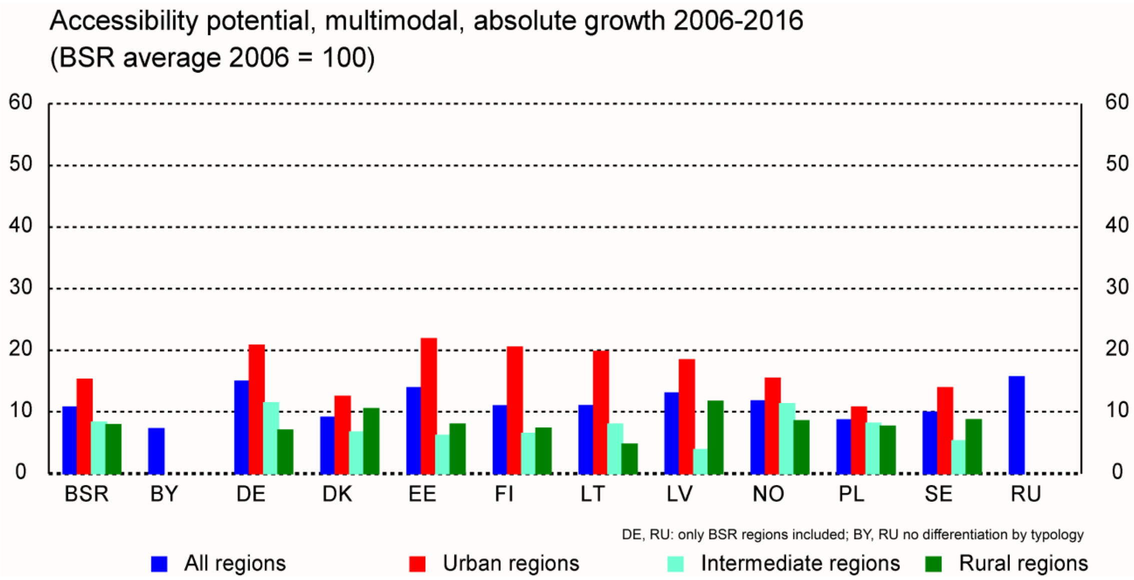

Figure 2.25 Accessibility potential by country and urban-rural typology, multimodal, absolute change 2006-2016.

Belarus with a rather low performance, have index value around 80. In all countries, there is a clear accessibility divide between urban regions and rural regions. This is particular true for Germany, Lithuania, Latvia, Estonia and little less pronounced in Finland and Norway. A much lower degree of polarisation between urban and rural regions is to be observed in Poland and Sweden.

Also, changes in air accessibility influence, in a significant way, the increase of multimodal index values (Figures 2.23 and 2.24). But due to negative development of air accessibility in some regions, also multimodal accessibility decreased. In absolute terms the general transport accessibility within the Baltic Sea Region has improved mostly in the vicinity of capitals and few others large agglomerations such as Helsinki, Stockholm, Oslo, Copenhagen, Tallinn, Riga, Vilnius, Minsk, Sankt Petersburg, Warsaw, Gdańsk, Poznań, Wrocław or Berlin. The improvement of accessibility in the vicinity of some cities results from the cumulative effect of modernisation of airports and the development of road infrastructure in the region. This applies, for example, to Wrocław and Gdańsk in Poland, but also to Riga and Minsk.

That the urban regions are benefitting most from accessibility increases is confirmed by the aggregation of multimodal accessibility changes to the urban-rural typology (Figure 2.25). In all countries of the BSR growth in multimodal accessibility is highest in urban regions. There are partly significant growth gaps between urban regions; this is most pronounced in Germany, Finland, Estonia, Latvia and Lithuania. On the other hand, differences in growth between countries are minor, all the countries saw average multimodal accessibility gains of around ten index points, the range is between eight and fifteen index points with the Russian BSR regions having on average the highest growth followed by the German BSR regions and the Estonian and Latvian regions. To conclude, disparities in accessibility did not rise between countries but between urban and rural regions within countries.

3 Accessibility to opportunities

Accessibility potential to population by different transport modes as analysed in the previous chapter is only one of many ways accessibility indicators can be specified. Looking at other options of interest to be reached via the transport network might give different insights in the overall performance of the BSR in terms of accessibility. This chapter presents as examples two other destination activities of interest labelled here as opportunities. The first one is to look at accessibility to local and regional services as an aggregate of different opportunities at different scales. The second example is another important opportunity for living, i.e. access to jobs. Due to restrictions of data available, these types of accessibility can only be presented for parts of the BSR. For the first example, data is only available for regions of the European Union, for the second study, data from previous studies is only available for some countries of the BSR.

3.1 Accessibility to local and regional services

Local and regional centres usually combine a range of different functions for the population living in the surroundings. Good access to those centres is an essential component of quality of life. The Joint Research Centre of the European Union has assessed to what degree the population of the EU regions can access what type of centre (Kompil and Lavalle, 2017a, b). The indicator is expressed as average road distance per person to the nearest centre. Calculation is based on a large-scale population grid, results are then aggregated to NUTS-3 regions.

Figure 3.1 shows the access to local centres. Ideally, they are serving about 5 to 10 thousand people and have opportunities such as schools, small health facilities, childcare services, sport

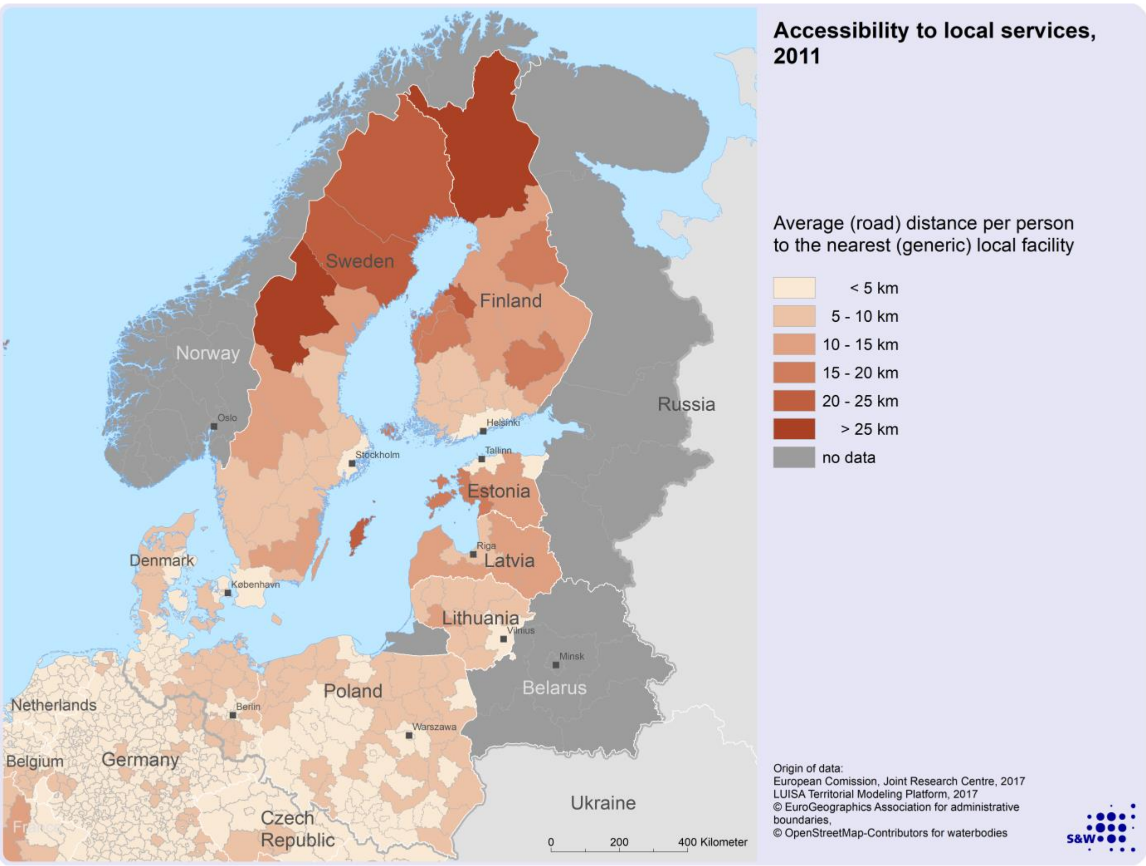

Figure 3.1 Accessibility to local services.

facilities, small markets etc. The spatial pattern of accessibility to local centres is closely linked to the various types of settlement structures in the BSR. In general, access to local centres and their services is better in the south-west and decreases gradually going north-east in the BSR. The polycentric settlement structures in Germany as well as Western and Southern Poland, with a huge number of smaller towns and cities provide good access of the population to local centres. Average road distances are in many regions less than 5 km or in the range of 5 to 10 km. People living in regions of Denmark or Lithuania or in the southern parts of Sweden or Finland have similar short distances. This is also the case for most of the capital regions in the BSR. In many areas in Latvia and Estonia the distance to the next centre is already more than 10 km. This is also the case in the middle parts of Sweden and Finland. Living further north in these two countries means to travel on average more than 20 or even more than 25 km to the next local centre.

Figure 3.2 gives the access to regional centres. Ideally, they are serving between 500 thousand and 1 million persons and do have usually specialised centres for education and health, large facilities for sports and culture, governmental services, high-tech services etc. The overall spatial pattern of access to regional centres is comparable to that of access to local centres; i.e. living more north- and eastwards in the BSR means to face longer distances to the next regional centres. Of course, average distances to regional centres are much higher than distances to local centres. From most BSR regions in Germany, Poland and Denmark average road distances to regional centres are in a range up to 50 km. However, there are a few regions in those countries that face longer distances. of up to almost 100 km. Distances in southern Sweden and southern Finland are also in the range of up to 60 km, further north in the two countries it goes up to much more than 100 km Very distinct is the situation in the three Baltic States. As Estonia, Latvia and Lithuania do have only very few such regional centres, disparities in its access are very high. Besides short distances in regions forming those centres, people living in other regions might face road distances of between 50 and 100 km or even beyond.

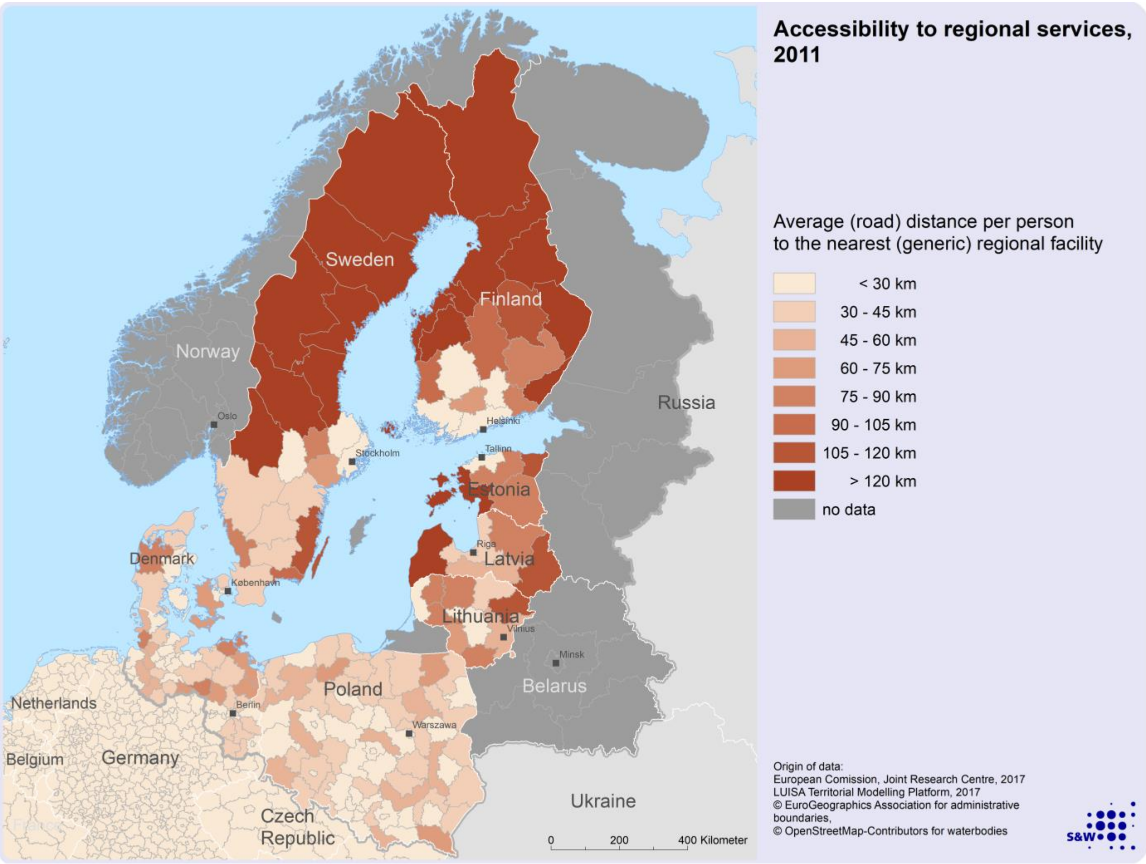

Figure 3.2 Accessibility to regional services.

3.2 Accessibility to jobs

The amount of jobs that is accessible in reasonable commuting time is an important factor considered by households when making location decisions. It reflects the opportunities of the regional labour market from the point of view of the population. However, accessibility data for this is usually not available at all. In the ESPON TRACC project (Spiekermann et al., 2015), an accessibility to jobs indicator was calculated for some regional case studies. There were three case studies located in the BSR covering Finland, the Baltic States Estonia, Latvia and Lithuania as well as Poland. The ESPON TRACC indicator was defined as the amount of jobs reachable from each LAU-2 region in less than 60 minutes travel time. The threshold of 60 minutes can be considered to represent usual maximum daily commuting times for one way.

In Figure 3.3, the number of jobs accessible within one hour travel time by car is presented for these five countries at municipal level. Figure 3.4 is a zoom-in map for the Polish case study showing also accessibility to jobs by car, Figure 3.5 shows accessibility to jobs by public transport. Figure 3.6 aggregates the accessibility to jobs data by the European urban-rural typology. For each regional type a box plot is shown for accessibility to job by car and by public transport.

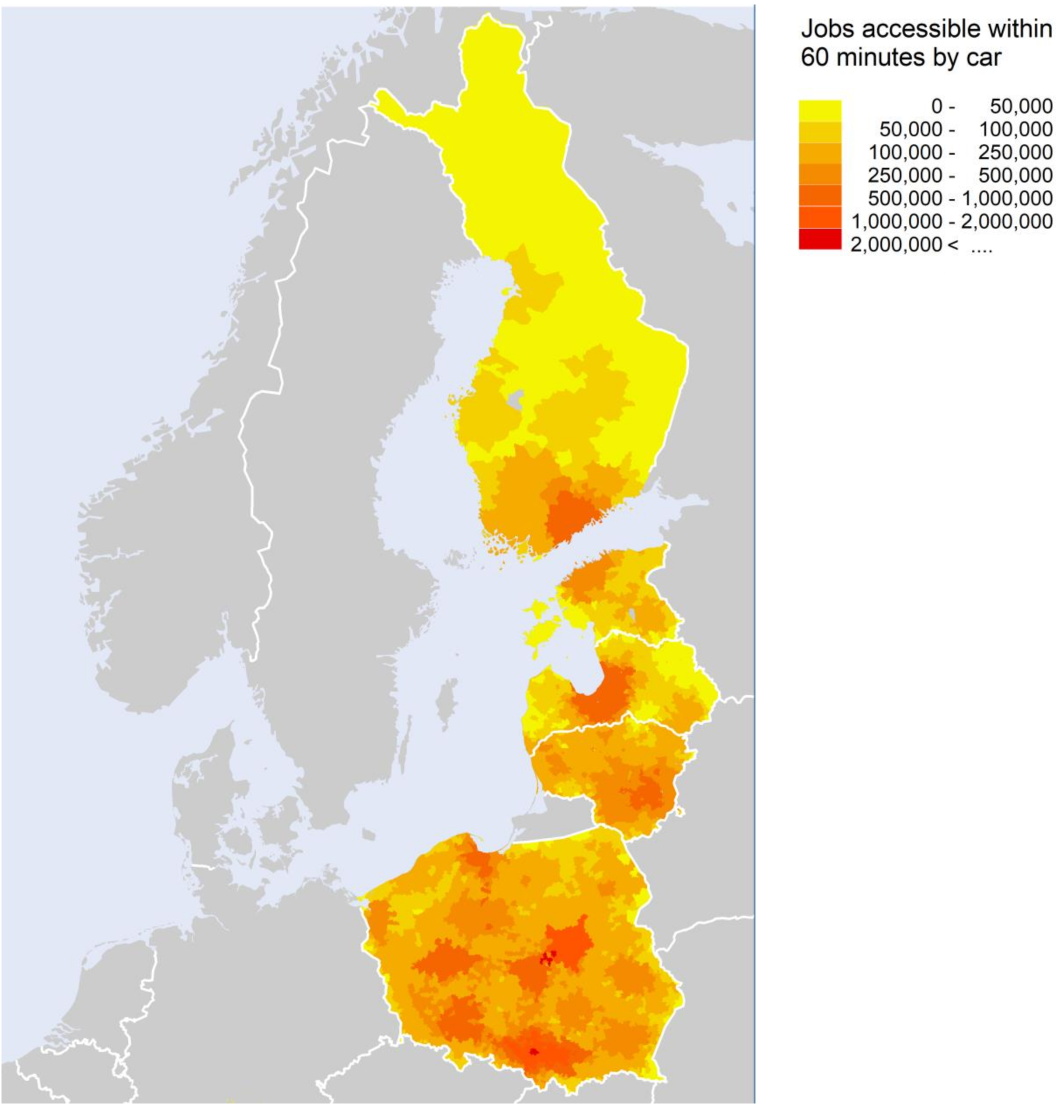

Figure 3.3 Accessibility to jobs at municipal level in Finland, Estonia, Latvia, Lithuania and Poland, road (Source: Spiekermann et al., 2015).

In Finland, the Helsinki region has a clear dominance in job accessibility by car, reaching its effect far in the surrounding areas via radial motorway connections to all directions (Kotavaara et al., 2013). Jobs are well accessible around regional centres, whereas apparent peripheries exist in Central, Eastern and particularly in Northern areas. In general, by public transport the accessibility of jobs is considerably lower than that by car. The best accessibility can be found in the capital region but to a more limited extent. Public transport based job accessibility is decent only in the immediate surroundings of regional centres. In the areas between the cities, accessibility is mainly at a poor level. Due to the limited coverage of the bus network, there are large areas with very low accessibility to jobs by public transport even in the southern part of the country.

In the three Baltic States, there are large differences in jobs accessibility, even for road (Schürmann, 2013). While from areas along the borders only up to 5,000 jobs can be reached. But from the highest accessible places more than 750,000 jobs within 60 minutes car travel time can be reached. This is true for the wider Riga agglomeration, as well as the area between Kaunas and Vilnius in Lithuania. Estonia has two labour market centres, which are Tallinn and Tartu. Apart from that job accessibility in Estonia is low with most places yielding between 10,000 and 100,000 jobs accessible. Accessibility for public transport is substantially lower. However, low accessibility areas are often interrupted by distinct axes of higher accessibilities along rail corridors. Accessibility is highest in star-shaped axes connecting the agglomeration centres into their hinterland. Accessibility to jobs shows obvious differences with specific spatial patterns for the three Baltic States, and also stark disparities between the two transport modes and the types of regions, with a strong concentration on the agglomerations.

Also the Polish case study attests a high territorial variability at the local dimension (Stepniak et al., 2013, see also Figures 3.4 and 3.5). Accessibility to jobs and in the same way also to many services of general interest is determined not only by the existence of extensive transport infrastructure, but also by appropriate connections to secondary networks. The analysis carried out at the municipal level reveals problems brought about by e.g. large distance between junctions on motorway exits (inter alia on Polish A2 motorway between Warsaw and Berlin). Local solutions have thus crucial influence on the ultimate effectiveness of investments pursued in the TEN-T corridors (frequently with the support of the EU cohesion policy). International investments can simultaneously contribute to broadening of regional labour markets. Analysis of accessibility to jobs in Poland indicates also the significant accessibility disparities between road and public transport. Accessibility to jobs by public transport is significantly more restricted spatially.

The analysis of accessibility to jobs in Poland indicates the formation of inner peripheries not only in eastern Poland, but also on the borderlands of central provinces. They are particularly visible in the case of job accessibility by public transport. The construction of new infrastructure does not always improve the situation if it is not accompanied by the development of secondary networks. Modernisation of railway lines also improves access from medium-sized to metropolitan cities. The situation of some units located, especially in Eastern Poland, but also in the Carpathians, can be described as transport exclusion. There is no possibility of getting to work to medium-sized cities by public transport. These are usually municipalities in which rapid depopulation occurs and disturb the demographic structure (aging of the population).

Since 2015, the situation on the Polish labour market has changed rapidly. The previously common problem of unemployment has been significantly reduced. However, the lack of hands to work has become a growing problem. This allows looking at the map of job accessibility, also from the employers' side. Poor internal accessibility to centres where foreign industrial investments were previously located limits the possibility of acquiring new commuters. This forces some companies to organise their own bus services. In this context, the accessibility of Polish jobs from Ukraine and Belarus is also gaining in significance.

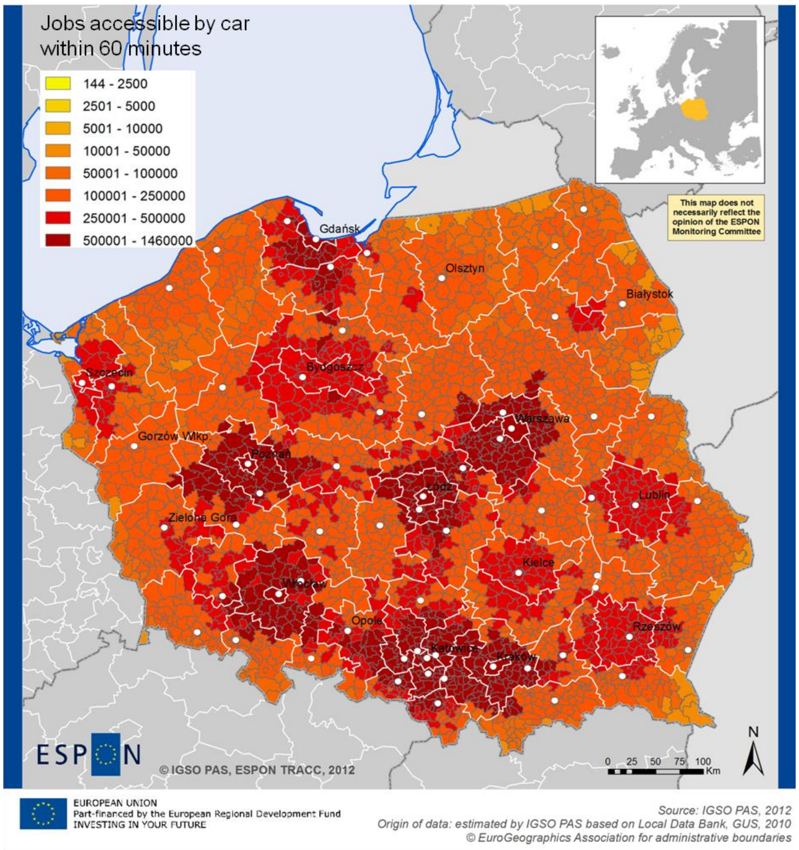

Figure 3.4 Accessibility to jobs in Poland, road (Source: Stepniak et al., 2013).

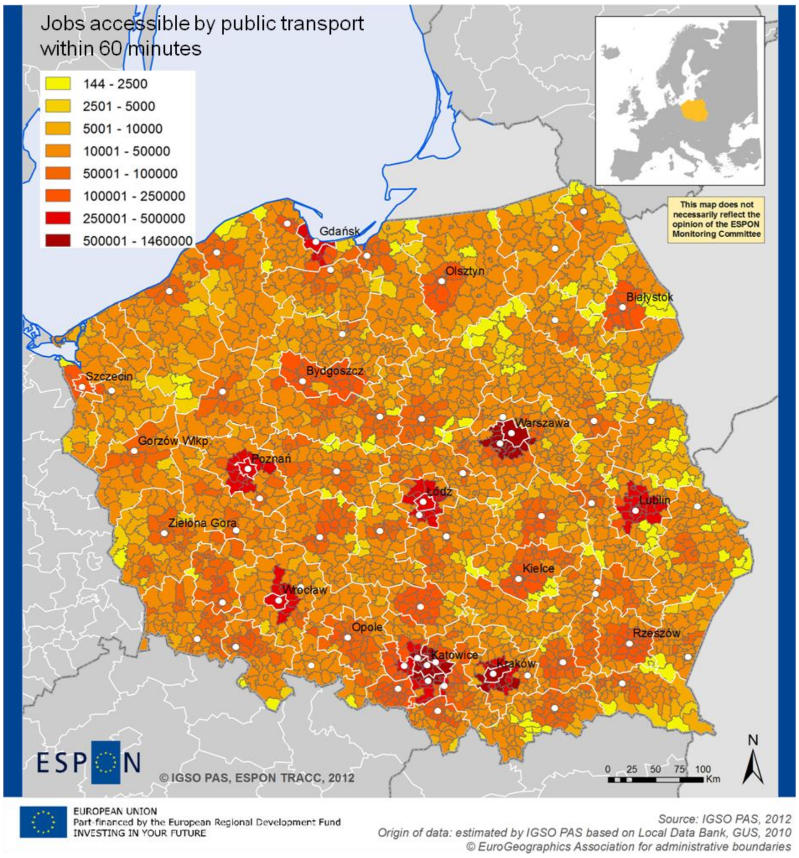

Figure 3.5 Accessibility to jobs in Poland, public transport (Source: Stepniak et al., 2013).

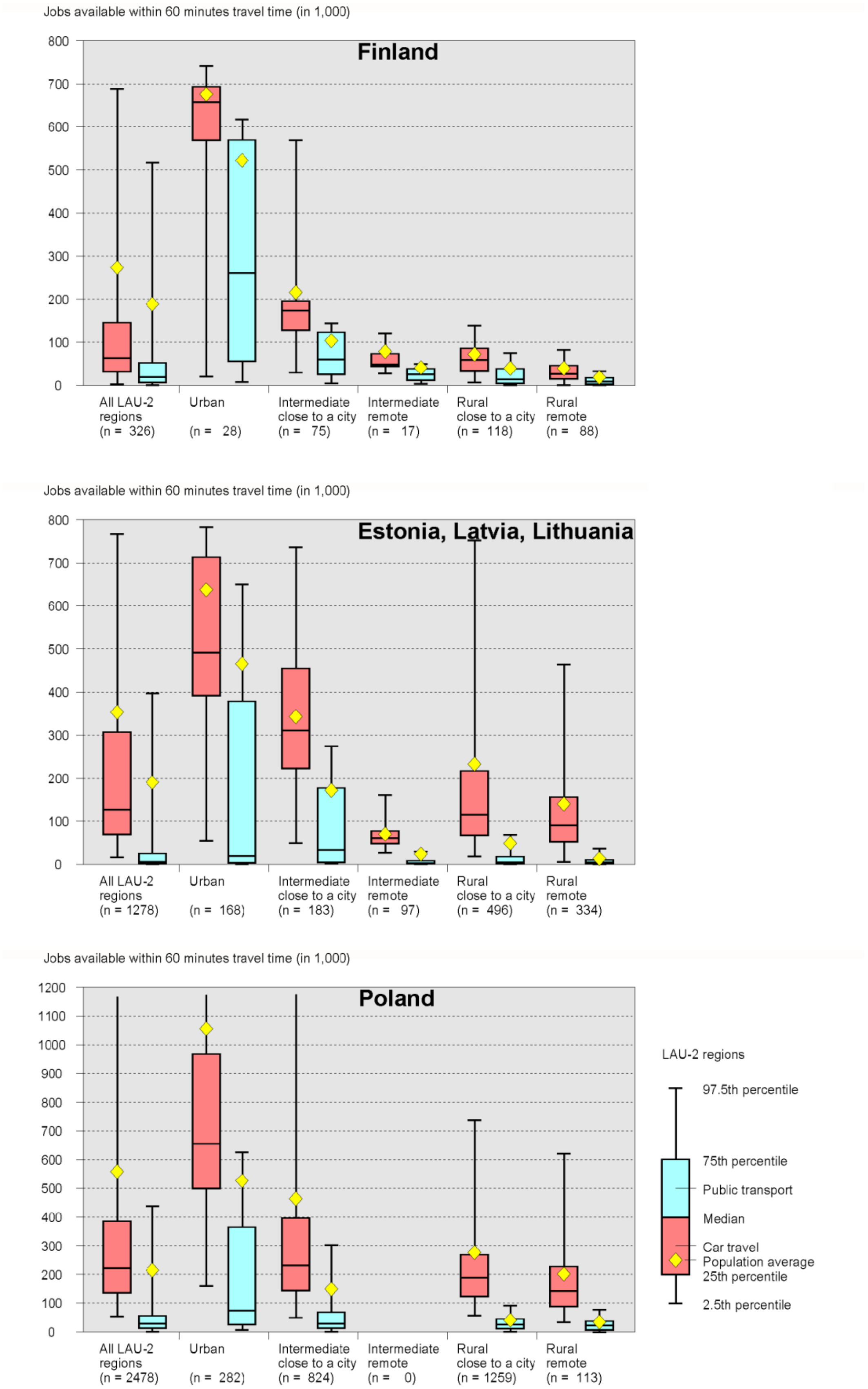

Figure 3.6 Accessibility to jobs by road and public transport at municipal level in Finland, Estonia, Latvia, Lithuania and Poland by urban-rural typology (Source: Spiekermann et al., 2015).

4 Maritime accessibility

Ferry routes are an essential element of mutual accessibility between Baltic coastal regions (Figure 4.1). The BSR ferry network is made up from relatively short distance ferries linking mainly islands to the mainland and long-distance ferries linking different parts of the macro region. However, for certain longer distance relationships their functioning is influenced by competition with regard to other means of transport. This concerns primarily air transport. Low-cost airlines between Poland, Baltic states and Scandinavia (destination for people that migrate in search of work) restrict demand for ferries, e.g. between Stockholm, Riga and Gdynia. Frequency of services for ferry lines is not noticeably greater than 20 years ago, despite the fact that there occurred a considerable development of both social and economic links. Construction of Oresund Bridge was one of the major causes of the withdrawal of ferry services between Świnoujście and Copenhagen that had been functioning on a daily basis for decades. The alternative that was meant to satisfy the demands proved to be a slightly shorter ferry line to Ystad in Sweden.

The structure of the ferry network and its specific functions determine the passenger volume in BSR ports (Figure 4.2). Whereas the western area is characterised by a many smaller, medium-sized and some larger ports handling often shorter distance ferry transport, but also long-distance ferry transport and cruise passenger, the north-eastern parts of the Baltic Sea is made up of rather few ports, however, handling large numbers of ferry and cruise passengers. Here, largest passenger volumes occur in Stockholm, Helsinki, Tallinn, and St. Petersburg which saw in particular a substantial growth in cruise passenger. Cruise ships call only at selected ports. And, those ports of the Baltic Sea have apparently developed a specific division of tasks (Figure 4.3). Whereas the German ports provide access to cruise ships, i.e. most of the cruise passengers of those ports start or end a cruise there, the other ports serve mainly as destination for excursions from the cruise ships. Copenhagen is the only major port that has developed both functions.

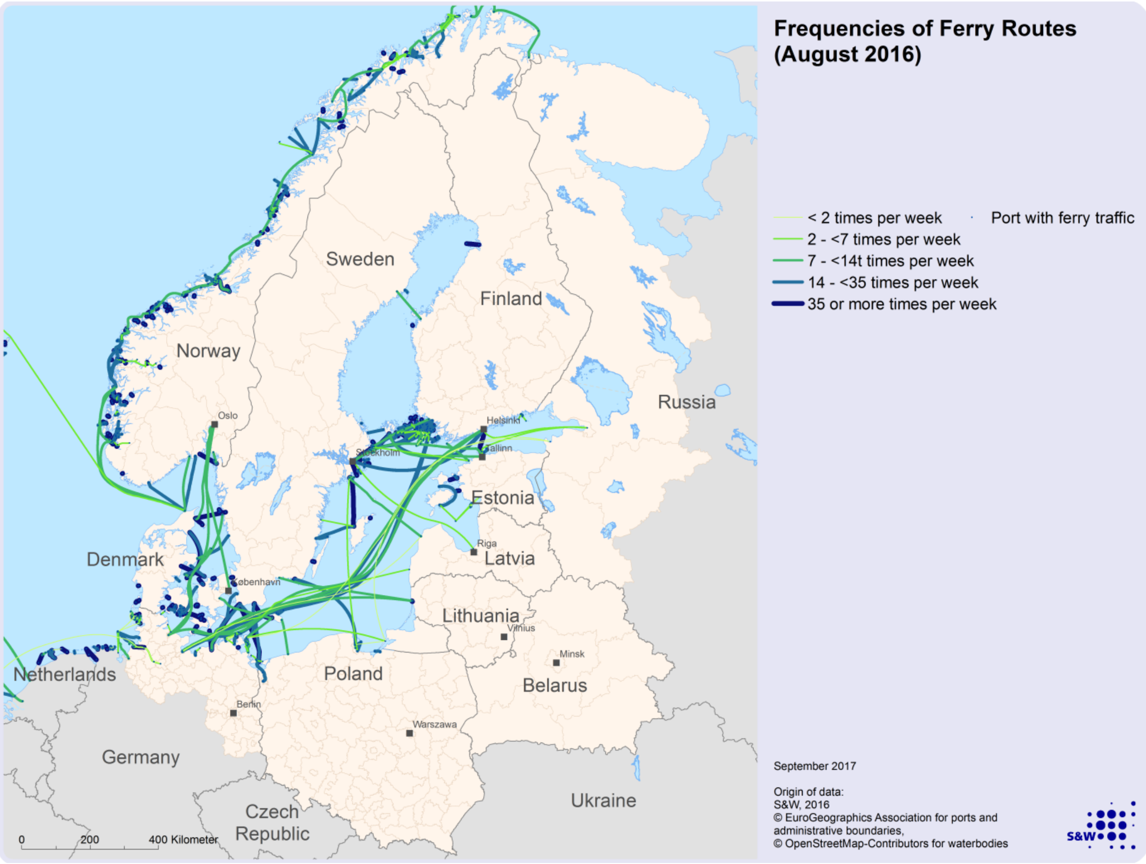

Figure 4.1 Ferry network, frequencies summer 2016.

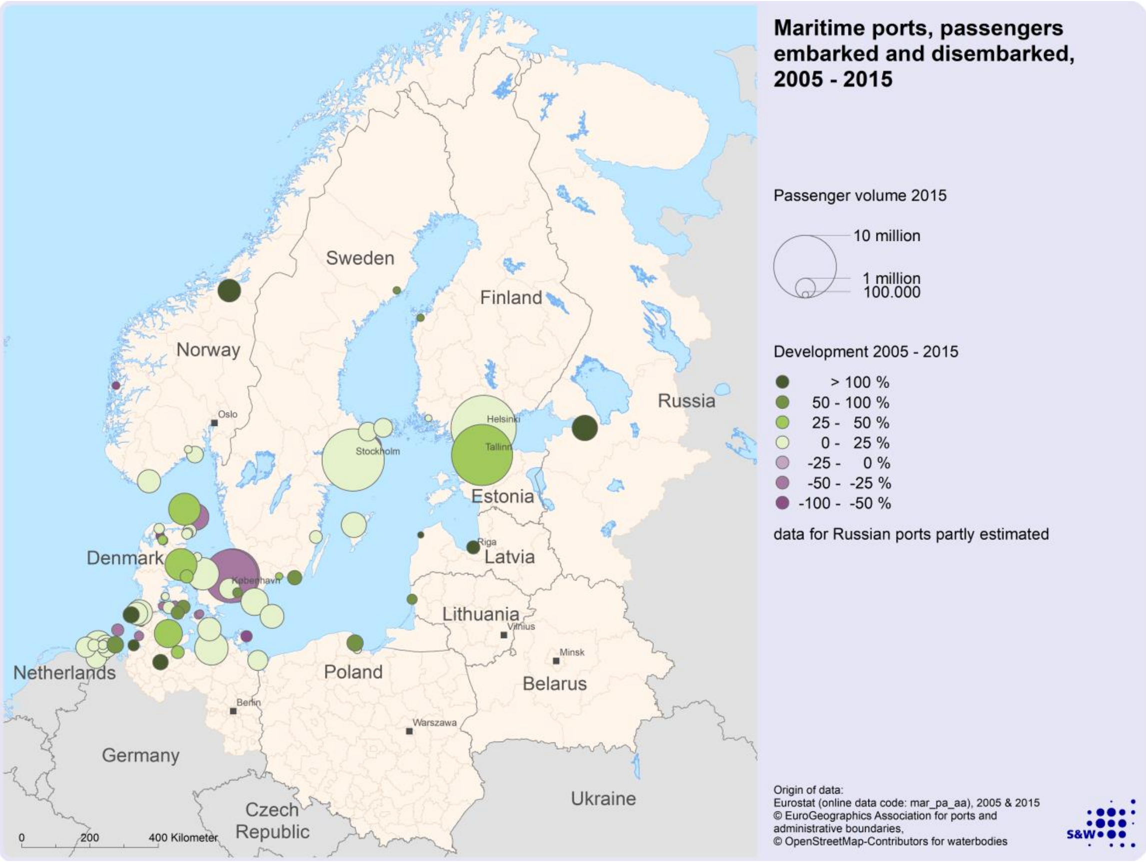

Figure 4.2 Passenger volume of maritime ports, 2005-2015.

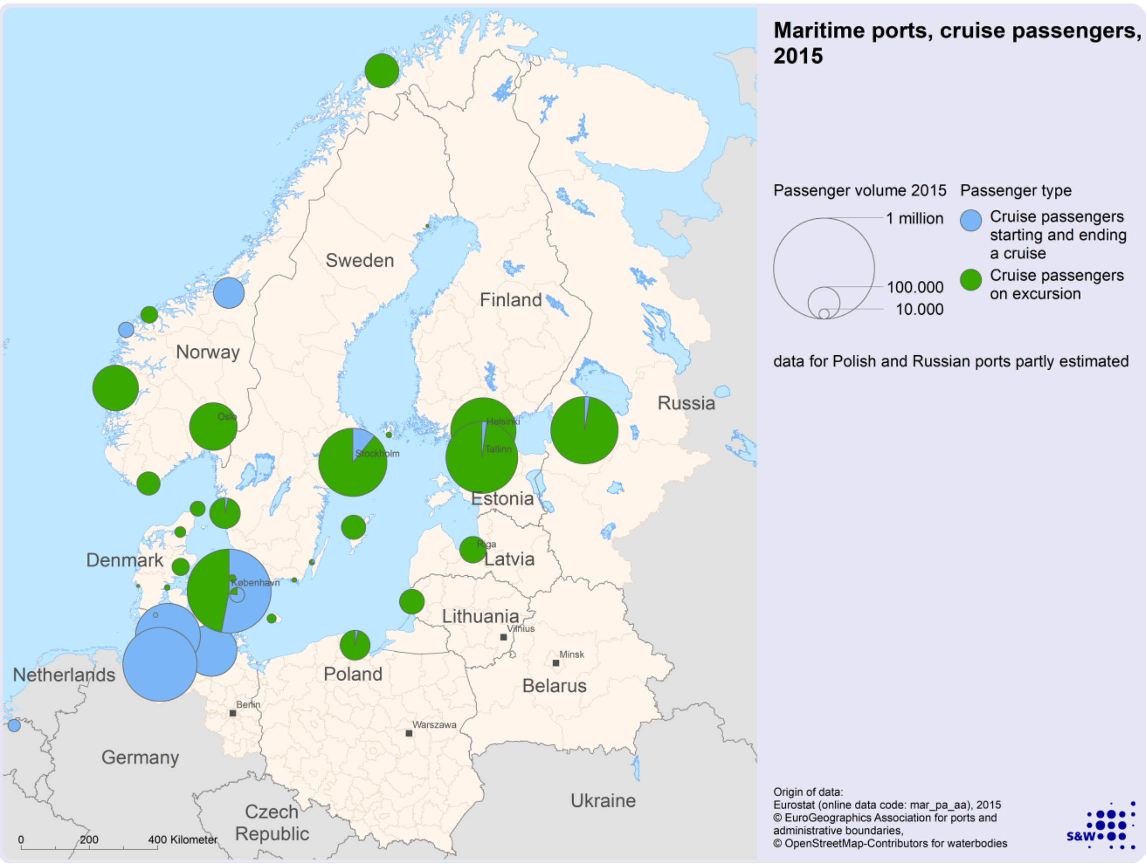

Figure 4.3 Cruise passengers of maritime ports, 2015.

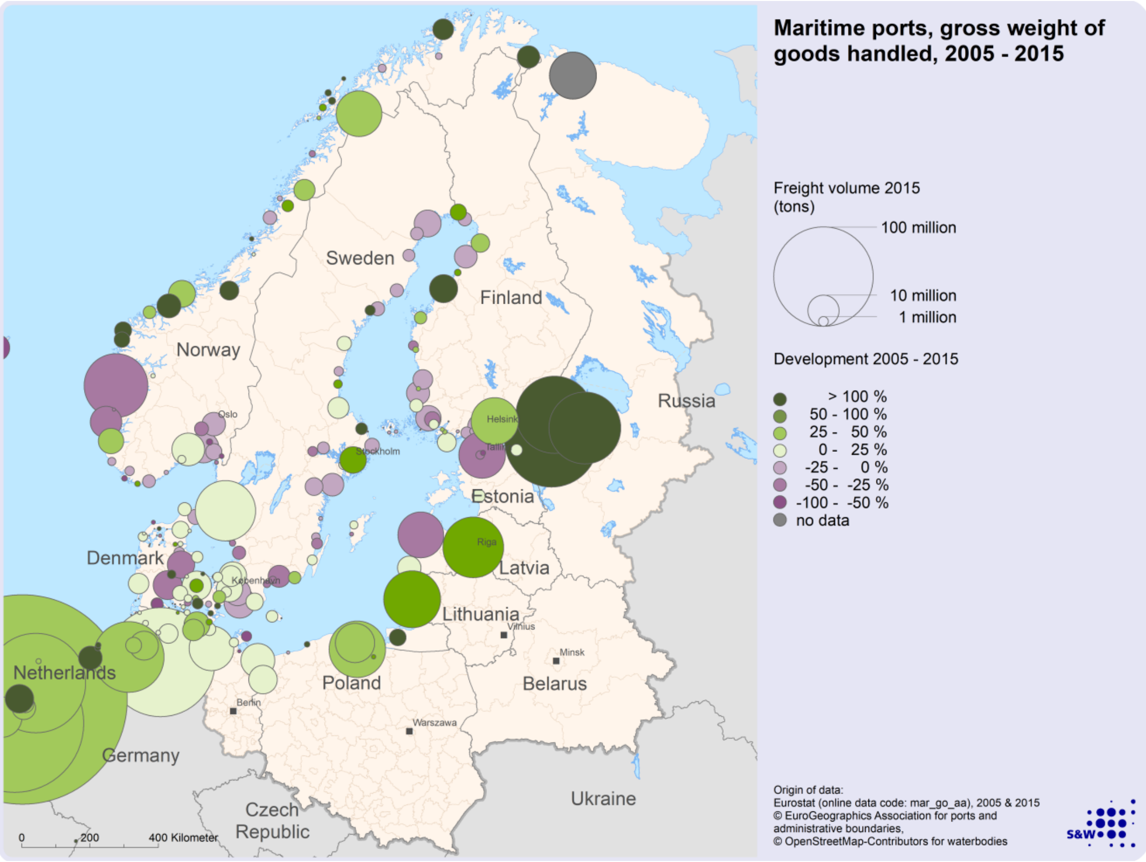

Figure 4.4 Freight volume of maritime ports, 2005-2015.

In maritime transport of goods, southern Baltic coast (Germany, Poland, Baltic States) is characterised by a lower number of decidedly large seaport establishments recording, in general, growth in cargo handling (Figure 4.4). However, goods volumes in those ports are much less than in the North Sea ports of Germany, the Netherlands and Belgium. In the coastal areas of Denmark, Sweden and Finland there is a dense network of small seaports, part of which is gradually decreasing the tonnage of transhipment cargo. Remarkable was a significant increase in capacity and freight volume of the Russian port of the Baltic Sea Basin. For example, the freight volume of Ust-Luga port (Leningrad Region) increased from 3.8 million tons to 93.4 million tons in 2016. The increase in the capacities of the Russian BSR ports is connected with a significant decrease in the volume of servicing of Russia export-import cargo in some ports of the Baltic States and Finland.

The ports do have very different functions as the differentiation by main cargo type is indicating (Figure 4.5). Some of the ports with larger volumes in Finland, Estonia and Norway have concentrated on liquid bulk. Most of the smaller ports along the Swedish and Finish Baltic coast concentrate either on dry bulk goods or on unitised goods. The larger ports at the southern coast of the Baltic Sea are more diversified, i.e. have significant tonnage of all three main cargo types. Annex A2 gives more information on selected individual ports by mapping their trade relationships with European countries. Again, the huge diversity of ports and their functions becomes apparent.

From the huge number of ports along the Baltic Sea only a selection is handling container traffic (Figure 4.6). The share of Baltic Sea in the container transport is not significantly large as compared with North Sea ports in Germany, Belgium and the Netherlands where the extreme large container ships are calling. However, container traffic in the ports of the Baltic Sea is growing steadily; rapid growth is noted especially in Gdańsk and Riga. Since 2012, the deepwater con

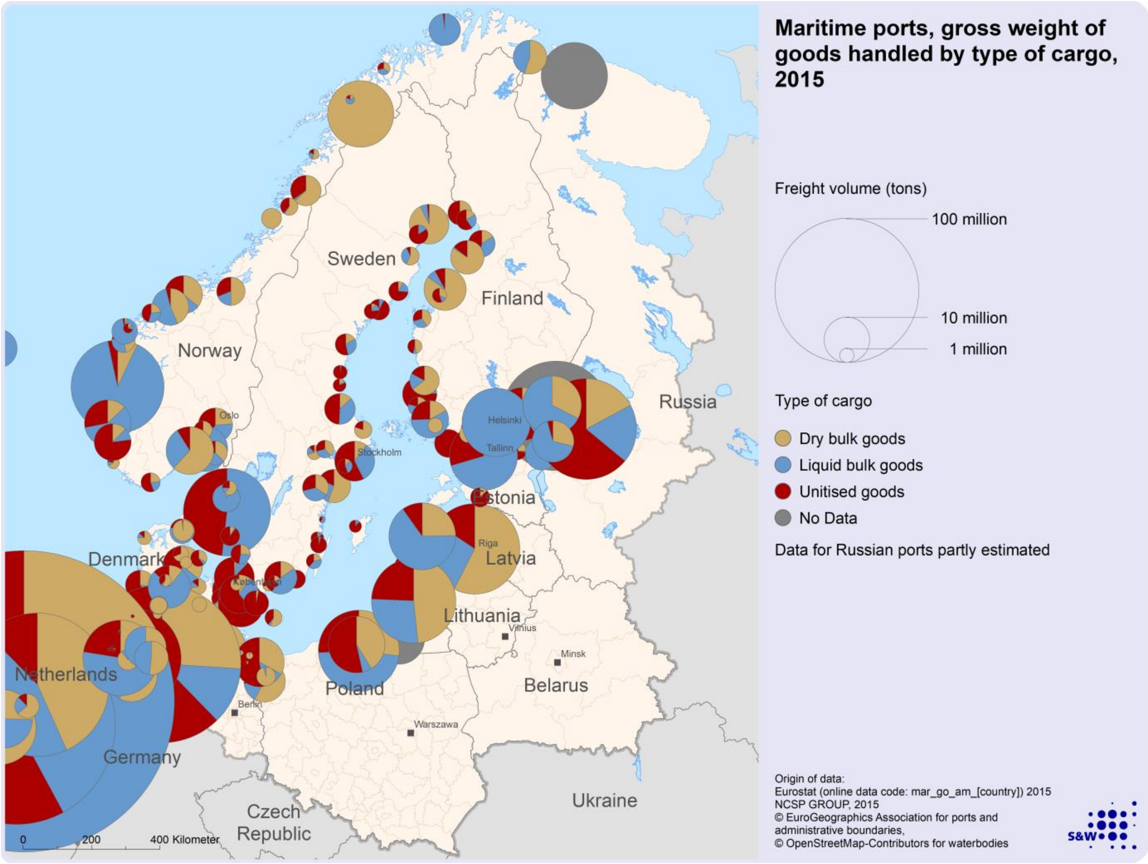

Figure 4.5 Freight volume of maritime ports by type of cargo, 2015.

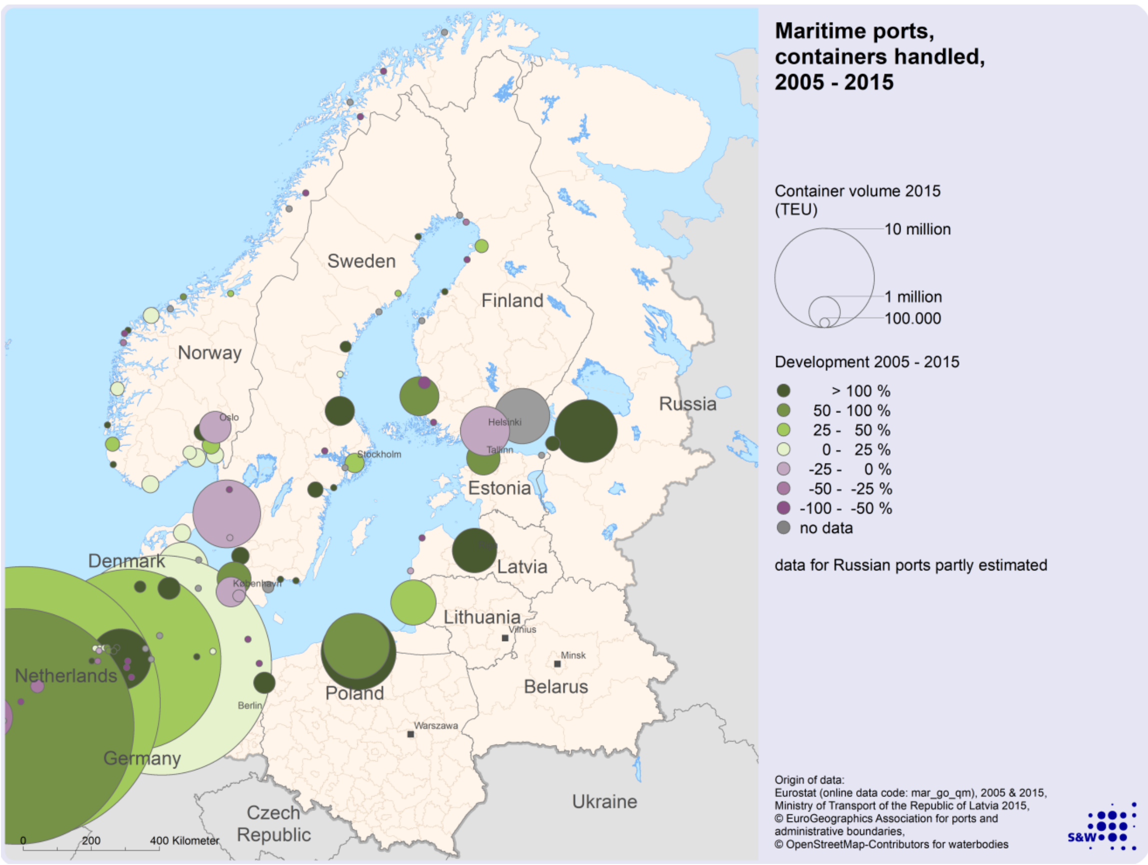

Figure 4.6 Container traffic of maritime ports, 2005-2015.

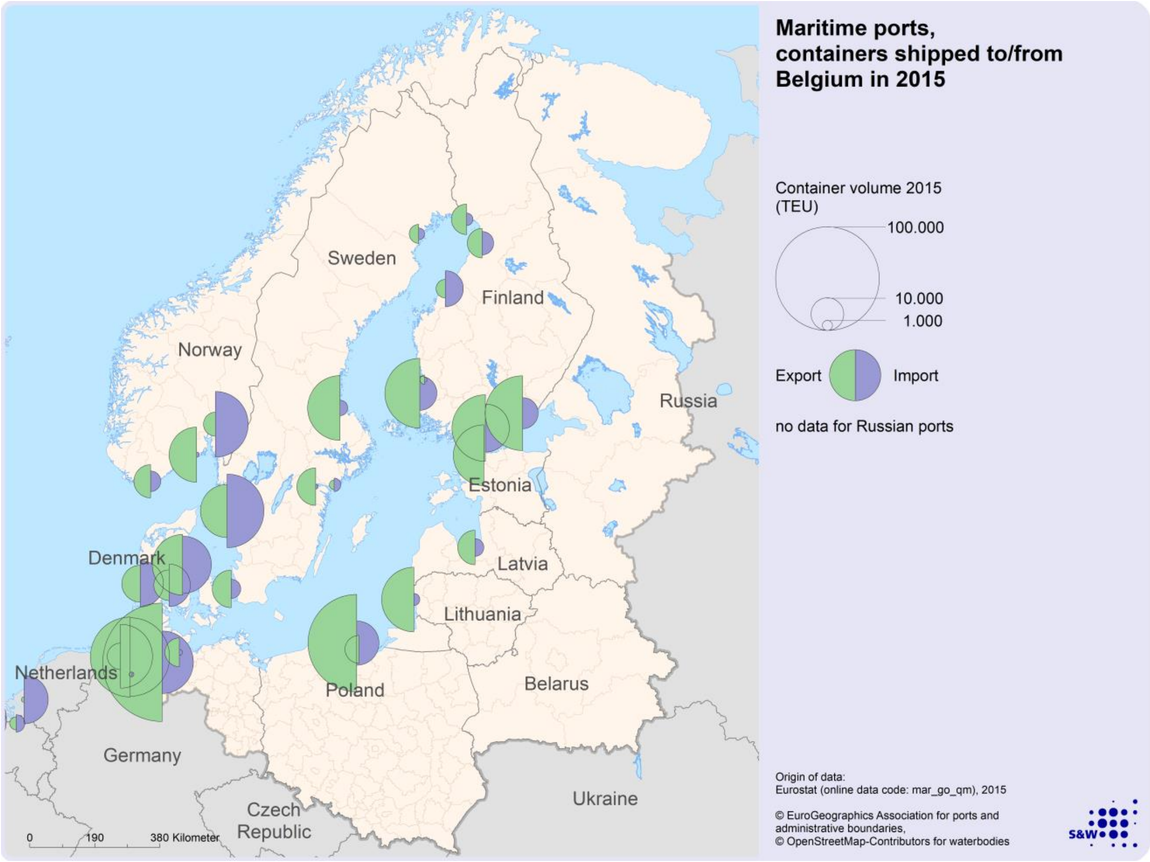

Figure 4.7 Container shipped to/from Belgian ports, 2015.

tainer terminal in Gdańsk is providing direct connection with the port of Shanghai. Gdansk is becoming the main hub in the Baltic Sea where reloading of containers takes place onto smaller forms of transport (mainly in transit to Russia).

However, most of the container traffic to or from the Baltic Sea Region with the world goes via the European main ports along the North Sea coast. Figures 4.7 to 4.9 show the connections with the ports in Belgium, The Netherlands (Rotterdam) and the German North Sea ports (Hamburg and Bremen ports) in terms of flows of loaded containers.

Lowest connectivity in term of container traffic is with the Belgian main ports which are predominantly Antwerp and Zeebrugge (Figure 4.7). Important to note is that the Belgian ports are much more used to export containers rather than receiving loaded containers from there. Only the ports in Denmark, Norway and western Sweden have a balance between export and import of containers or even a surplus of imported containers. All other main ports located in the Baltic Sea send clearly more loaded containers to the Belgian ports than receiving from there. The connectivity in terms of container volumes is somewhat higher between the Baltic Sea ports and the Dutch ports (which is mainly Rotterdam, see Figure 4.8). At the same time, the container trade volume is more balanced for most of the Baltic ports, i.e. the number of imported and exported containers from/to Rotterdam is in the same dimension.

Most important as hubs for containers to or from the Baltic Sea are the German ports at the North Sea coast (Hamburg and Bremen ports, see Figure 4.9). Not only the total volume of container flow between the Baltic and the German North Sea ports is much higher than for the two other world port regions, but also the number of ports in the Baltic Sea that has container traffic with the German North Sea ports is substantially larger. So, the Hamburg and Bremen ports are the most important maritime hubs for container traffic between the BSR and the world.

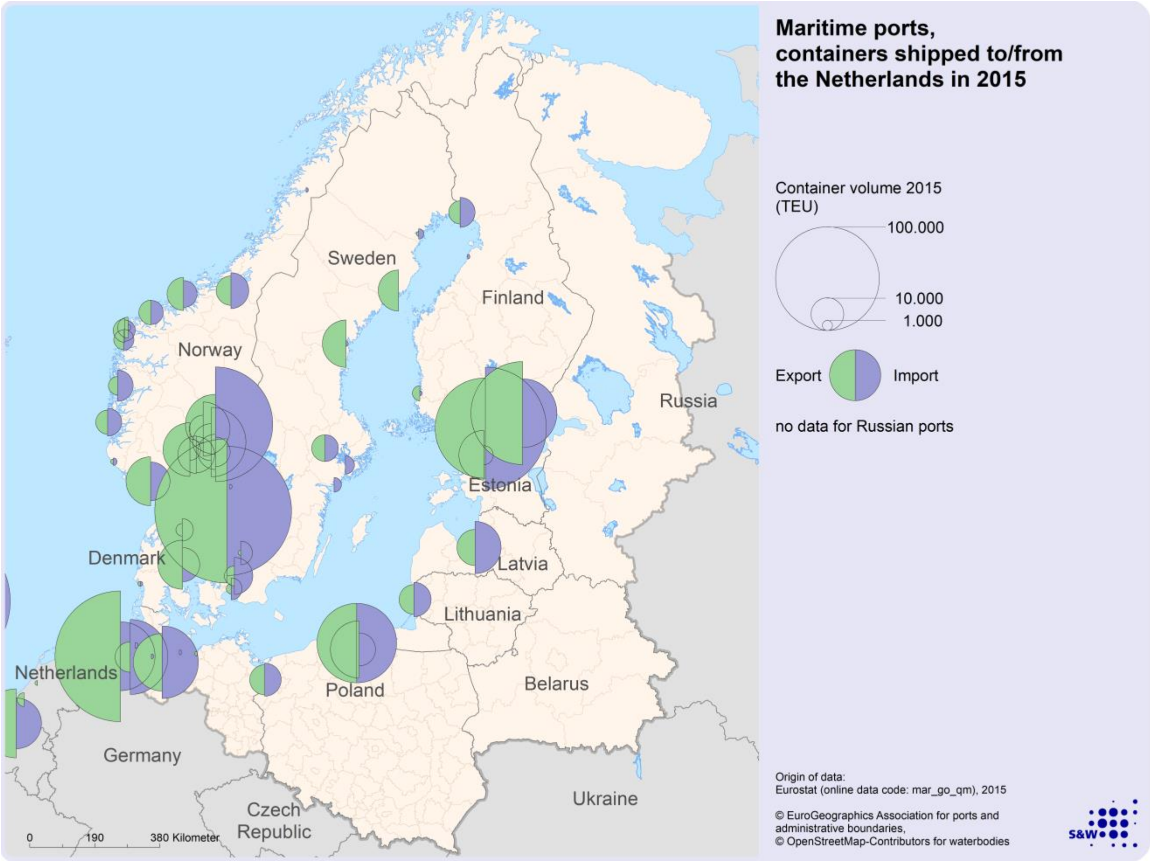

Figure 4.8 Container shipped to/from Dutch ports, 2015.

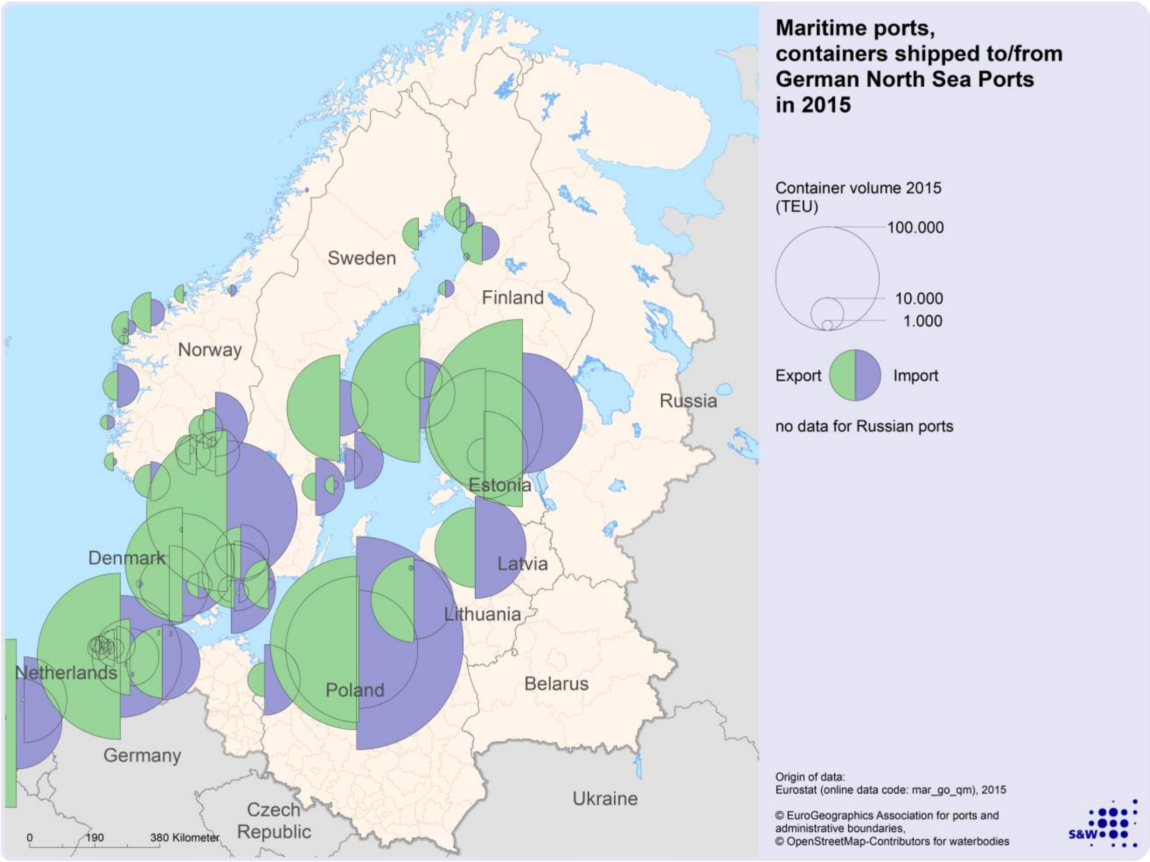

Figure 4.9 Container shipped to/from German North Sea ports, 2015.

5 Air connectivity of the Baltic Sea Region

Because of its remote location regarding the core areas of the European Union and its partly sparsely populated areas, air connectivity of the BSR is a decisive factor for competitive accessibility. As shown in Chapter 2, fairly good air accessibility compensates partly for lower road and rail accessibility of the macro region. This chapter provides a little bit closer look into the air connectivity of the BSR.

The BSR is characterised by a rather dense network of international and regional airports (Figure 5.1) serving the BSR (Figure 5.2) and destinations outside the BSR (Figure 5.3). Airports with largest passenger volumes are the airports of the Nordic capitals Copenhagen, Oslo, Stockholm and Helsinki as well as the airports of St. Petersburg, Warsaw, Hamburg and the two Berlin airports. The airports of the capital cities of Estonia, Latvia, Lithuania and Belarus have clearly lower numbers of passengers, and the volumes are comparable with some of the second-tier airports in Poland (Krakow, Katowice, Wroclaw, Gdansk), Billund in Denmark, Gotheborg in Sweden and Stavanger, Bergen and Trondheim in Norway. An important characteristic for air connectivity in the BSR is the considerable number of smaller regional airports in Norway, Sweden and Finland.

Many airports of the BSR, in particular also those of Poland, the three Baltic States, Belarus and Russia have seen a rapid growth in the last decade. For example, the passenger volume of St Petersburg airport increased from 5,1 million in 2006 to 13,3 million people in 2016, at Kaliningrad airport during that period from 0,7 million to 1,6 million people. In Poland, there was at the same time a deconcentration of air traffic towards the second-tier airports of the country. The largest increase in air traffic was recorded in the migration directions of Polish employees and in holiday destinations. The orientation of Polish air traffic towards the BSR is relatively small, with the

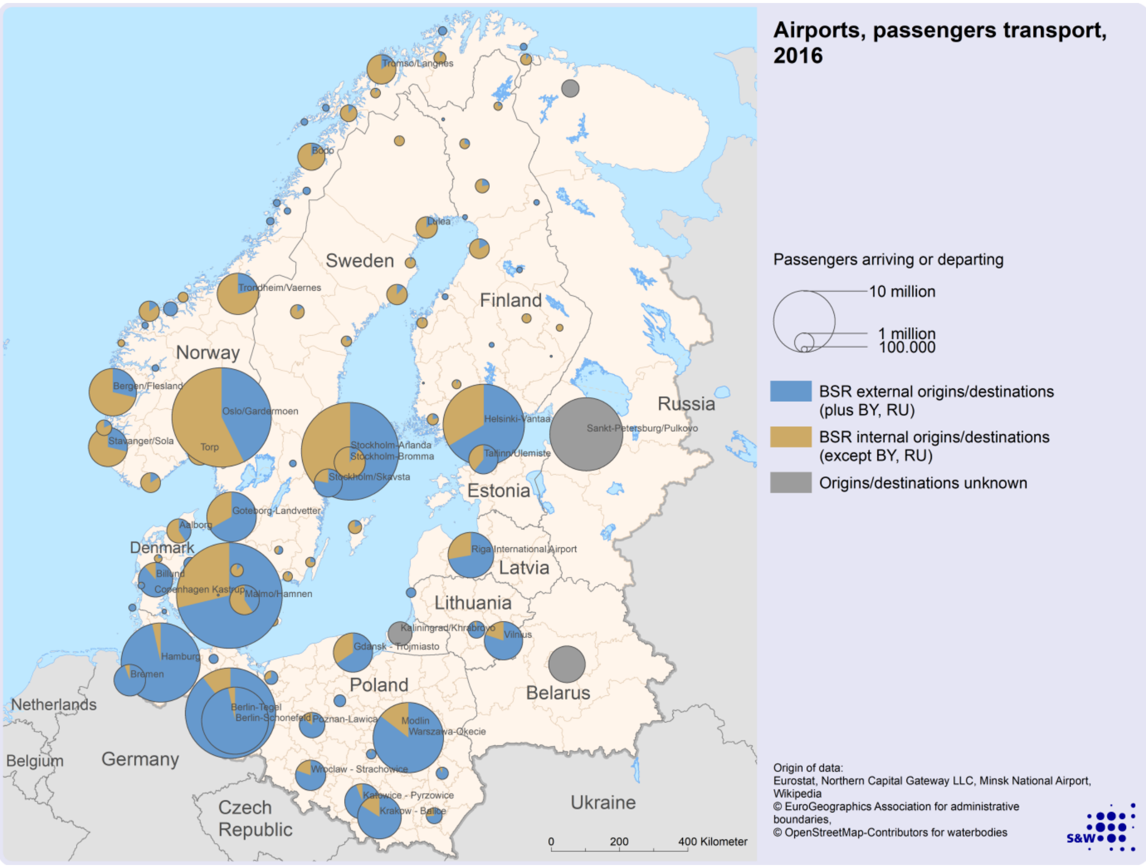

Figure 5.1 Passenger volume of airports, 2016.

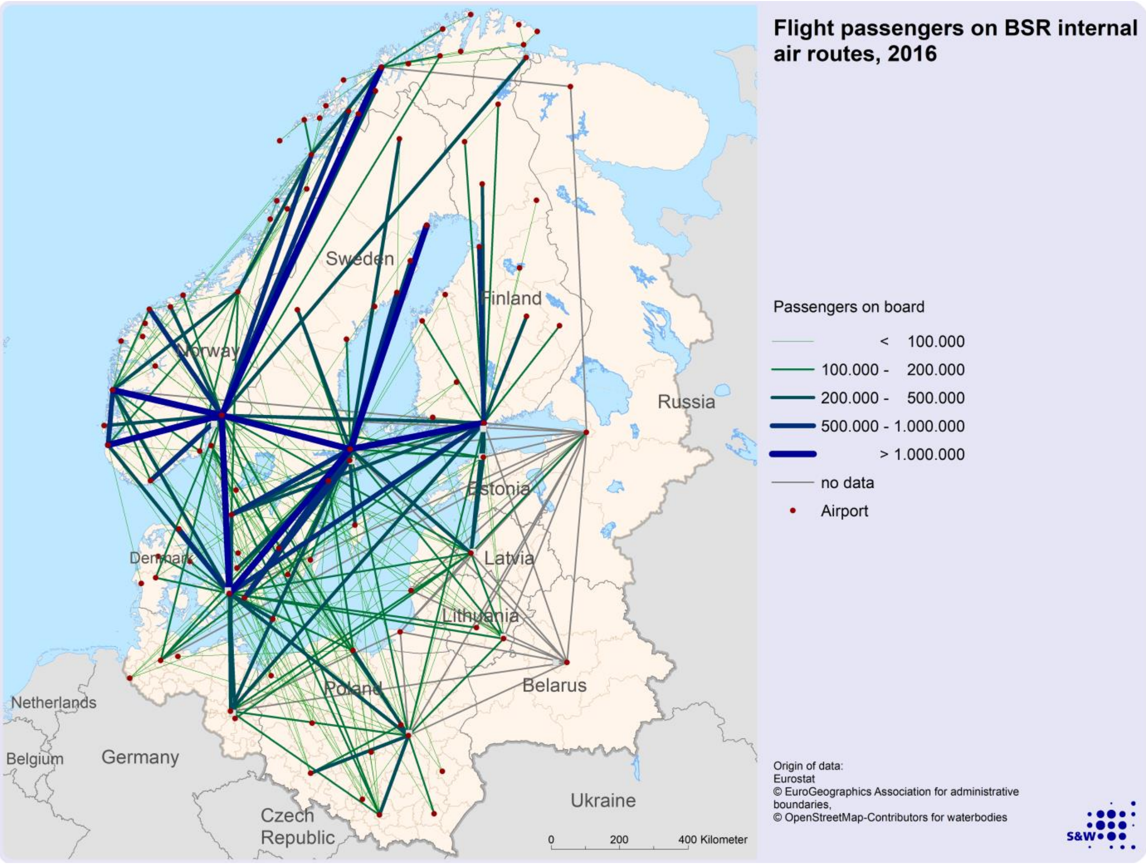

Figure 5.2 Flight routes and passenger volume inside BSR, 2016.

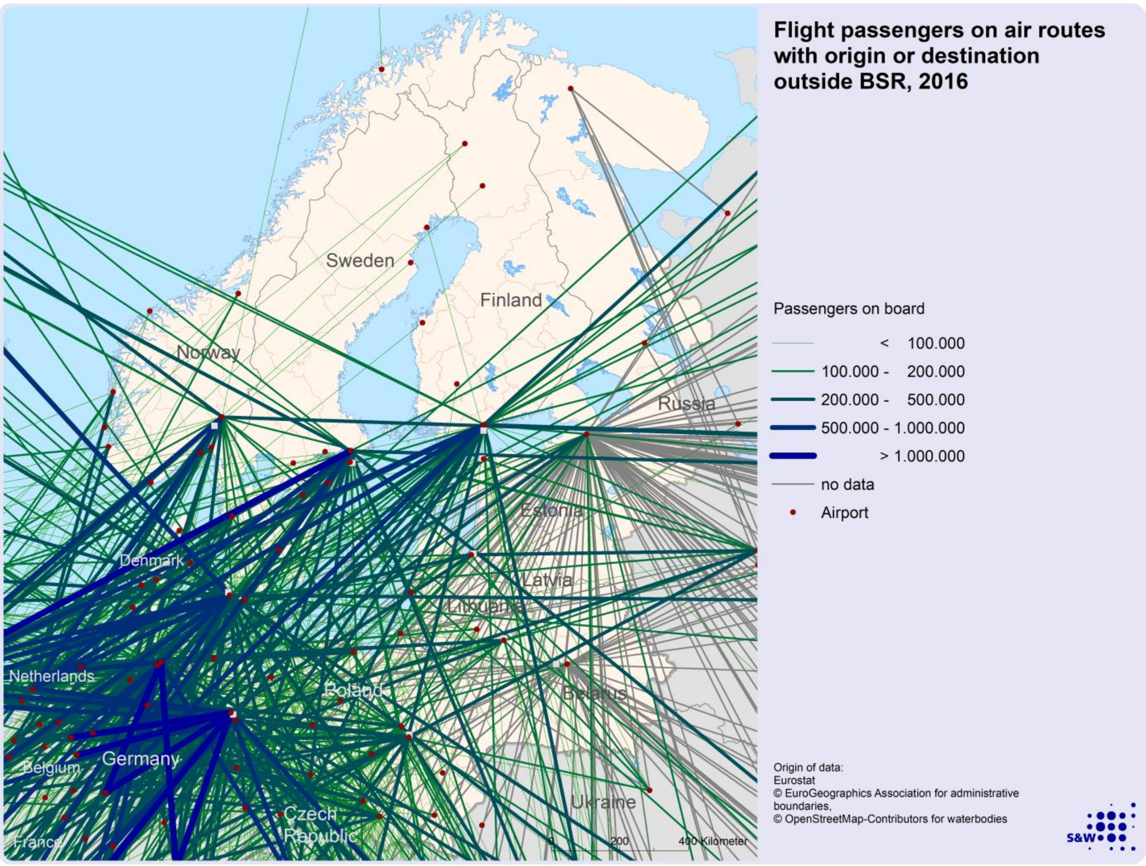

Figure 5.3 Flight routes and passenger volume between BSR and external airports, 2016.

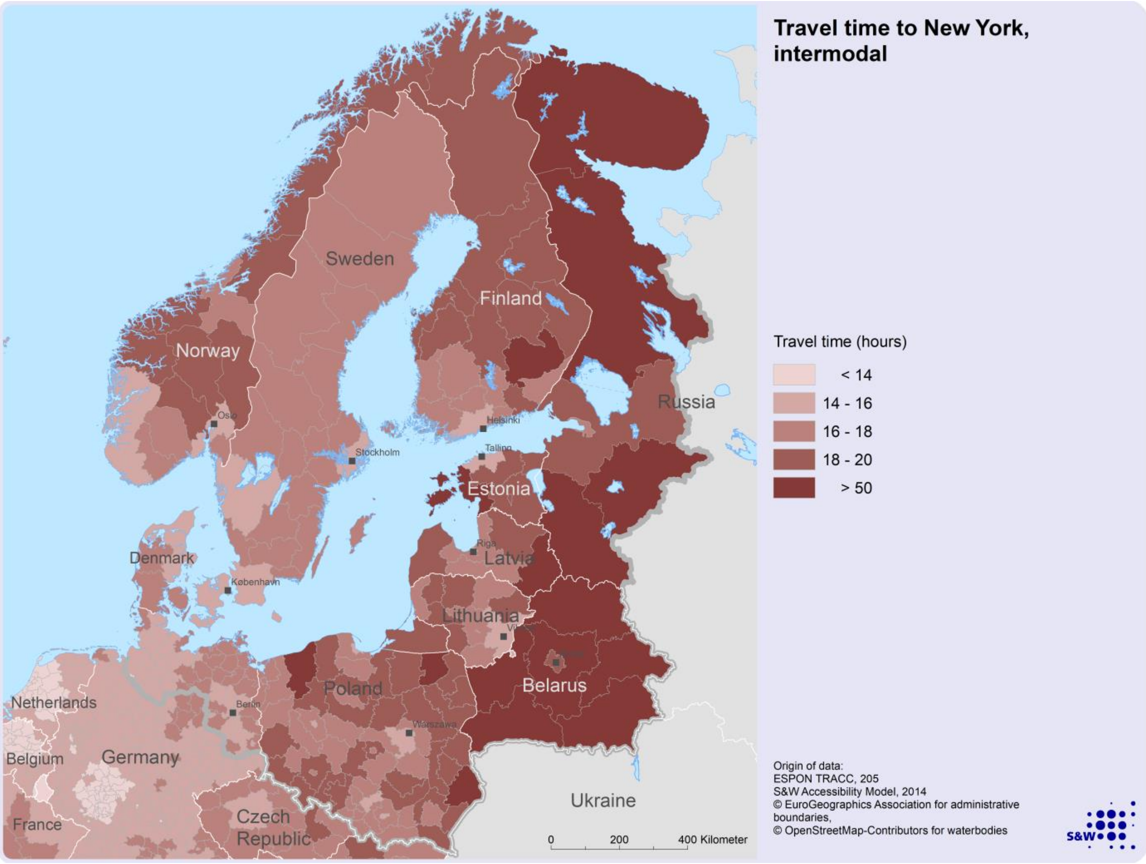

Figure 5.4 Intermodal travel time to New York City.

exception of Gdańsk, using the hub in Copenhagen and servicing flights to Norway (the place of work of many Polish citizens). The resulting spatial image confirms that northern Poland is more strongly associated with the BSR than the central and southern parts of the country. Relatively weak connections with the BSR are also shown by the airports of northern Germany. Other countries, in particular the Nordic countries with many domestic flights and to a lesser degree the Baltic Republics have a stronger orientation of flights within the BSR.

For flight connections within the BSR, the airports of Copenhagen, Oslo, Stockholm and Helsinki are the major hubs (Figure 5.2). Besides links to all capital cities in the BSR and some smaller cities, they have a substantial number of flight connections within their own country to link all the smaller cities to the capitals. Not only the flight between those four airports, but also some connections within Norway and Sweden have yearly passenger numbers which are clearly beyond 1 million passengers and which are higher than the figures for many connections running from there to destinations outside the BSR (Figure 5.3). The airports of St. Petersburg and Minsk have flight services to most capitals of the BSR, St. Petersburg also to major regional centres. Kaliningrad has regular flights with some cities of the BSR such as Berlin, Warsaw, Minsk, Riga and St Petersburg. The airports of the capital cities plus a few additional airports such as Hamburg, St. Petersburg and the second-tier Polish airports provide also the most demanded flight connections to destinations outside the BSR (Figure 5.3). Cities in the far northern parts of the BSR are usually not linked to destinations outside the BSR; exceptions are for instance Murmansk, Trondheim or Bergen.

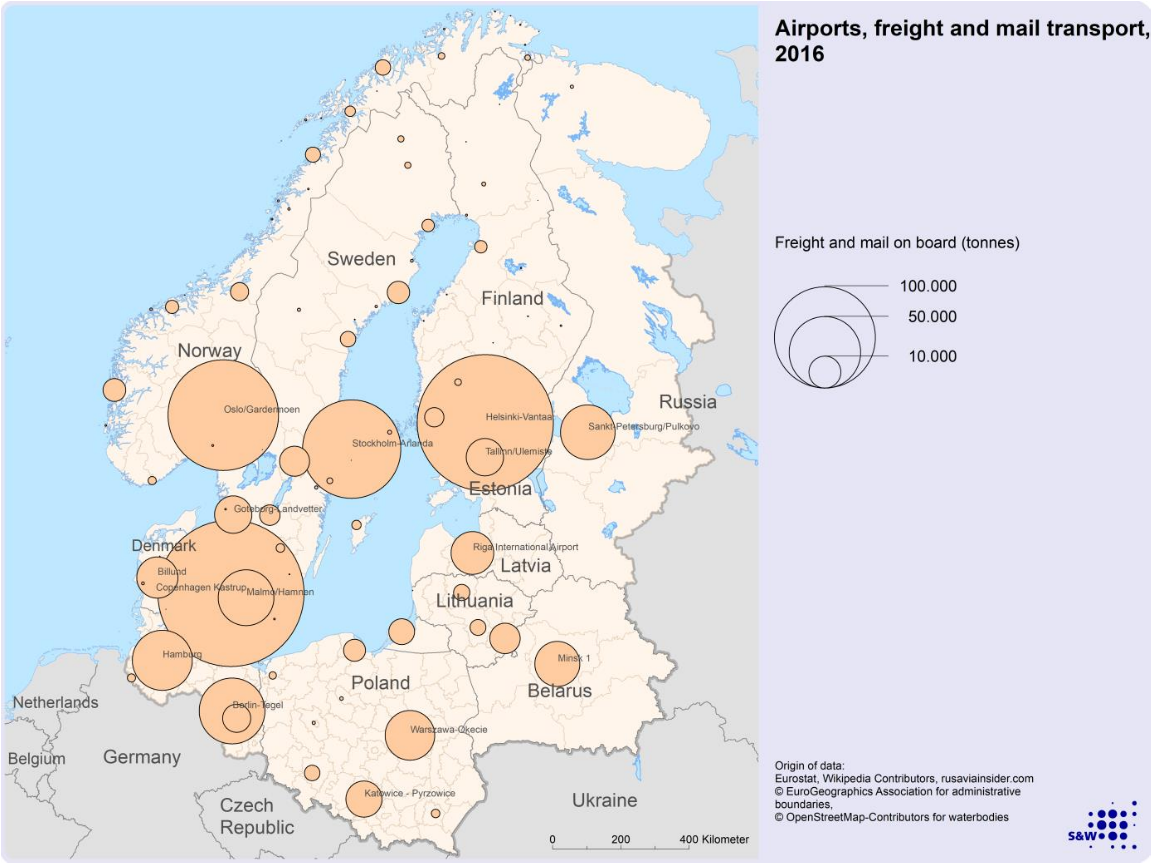

Figure 5.5 Freight volume of airports, 2016.

Figure 5.4 displays what the air connectivity means in terms of travel times to global destinations. The map shows intermodal travel times from the centres of the regions to New York City as example. As expected, travel times from BSR origins are longer than from western European regions. However, the capital cities of the BSR have travel of around 15 hours to this world city, i.e. only little more than from western Europe. However, apart from capital cities other people from other regions need substantial more time to or from New York, maybe an indication why economic activities, in particular that of global players concentrates in the capital regions of the BSR.

The air market for freight is much more concentrated on a few airports in the BSR than passenger traffic (Figure 5.5). The airports of the four capitals of the Nordic countries, Copenhagen, Oslo, Stockholm and Helsinki have a multiple freight volume compared to the airports of other capitals in the BSR. Other airports only play a minor role for air freight traffic with the exception of Hamburg, Billund, Goteborg, Malmö and Katowice.

6 Effects of TEN-T investments on accessibility potential of the BSR

What will be the future development of accessibility in the BSR? To address this question, accessibility scenarios for road and rail up to the year 2030 are analysed. The accessibility scenarios are meant to describe realistic future situations according to planned transport infrastructure development. Therefore, the planned trans-European transport networks of the European Union are forming the base of the scenarios. The road and rail transport scenarios are entered into the model's network database exogenously and implemented following an expected and realistic time table for the development of the TEN-T.

6.1 The context of future accessibility changes

The development of population and transport infrastructure are the crucial elements of future accessibility potential changes.

6.1.1 Future demographic changes

The prognosis of future demographic changes indicates a probable continuation of the processes described for the past. It should be assumed that in several regions (rural parts of BSR area in Germany, many rural parts of Poland, non-capital regions of the Baltic States, Belarus, BSR areas of Russia and several regions in Finland) depopulation will deepen further. Positive population development in the BSR will be in more than a dozen metropolises and in Sweden and Norway. Thus, also the transport accessibility calculated in the macro scale will be determined by the relations (and at the same time the infrastructure) connecting these centres. The transport challenge will be to service less and less populated peripheral zones and ensuring the efficiency of the transport system in and around the metropolises.

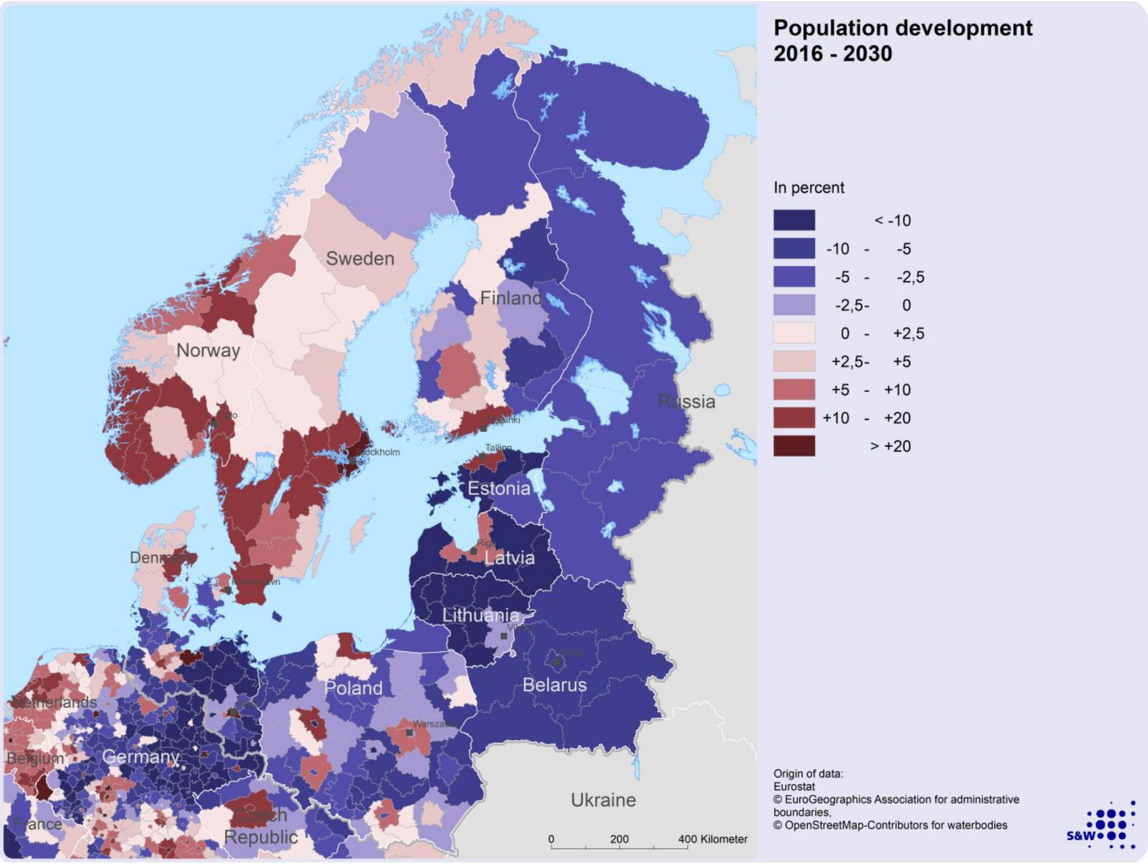

Figure 6.1 Population development, 2016-2030.

6.1.2 Future transport infrastructure development

The future, long-term transport infrastructure development in and outside the BSR is subject to political decisions at different territorial levels, in particular at the national and the European level. Some of which have already been taken, some of which to be taken or maybe to be revised. The Trans-European Transport Network (TEN-T) of the European Union (EU, 2013) gives a good orientation on the development of the main corridors and strategic transport links in the BSR.

The TEN-T define for different transport modes different levels of the transport networks with different horizons for implementation. The comprehensive network shall ensure good accessibility of all regions to be implemented by 2050. The core network contains the most strategic parts of the comprehensive network expected to be implemented by 2030. For the implementation of the core network, a multimodal corridor approach has been adopted.

There are four strategic corridors of the TEN-T running through the BSR (EC, 2013), the Scandinavian-Mediterranean corridor, the North Sea-Baltic corridor and the Baltic-Adriatic corridor. The Orient / East Med corridor overlaps in the BSR parts of Germany with sections of the above corridors.

The ***Scandinavian-Mediterranean corridor*** runs from the Finnish-Russian border via Helsinki to Stockholm and Malmö and Copenhagen. There are two legs to the European mainland. One is running through Denmark to Hamburg and further south to Nuremberg. The other continues via the German seaport of Rostock towards Berlin and then further south via Leipzig and Nuremberg where it joins the first leg to go further south to Italy. The infrastructure development projects in this corridor within the BSR are mainly related to rail (EC, 2013).

This corridor includes one of the most important transport infrastructure projects in the western part of the BSR, the Fehmarn Belt Fixed Link to remove one of the main remaining bottlenecks in the European transport network by directly connecting Denmark's capital and Sweden with Hamburg and Schleswig Holstein and thus the European mainland. Since the early 1990s the link is listed as one of the TEN-T Priority Projects of the European Union. The connection will be constructed as a tunnel for both road and rail. Seen from now, the 18 km tunnel will be put in operation by the end of the next decade. It will replace the current car and rail ferry services between the islands of Fehmarn (Germany) and Lolland (Denmark) respectively avoids a detour of about 150 km via existing land connections from Denmark to Germany via the Danish mainland (Jutland). Rail travel time between Copenhagen and Hamburg will be reduced by the tunnel and corresponding rail infrastructure from about 5 hours (Hamburg-Copenhagen), respectively 4:40 h (Copenhagen-Hamburg) to about 3 hours and 15 minutes.

Embedded and related to the corridor development are the plans in Denmark, Sweden and Finland to further accelerate rail transport. In Denmark, a high-speed strategy "Hour model" for intercity connections shall reduce travel time between the neighbouring pairs of the four largest cities of the country to one hour. Travel time between Copenhagen and Aalborg will be reduced from approximately 4:30 hours to about 3 hours. The new high-speed line between Copenhagen and Ringsted, a section of the TEN-T corridor will be put in operation in 2019. Sweden is in the process of further upgrading and increasing the operational speeds in the Nordic triangle to up to 250 km/h. There are long term plans to introduce faster high-speed rail with new lines between Stockholm and Gothenburg (Götalandsbanan) and Jönköping–Copenhagen (Europabanan), however, decisions have been postponed. Speeds of more than 300 km/ would reduce rail travel times between Stockholm and Gothenburg from 3 to about 2:15 hours and between Stockholm and Copenhagen from 5 h to about 2:45, thus would be in the same dimension as flight times including check-in etc. In Finland, the corridor development might include new fast or high-speed rail lines between Turku and Helsinki and between Helsinki and the Russian border towards St. Petersburg.

In Norway, not directly part of the Scandinavian-Mediterranean corridor, extensions of the high-speed line running northwards from Oslo are under way. Most important transport infrastructure project, however, might be the coastal highway along the North Sea coast that would through a combination of several tunnels and bridges across the numerous fjords clearly reduce road travel times in the coastal regions of Norway.

The ***North Sea-Baltic corridor*** stretches from the large seaports in Belgium, the Netherlands and Germany to the BSR seaports in the Baltic States and Finland. Within the BSR, there is a leg of the corridor starting in Hamburg and running towards Berlin. The corridor continues to Warsaw and from there northwards via the Baltic States and continues to Helsinki. In the Baltic States, the corridor has branches to Ventspils in Latvia and to Klaipeda and Vilnius in Lithuania. Most of the corridor projects are related to improvement of rail infrastructure, but also port development and cross-border road improvements are included (EC, 2013)

The Rail Baltica to be developed is the most prestigious and aspiring project will form the back-bone of the corridor in the BSR. It will connect Estonia (Tallinn), Latvia (Riga), Lithuania (Kaunas and a branch to Vilnius) and Poland (Warsaw) through a new high-speed rail link (up to 250 km/h) in European standard gauge. There are no direct rail connections between the Baltic capitals nowadays, i.e. rail journeys would include long detours. Bus travel times are about four hours for each relation. In future, rail travel times between Tallinn and Riga will be slightly less than two hours, between Riga and Vilnius about two hours. Rail travel between the Baltic capitals will be-come highly competitive with other modes in terms of time and cost. Rail Baltica might be ex-tended with a rail tunnel between Riga and Helsinki to Finland. Polish plans in the North Sea-Baltic corridor consider high-speed rail development connecting Warsaw, Łódź and Kalisz, with branches to Wrocław and Poznań (Y line). The high-speed line might permit speeds of up to 360 km/h.

The **Baltic-Adriatic corridor** runs from the Baltic ports in Poland via the Czech Republic, Slo-vakia and Austria to Italy and Slovenia and their ports at the Adriatic Sea. So, only Poland is touched by this corridor. Here, the corridor has several branches. Two sub-corridors start at the ports of Gdansk and Gdynia and connect directly and via Warsaw to Katowice and beyond, a third one runs from Szczecin/Świnoujście via Poznań and Wrocław to Ostrava. Main projects in the corridor are devoted to upgrade of rail lines.

In Poland, the government changed some of its investment plans related to the corridors running through the country in 2016. The section of the S6 expressway from Gdańsk to Koszalin has been cut off from the list of road investments to be constructed with EU support in 2014-2023 programming period. This road is to be built in the PPP program. Thus, the route improving the accessibility of the Baltic coastal belt in Poland will not be created by 2023. On the other hand, works on railway and road investments in eastern Poland (including Via Baltica and Rail Baltica) have accelerated. Poland has also started efforts to include the Via Carpatia route from Klaipeda in Lithuania via Eastern Poland in the direction of Hungary, Bulgaria, Greece and Turkey to the TEN-T core network. In Poland, this initiative is criticised due to its peripheral location. At the same time, it can improve access to Baltic ports, and thus the overall accessibility of the Baltic macro region.

The future development of the BSR will besides the development of the European-Transport network and the additional national infrastructure developments also be influenced by possible transport route developments north and east of the macroregion for cargo transport between the countries of East and South-East Asia (China, South Korea, Japan, etc.) and Western European countries. In addition to traditional route for cargo transport by sea vessels through the Suez Canal, the increase in freight volume using the Northern Sea Route (NSR) the Trans-Siberian Railway (Transsib) or the New Silk Route might be possible. One advantage would be significantly shorter lengths of routes and times of cargo delivery between Asia and Europe compared to the traditional and not always safe sea route through the Suez Canal.

In Russia the Strategy and the State Program for the development of the Arctic zone of Russia were adopted. It includes the development of the Northern Sea Route; the capacity of icebreaking fleet is increasing, the Sabbeta port has been built on the Yamal peninsula and since 2013 it has been proving export of liquefied natural gas and functioning of the NSR. Freight volume via the NSR increased already from 2 million tons in 2006 to 7.3 million tons in 2016. There is an annual growth in the number of commercial ships, including foreign passing thought the NSR. The growth of transportation is supported not only by the improvement of the transport infrastructure and capacity of icebreaking fleet, but also by the climate change in the Arctic.

There is political and economic rapprochement between Russia and China, which contribute to the achievement of agreements to increase the volume of transit of Chinese goods through the territory of Russia. Plans are being implemented to increase the Transsib capacity which is at present practically depleted. The Transsib would offer a transport time for goods between China and Europe of 14-15 days and in the long term of only 7-10 days which is highly competitive compared to the 40-45 days along the traditional sea route. However, the cost by traditional sea transport would be still 2.5 times cheaper than by Transsib.

A further important element that may affect the future accessibility of the BSR is potential investments in the European-Asian infrastructure of the so-called New Silk Road. The countries of Baltic Europe and the Balkans are currently competing for the route of these connections. The distribution of trade relations with China in the European Union seems to favour the Baltic direction. The eastern border of Poland is a favourable place for intermodal solutions within the potential corridor (tracks gauges changes). However, a strong competition of logistic centres and terminals in Russia, Belarus, Poland and Germany may emerge. The formal course of New Silk Road is defined by a document issued under the auspices of the UN: Intergovernmental Agreement on the Trans-Asian Railway Network from 2006 (Asian part). The real chance of developing these connections is strongly conditioned by geopolitical and macroeconomic factors. The development of industrial and logistics infrastructure may lead to the formation of intermodal hubs outside the EU with a possible consequence that future transport of goods to Poland, Scandinavia and Western Europe would be mainly based on road.

The most striking example for the development of such a new big infrastructure taking advantage of possible future accessibility advantages is the development of the Industrial Part Great Stone near the Minsk airport. This joint venture of China and Belarus is clearly based on the expectation that such interface regions between the Eurasian and the European economic blocks will have strong locational assets through the improved connectivity to Asia and to Europe.

6.2 Future accessibility potential by road

Figure 6.2 shows the accessibility potential by road for the year 2030 and standardised to the BSR average of that year. The assumptions made for road network changes have mainly been based on the TEN-T core network development. The standardisation of the indicator does not point to the changes as the overall pattern of high and low accessibility by road is similar to the current one, however, the level of accessibility will grow almost everywhere in the BSR.

These possible future changes due to the TEN-T core network are highlighted in Figures 6.3 and 6.4 which display the development of accessibility by comparing the future situation of 2030 with the current one. On the one hand, improvements in accessibility are to be recorded towards eastern direction, especially in Poland and beyond through the completion of the construction of Via Baltica route in Poland. However, because of low population density, the areas closely adjoining the Baltic Sea will still be in a relatively low situation in terms of the standardised accessibility indictor in Poland, Lithuania and also in Estonia (Figure 6.2). In Poland, the main changes will take place in the eastern part. This will result in better accessibility of west Belarus and Lithuania. However, the beneficial impact of Polish investments on the regions located towards the East and North-East from Poland's border will be significantly reduced by demographic crisis with some depopulation trends in these areas. In the northern parts of the BSR, the key investment will be the Fehmarn Bridge, which should radically improve the accessibility of East Denmark (Zeeland), as well as Sweden and Norway together with further road investments there. Schleswig-Holstein will also benefit from the link to Scandinavia as well as from completing motorway links (A20) north of Hamburg.

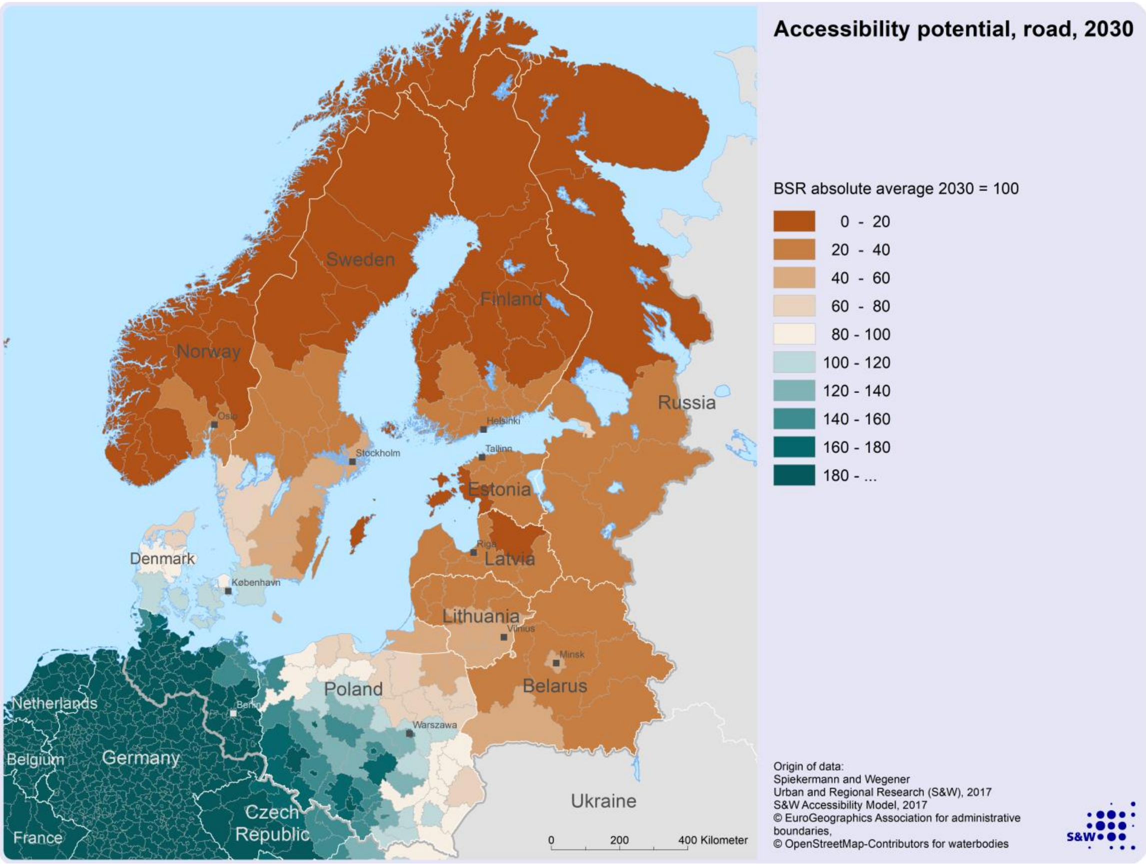

Figure 6.2 Accessibility potential, road, 2030.

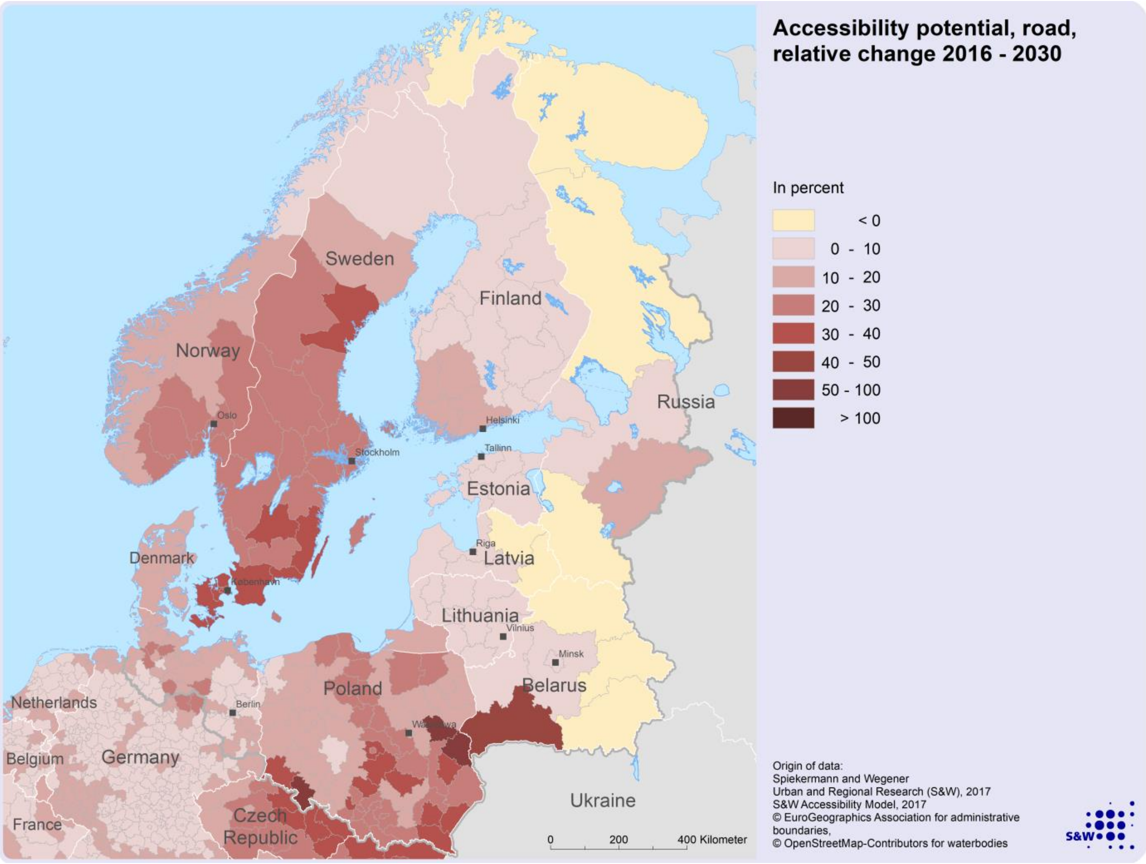

Figure 6.3 Accessibility potential, road, relative change 2016-2030.

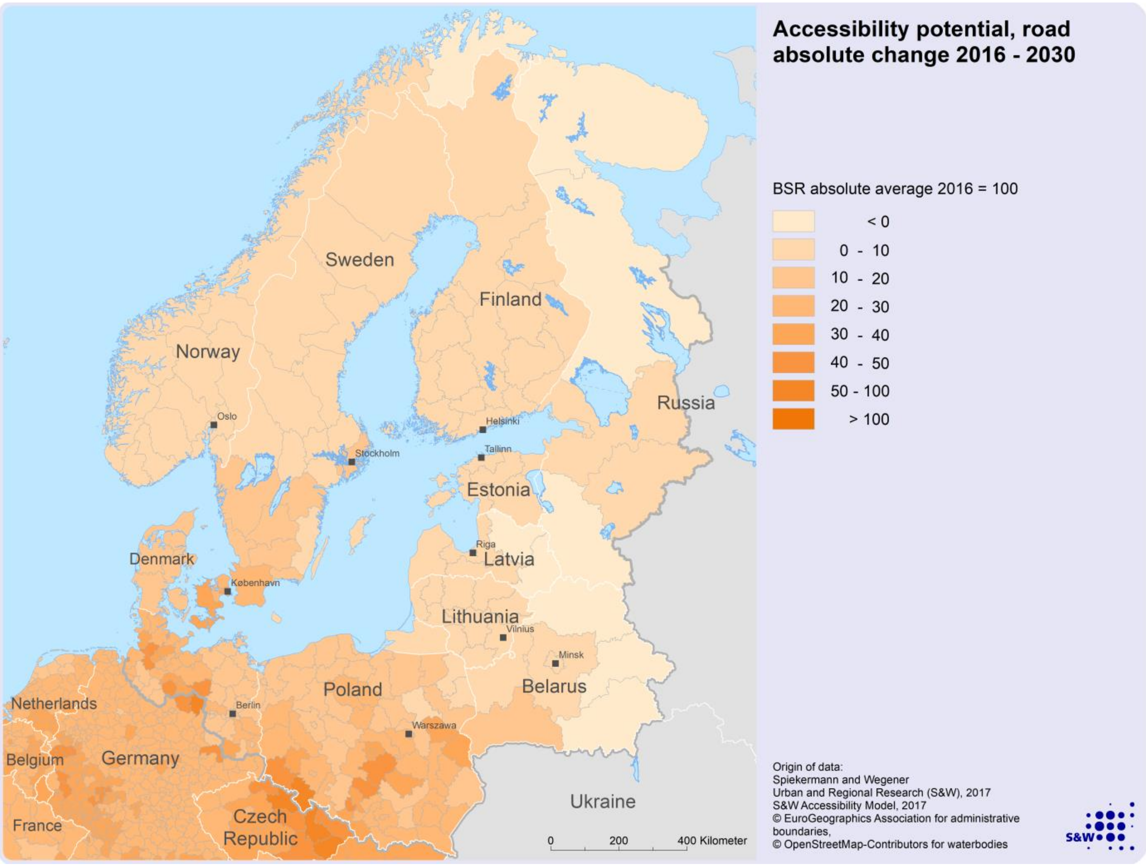

Figure 6.4 Accessibility potential, road, absolute change 2016-2030.

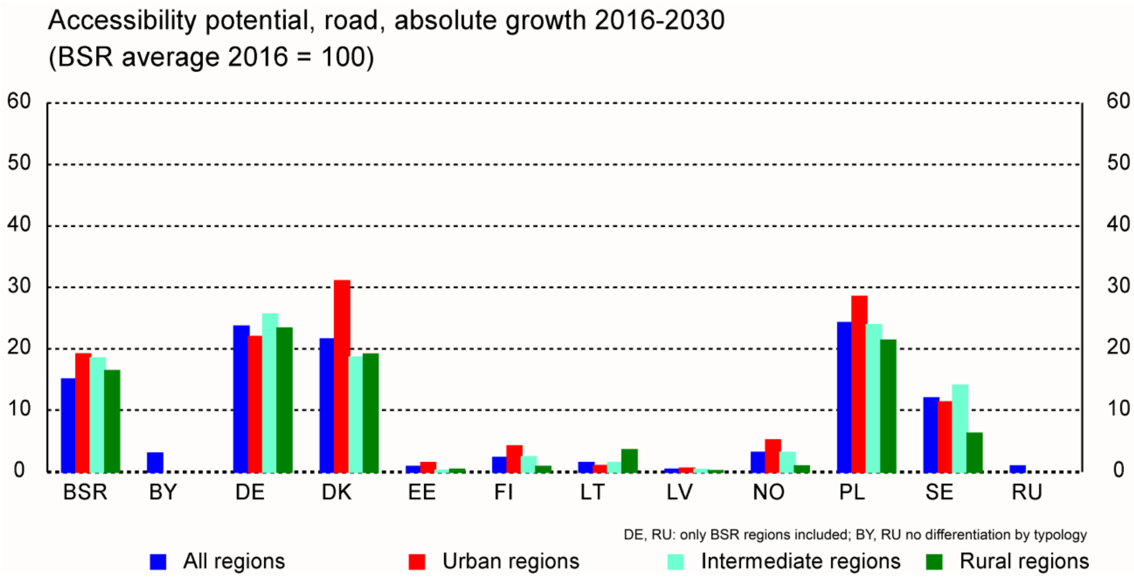

Figure 6.5 Accessibility potential by country and urban-rural typology, road, absolute change 2016-2030.

In terms of accessibility potential by road, Poland, Germany (BSR regions) and Denmark and to a slightly lesser degree also Sweden are the countries that benefit most of the envisaged development of the road networks in Europe (Figure 6.5). Growth of accessibility in Poland and Denmark is mainly in favour of the urban regions whereas in the BSR part of Germany all regional types gain with a similar level. In most other countries, the increases in the potential type assessment are only modest. The regions of those countries of the BSR do not benefit in terms of accessibility although there will be new high-quality road infrastructure in place. The modest growth or even decline in accessibility by road is due to the fact that the underlying population projection expects strong population losses for parts of that area. That means that the demographic development offsets the benefits of the improved road network, i.e. population market potential type accessibility indicator will grow only little if at all.

When assessing the effects of future investments in the TEN-T Baltic Sea-North core corridor (especially Via Baltica, but also Rail Baltica), the structure of the huge traffic currently taking place on this route must be taken into account beyond what can be grasped by accessibility indicators. This is largely transit traffic between Russia and Western Europe. HGVs cross the EU border in Latvia and then use the route through Lithuania and Poland to Warsaw and further west to Berlin. Internal traffic under the BSR is much smaller and would probably require smaller scale investments.

6.3 Future accessibility potential by rail

The assumptions made for rail network changes have mainly been based on the TEN-T core network development. The possible future accessibility potential by rail pattern (Figure 6.6) has a lot in common with the current one. However, disparities between high and low accessibility areas seem to be less pronounced, and, the area of above BSR average accessibility will extend further away from the south-western areas of the BSR towards eastern and northern directions. High-speed rail will also bring higher accessibility to regions outside the area with high accessibility potential by road. Clearly visible are those corridors in Germany towards Berlin and beyond in Poland towards Warsaw and in Denmark towards Copenhagen and even beyond to the Scania region in Sweden. Clearly below BSR average accessibility by rail will also in future be found in the Nordic countries and the Baltic States. Lowest accessibility by rail will remain in the far north regions, the Baltic States, Many regions of western parts of Poland will have accessibility by rail above the BSR average with few exceptions that will be slightly below average. But similar to the future road pattern, Figure 6.6 is standardised to the future average and therefore shows only the relative position of the regions against each other, but not the real changes to be expected.

By displaying the accessibility changes only (Figures 6.7 to 6.9), the highly spectacular improvements in rail accessibility that will take place in the BSR in the next fifteen years will become apparent. This is mainly due to the completion of the Rail Baltica project running across the south-eastern area of the BSR where today rail transport plays a marginal role in socio-economic development. Several regions of the Baltic States, but also in Belarus which benefits as well, will double its accessibility potential by rail. The Rail Baltica even outsets the negative effect of population decline in the regions of the Baltic States.

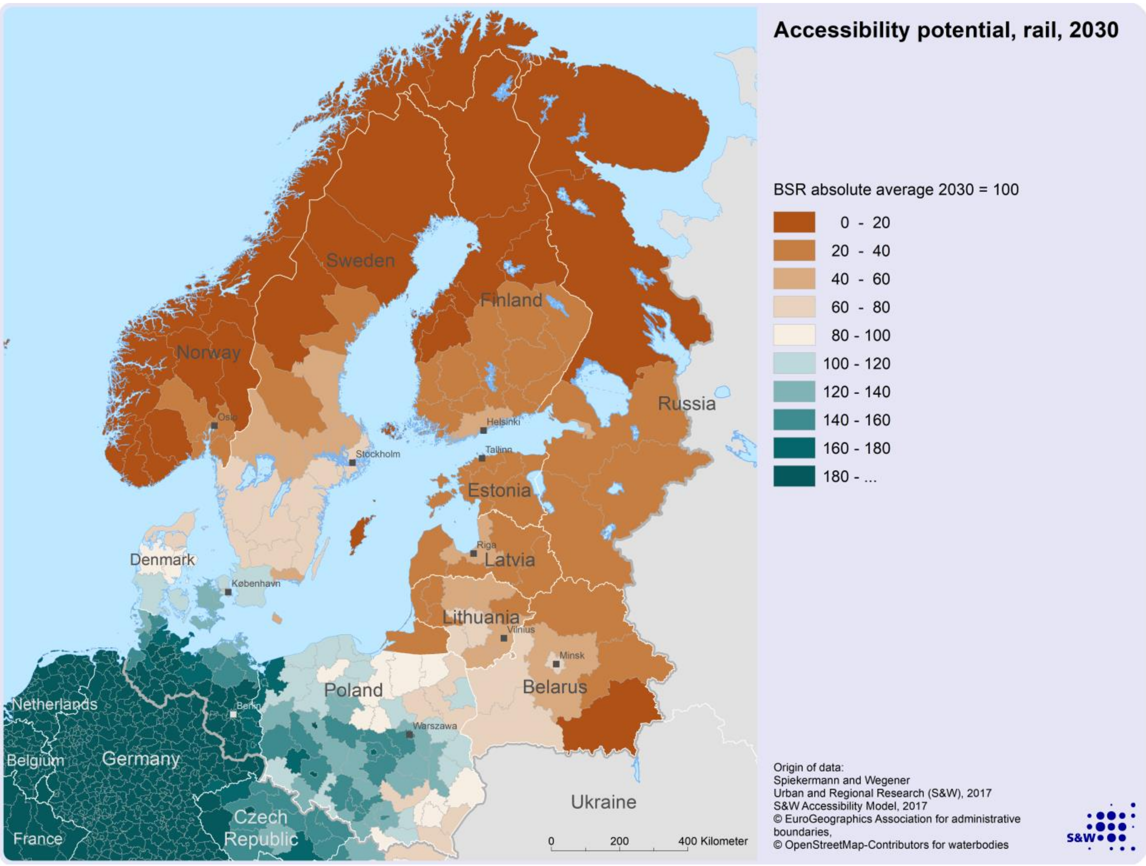

Figure 6.6 Accessibility potential, rail, 2030.

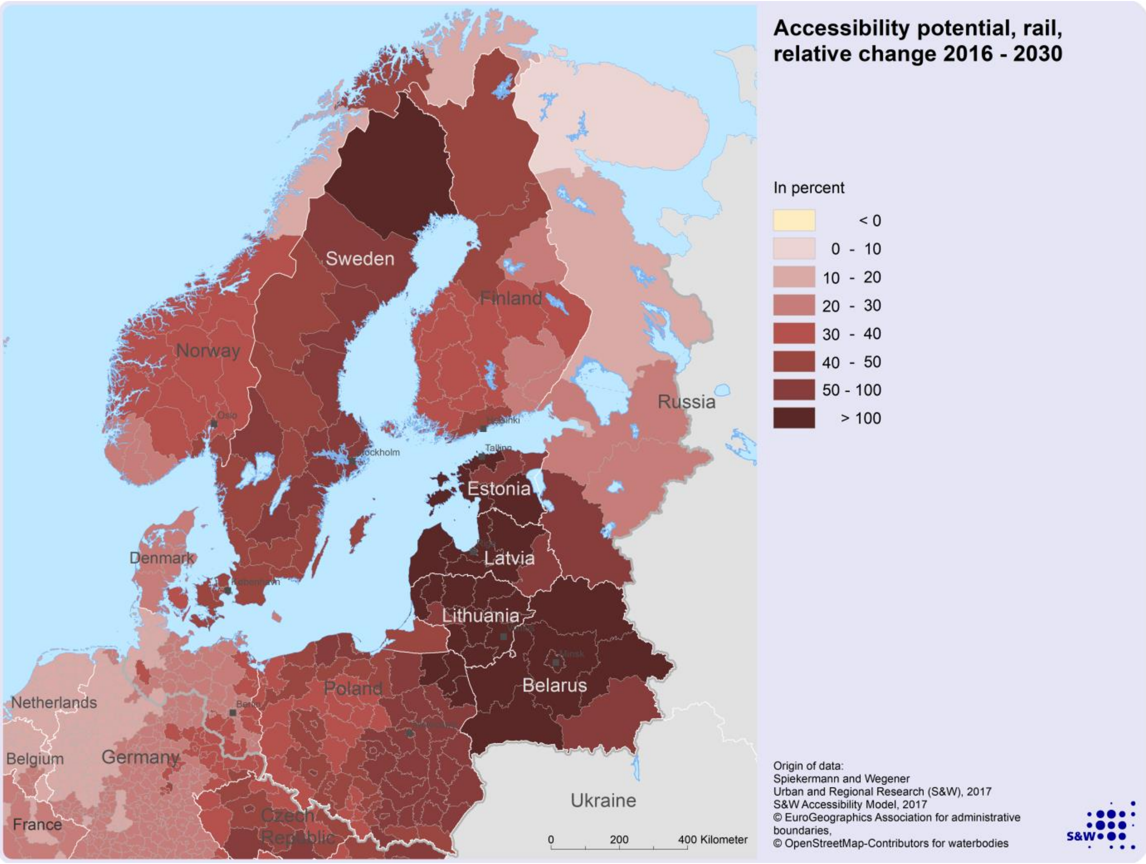

Figure 6.7 Accessibility potential, rail, relative change 2016-2030.

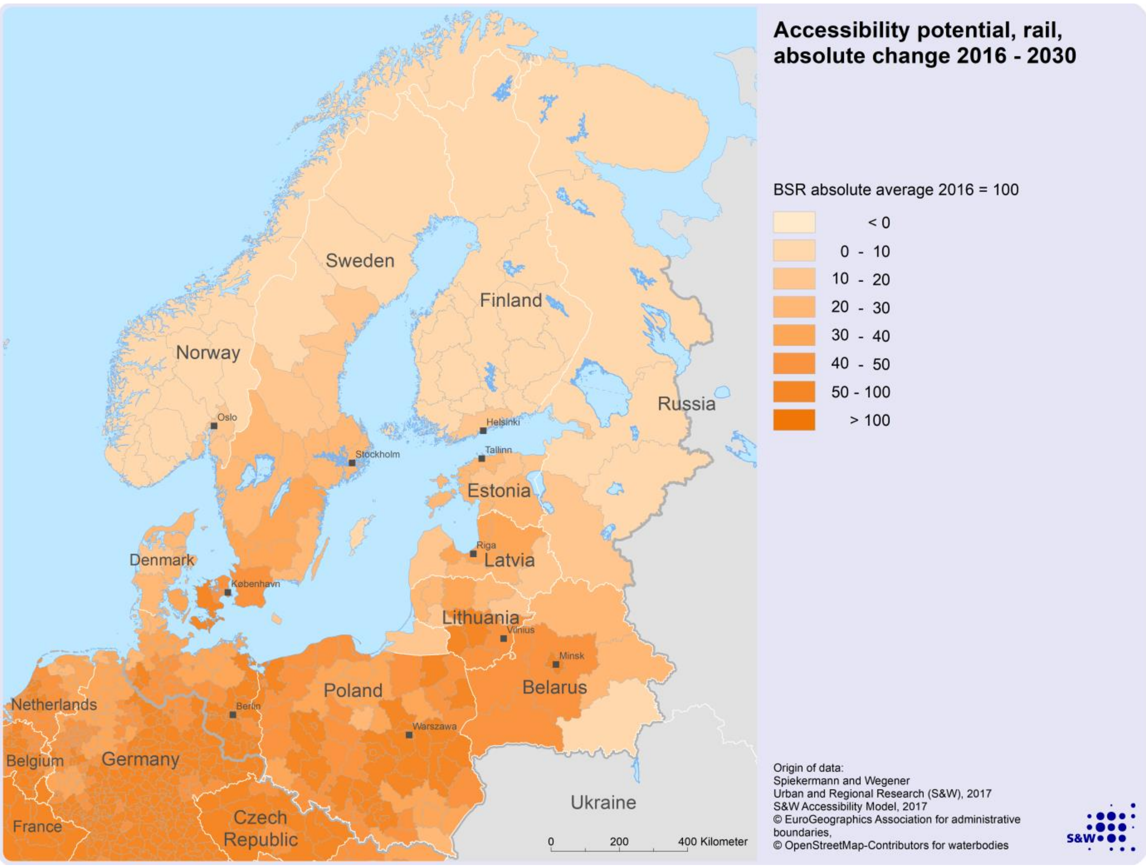

Figure 6.8 Accessibility potential, rail, absolute change 2016-2030.

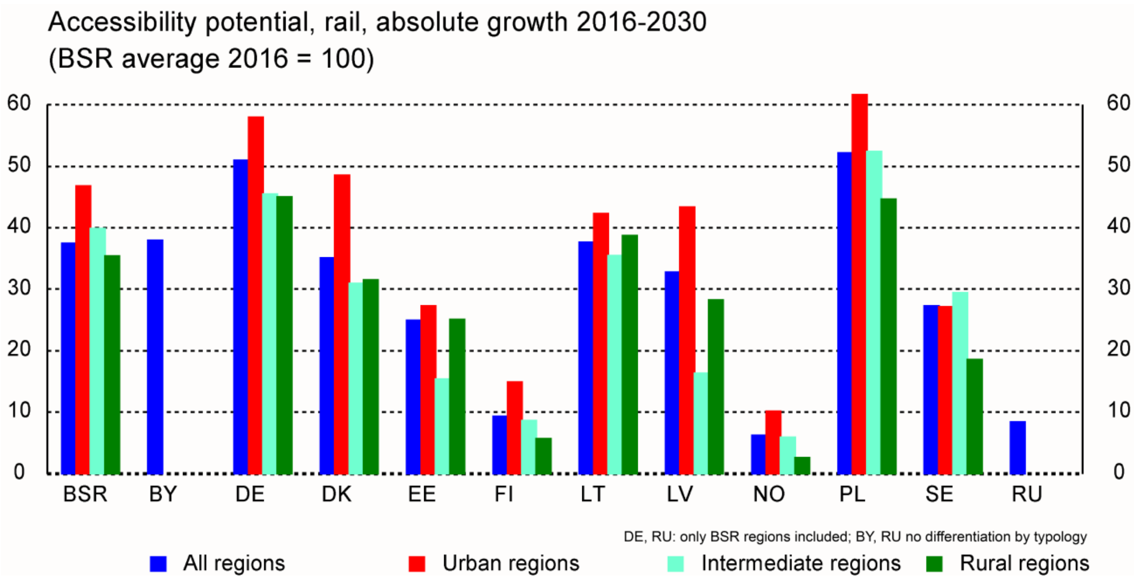

Figure 6.9 Accessibility potential by country and urban-rural typology, rail, absolute change 2016-2030.

In the case of Sweden and Denmark, of similar importance will be the above-mentioned Fehmarn Bridge. The future high-speed rail connections linking without interruption Hamburg with Copenhagen and beyond to Sweden will benefit the Scandinavian regions by increasing accessibility potential by rail by more than 50 percent for most regions.

In terms of absolute increases of rail accessibility (Figures 6.8 and 6.9), the greatest improvements will be in Polish and German regions, followed by Lithuania, Belarus, Denmark, Latvia, Sweden and Estonia. The expected improvements for Russia, Finland and Norway are only modest. The future development of the high-level rail infrastructure of the BSR will benefit urban regions in all countries (except in Sweden) much more than rural regions. This is a specific to high-quality and high-speed rail infrastructure which serves primarily the larger urban regions and thus might increase development opportunities between cities and countryside in the BSR countries.

The increases of accessibility potential by rail are very much higher than those for road. This is besides improvements of the overall conventional rail network mainly because the introduction of (almost) high-speed rail services into the BSR will introduce a new level of service to the region which is so distinct from current levels of operation in many parts of the BSR whereas the improvements in the road network are substantial, but will not yield such big jumps in possible travel speeds as it is the case for rail.

6.4 Future accessibility changes in Poland by road and rail

This chapter on accessibility changes to be expected in future closes with another look into more spatial detail using a research study for Poland, commissioned by the Polish Ministry of Development. In the study multimodal accessibility indicator (MAI) was estimated for the needs of program documents for the cohesion policy for the 2014-2020 financial perspective (Komornicki et al. 2018). The simulations were done separately for the planned road and rail investments, each time for passenger (population as an attraction variable) and goods transport (outcome of population plus GDP as an attraction variable), as well as based on the synthetic approach.

The effect of the planned investment measures in passenger transport are noticeable along the concrete routes, but most frequently in the sections more distantly located from major metropolises (including Warsaw; effects of low base). Effects are distributed quite evenly in the space of Poland, however, these are more concentrated in East and North Poland (previously poorly accessible regions). In the case of relative changes in the Road Transport Accessibility Index for goods (Figure 6.10) the above-described effect of the accessibility improvement on more peripheral sections of new road routes is also visible. At the same time, however, as a result of taking into consideration the role of the forecast changes in GDP, the advantages are discernible in the vicinity of Warsaw, and also the entire Mazowieckie Voivodeship turns out to be a tangible beneficiary. Moreover, belts with increasingly improved accessibility (along the new expressways) are broader, including significant areas of eastern voivodeships. This proves that the improvement in accessibility in goods traffic may be an important pro-development factor in the quite vast peripheral areas, while in regard to passenger transportation the effect is more restricted spatially. The areas characterised by a marked improvement in terms of rail accessibility tend to have more mosaic character (as compared to road transport) and are more tied to particular investments. Improvement in rail accessibility will be visible not only in the best accessible areas (in 2013 - central and South Poland), but also in the peripheral areas (Figure 6.11).

The study has shown that in the 2014-2023 period the transport accessibility in Poland will be steadily improving both at the national as well as international level. Improvement in goods transport will additionally depend on the forecast GDP in the particular regions. Improvement in passenger transport, to a larger degree, will depend on the undertaken interventions. Distribution of the effects of planned investments indicates that these effects are a continuation of the previously initiated actions. The investment measures will benefit in the first place East and North Poland (especially in road transport). It has been found out that Poland gradually moves to the stage where some regions become saturated with up-to-date transport infrastructure (in particular road and air). This concerns primarily the western and southern parts of Poland. In these areas, the subsequent investments produce less noticeable effects in terms of improved accessibility. Therefore, it is necessary to evaluate these investments also from other points of view (e.g. modal shifts). In Eastern and Northern Poland, new investments are still an important condition for economic development. They are also a factor weakening the negative effect of depopulation. They allow longer commuting distance and reveal some endogenous potentials (e.g. tourism).

Poland is a transit country, mainly in heavy east-west road traffic. Therefore, the accessibility of regions must be assessed simultaneously on a national and European level (including travel destinations outside the European Union). Earlier in this report, a relatively low level of accessibility of a belt located in the immediate vicinity of the Baltic Sea and in North-Eastern Poland was presented. The same areas are characterised by the lowest national accessibility. Expected improvement of accessibility may mean there not only strengthening of development potentials, but also improvement of traffic in the system of the entire BSR.

According to the results of previous research (Rosik et al. 2015, Komornicki et al., 2018), investments in Poland improved the transport situation, but at the same time increased spatial polarisation in terms of accessibility. The regions connected to the motorways or modernised railway are in a privileged position in relation to other regions. The forecasted change in accessibility to 2023 indicates that polarisation should no longer increase. Further road and rail investments will close the network and balance the level of accessibility between regions. This leads to the general conclusion that stopping or slowing down the fast investment process can lead to a petrification of strong territorial disparities.

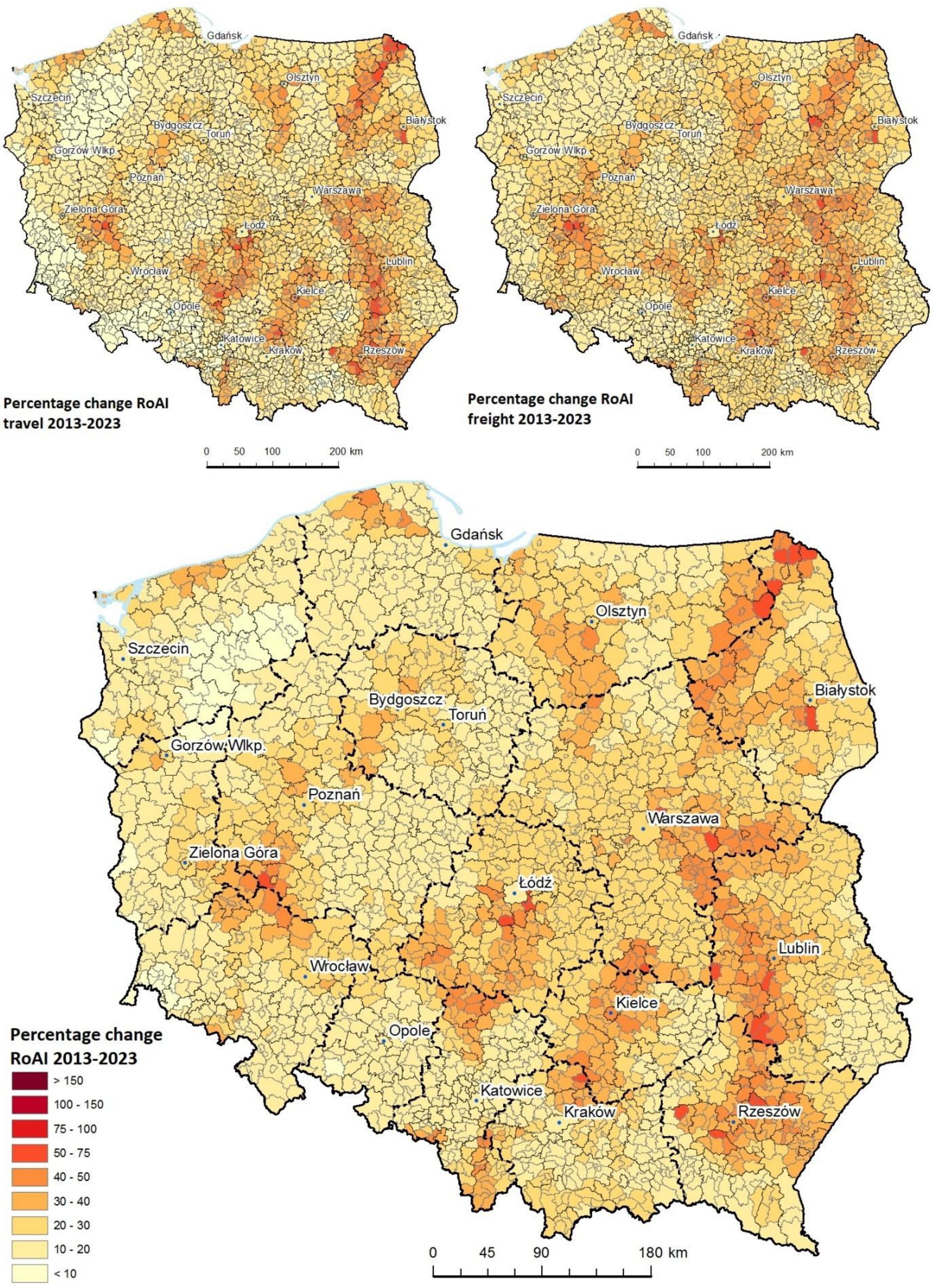

Figure 6.10 Accessibility potential, Poland, road, relative change 2013-2023 (Source: Komornicki et al., 2018*).*

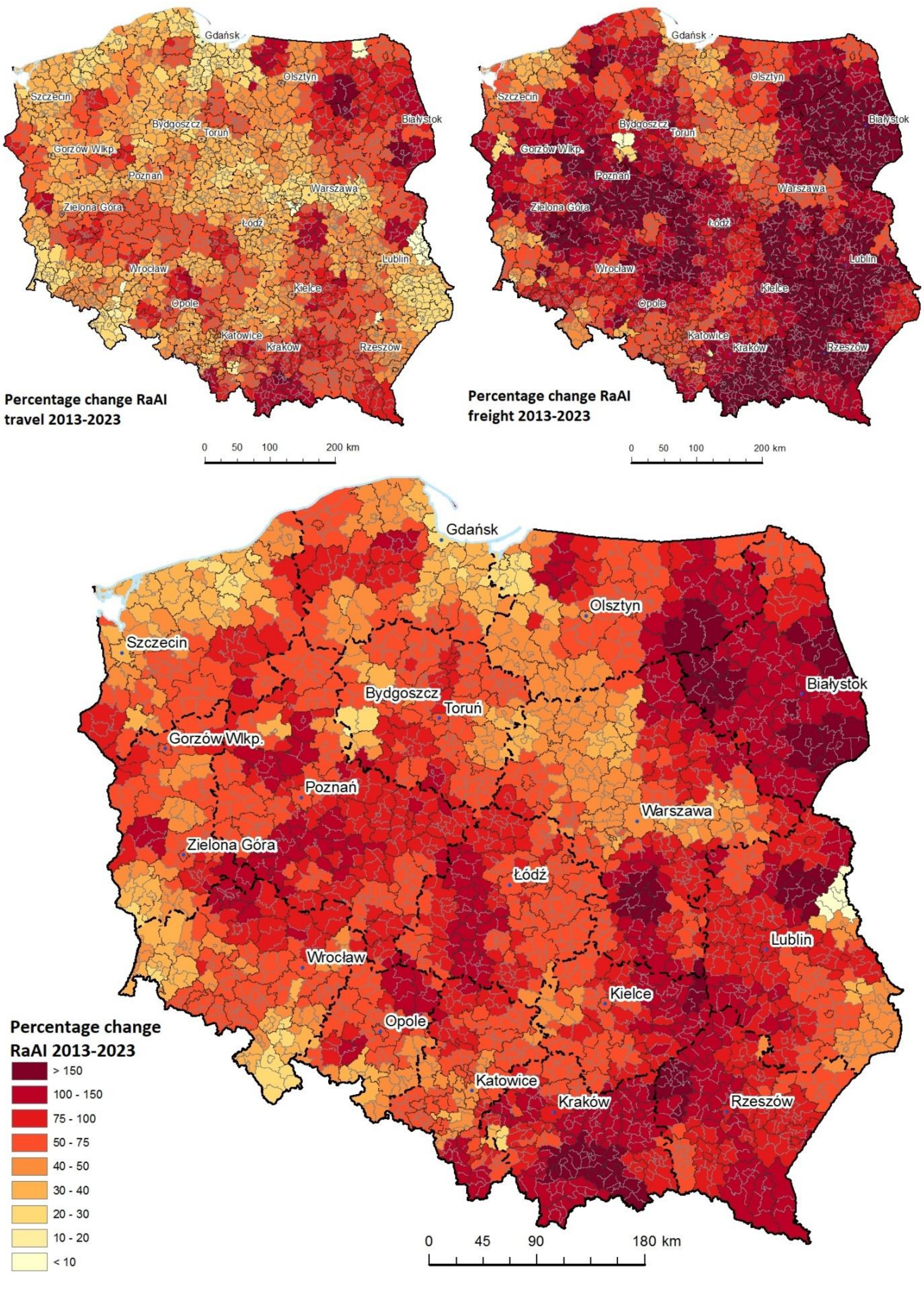

Figure 6.11 Accessibility potential, Poland, rail, relative change 2013-2023 (Source: Komornicki et al., 2018*).*

7 Regional effects of the TEN-T and potentials for regional development

In general, accessibility corresponds to a certain degree to the economic performance of regions. There seems to be a clear relationship between accessibility and GDP. Previous studies have shown that this relationship is much stronger for multimodal accessibility than looking at individual transport modes.

Figure 7.1 gives an idea how regional GDP and regional accessibility potential multimodal are interrelated. The scatter diagrams shows for each NUTS-3 region of the EU and corresponding regions in non-EU countries (Switzerland, Norway, Belarus, BSR-regions of Russia) the level of accessibility potential multimodal for 2016 standardised to the EU28 average and the level of GDP per capita in PPS for 2015 standardised to the EU28 average. Each dot represents a NUTS-3 region, the red dots are the BSR regions, the grey dots other EU or Swiss regions.

In a hypothetical case in which accessibility would explain regional economic performance in total, all dots would be on the diagonal. This is of course not the case, however, there is a general tendency visible that regions with lower levels of accessibility have a lower economic performance and that regions with higher accessibility do better in economic terms. In general, the regions of the BSR behave similar to all European regions. However, there are two major groups of outliers which distort the basic relationship. On the one hand, there are regions that have low or very low accessibility and high GDP which are mainly regions from the Nordic countries. On the other hand, there are regions with high accessibility but only moderate or even below-average GDP which are mainly regions in the European centre that do not belong to the group of best performing regions in economic terms.

The next maps show the relationship between multimodal accessibility and GDP per capita in its spatial dimension (Figures 7.2 and 7.3). The first map shows for which regions both indicators are above, both indicators are below averages or one indicator is above and the other below the averages. Two categories dominate the BSR. First, most regions in the southern and eastern parts of the BSR, in Germany, Poland, the Baltic States, Belarus, Russia and Finland, with the

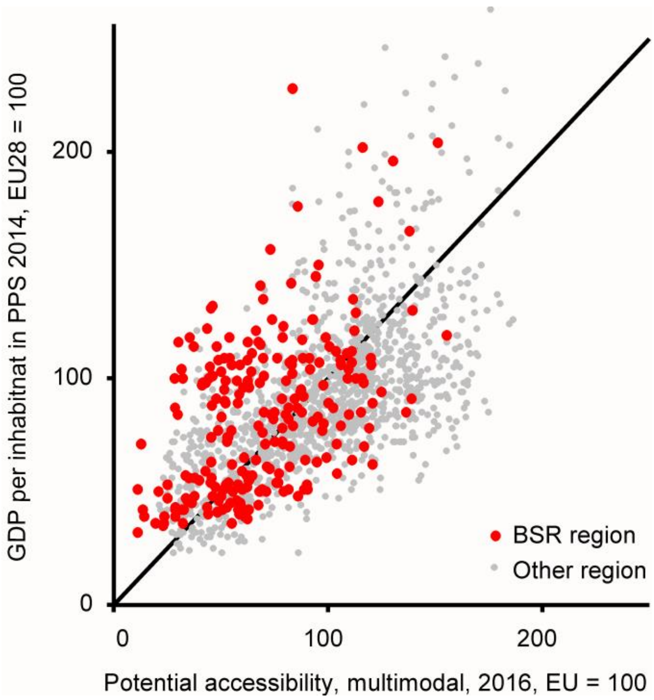

Figure 7.1 Accessibility potential vs. GDP, 2016.

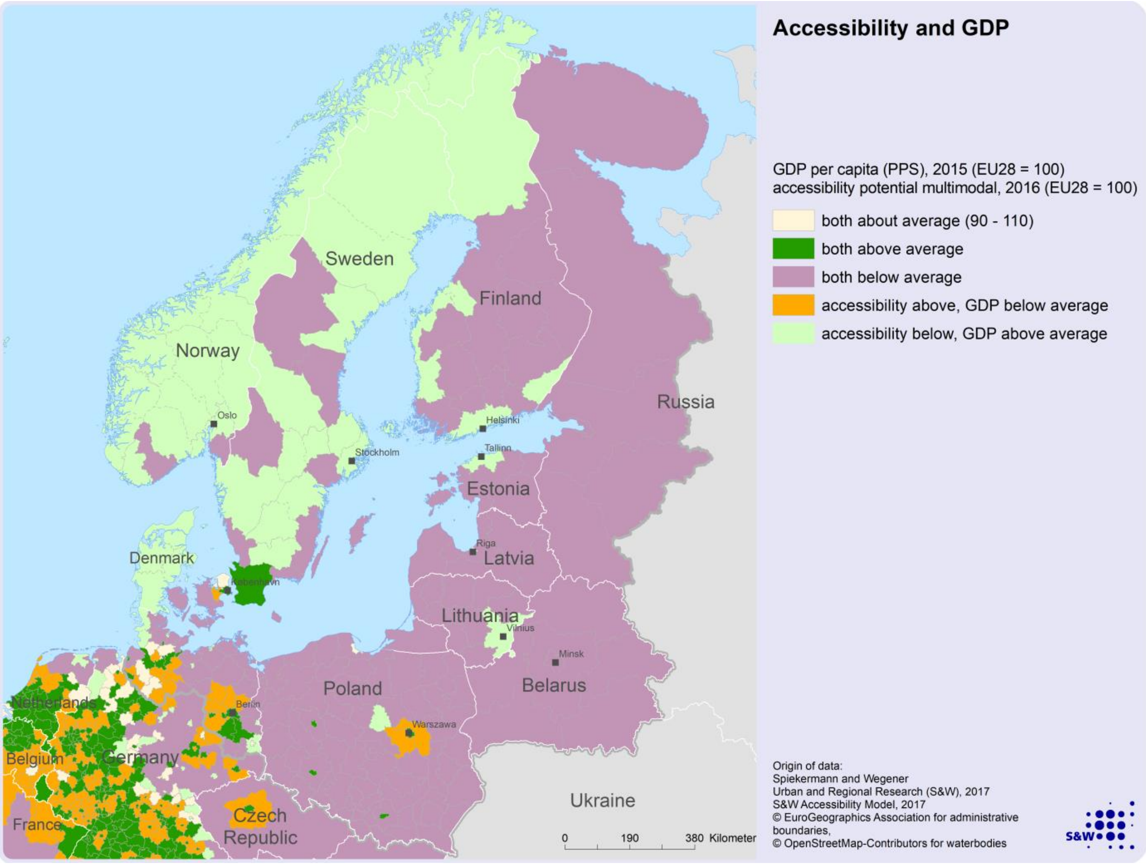

Figure 7.2 Accessibility potential and GDP, 2016.

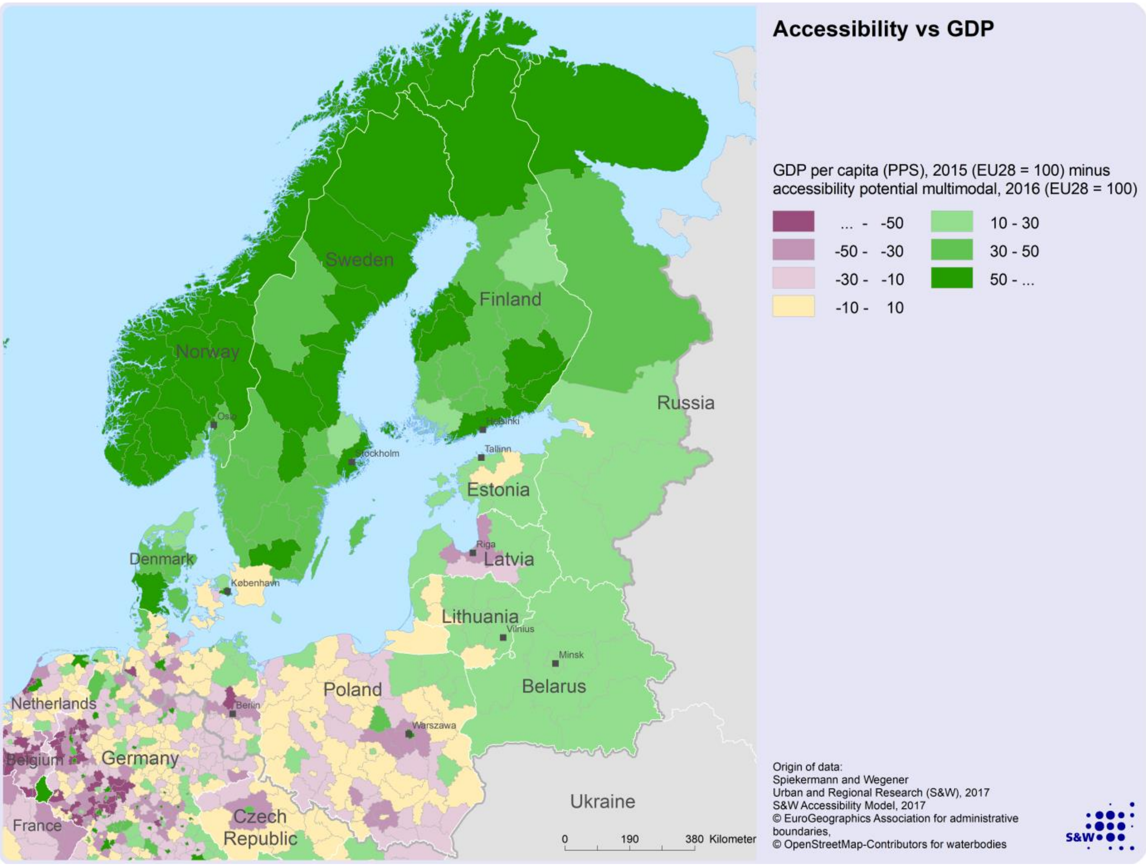

Figure 7.3 Accessibility potential vs. GDP, 2016.

exception of capital regions (as well as southern European regions) are performing in both categories below average. Secondly, most regions in Norway and Sweden and some in Denmark and BSR part of Germany as well as the capital regions of Finland, Estonia and Lithuania have a below average accessibility, however, their economic performance is above EU28 average despite low accessibility. Only few metropolitan regions in the BSR, Copenhagen/Malmö, Hamburg, Berlin, Poznan, Wroclaw and Warsaw have accessibility and GDP performing better than the European average. The hinterlands of these regions partly have above average accessibility, but the GDP is below.

Figure 7.4 presents more precisely to what degree the economic performance corresponds to the expectation from the location, i.e. the map shows how much the regions perform better or worse than their accessibility would suggest. This is done by building the difference between the standardised index values for accessibility and GDP. Positive values indicate higher economic performance than accessibility, negative values indicate the opposite, i.e. higher accessibility than GDP. Looking at the relationship between regional accessibility and economic performance in this way, new insights emerge. Nearly all regions in the Nordic countries, of the Baltic States, of Russia and Belarus, and a few in the other countries are overperfoming, i.e. they have a much better economic performance than location would suggest and thus other important regional assets. Overperforming are also many core cities of agglomerations in western Europe. Many regions in Poland and Germany (BSR part) as well as Riga and its surrounding are underperforming, i.e. the degree of accessibility cannot be utilised in economic performance. In most cases, these regions are rural regions or old-industrialised regions in the process of economic transition or suburban regions of metropolitan regions. In the two countries Germany and Poland, there are also several regions in which the degree of economic performance corresponds to the level of accessibility.

How investments in the transport infrastructure of the BSR and of other parts of Europe might affect the economic performance of regions? The previous chapter has shown that investments in the TEN-T will have positive effects on the accessibility of the BSR regions and that primarily rail investments will make a difference. In the course of this study, no full assessment of the regional effects of future TEN-T development can be made. However, a study on the effects of the Rail Baltica with a tunnel extension to Helsinki (Spiekermann and Wegener, 2013) provides insight in the way new transport infrastructure might influence regional development in the BSR and thus can be used to speculate about those effects. Of course, modelling results on future regional development depend on the modelling philosophy and the kind of scenarios investigated.

In this study, the future transport network evolution is covered in a set of interrelated scenarios which are simulated with a regional socio-economic model (SASI model). First, a Reference Scenario was defined which includes a modest development of transport infrastructure in Europe. In the Reference Scenario it is assumed that the current TEN-T core network proposed by the European Commission in 2011 will be implemented. However, the Rail Baltica which is part of the core network is not part of this Reference Scenario. In three scenarios, more and more infrastructure was added: (1) the Rail Baltica, (2) the Helsinki-Tallinn tunnel project, (3) the full implementation of the TEN-T beyond the core network. The results of the three scenarios are presented as differences to the reference scenario for the year 2051 for accessibility and GDP. Figure 7.4 shows the results for GDP. It can be seen that the three Baltic States are the main beneficiaries of the Rail Baltica (upper left map); the additional increase in GDP per capita might be up to 3 percent higher than in a situation without the new rail link. By adding the tunnel to Finland (upper right map), also the Finnish regions would benefit from the improved rail link to central Europe. Finally, if those infrastructure development would be embedded in the TEN-T comprehensive network which contains a lot of secondary links in the region, the positive GDP effects would be even larger and would spread over all regions of the BSR with highest gains in GDP in the three Baltic States and in Finland.

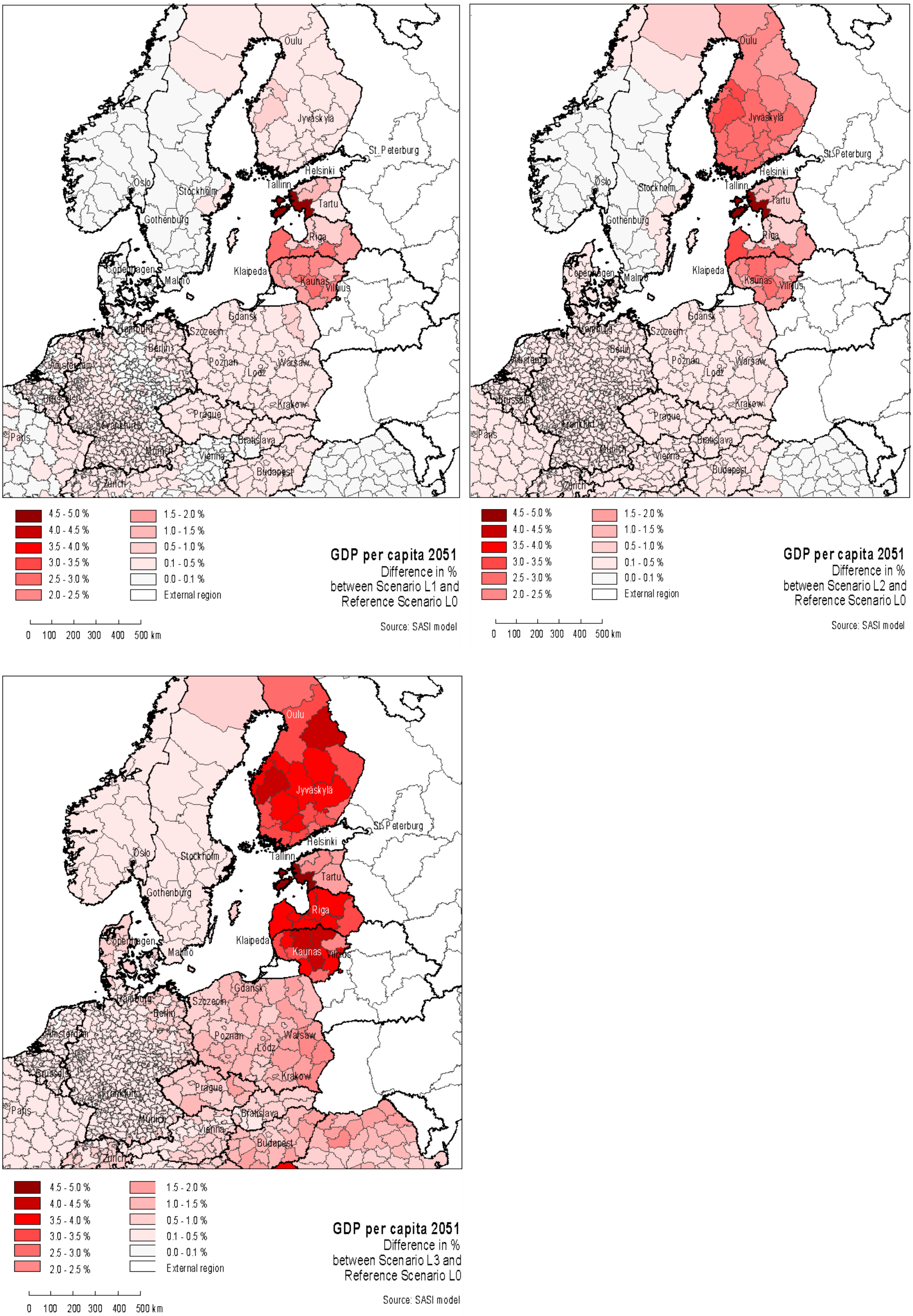

Figure 7.4 Long-term regional economic effects of TEN-T development, Rail Baltica (upper left), addition of Helsinki-Tallinn tunnel (upper right), addition of other TEN-T network development (lower left).

8 Conclusions

Accessibility is a key concept for territorial development and an essential location factor. It has significance in various spatial scales. Even in the areas geographically located far away from the European Union core, where accessibility is generally poor, its local differentiations may decide about development.

The important role of the TEN-T for territorial development and territorial cohesion, including Baltic – North Sea TEN-T base corridor was recognised. The choice of TEN-T base corridors in the BSR was favourable from the point of view of better transportation connectivity of metropolitan centres. At the same time, the TEN-T network fails to sufficiently include the coastal areas adjoining directly the Baltic Sea (especially in Poland and Sweden). Also, routes linking the southern coast of Baltic with the hinterland in South-East Europe require certain additional development and expansion. Development of the TEN-T will yield a lot of improvements in the regional, national and international connectivity, also beyond the external EU border. The investments into a high-quality rail network might bring enormous advantages for the affected regions (ex. the strong effects of the future Rail Baltica), but on the other hand fast improvement of air accessibility in Poland and Baltic States (low cost airlines) creates a competition for passenger rail transport. At present, air transport balances the level of multimodal accessibility in the Baltic macro region. Large geographic distances cause that its role must remain significant.

The area of the BSR is characterised by a very strong internal differentiation of accessibility levels (irrespective of the mode of transport and the applied method of analysis). At the same time, the BSR plays an important role in Europe's transport system. This role is gradually increasing, including thanks to increased participation in intercontinental exchange and as a result of improved accessibility to land ports. An important factor was the EU enlargement to the countries of the southern Baltic coast.

Transport infrastructure projects can have substantial impacts on accessibility potential of individual regions and cities. In particular, high-speed rail has been able and will be able to reshape the BSR in terms of accessibility by bringing higher accessibility to regions outside the European core. The same is true with accessibility by air which can benefit also more remote cities and regions. However, air transport is much more dependent on market behaviour of carriers with a larger fluctuation of air services at individual airports and thus with the possibility of fast growing but also fast decreasing accessibility by air in the adjacent regions.

In the period 2006-2016 the BSR road and rail accessibility improved, but the improvement was territorially selective. The future positive changes are also going to be selective. Changes in Poland and Sweden are the most visible. South-West part of the BSR (Poland and Mecklenburg) is still relatively poor accessible in comparison with other European regions at similar distances from the „Pentagon”. Poland improved accessibility in central and southern parts of the country, but not along the Baltic Sea coast. Development of Polish North-South corridors improved the accessibility of Sweden or even Norway. Western Belarus and Lithuania also improved accessibility because of Polish road and rail investments. This is an important conclusion related to changes of absolute accessibility. Transport investments in one part of the BSR do - in terms of accessibility - benefit not only that region in which the investment takes place, but has through a wider network effect also positive effects on other parts of the macro region.

Investments in road and rail transport have increased internal polarisation in terms of the level of accessibility, primarily in Poland, but to a certain extent also in Sweden and Finland. This process was not visible in the Baltic republics. It can be expected that further investments should not have such a large polarising impact. On the contrary, differences are likely to decrease.

The development of maritime passenger and freight traffic during the last ten years has been very heterogeneous. On the Baltic Sea container transport developed rapidly (direct line from Shanghai to Gdańsk). Container traffic has a high degree of concentration (St. Petersburg, Gdansk/Gdynia). The role of ports on the southern Baltic coast is growing. The accessibility of the Baltic ports in relation to global freight hubs has definitely improved. In conditions when container transport took over the Baltic goods movement, and low-cost airlines passenger traffic, the relative importance of traditional ferry lines decreased.

Accessibility to the ports of the southern Baltic coast has improved clearly but only in particular places. This means that in the conditions of possible further development of shipping (especially container transports) routes distributing the goods transport from seaports can be overloaded with traffic. Therefore, it is important to increase the role of railways in these sections (e.g. in the service of Gdańsk and Klaipeda).

Accessibility and the needs of BSR infrastructure development strongly depends on geopolitical and demographic factors. These two determinants may undermine the effect of transport infrastructure development. In the former case, the restriction may have an abrupt character, relating to the changes in permeability of borders as well as in the demand for transport of goods (e.g. trade embargoes, tightening the visa regime, etc.). In the latter case, these changes are long-term processes related with population movements and with changes of demographic structure.

The geopolitical factor is visible inter alia in the pattern of road and rail infrastructure along the southern coast of the Baltic. In both cases (Via Baltica and Rail Baltica routes) the routes evade the Kaliningrad Oblast of the Russian Federation. The construction of the Rail Baltica along the current planned route is the result of the fact that the traditional main railway line Warsaw-Hrodna-Vilnius is crossed/cut by the existing state borders. Plan of construction of Rail Baltica as high-speed rail line is conditioned, to a large degree, by taking into account the Russian demographic potential. Intensification of linkages with Sankt Petersburg would be an essential reason for implementation of investment in the aforementioned shape of a high-speed rail line.

The main demographic problem lies in depopulation of Baltic States and Eastern Poland as well as of some oblast's of Belarus and Russia. In some regions accessibility decreased because of depopulation (Eastern Belarus, Russian Karelia, Northern Norway). In other regions depopulation was balanced by transport infrastructure development (Lithuania, Latvia, North-East Poland). In these cases, transport investments may be acknowledged as a necessary precondition for preserving the current developmental opportunities and the population's standard of living. Simultaneously with depopulation of peripheral areas, there occurs concentration of population in the metropolitan areas of Baltic macro region and in some medium-sized cities. Consequently, the value of accessibility potential index tends to grow there, in part due to the increase of population. This frequently contributes to local transportation problems such as congestion.

The value of the accessibility potential indicator depends directly on the population distribution. Rapid demographic changes in the Baltic macro region cause an increase in the index in the metropolitan areas that concentrate population and its decrease in the vicinity of these centres. The development of transport infrastructure can for this decline by expanding the commuting zone. This is important from the point of view of employers (for example, the lack of manpower is becoming a growing problem in Poland). However, this applies to the spatially limited concentric system. In the case of further peripheral areas, depopulation is already a reason for limiting the scale of some investments. It may also mean greater importance of support for local public transport (among others due to the changing age structure of the population).

9. Recommendations

The current, and also the planned development of infrastructure (both rail and road) insufficiently improves the accessibility of regions directly adjacent to the Baltic coast (Poland, Lithuania, and also Sweden and Mecklenburg). It is expedient to create and support the corridor TEN-T running directly along the southern coast (Via Hanseatica). The positive impact of the construction of longitudinal infrastructure in Poland on the Nordic accessibility provides an argument for development of other transport corridors from Baltic ports in Poland and Lithuania in the direction of South-East Europe (the so-called Via-Carpathia).

The current distribution of passenger flows and demographic potential backs up the usefulness and advisability of development of high-speed rail transportation in the corridors: a) Hamburg-Copenhagen-Stockholm; b) Berlin-Warsaw. Decisions concerning the standard of the Rail Baltica construction have to be taken cautiously, with taking into account geopolitical (linking Sankt Petersburg) and demographic factors (depopulation of Latvia, Lithuania and East Poland). This concerns in particular the passenger traffic (potential high-speed rail option). Under the framework of the Baltic states cooperation (including the VASAB project) liberalisation of rules of travelling between European Union and Belarus and Russia should be, as far as possible, pursued. This should allow for strengthening the market basis of investments (especially rail) and for making the more optimal use of the existing infrastructure (e.g. rail infrastructure in Belarus).

It has been shown that the past and future introduction of high-speed rail has much larger effects on the accessibility potential than development of the road network. From a spatial development point of view, road accessibility is a pre-condition for regional development. However, the role of a game changer is with high-speed rail. The introduction of a new level of service in terms of speed and related travel time between the agglomerations of the BSR would be of enormous benefit for the connected cities, and, with appropriate secondary networks also of benefit for the surrounding regions.

The CEF (Connecting Europe Facility) mechanism should be evaluated positively as an instrument allowing for the construction of infrastructure sections (especially rail) that links the states of the Baltic Sea macro region. This mechanism should to a larger degree support multimodal solutions, in particular in goods transport in the West-East direction, as well as in relations crossing across the Baltic. An element enhancing the multimodal solutions are the change of track gauge on the eastern border of Poland and transhipments facilities/points. Cross-Baltic ferry connections should be more frequent (for better use of the new North-South road and rail infrastructure in Central Europe, by Scandinavian flows). Development of the sea transport (mainly containers) in Gdańsk, Klaipeda and Riga should be followed by rail and intermodal solution inside Poland, Lithuania and Latvia (otherwise road freight traffic will increase significantly).

Concentration of shipping traffic in large ports of the southern Baltic coast (Gdańsk, Klaipeda, Riga) poses a threat to the road and rail networks that serve them. They are often used simultaneously in the transport of goods and passengers. These are sections that require special attention, also in terms of modal changes (increasing the role of the railway).

The initiated investments (railway and road) in countries with less developed infrastructure (Poland, the Baltic republics) should not be interrupted, as it would threaten to maintain a significant accessibility polarisation (larger than at the threshold of accession to the EU).

The study showed that there are sections of the road and rail network in the transport system, which influence on the level of accessibility in the whole BSR is definitely higher than others. Future investments should focus on such sections (e.g. Via Baltica on the Polish-Lithuanian section).

The spatially more detailed accessibility to job indicator proves that in the territory of the BSR, regardless of the development of infrastructure, zones of internal periphery located between large metropolises are formed and consolidated. In some extreme cases, poor accessibility in public transport can lead to transport exclusion. The condition to overcome these processes is to pay more attention also to networks of regional significance. Identification of these problems is possible only if accessibility analyses are also performed at the local level (using units LAU1 or LAU2). This allows a resolution that identifies the local transport exclusion. Undertaking such BSR studies seems to be deliberate.

Finally, it has to be stated that transport infrastructure development is not the only and maybe not the most important issue to take care of. With respect to territorial cohesion in Europe and in the BSR, multi challenged regions (economy, demography, social) need comprehensive strategies to develop their assets and to develop them as attractive locations to live and to develop competitive economic activities. The development of high-quality transport infrastructure and connections can only be one element in such strategies aiming at territorial cohesion and a balanced development of the BSR. And, with respect to the environment and combating climate change, the environmental consequences (which was not subject of this study) of new transport infrastructure and ever rising transport volumes have to be seriously taken into account and to be assessed against the possible benefits.

10 References

BMVI - Bundesministerium für Verkehr und digitale Infrastruktur (2017): Verkehr in Zahlen 2017/2018. Hamburg: DVV Media Group.

Destatis - Statistisches Bundesamt (2018): Statistisches Jahrbuch Deutschland und Internationales 2018. Wiesbaden: Destatis.

Dijkstra, L., Poelman, H. (2011): Regional typologies: a compilation. Regional Focus 01/2011. Brussels: European Commission, Regional Policy.

EC - European Commission – Directorate General for Mobility and Transport (2013): The core network corridors. Trans-European transport networks 2013. Brussels: European Commission.

ESPON (2014): Baltic Sea Region - Territorial Monitoring. Luxembourg: ESPON & Nordregio/IGSO PAS/BGI Consulting.

EU - European Union (2013): Regulation (EU) No 1315/2013 of the European Parliament of and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU. Official Journal of the European Union L 348, p. 1-128.

Eurostat (2018): EU Transport in Figures. Statistical Pocketbook 2018. Luxembourg: Publications Office of the European Union.

Hanell, T., Bengs, C., Bjarnadóttir, H., Platz, H., Spiekermann, K. (2000): The Baltic Sea Region Yesterday, Today and Tomorrow – Main Spatial Trends. Working Paper 2000:10. Stockholm: Nordregio.

Kompil, M.; Lavalle, C. (2017a): Access to local services. European Commission - Joint Research Centre.-

Kompil, M.; Lavalle, C. (2017b): Access to regional services. European Commission - Joint Research Centre.-

Kotavaara, O., Antikainen, H., Rusanen, J. (2013): TRACC - Transport Accessibility at Regional/Local Scale and Patterns in Europe. Volume 3 TRACC Regional Case Study Book. Part G Finland case study. Luxembourg: ESPON and Department of Geography, University of Oulu.

Komornicki T., Rosik P., Stępniak M., Śleszyński P., Goliszek S., Pomianowski W., Kowalczyk K. (2018) Evaluation and Monitoring of Accessibility Changes in Poland Using the MAI Indicator. Warsaw: IGSO PAS, MD.

Līviņa, A., Jānis Turlajs, J., Druvaskalne, I.D., Valtenbergs, V., Klepers, A. (2016): Development of Cities in the Baltic Sea Region. Research report. Valmiera/Riga: HESPI/ Jana seta Map Publishers.

Mathis, P., Buguellou, J.-B., Coquio, J., Guimas, L., L'Hostis, A., Bozzani, S., Font, M., Ulied, A., Reynaud, C., Decoupigny, C., Manfredini, F., Pucci, P., Spiekermann, K., Wegener, M. (2005): Transport Services and Networks: Territorial Trends and Basic Supply of Infrastructure for Territorial Cohesion. Final Report of ESPON 1.2.1. Tours: Universität Tours.

Rosik P., Stępniak M., Komornicki T. (2015): The decade of the big push to roads in Poland: impact on improvement in accessibility and territorial cohesion from a policy perspective. Transport Policy 2015, 37, p. 134-146.

Schürmann, C. (2013): TRACC - Transport Accessibility at Regional/Local Scale and Patterns in Europe. Volume 3 TRACC Regional Case Study Book. Part F Baltic States case study. Luxembourg: ESPON and RRG.

Schürmann, C., Spiekermann, K. (2006): Accessibility Analysis of the Baltic Sea Region. Final Report for the Baltic Sea Region INTERREG IIIB Secretariat. Dortmund: Spiekermann & Wegener Stadt- und Regionalforschung und Oldenburg i.H.: Büro für Raumforschung, Raumplanung und Geoinformation.

Spiekermann, K., Aalbu, H. (2004): Nordic Peripherality in Europe. Nordregio Working Paper 2004:2. Stockholm: Nordregio.

Spiekermann, K., Wegener, M. (2013): Regional impacts of a railway tunnel between Helsinki and Tallinn. Final Report of a Quantitative Impact Assessment in the course of the Central Baltic Interreg IVA project Helsinki-Tallinn Transport and Planning Scenarios (H-TTransPlan). Dortmund: S&W.

Spiekermann, K., Wegener, M., Kveton, V., Marada, M., Schürmann, C., Biosca, O., Ulied Segui, A., Antikainen, H., Kotavaara, O., Rusanen, J., Bielanska, D., Fiorello, D., Komornicki, T., Rosik, P., Stepniak, M. (2015): Transport Accessibility at Regional/Local Scale and Patterns in Europe. TRACC Executive Summary and Final Report. Luxemburg: ESPON and S&W.

Stepniak, M., Rosik, P., Komornicki, T. (2013): TRACC - Transport Accessibility at Regional/Local Scale and Patterns in Europe. Volume 3 TRACC Regional Case Study Book. Part E Poland case study. Luxembourg: ESPON and IGSO PAS.

VASAB (1994): Visions and Strategies around the Baltic Sea 2010. Towards a Framework for Spatial Development in the Baltic Sea Region. Tallinn: The group of focal points of the BSR.

VASAB (2001): VASAB 2010 Plus. Spatial Development Action Programme. Gdansk: VASAB Secretariat.

VASAB (2009): VASAB Long-Term Perspective for the Territorial Development of the Baltic Sea Region. Towards Better Territorial Integration of the Baltic Sea Region and its Integration with other Areas of Europe. Riga: VASAB Secretariat.

VASAB (2014): Tallinn Declaration. 8th VASAB Conference of Ministers Responsible for Spatial Planning and Development of the Baltic Sea Region, Tallinn 26 September 2014. Riga: VASAB Secretariat.

VASAB (2016): Development of Cities in the Baltic Sea Region. Riga: VASAB Secretariat.

Annex

A1 Methodological remarks

Accessibility indicators are usually not provided by statistical agencies. Accessibility indicators cannot simply be collected but are output of accessibility models. In ESPON, the calculation of accessibility indicators got attention from the beginning. Projects of the ESPON 2006 and 2013 Programmes have produced various indicators and maps in different study fields for all countries of the ESPON space over the last years. Many of them have been widely used in European and national documents, and became input to deeper policy analyses inside and outside of ESPON. Thus, ESPON has become the main source for comparative accessibility indicators for European regions. The accessibility potential indicators used in this study are updates of the ESPON indicators developed by the authors of this study which have been also the provider of the ESPON accessibility indicators.

Calculation of accessibility potential

Accessibility potential is based on the assumption that the attraction of a destination increases with size, and declines with distance, travel time or cost. Here, destination size is represented by region population. Thus, accessibility potential to population is seen as an indicator for the size of market areas for suppliers of goods and services. Though accessibility potential is founded on sound behavioural principles, it contains parameters to be calibrated. It is a construct of two functions, the activity function representing the activities or opportunities to be reached, and the impedance function representing the effort, time, distance or cost needed to reach them. For accessibility potential these two functions are combined multiplicatively,

$$A_i = \sum_j W_j^a \exp(-\beta c_{ij})$$

where Ai is the accessibility of area i, Wj is the activity W to be reached in area j, and cij is the generalised cost of reaching area j from area i. Ai is the total of the activities reachable at j weighted by the ease of getting from i to j. The interpretation is that the greater the number of attractive destinations in areas j is and the more accessible areas j are from area i, the greater is the accessibility of area i. The impedance function is nonlinear. Generally a negative exponential function is used in which a large parameter beta indicates that nearby destinations are given greater weight than remote ones.

The accessibility model uses centroids of NUTS-3 regions as origins and destinations. It calculates the minimum paths through the networks, i.e. minimum travel times between the centroids of the NUTS-3 regions. As a whole, all these individual o-d-travel times constitute the travel time matrices, which is one important output of this project.

For each NUTS-3 region the value of the accessibility potential indicator is then calculated by summing up the population in all other European regions, including those outside ESPON space and also including population of northern African and Middle East countries, weighted by the travel time to go there. For this weighting, the parameter β has been set to 0.005. That means that assuming a travel time between two regions of zero minutes (which does not occur in reality), the population of the destination region would be included with its full value in the accessibility potential of the origin region, while for a travel time of little more than two hours the weight is 0.5, and for a travel time of little more than five hours the weight goes down to 0.2 only (see Figure A1.1).

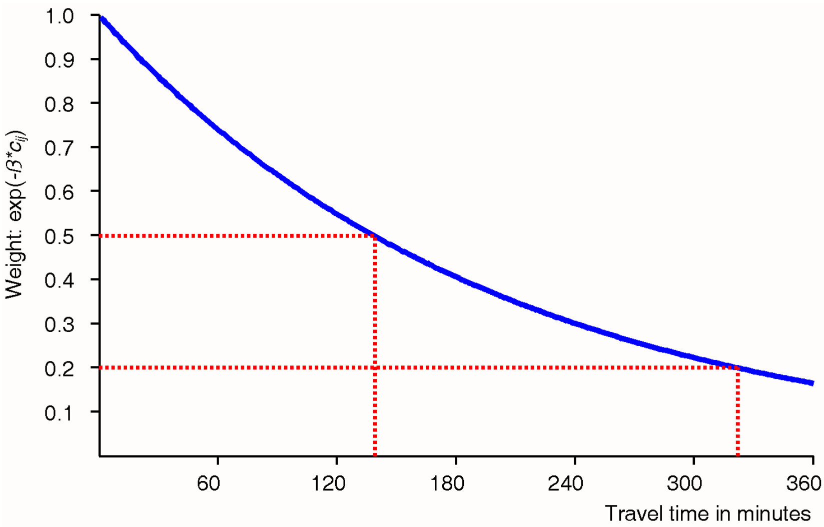

Figure A1.1. Weighting of destination population.

For the calculation of accessibility indicators, population at NUTS-3 level and somewhat larger zone for areas outside the EU (Eastern Europe, Middle East, northern Africa) is necessary to reflect the attractiveness of the regions. As by definition, no empirical data are available for future years, population projections from Eurostat amended by national population forecasts of the United nations for territories that are not covered by the Eurostat projections were used for the future year 2030.

As explained above, population is an integral element of accessibility potential. Therefore, the changes in population over time can have an influence on this type of accessibility that is larger than the development of the transport infrastructure. The past and future development of the population is presented in the main text, Figure 2.1 shows the past population development and Figure 6.1 shows the future population development used for the calculation of accessibility potential.

A2 Additional maritime accessibility maps

On the following pages, Figures A2.1 - A2.18 show the cargo inward and outward flows of nine selected ports of the BSR in detail.

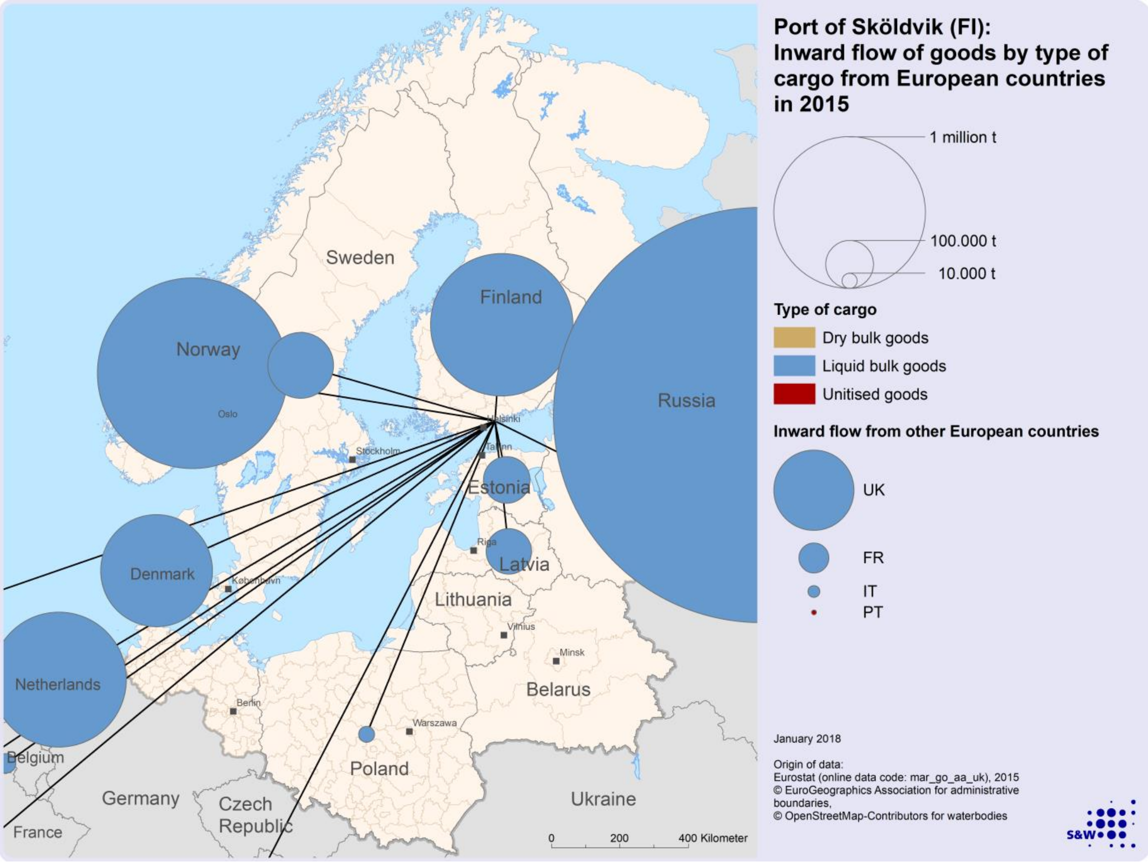

Figure A2.1 Port of Sköldvik (FI): Inward flow of goods, 2015.

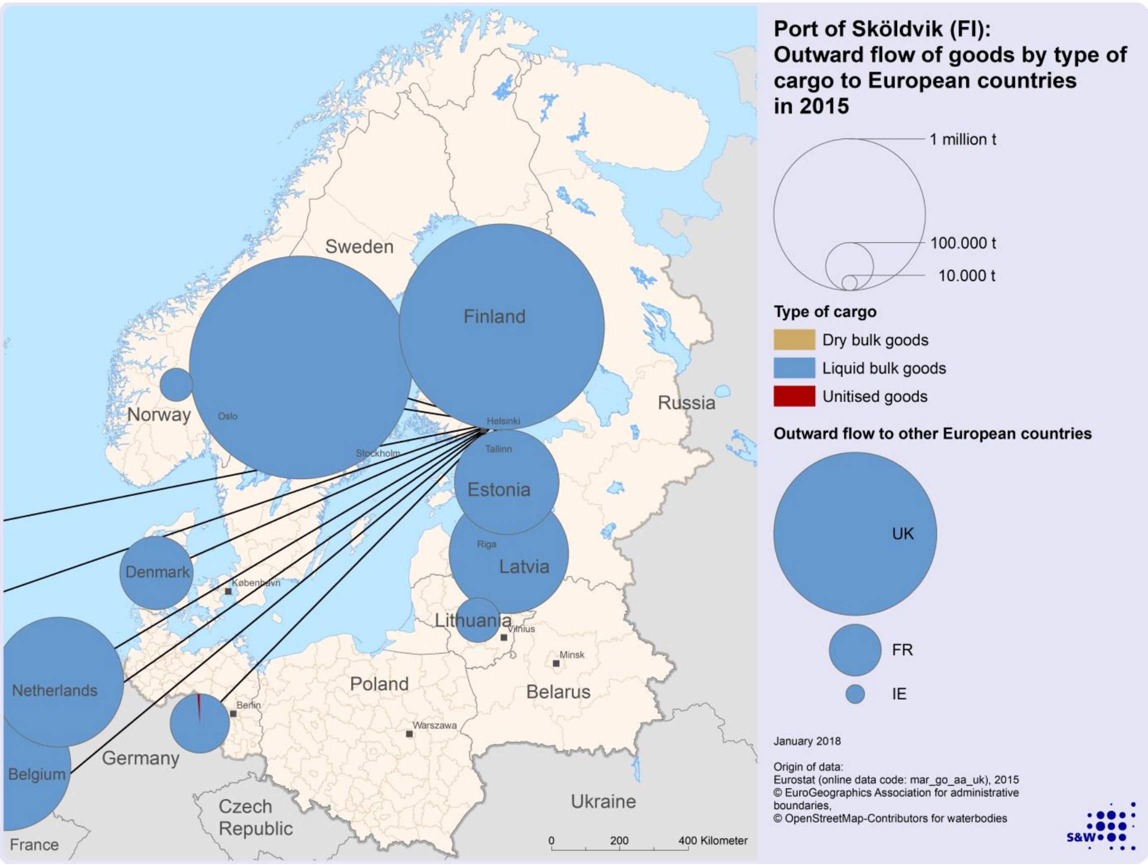

Figure A2.2 Port of Sköldvik (FI): Outward flow of goods, 2015.

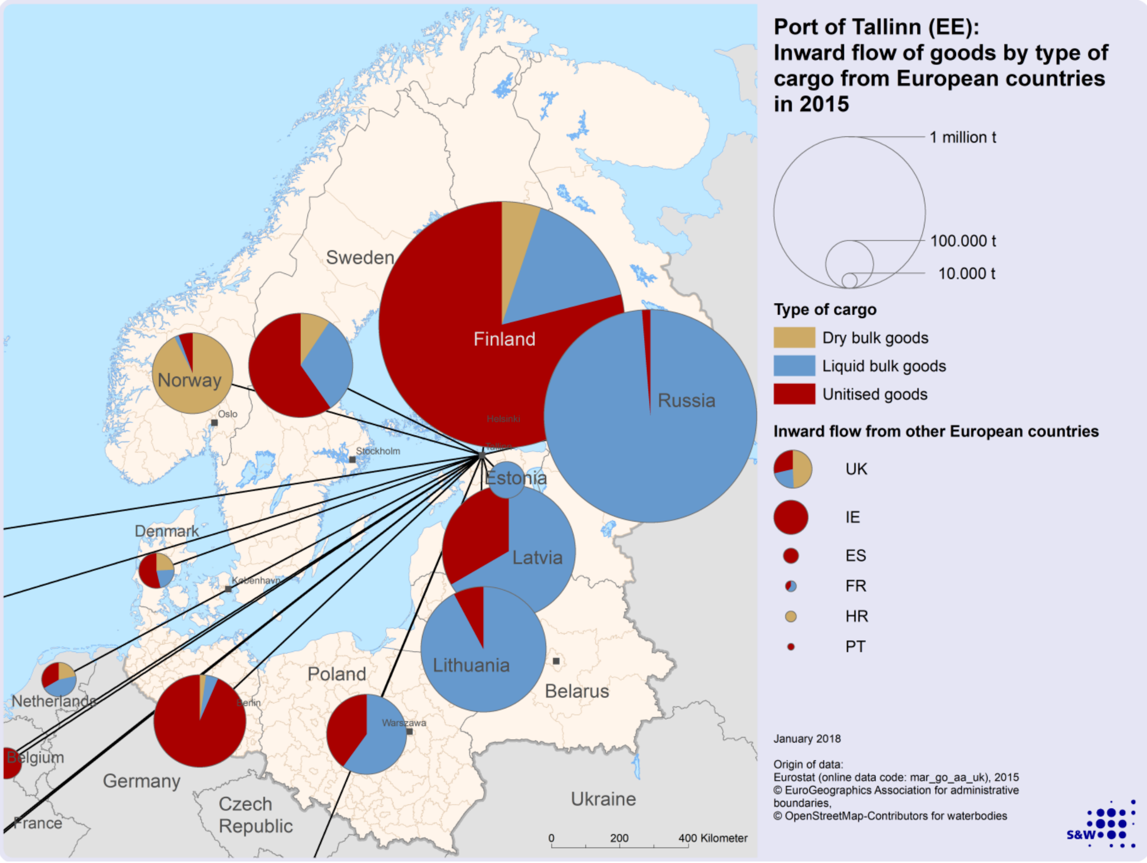

Figure A2.3 Port of Tallinn (EE): Inward flow of goods, 2015.

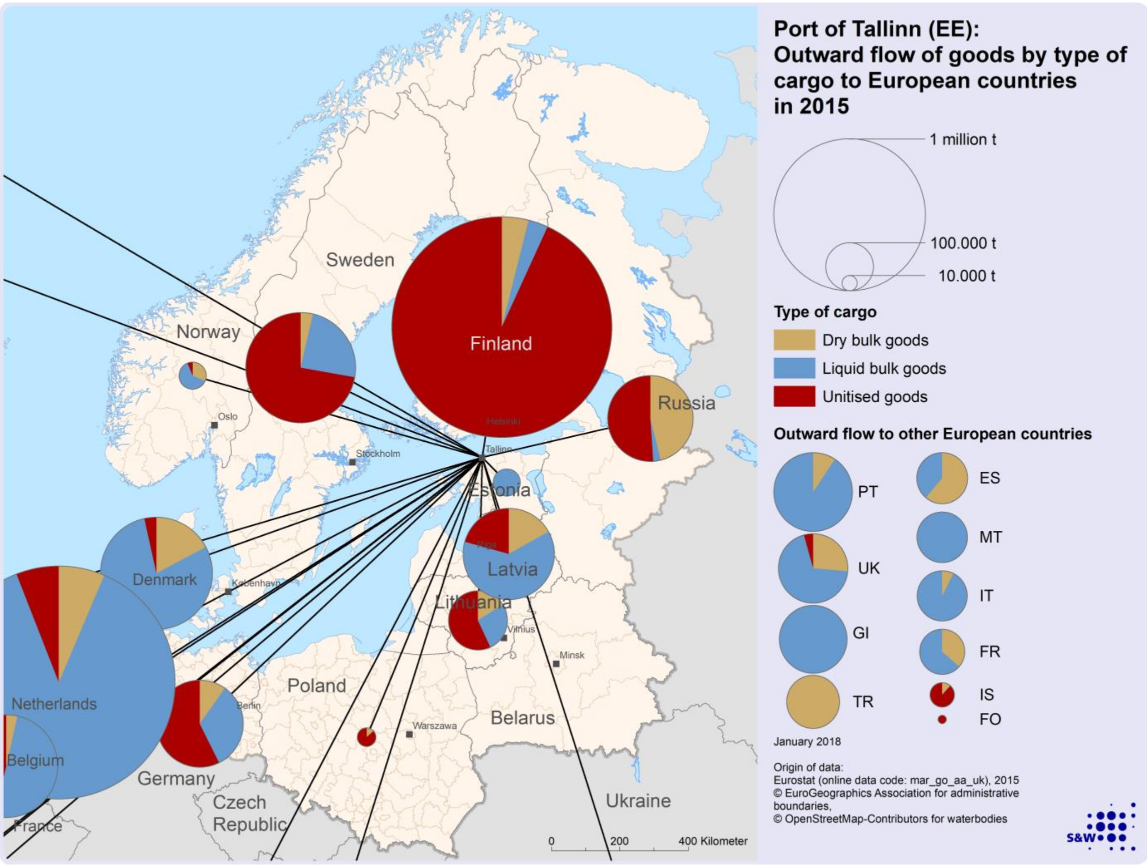

Figure A2.4 Port of Tallinn (EE): Outward flow of goods, 2015.

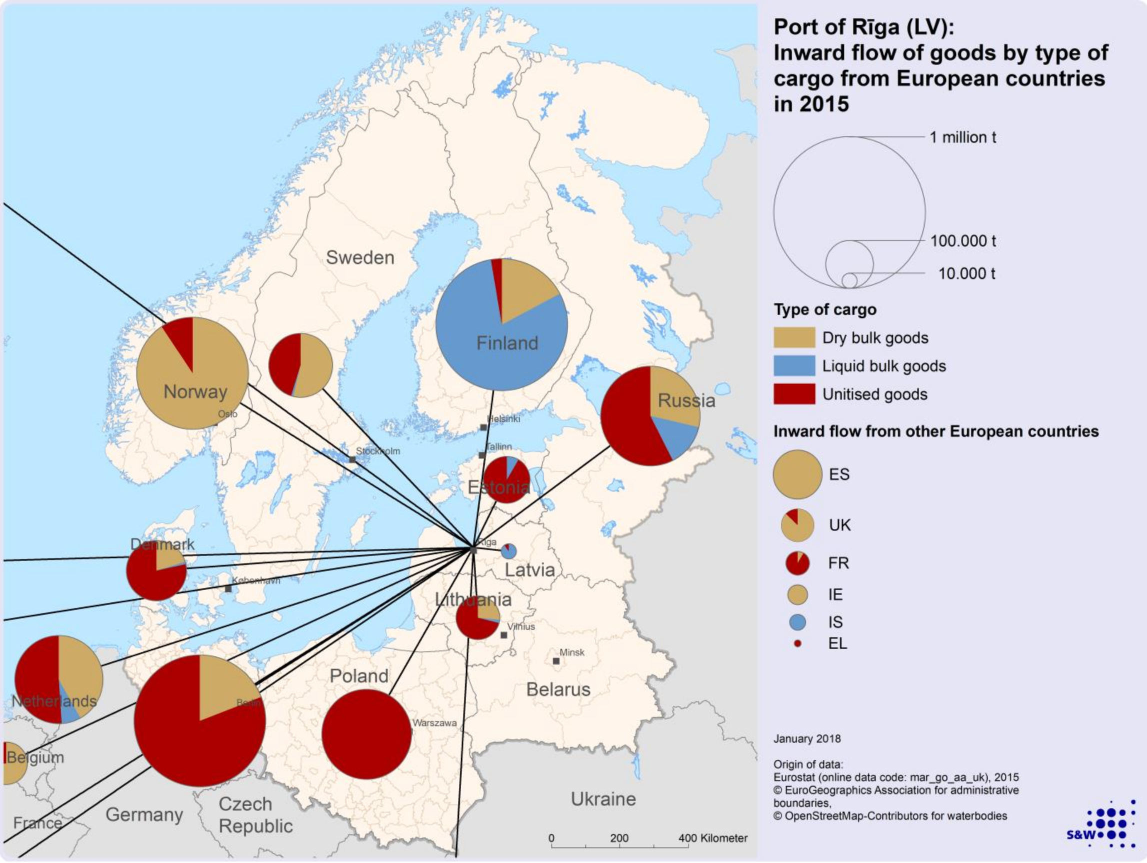

Figure A2.5 Port of Riga (LV): Inward flow of goods, 2015.

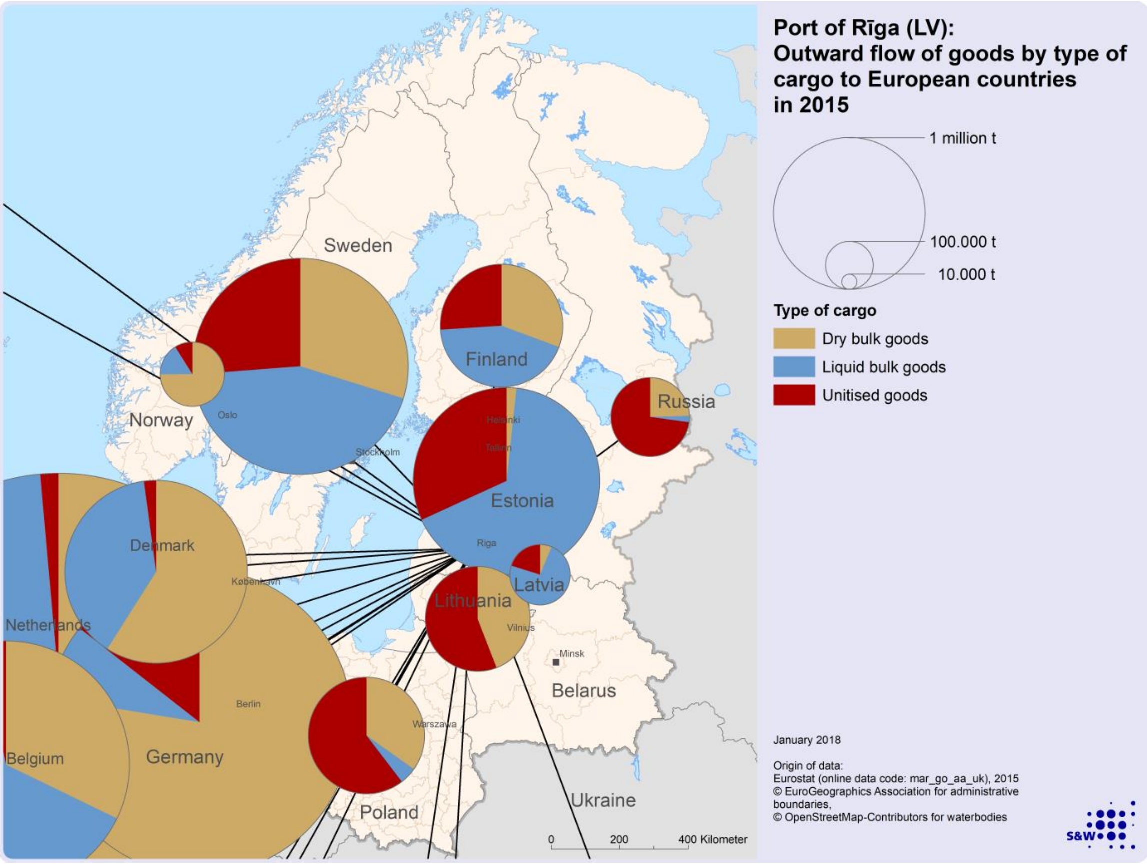

Figure A2.6 Port of Riga (LV): Outward flow of goods, 2015.

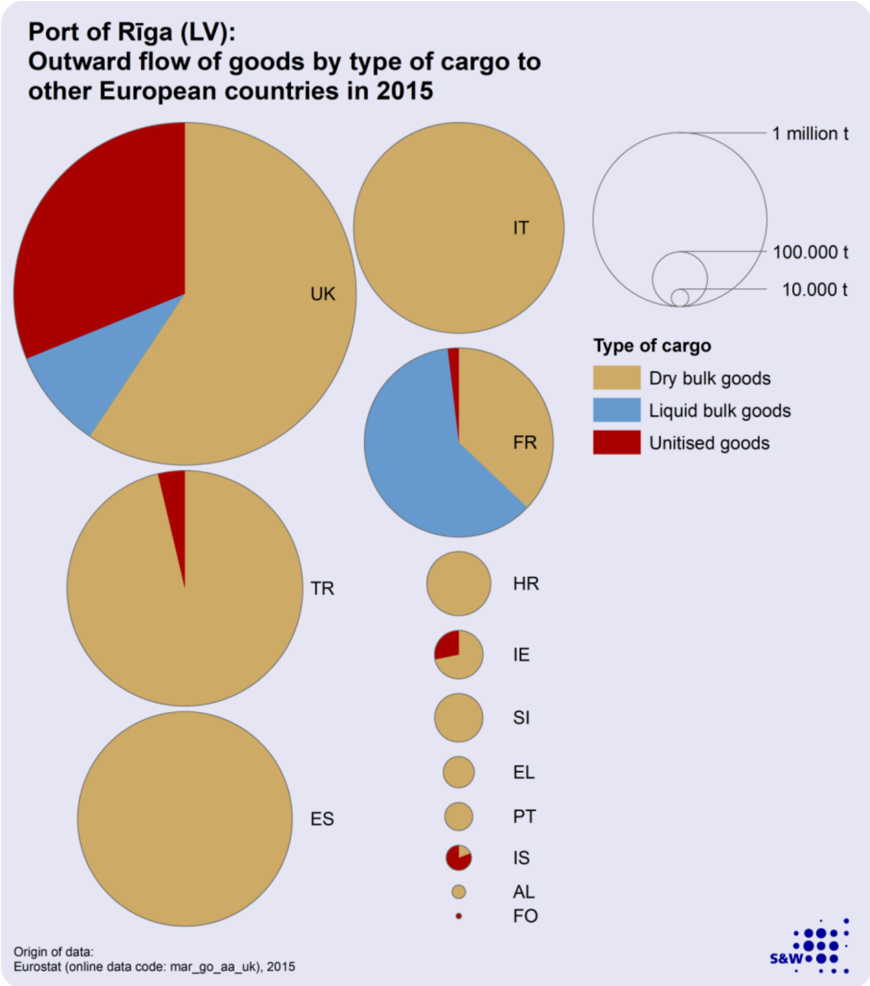

Figure A2.6 (continued) Port of Riga (LV): Outward flow of goods, 2015.

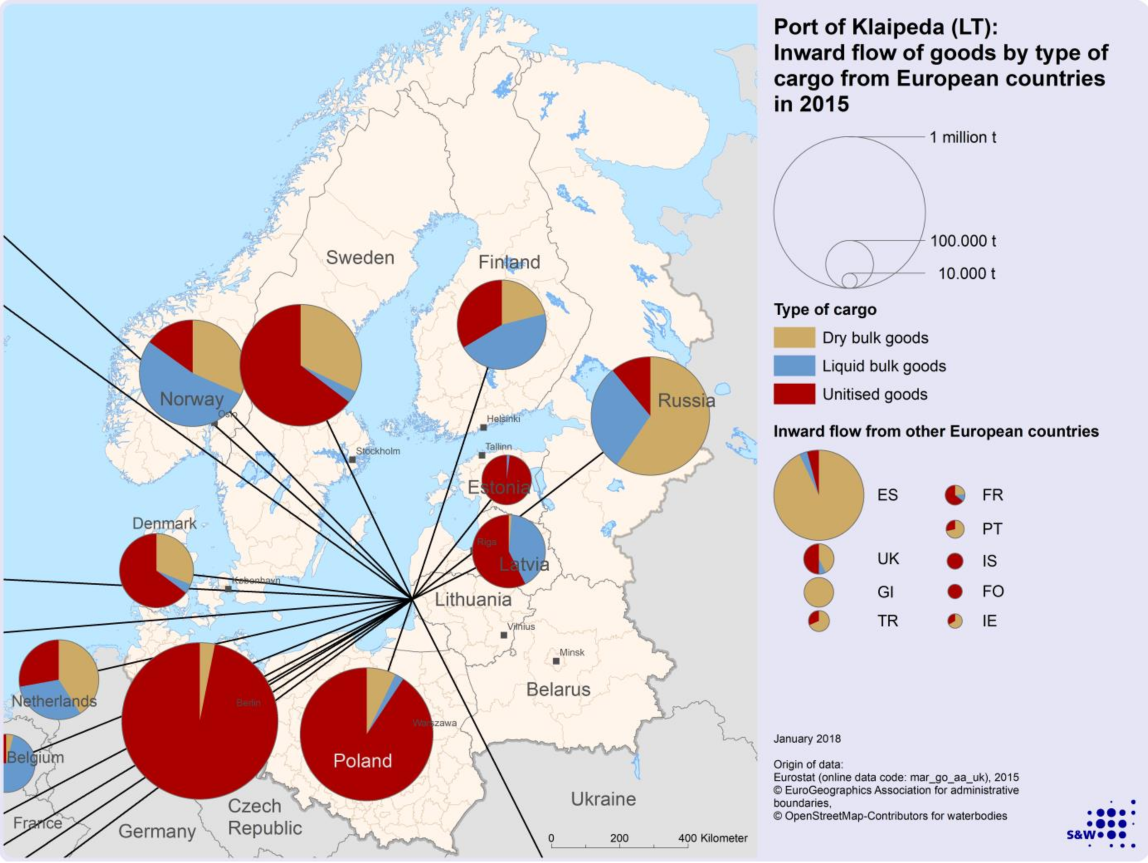

Figure A2.7 Port of Klaipeda (LT): Inward flow of goods, 2015.

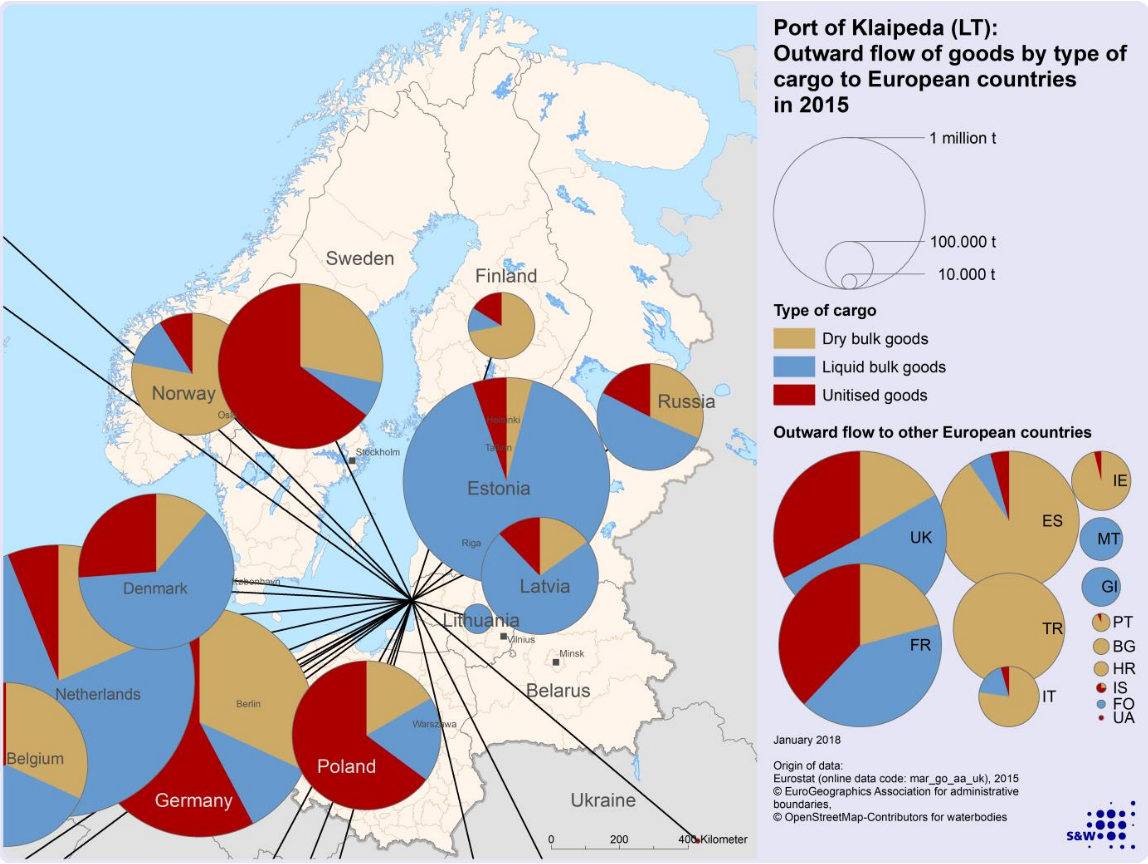

Figure A2.8 Port of Klaipeda (LT): Outward flow of goods, 2015.

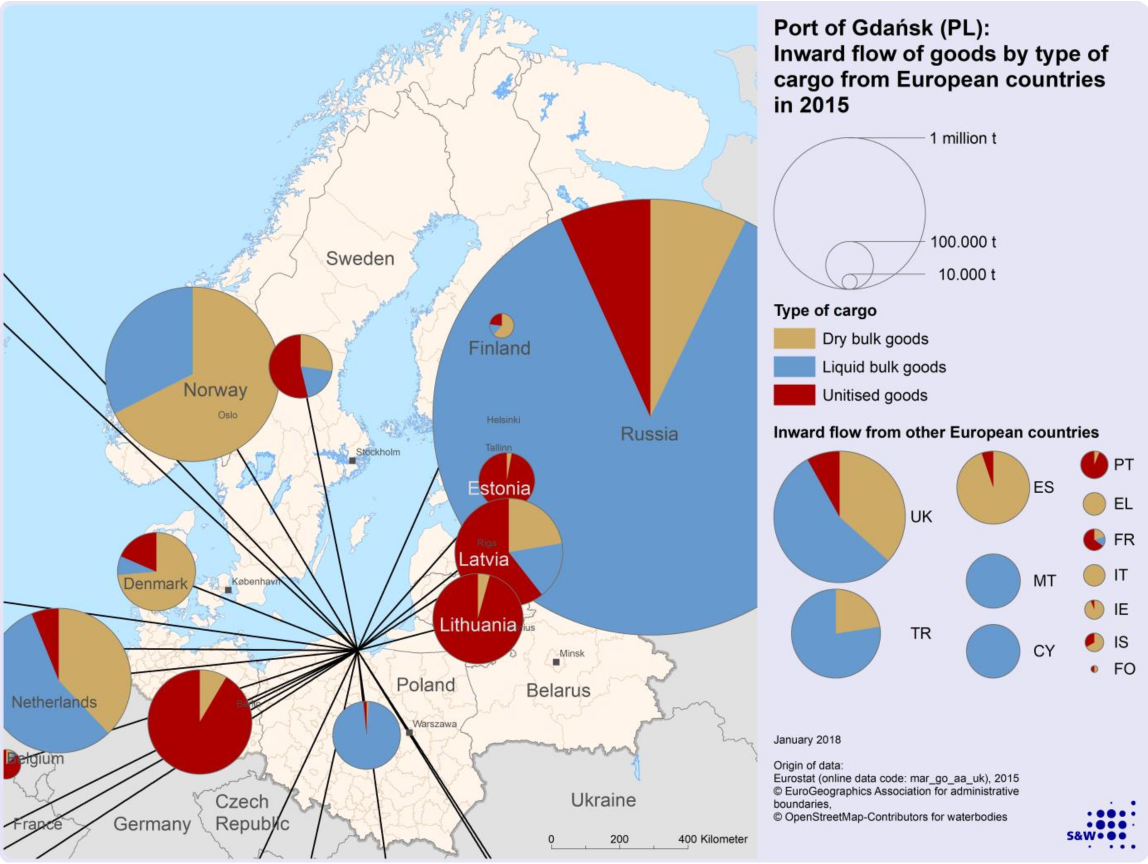

Figure A2.9 Port of Gdansk (PL): Inward flow of goods, 2015.

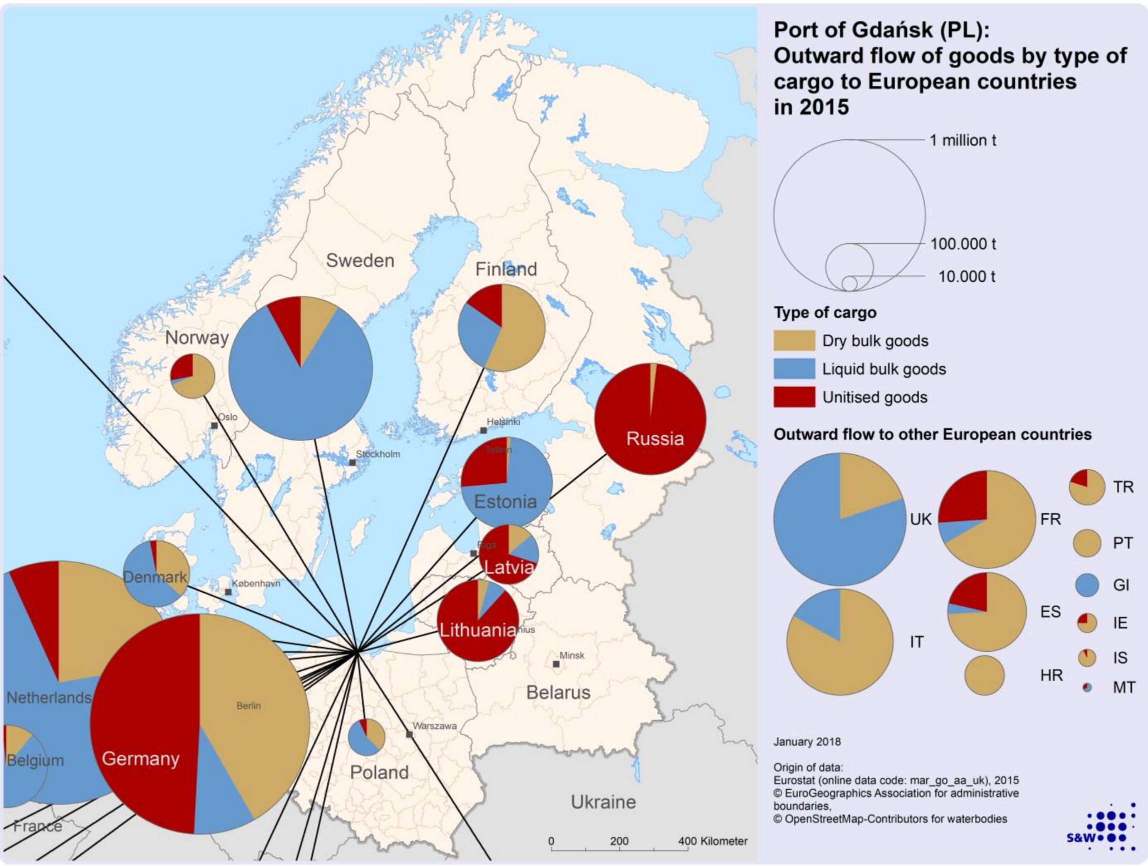

Figure A2.10 Port of Gdansk (PL): Outward flow of goods, 2015.

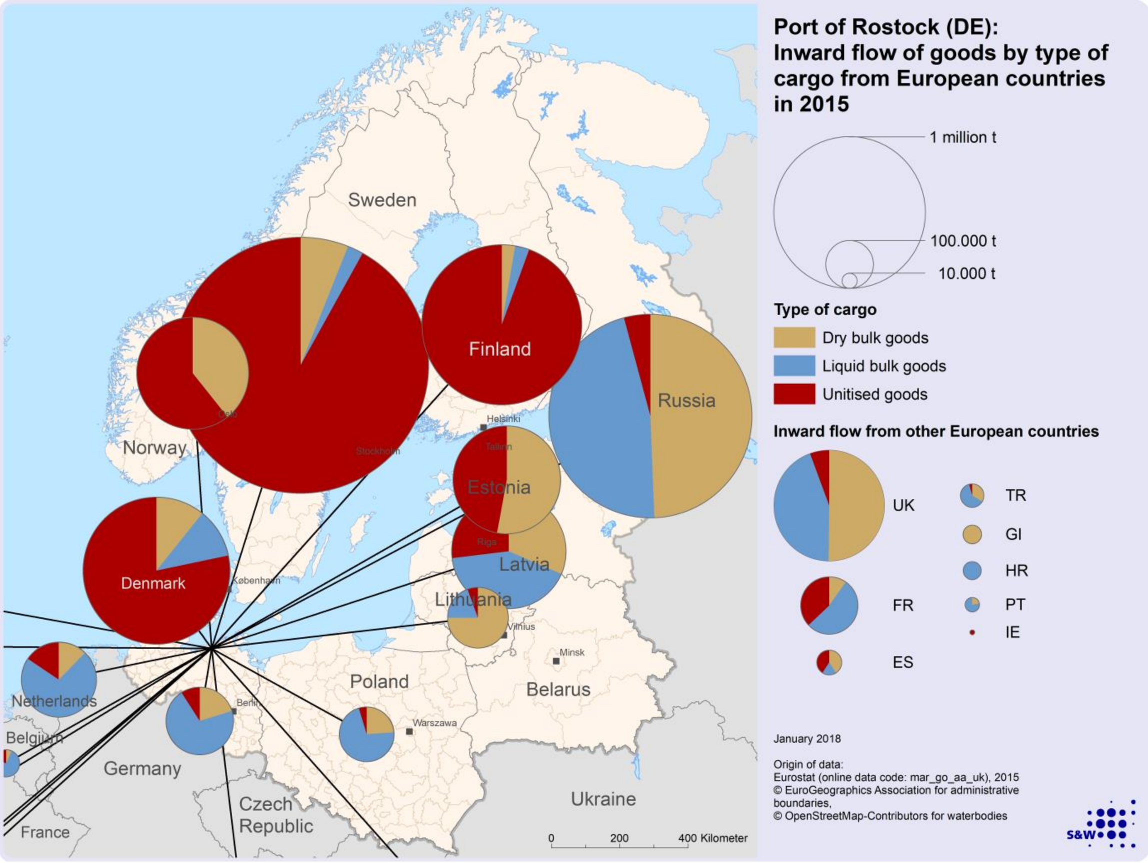

Figure A2.11 Port of Rostock (DE): Inward flow of goods, 2015.

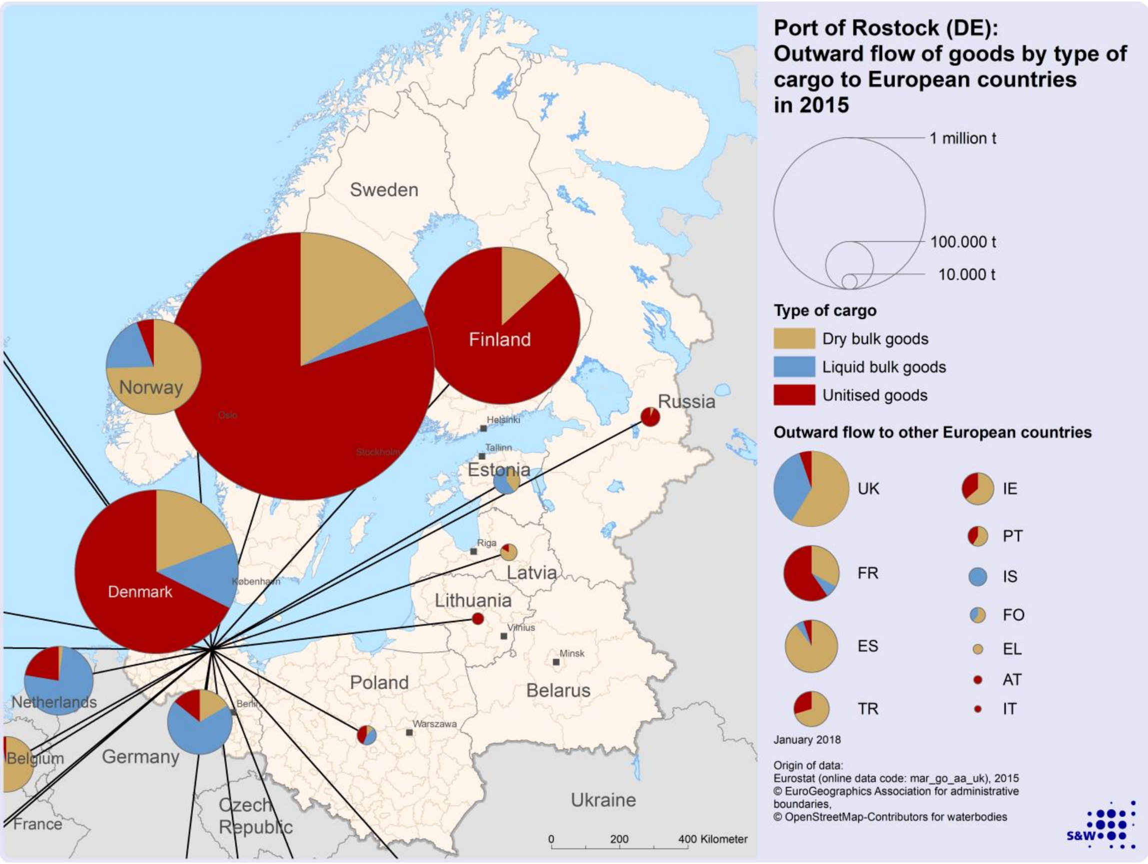

Figure A2.12 Port of Rostock (DE): Outward flow of goods, 2015.

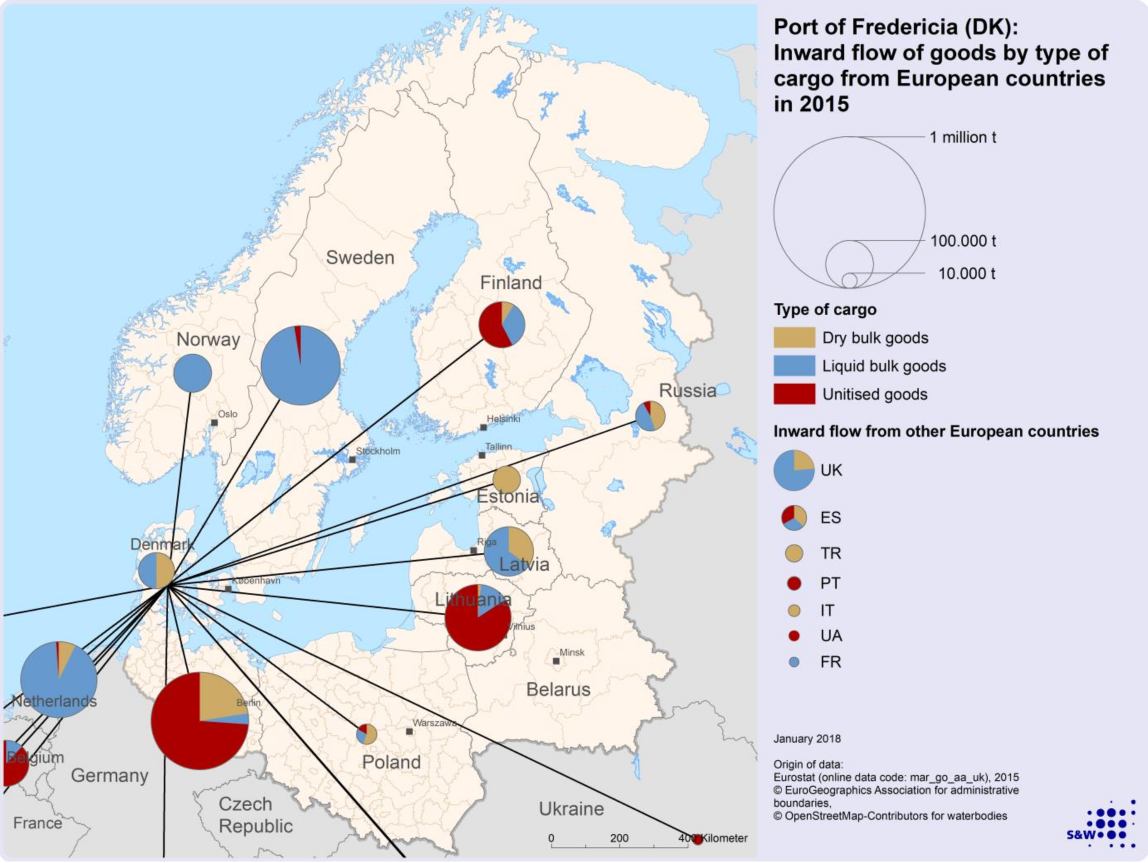

Figure A2.13 Port of Fredericia (DK): Inward flow of goods, 2015.

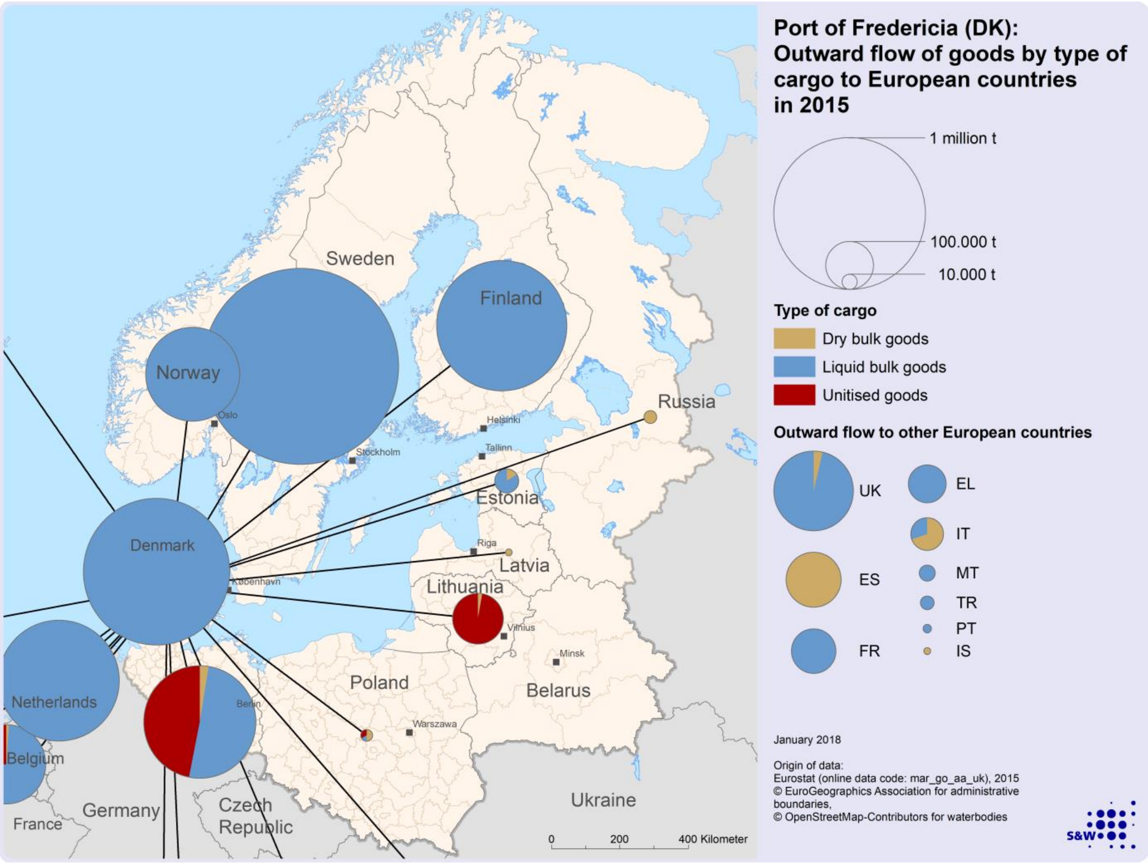

Figure A2.14 Port of Fredericia (DK): Outward flow of goods, 2015.

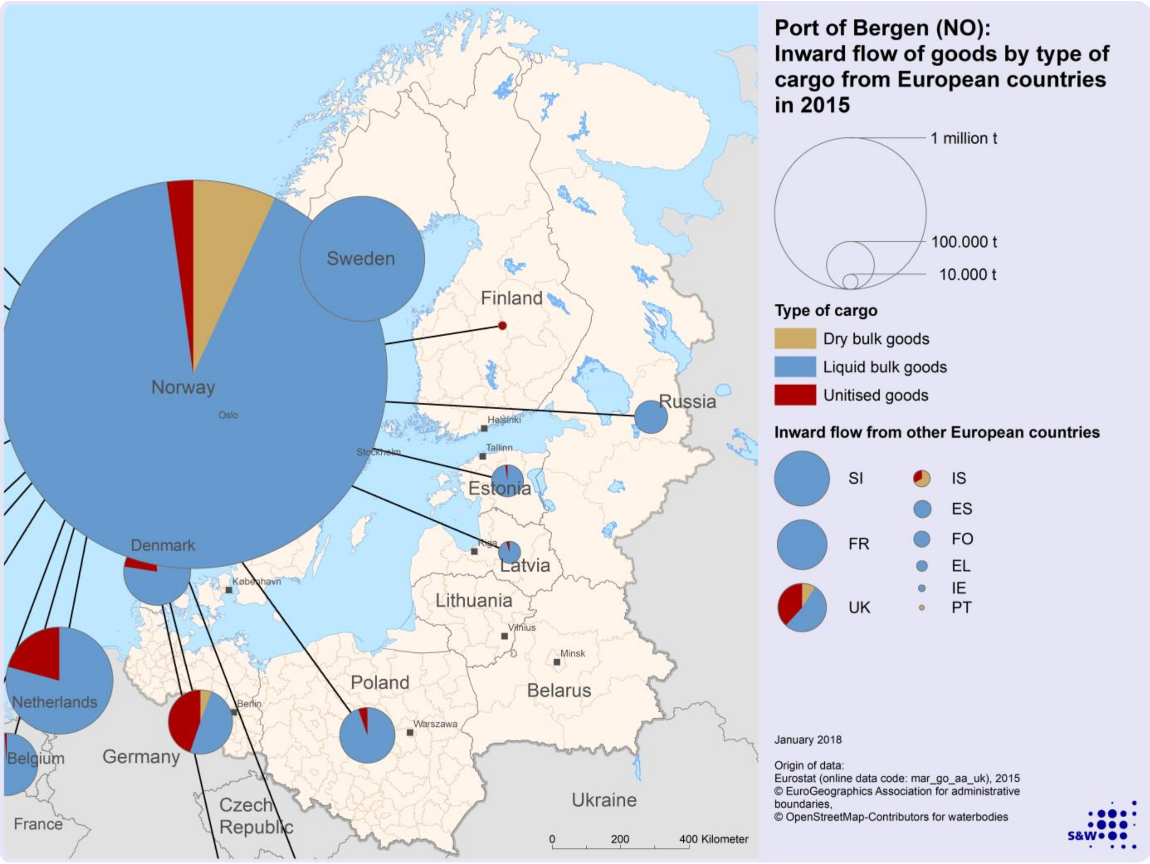

Figure A2.15 Port of Bergen (NO): Inward flow of goods, 2015.

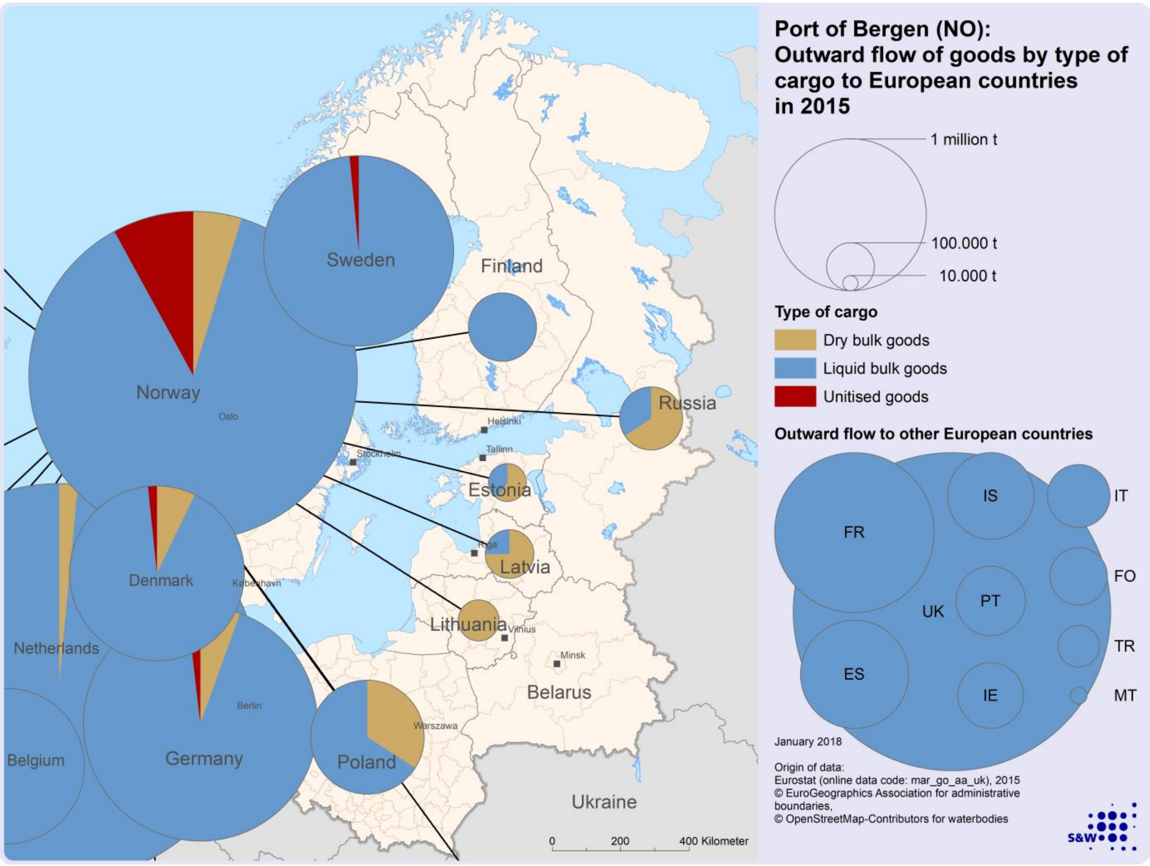

Figure A2.16 Port of Bergen (NO): Outward flow of goods, 2015.

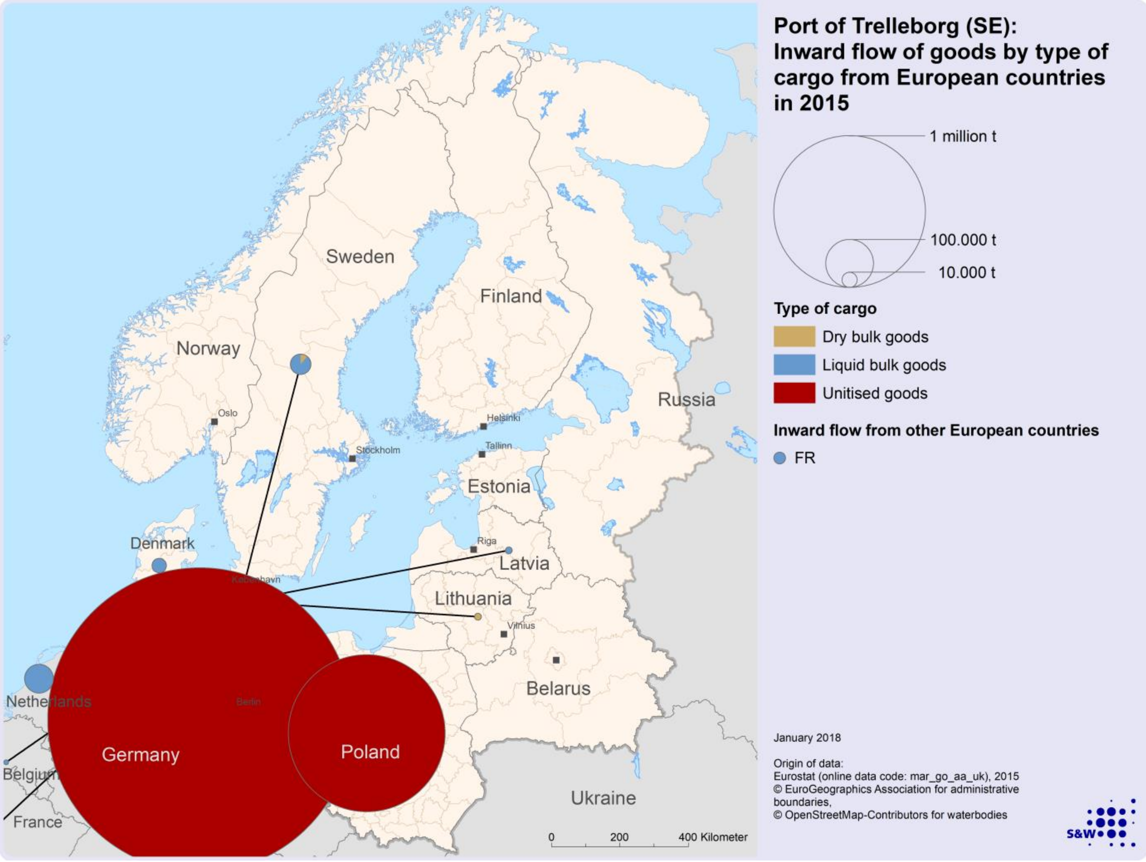

Figure A2.17 Port of Trelleborg (SE): Inward flow of goods, 2015.

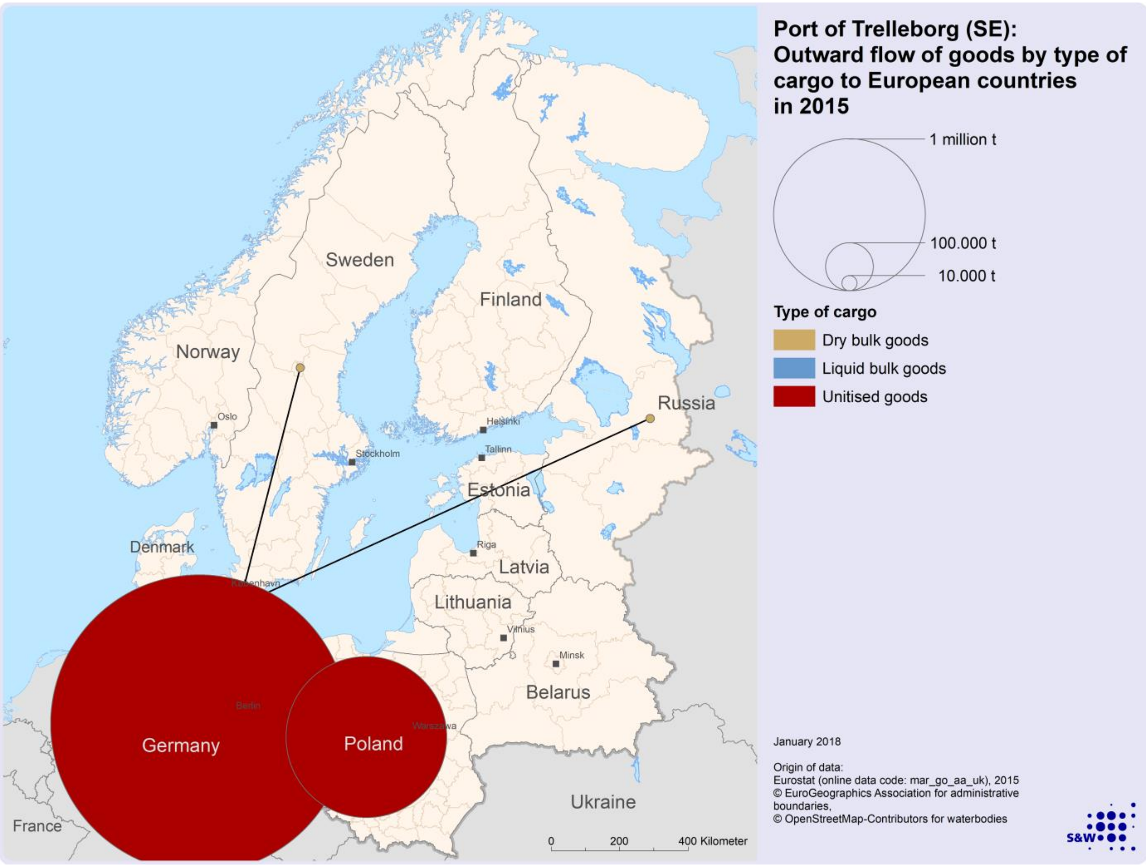

Figure A2.18 Port of Trelleborg (SE): Outward flow of goods, 2015.