
The Fehmarn Belt axis: a knowledge region emerges

There is a long tradition of collaboration along the Fehmarn Belt axis; in other words, between the Hamburg metropolitan region and the Øresund region. As early as in 1863, the Danish government drew up plans for the shortest transport link between Hamburg and Copenhagen, these becoming concrete 100 years later with the construction of the Fehmarn Sound Bridge.

This so-called Vogelfluglinie (bird flight line) transport corridor was then extended in 2000 when the Øresund Bridge went into operation as a land link between Denmark and Sweden. This helped boost the social and economic integration of the Copenhagen metropolitan area, Sweden's third-largest city Malmö and the science hub Lund.

Based on these experiences, the Danish government seized the initiative in 2008 and promoted the signing of a treaty between the Kingdom of Denmark and the Federal Republic of Germany for the construction of a fixed link across the Fehmarn Belt. This treaty was then ratified in 2009.

In accordance with the treaty, the fixed link across the Fehmarn Belt will be realised as an 18-kilometre-long tunnel between the islands of Lolland and Fehmarn. The tunnel will comprise a double-track railway line and a four-lane motorway. This will allow the 45-minute ferry crossing to be replaced with a ten-minute car drive or seven-minute train journey.

Facts about regional development along the Fehmarn Belt axis

The Fehmarnbelt Business Council (FBBC) has been overseeing the project since the beginning. It is the FBBC's objective to make the most of the opportunities generated by the new infrastructure and to identify and tackle any challenges early on. This can make continued social and economic integration all along the Fehmarn Belt axis a success.

In order for the FBBC to achieve its objective, the areas of action required for the region to continue to grow together must be identified and the appropriate projects need to be implemented. And the debate regarding the pros and cons of a Fehmarn Belt Fixed Link, the opportunities for regional development and the past results of German–Danish collaboration is to be made more objective and be backed up on the basis of quantifiable facts.

The FBBC therefore decided in 2017 to measure the *effects (= results) of integration* so far along the Fehmarn Belt axis in order to provide answers to the question as to how well-integrated the region is. The Fehmarn Belt Index, or FBx for short, is used to gauge this.

The Fehmarn Belt Index (FBx) at a glance

To objectively answer the question as to how integrated the region along the Fehmarn Belt axis is, the FBBC sets great store by a comprehensive understanding of the term *integration*. It comprises not only economic, but also scientific, social and transport integration. As such, the FBx measures integration in four areas:

- Integration of the labour market
- Economic integration
- Scientific integration
- Transport integration

The FBx is a composite index comprising four sub-indices and its general structure is comparable with that of the Øresund Integration Index (Øresundskomiteen, 2013). This measured the development of integration in the Øresund region over a 15-year period.

Analysis of an index makes sense when developments can be observed over an extended period. In the case of the FBx, its early development means it can be used to measure how the Fehmarn Belt region grows together both *before and after* the fixed link is completed. The year 2008 was chosen as the reference year for the FBx as this includes the financial and economic crisis of 2007/08.

When talking about the fixed link across the Fehmarn Belt, reference is often made to the 'Fehmarn Belt region', the 'Fehmarn Belt axis' or the 'German–Danish region'. For the purposes of calculation and presentation of the FBx, the region needs to be precisely defined. The region is described on the basis of the statistical regions Capital Region Copenhagen (NUTS DK01) and Zealand (NUTS DK02) as well as Hamburg (NUTS DE600), Schwerin (NUTS DE804), the Nordwestmecklenburg district (NUTS DE80M), Lübeck (NUTS DEF03), the Herzogtum Lauenburg district (NUTS DEF06), the Ostholstein district (NUTS DEF08), the Segeberg district (NUTS DEF0D) and the Stormarn district (NUTS DEF0F).

FBx Index for science, technology and innovation at a glance

The area of science, technology and innovation (STI for short) is de facto of particular importance regarding the perception of regional integration along the Fehmarn Belt axis:

Regional scientists point out that (improved) cross-border cooperation in the area of STI is *de facto* of relevance to future developments (Lundquist and Trippl, 2009). This has already been addressed as an issue within the context of the Øresund link, with the even greater development (and its measurement) of a region driven by innovation being hindered by the lack of a measuring instrument (Nauwelaers et al., 2013).

The need to focus on the topic of STI is likewise underscored by measurement of the *perception* of integration. In a representative study of attitudes and expectations regarding the fixed link across the Fehmarn Belt (IPSOS, 2017), 26 per cent of those surveyed (n =

1,000 in Hamburg and Schleswig-Holstein, top two boxes) stated that they anticipated 'improved cooperation in the area of research'. This was the lowest expectation among the 14 possible statements.

In view of this, the FBBC decided to afford the topic of STI along the Fehmarn Belt axis extra weight and make regional integration in this area (more) quantifiable. This is achieved with the FBx sub-index 'Science, technology and innovation'.

This comprises three underlying indices that reflect the activities in the area of innovation and scientific cooperation between the German and Danish parts of the Fehmarn Belt region. These comprise:

- Joint registration of patents from applicants based in the German *and* Danish parts of the Fehmarn Belt region (other patent applicants based outside of the region may also be involved)
- Joint publication of the results of scientific research produced by authors based in the German *and* Danish parts of the Fehmarn Belt region (other authors based outside of the region may also be involved)
- Joint execution of EU-funded research and development projects with coordinators and/or participants based in the German *and* Danish parts of the Fehmarn Belt region (other coordinators and/or participants based outside of the region may also be involved)

To preclude general developmental trends and/or possible cyclical influences, each of the three aforementioned underlying indices is corrected by a benchmark index. These benchmark indices include:

- Joint registration of patents from applicants based in Germany and Denmark (other patent applicants based outside of Germany and Denmark may also be involved)
- Joint publication of the results of scientific research produced by authors based in Germany and Denmark (other authors based outside of Germany and Denmark may also be involved)
- Joint execution of publicly funded research and development projects with coordinators and/or participants based in Germany and Denmark (other coordinators and/or participants based outside of Germany and Denmark may also be involved)

The three indices form the *input side* of innovation in the region together with 'R & D projects' and 'Scientific publications', and the *output side* together with 'Patent applications' (Carvalho, Carvalho and Nunes, 2015). The corrected underlying indices 'R & D projects' and 'Scientific publications' each account for 40 per cent of calculation of the FBx STI Index, with the corrected underlying index 'Patent applications' accounting for the remaining 20 per cent. Regarding the different weighting of the sub-indices, please refer to the detailed remarks of the OECD (Freudenberg, 2003).

The data used to calculate the three underlying indices and the corresponding benchmark indices is sourced from the OECD (patents by regions), Web of Science (scientific publications) and the European Commission (cross-border research and development projects).

Taking these measurement notes into account, the FBx STI Index indicates a positive development over time, with the index having almost doubled between the reference year of 2008 (= 100) and 2017 (= 194). The 'Science, technology and innovation' category can therefore be considered a driver of regional integration overall.

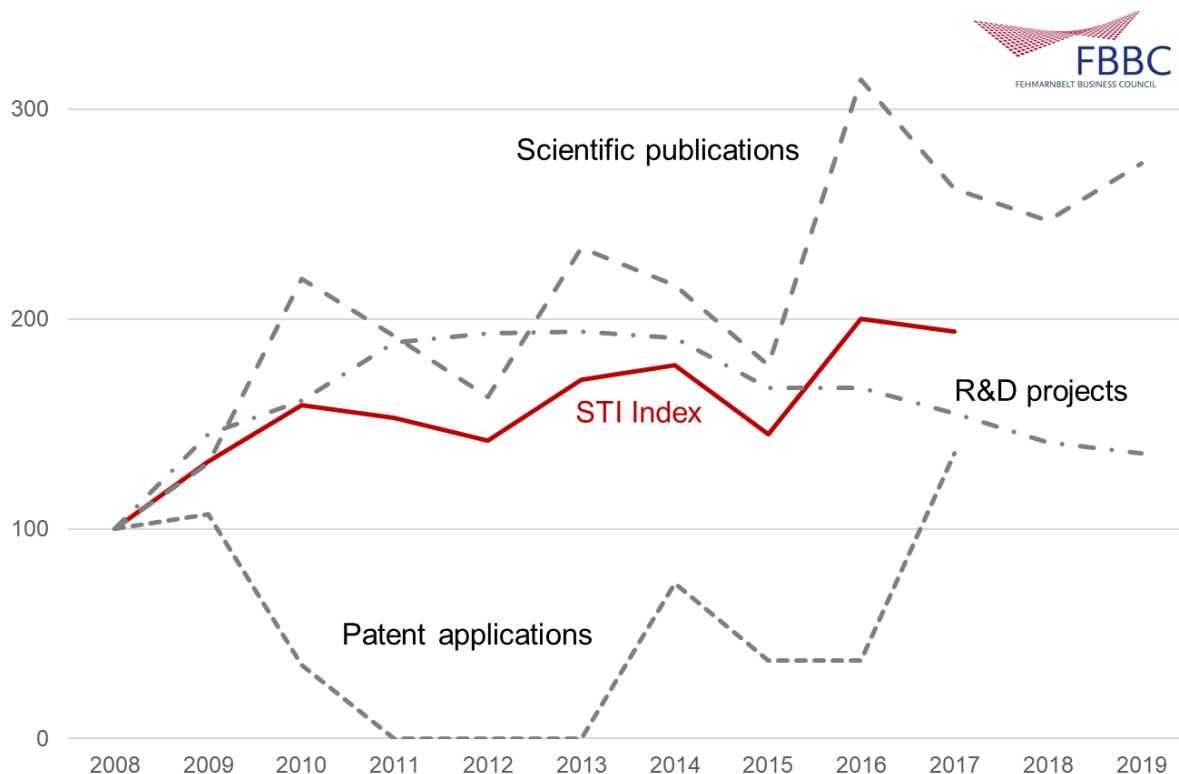


Figure 1 – The FBx STI Index (as at November 2020)

There was a particularly positive development on the input side, while there appears to still be potential for development on the output side. This will be presented in greater detail below with a more in-depth look at the three sub-indices.

FBx STI Index – ❶ Joint patent applications (output)

Joint patent applications are a suitable metric for gauging the cross-border collaboration of companies, research and development institutes and other organisations within a region (OECD, 2013). This indicator is accordingly used at the European level to measure cross-border cooperation in the area of innovation (Lata, Scherngell and Brenner, 2013; 2015).

The OECD's database of patents by regions was used for calculation of the underlying index and the benchmark index for joint patent applications. For the purposes of the underlying index, patents were considered 'cross-border co-patents across the Fehmarn Belt' if at least one inventor was involved in both the Danish *and* German parts of the Fehmarn Belt region. For the purposes of the benchmark index, joint patents were classified as patents involving at least one Danish *and* one German inventor. The year of application was between 2008 and 2019.

It may be noted that patent activities in the Fehmarn Belt region – involving one German and one Danish applicant – is generally moderate. At most, there are three applications a year. There was no change in the underlying index in comparison to the reference year (2008 = 100). In view of the only moderate patent activities, more in-depth research into, for example, the geographic spread within the Fehmarn Belt region would not generate any additional insights.

FBx STI Index – ❷ Joint scientific publications (input)

Joint, cross-border publications are a gauge of the degree of scientific collaboration between research institutes within a region (OECD, 2013). Due to the wealth of data available, this indicator is used regularly, for example to measure integration in the Øresund region (Coenen et al., 2004; Hansen, 2013).

The latest version of the Web of Science database available online is used as a data source. This includes data on scientific publications. For the purposes of the underlying index, publications were considered 'cross-border co-publications across the Fehmarn Belt' if at least one author was involved in both the Danish *and* German parts of the Fehmarn Belt region. In this case, the Fehmarn Belt region was defined on the basis of the appropriate postcodes (matching of the postcodes to the NUTS codes). For the purposes of the benchmark index, joint publications were classified as publications involving at least one Danish *or* one German author. The year of publication was between 2008 and 2019.

There is lively joint publication activity in the Fehmarn Belt region and this is developing positively. There were 19 joint publications in the reference year (2008 = 100) and a total of 70 in 2019 (index = 368). As such, joint publication activity in the Fehmarn Belt region is developing more positively than the benchmark index. The geographic focus (where the authors are based) is on the Hanseatic city of Hamburg on the German side and the Copenhagen metropolitan area on the Danish side.

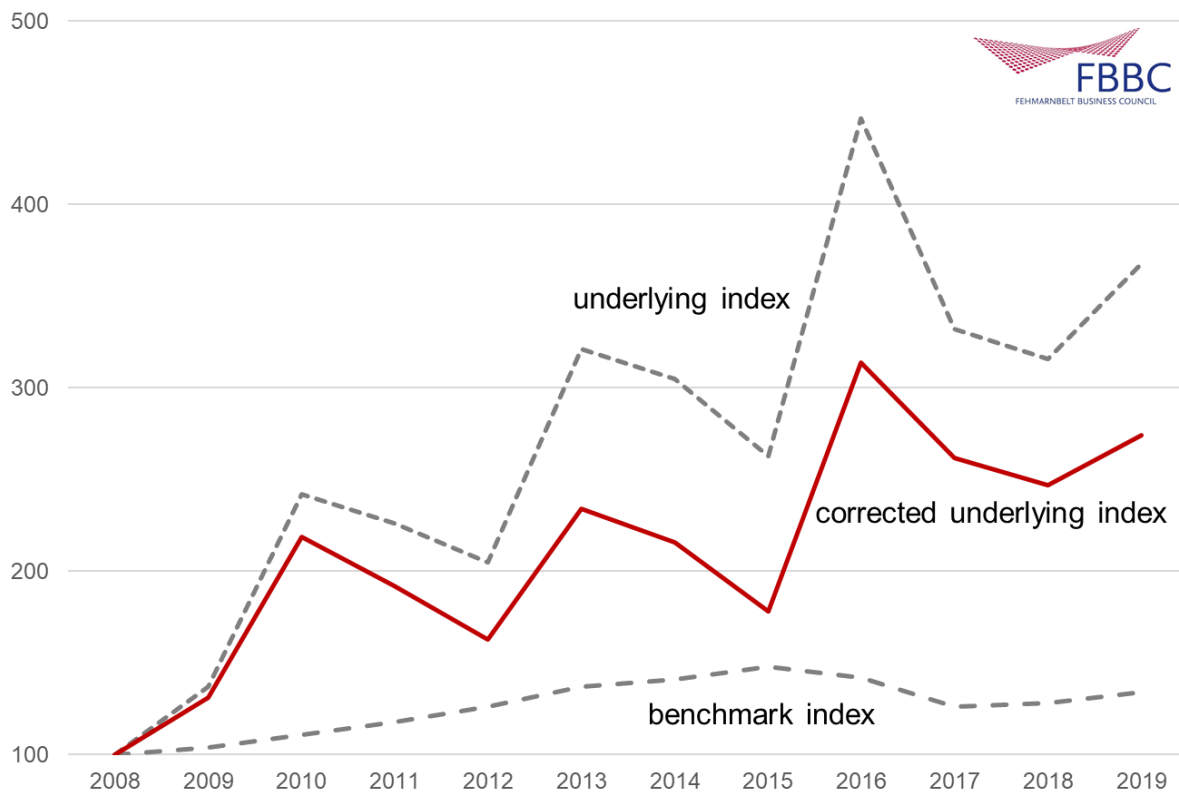


Figure 2 – Joint scientific publications (as at November 2020)

FBx STI Index – ③ Cross-border research and development projects (input)

Cross-border research and development projects are a gauge of the intensity of the collaboration of research institutes within a region (OECD, 2013). This is also confirmed by use as part of European benchmarks (Lata et al., 2013; 2015).

The latest version of the European Commission’s CORDIS database (European Commission, 2020) was used as a data source. This database contains information on EU-funded research and development projects running between 2007 and 2013 as part of the Seventh Framework Programme (FP7) and between 2014 and 2020 as part of the Horizon 2020 programme.

For the purposes of the underlying index, projects were considered ‘cross-border collaborative projects across the Fehmarn Belt’ if at least one coordinator/participant/partner was involved in both the Danish *and* German parts of the Fehmarn Belt region. In this case, the Fehmarn Belt region was again defined on the basis of the appropriate postcodes. For the purposes of the benchmark index, joint research and development projects were classified as projects involving at least one Danish or one German coordinator/participant. The projects running each year between 2008 and 2019 were taken into account.

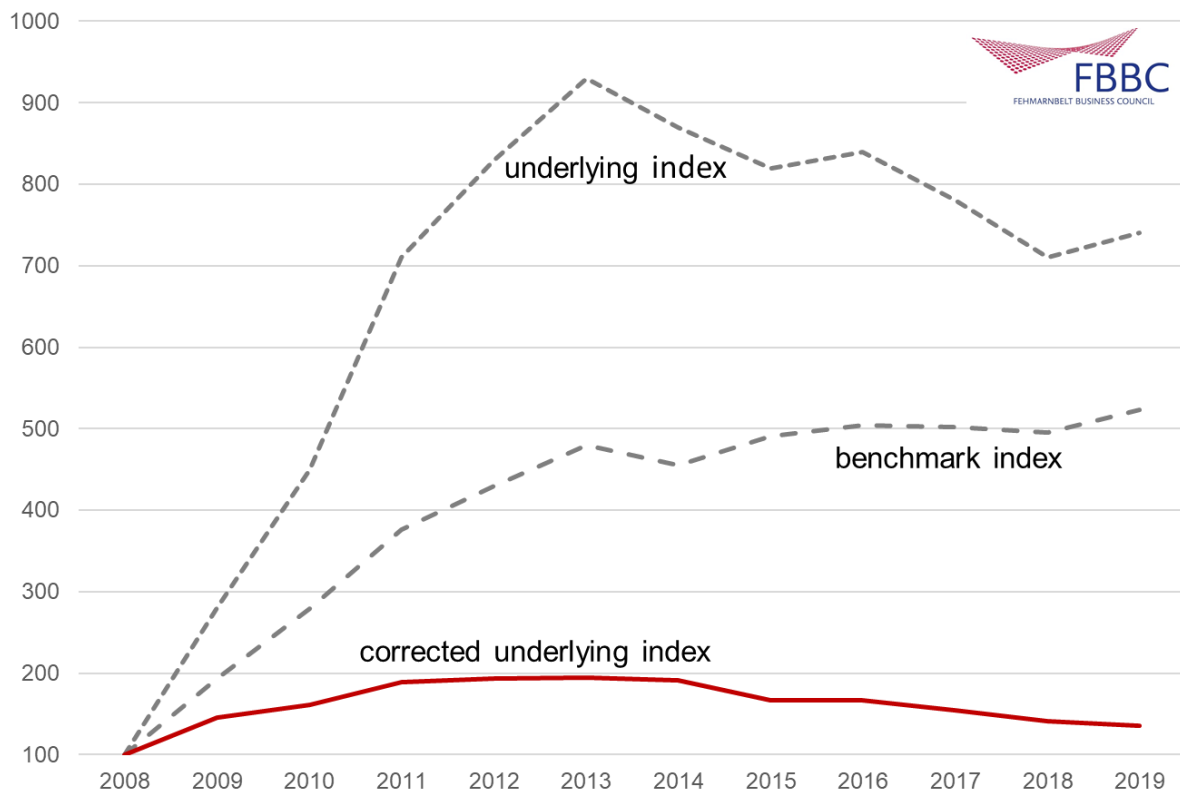


Figure 3 – Cross-border research and development projects (as at November 2020)

Joint project activity as part of EU-funded research and development projects in the Fehmarn Belt region is developing positively. There were ten joint projects in the reference year (2008 = 100) and a total of 71 in 2019 (index = 710). As such, joint project activity in the Fehmarn Belt region is developing more positively than the benchmark index. The geographic focus (where the authors are based) is on the Hanseatic city of Hamburg on the German side and the Copenhagen metropolitan area on the Danish side.

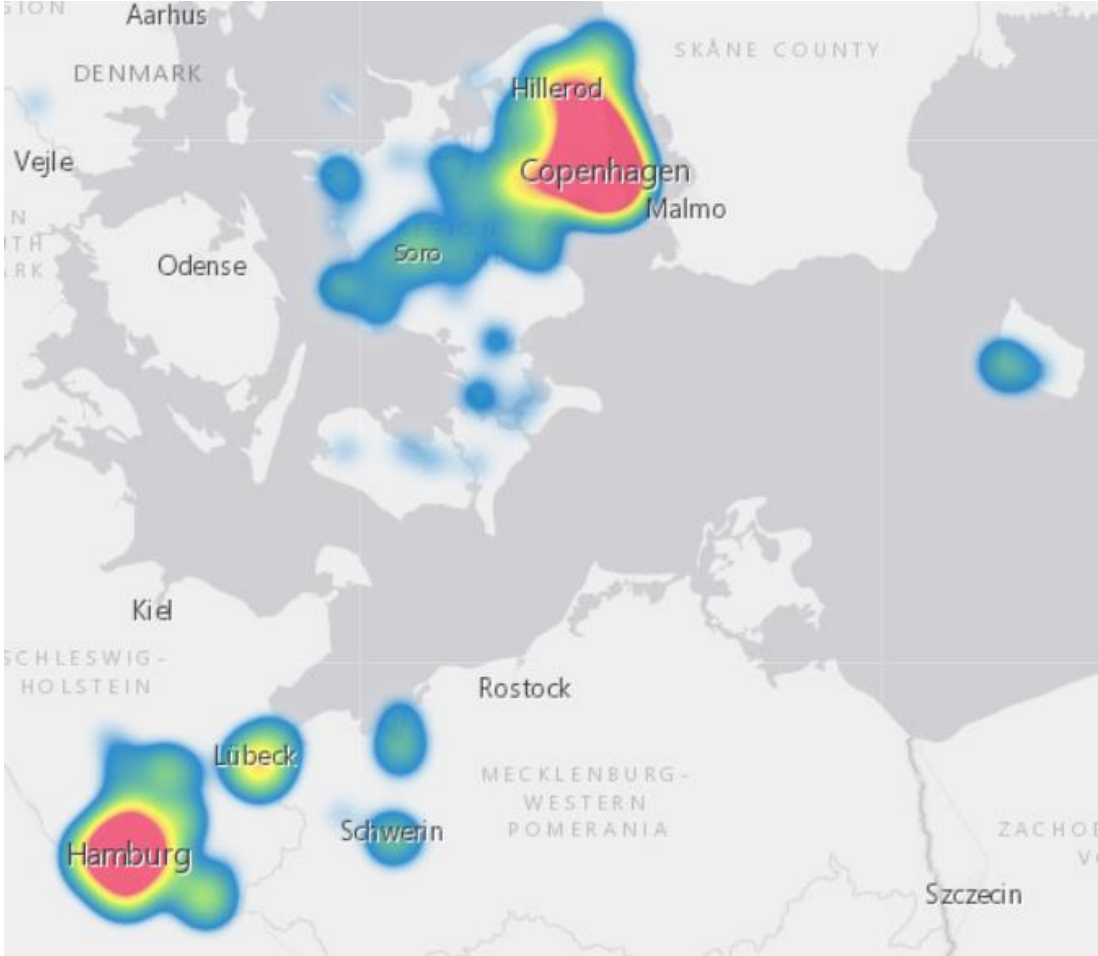


Figure 4 – Location of the participants in cross-border R & D projects in the Fehmarn Belt region (as at November 2020)

References

- Carvalho, N., Carvalho, L. and Nunes, S.** (2015), A methodology to measure innovation in the European Union through the national innovation system, *International Journal of Innovation and Regional Development*, 6 (2), pp. 159–180.
- Coenen, L., Moodysson, J. and Asheim, B.** (2004), Nodes, networks, and proximities: on the knowledge dynamics of the Medicon Valley biotech cluster, *European Planning Studies*, 12 (7), pp. 1,003–1,018.
- European Commission** (2020), CORDIS: Community Research and Development Information Service, retrieved from <https://cordis.europa.eu/> on 28 December 2020.
- Freudenberg, M.** (2003), Composite indicators of country performance: a critical assessment, *OECD STI Working Papers*, 2003 (16).
- Hansen, T.** (2013), Bridging regional innovation: cross-border collaboration in the Øresund Region, *Geografisk Tidsskrift-Danish Journal of Geography*, 113 (1), pp. 25–38.
- IPSOS** (2017), Einstellungen und Erwartungen zum Fehmarnbelt-Tunnel Kernbefunde, *IPSOS Operations GmbH*, unpublished.
- Lata, R., Scherngell, T. and Brenner, T.** (2013), Observing Integration Processes in European R&D Networks: A Comparative Spatial Interaction Approach Using Project Based R&D Networks and Co-patent Networks, in: T. Scherngell (ed.), *The Geography of Networks and R&D Collaborations* (pp. 131–150), Cham, Springer.
- Lata, R., Scherngell, T. and Brenner, T.** (2015), Integration Processes in European Research and Development: A Comparative Spatial Interaction Approach Using Project Based Research and Development Networks, Co-Patent Networks and Co-Publication Networks, *Geographical Analysis*, 47 (4), pp. 349–375.
- Lundquist, K.-J. and Trippl, M.** (2009), Towards Cross-Border Innovation Spaces. A theoretical analysis and empirical comparison of the Öresund region and the Centrope area, *Institut für Regional- und Umweltwirtschaft Discussion Papers*, 2009 (5).
- Nauwelaers, C., Maguire, K. and Ajmone Marsan, G.** (2013), The case of Oresund (Denmark-Sweden), *OECD Regional Development Working Papers*, 2013 (21).
- OECD (2013)**, *Regions and Innovation: Collaborating Across Borders*, Paris: OECD Publishing.
- Öresundskomiteen** (2013), The Öresund Integration Index, retrieved from <http://www.oresundskomiteen.org/en/2013/10/the-oresund-integration-index/> on 28 December 2020.