

## *Commuting at the speed of sound: Potential effects of the Hyperloop on passenger flows in the Stockholm–Helsinki region*

Johan Tedestål (23432)

### **Abstract**

In a pre-feasibility study from 2016 KPMG and Ramböll showed the potential for a Hyperloop connection between Stockholm and Helsinki that could enable daily commutes in a region where that as of today is impossible. The Hyperloop, a technology using train-like pods in a vacuum tunnel was first proposed by Elon Musk in 2013 and would enable faster than airplane travel at ground level and have significant effects on city-to-city travel. This thesis investigates the potential sources for parts of the travel volumes proposed in a KPMG pre-feasibility study, by focusing on commuters, that could be a key group for making the infrastructure investment worthwhile. The project being far in the future if completed prompts a qualitative investigation with empirical evidence from other border regions and infrastructure projects and takes clues from economics, sociology and geography to determine the potential for successful integration and high amounts of daily commuters. The Stockholm–Helsinki border region is assessed from different perspectives and three scenarios of speed of integration and growth of commuting is created. Results are that Swedish Finnish-speakers and Finnish Swedish-speakers who decide to relocate or start to work on the other side of the sea could be essential for the success of the project, as well as the careful statement that the region seem to have factors indicating that an investment could be justified.

**JEL Classification Codes:** R12, R23, R42

**Keywords:** Hyperloop, Commuting, Border region, Stockholm, Helsinki, Language

Supervisor: Anders Olofsgård

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## Introduction

In 2012, American-South African entrepreneur Elon Musk started hinting at a transportation system he had figured would be cheaper and faster than the California High-speed Rail and as a white paper for the so called Hyperloop was released in August 2013, several companies as well as student teams started working on the open-sourced system.

In July 2016, KPMG, Ramböll, and newly founded company FS Links released a feasibility study together with one of the companies, Hyperloop One, for a Hyperloop corridor between Stockholm and Helsinki that would take people between the capitals in 28 minutes at a price of EUR 17–25 per trip. According to KPMG there are several reasons why such a solution would enable daily commutes between the cities: the speed of the transportation system and the lack of stops along the way would make it fast enough, the small pods and frequent trips would make it be used much more like a subway than an airplane and the electric propulsion would allow it to be environmentally friendly.<sup>1</sup>

The project was presented as a way of commuting daily between the two cities, something that is not feasible with air-flight and thus a completely new situation of potential integration of two regions emerges. KPMG did build a business case for why it would make sense to undertake the project, but economic theory was not used and no formal paper was published on the estimations. Since this is a project that could become a reality and if that happened would have large societal and economic effects in a bi-national region that would become much more integrated and researching the potential for commuting is something that could contribute to the literature on border regions as the Hyperloop is yet absent. It would also be useful for policy and investment decisions to understand the effects the project could have in the region.

## Background

The Hyperloop is a suggested transportation system that lets passengers travel at speeds just below the speed of sound, without having to get to the altitude required for an airplane. The system often referred to as a fifth mode of transport consists of a train-like pod and a long tube with vacuum, allowing a busload of people at a time to travel long distances in a short period of time. The original white paper created interest in the technology and now the Stockholm–Helsinki feasibility study has generated interest for the technology in this region specifically. Other tube transportation systems have been proposed for a long time starting with Jules Verne's *Paris in the Twentieth Century*, but not until the Hyperloop has there been large sums of money and attention on such solutions.

### Hyperloop routes

The original Hyperloop suggestion in the white paper called for a system between Los Angeles and San Francisco, but afterwards several other early corridors have been suggested including the Stockholm–Helsinki one as well as San Francisco–Las Vegas and Abu Dhabi–Dubai. To limit the scope of this thesis, focus will be on the Stockholm–Helsinki route in particular. This thesis could however provide inspiration for methods of assessing the effects on commuting when constructing Hyperloop systems between other cities in the world, if the technology would become widespread.

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<sup>1</sup> KPMG, Enabling the Stockholm – Helsinki super region: Pre-feasibility study including Hyperloop One technology, [www.kpmg.com](http://www.kpmg.com), downloaded: March 21, 2017.

The Hyperloop as a topic is something important to research because of the large societal affects that could stem from it. Hyperloop has sometimes been referred to as the “internet of transportation,” being able to transport passengers and goods in such a quick and cheap way that it despite being much slower, in many ways is quite analogous to the network of the internet.<sup>2</sup> There are other likely upcoming transportation technologies that would be interesting to research, most notably automotive autonomy, which however does not have the same obvious potential effects on speed and commuting, and there are hypothetical transportation systems like electric air-flight, but estimates are more unexplored and would be speculative in nature.

The goal of exploring the Stockholm–Helsinki Hyperloop corridor is not explicitly to create further arguments for why it would be a sound or unwise decision but much rather to pre-estimate the effects of it and understand the region in the context of the transportation system. This would both allow for understanding of effects soon to occur once potential construction would commence and would enable taking commuting and labor into consideration for future suggested routes.

### **The conducted feasibility study**

The KPMG-Ramböll feasibility study was the first real business plan of a Hyperloop system in the world when it was released as a presentation in Almedalen, Sweden July 4, 2016.<sup>3</sup> It featured technical feasibilities, legal considerations and potential economic benefits. Technically it was considered very possible, environmentally no concerns could hinder the project and legally it was also something that could be done and a legal roadmap had been created.

### **Hyperloop – fast from origin to final destination**

What is interesting with the Hyperloop concept is that it is a very fast means of transportation capable of moving people and goods at very high speeds, but especially that it is being designed to be fast even when including the “last mile” of transportation. While an airplane is a very fast transport vessel, it generally takes a lot of waiting time and time for getting to the airport, so in total the travel time constantly is quite high. Hyperloop stations would be placed much more local in the cities like the train stations of today. In stations, small pods would depart constantly, meaning that the choice of departure time would be more like the choice of which subway train to ride. Furthermore, airplanes traveling short to medium distances spend a lot of time ascending and descending and airplanes fly slow nowadays because of fuel consumption<sup>4</sup>, so the total traveling time becomes much larger for air travel than with Hyperloop.<sup>5</sup> For longer distances electric airplanes would likely still be more efficient in terms of energy and speed.

Below is one of the first comparisons Hyperloop One, the company behind the project in the Nordic Region, did to compare traveling time from San Francisco to Los Angeles. The table put together for this thesis based on a drawing from the company demonstrates time spent traveling by car, airplane, High Speed Rail or the Hyperloop between the cities. The total

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<sup>2</sup> Bradley, Ryan, The Unbelievable Reality of the Impossible Hyperloop, *MIT Technology Review*: [www.technologyreview.com](http://www.technologyreview.com), May 10, 2016, downloaded: May 5, 2017.

<sup>3</sup> KPMG Sweden, What would happen if you could travel between Stockholm and Helsinki in 30 minutes?, July 4, 2016, *Youtube*: [www.youtube.com](http://www.youtube.com), downloaded: July 4, 2016.

<sup>4</sup> Kemp, John, REFILE-COLUMN-Airlines fly slower to cut fuel bill, John Kemp, September 26, 2014, *Reuters*: [www.reuters.com](http://www.reuters.com), downloaded: May 5, 2017.

<sup>5</sup> KPMG, Enabling the Stockholm – Helsinki super region.

estimated travel times for the different means of transportations demonstrates that not only is the Hyperloop faster during the actual transport phase but the total time given the distance is a lot shorter than the alternatives.<sup>6</sup>

<b>Type of time spent:</b>	<b>Drive I-5</b>	<b>Flight: SFO–LAX</b>	<b>Full HSR</b>	<b>Hyperloop</b>
Walking to/from transport	<0.1 h	-	0.3 h	0.2 h
Car/taxi	7.2 h	1.7 h	-	-
Meal break	0.5 h	-	-	-
Refueling	0.2 h	-	-	-
Parking	0.1 h	-	-	-
Passenger ride	-	1.5 h	2.6 h	0.5 h
Baggage claim	-	0.3 h	-	-
Waiting	-	1.5 h	0.2 h	<0.1 h
Security check	-	0.3 h	0.1 h	0.1 h
<b>Total:</b>	<b>8.0 h</b>	<b>5.3 h</b>	<b>3.2 h</b>	<b>0.8 h</b>

The table below based on numbers from the feasibility study, demonstrate the same thing for the Stockholm–Helsinki region. To get from Stockholm to Helsinki is estimated to take 17.5 hours by boat and 3.5 hours using air travel, even though only approximately one hour is spent in the air. With Hyperloop given the suggested system, it would now take 28 minutes from station to station. This does not include the time of going to the stations and to the final destination for the last mile which would add several minutes at both ends. The total time however would be much shorter than currently using air travel.<sup>7</sup>

<b>Route:</b>	<b>Time by boat</b>	<b>Time by airplane</b>	<b>Time by Hyperloop</b>
Stockholm–Helsinki	17.5 h	3.5 h	28 min
Stockholm–Turku	11 h	-	18 min
Stockholm–Arlanda	-	-	3 min
Turku–Helsinki	-	-	12 min
Salo–Helsinki	-	-	10 min

The project was expected to cost EUR 19 billion in total, with 42.7 million passengers annually riding in pods with 24–90 seats, generating EUR 1.07 billion from tickets and EUR 321 million from time-savings. During the presentation Ramböll noted that the project could take 8 years to build on the respective mainland and then 4 years over the sea.<sup>8</sup>

### **The feasibility study and unanswered questions**

For the economic estimates that KPMG did, the project was compared to the construction of the Øresund bridge which also cut travel time significantly between Copenhagen and Malmö and created a bi-national city region. It served as an ideally similar example to show the potential economic benefits of connecting two regions. Lessons included cost reduction of

<sup>6</sup> Hines, Nickolaus, Hyperloop One Infographic Boasts 50-Minute Trip From SF to LA, *Inverse*, May 16, 2016, downloaded: June 18, 2017.

<sup>7</sup> KPMG, Enabling the Stockholm – Helsinki super region.

<sup>8</sup> Ibid.

transport, large job creation as a direct effect of the bridge, increased goods transportation volume and an increase in the number of commuters, from 2,800 in 1999 to 18,000 in 2013. The KPMG report then went into the economic potentials of time reductions for the Hyperloop project and showed that those societal time savings could outweigh the investment-cost. Economic theory was however not used to estimate the number of commuters and movers that could come to with the construction of the project based on the Øresund example and no scientific publishing was made for the other numbers and instead the case was mostly built on being able to save 25 million hours yearly.<sup>9</sup> Thus this background creates the question of with so much shorter traveling time, how many people would commute to or move to the other city? This question is important in the wider context that if Hyperloop-routes were built across Europe and other parts of the world, then physical mobility of people could cover much larger areas than it currently does and that could create economic activity that could be researched after being implemented. The project is interesting in many ways, but the scope here is limited to what might affect commuting, because commuting tends to be a large share of all travel in infrastructure projects and could provide much insight into the realness of the travel volumes proposed for the project. The studied research question will be: *If this proposed transportation system was built in the region, what would be the sources for cross-border daily commutes and could these indicate a justification of the investment?*

## Literature Review and Empirical Outcomes

To understand what borders are and their dynamics it is useful to begin with literature that starts with a top-down-view. One book on Border Studies mentions that it is unclear whether studies should be on border regions or the bounding of them.<sup>10</sup> Ehlers et al. wrote after a seminar in 2001, that border studies have moved towards a common research agenda with multiple disciplines and listed several examples useful to understand bi-national regions. It is concluded that anthropology, history, sociology, human geography, and political science all are useful to understand the integration in the regions and since there is no framework for such analysis, qualitative studies are underlined to be important for future studies.<sup>11</sup> With the assumption that this notion is correct, studies of different border regions with literature from different fields will be used to investigate the economic research question.

### Border studies

The question asked in the seminar paper by Ehlers was what could be learned from the so many different border regions and binational cities. In some of those areas, there has even been efforts to try to integrate the areas by creating a new identity. There is however an example between Sweden and Finland with the cities Haparanda and Tornio, where despite strong ties no common identity could be found. There are also examples like Guben–Gubin between Poland and Germany where a river has acted like a natural divider, which during peace times has been useful for trade but during political instability has acted more like a border. Then there is the Øresund case also used in the KPMG study that is described as being similar to the English Channel Tunnel where two cities were connected over wide waters, where the latter is characterized by less common identity. Then there is San Diego and Tijuana on the US–

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<sup>9</sup> KPMG, Enabling the Stockholm – Helsinki super region.

<sup>10</sup> Wastl-Walter, Doris, *The Ashgate Research Companion to Border Studies*, Ashgate Publishing Ltd, 2016, p. 18.

<sup>11</sup> Ehlers, Nicole, Buursink, Jan, Boekema, Frans, Introduction: Binational cities and their regions: From diverging cases to a common research agenda, *GeoJournal*, v. 54, Issue 1, pp. 1–5, 2001.

Mexican border where the only cooperation is some information sharing between the local governments for the sake of security, but just like the Haparanda–Tornio region, immigration across the border was important to establish the area.<sup>12</sup>

Schack in a paper also states that it is not enough to study borders as state borders, but as multi-contextual borders in the regions. He states that there is too much focus on national borders and that results from border studies are wrong when national data from two countries are used, given that border regions themselves are defined much more like a border region, than the border being a straight separator between two nations. Also mentioned are the different research fields and that distance and cost models could serve as one source of analysis, while sociology for social space and language could be another.<sup>13</sup>

Schack mentions a model by Giaoutzi et al.<sup>14</sup> with a “spatial layer” of several layers that each interact with the networks of society where borders hinder communication in the layers. These layers are the cultural, political, economic, legal and, the social one. Schack interprets this as that the authors mean that borders are the formal borders that also crosses the other layers.<sup>15</sup> These layers are similar to topics that other literature about borders mention, Paasi writes about practices and discourses that are cultural, political, economic, and administrative,<sup>16</sup> Matthiessen writes about the functional, cultural, and administrative regions.<sup>17</sup> Other theory does thus indicate that similar factors are important for evaluating borders. Schack then reframes the spatial layer model and sees missing links in the networks of all the different spatial layers as borders, so that the missing links in the legal network layer is the legal borders, etcetera. Schack makes clear that it is about the quality of the border regions, not the integration of them.<sup>18</sup> These layers, with costs and distances included in the economic layer will be the framework used to assess the quality of the border region that would emerge with the Stockholm–Helsinki Hyperloop.

There are other models that could be used to analyze passengers in the region. Peterson uses an ex post approach, testing three different models with different data to explain how passengers travelled after the fact.<sup>19</sup> This is interesting but less helpful for the research question. Most literature on these types of research uses different spatial interaction models, or gravity models. For example, Grosche et al. in used a gravity models for airplanes between 1,228 city-pairs using two different models. This approach is based on economic factors and explains the attraction between two geographical points like two cities. The basic gravity model in the

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<sup>12</sup> Ehlers, Nicole, Buursink, Jan, Boekema, Frans, Introduction: Binational cities and their regions.

<sup>13</sup> Schack, Michael, On the Multi-contextual Character of Border Regions, 39th Congress of the European Regional Science Association: "Regional Cohesion and Competitiveness in 21st Century Europe", Dublin, Ireland, August 23-27, 1999.

<sup>14</sup> Giaoutzi, M., Suarez-Villa, L. and A. Stratigea, Spatial Information Aspects and Communication Barriers in Border Areas. In: Ratti, R. and S. Reichman (Eds.), *Theory and Practise of Transborder Cooperation*, Basel / Frankfurt a.M. 1993, (through secondary source, Schack, 1999).

<sup>15</sup> Schack, On the Multi-contextual Character of Border Regions.

<sup>16</sup> Paasi, A., Bounded Spaces in the Mobile World: Deconstructing Regional Identity, *Tijdschrift voor Economische en Sociale Geografie*, v. 93, Issue 2, pp. 137–148, 2002, (Source through Wichmann Matthiessen, 2004).

<sup>17</sup> Wichmann Matthiessen, Christian, The Öresund Area: Pre- and post-bridge cross-border functional integration: the bi-national regional question, *GeoJournal*, v. 61, Issue 1, pp. 31–39, March 30, 2004, p. 1.

<sup>18</sup> Schack, On the Multi-contextual Character of Border Regions, p. 5.

<sup>19</sup> Peterson, Tom, Conference Paper: Modelling cross-border transport: Three cases in Öresund, 44th Congress of the European Regional Science Association: "Regions and Fiscal Federalism", Porto, Portugal, August 25-29, 2004.

airplane study used population, catchment area around the airport, buying power index, GDP, geographical distance and average travel times as factors.<sup>20</sup> Later in this thesis, in the Method section it will be explained why despite the usefulness of such approaches, a qualitative approach is instead used.

The Schack paper is also useful in that it investigates another border region, the Schleswig area between Germany and Denmark where there were many minority schools for children living in the other country. This provides an interesting insight into border regions: Since the Danish schools in Germany were deemed better than the German ones, Germans also attended those schools. This cultural cooperation is thus better for minorities. The author believes that minorities also were more critical to the established “Euro region” as well as establishing a border region council, because that would diminish their status as minorities, making them less able to benefit from that. The author continues to state that the region that had been through two world wars, instead was in a cultural war between national symbols and how to define oneself, as there is status for minorities legally and politically but not culturally.<sup>21</sup>

### **The Øresund Bridge and connecting two cities**

Looking at other infrastructure projects with bi-national city connections in more detail to see how that has affected different regions will aid the understanding of the Stockholm–Helsinki region. The example mentioned in the feasibility study was the Øresund case where the numbers clearly show that the region was opened up by the infrastructure project. Many pieces of research on this region has been published and should guide the effects of this other project. Research seem to focus on the integration of the two regions, economic growth created by the ease-of-access, collaboration over the boarder and about the effects on traveller volume.

The Øresund Bridge was opened in 2000 and connected Copenhagen in Denmark with Malmö, Lund, and the rest of Scania in Sweden to create a bi-national region. When completed people could travel freely over the Øresund strait and reduced the traveling time from 60 to 10 minutes.<sup>22</sup> This had many effects including decisions to move across the strait especially in the direction from Denmark to Sweden. In 2000, 9,588 Danish citizens lived in Scania and in 2012 that number was 25,117.<sup>23</sup> According to data from the Øresundsbro Consortium the total amount of traffic also increased significantly over time. In 1993 2 million cars crossed the strait using ferries, in 1999 before the bridge opened the number was 3.2 million and in 2003 the number had risen to 6.2 million, during these years the number of persons crossing also increased from 16.7 million to 26.8 million. Much of this traffic was found to be holiday traffic in the summer and during Christmas, even though the majority of total traffic had a functional purpose.<sup>24</sup> It has also been found that migration was low before the bridge opened and when it did open it was in the Denmark to Sweden direction. A NASA feasibility study for Hyperloop using Øresund for example notes that the migration was mainly driven by higher wages in Denmark and lower housing costs in Sweden.<sup>25</sup> Statistics show that there was high correlation

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<sup>20</sup> Grosche, Tobias, Rothlauf, Franz, Heinzl, Armin, Gravity models for airline passenger volume estimation, *Journal of Air Transport Management*, v. 13, Issue 4, pp. 175–183, July, 2007.

<sup>21</sup> Schack, On the Multi-Contextual Character of Border Regions, p. 7.

<sup>22</sup> Wichmann Matthiessen, The Öresund Area: Pre- and post-bridge cross-border functional integration.

<sup>23</sup> Orestat, Tillgänglighet och mobilitet – Flyttning, [www.orestat.se](http://www.orestat.se), downloaded: March 11, 2017.

<sup>24</sup> Wichmann Matthiessen, The Öresund Area: Pre- and post-bridge cross-border functional integration.

<sup>25</sup> US Department of Transportation, Catherine L. Taylor, David J. Hyde, Lawrence C. Barr, Hyperloop Commercial Feasibility Analysis: High Level Overview, prepared for NASA, [www.ntl.bts.gov](http://www.ntl.bts.gov), June, 2016, downloaded: February 26, 2017.

between price premium in Copenhagen and the number of migrants moving to Scania. Most who relocate are Danish citizens for both directions and this has been the case since the opening of the bridge.<sup>26</sup> Matthiessen in his geographical writings also notes that larger machines and household products were cheaper in Sweden and that the higher wages in Denmark was partially offset by higher Danish income tax, while firms in Sweden pay for social expenditures. Thus many commuters work in Denmark and live in Sweden.<sup>27</sup> In 2010 the number who moved to Zealand from Scania exceeded the migration in the other direction and most were Danish citizens moving back.

Also to be noted is the growth of inhabitants in the Øresund region in general. Statistics indicate that there was a net increase in residents of 270,000 in the region from 2000–2012, where 100,000 were from external immigration, 40,000 were from birth excess, and 40 000 from other regions in the countries, mostly from Sweden.<sup>28</sup> Regarding commuting and the most recent statistics from 2015 the situation is that 95,900 people traveled across the strait each day and 75,000 of those were using the Øresund Bridge. Of those 75,000, 42,900 went by car and 32,100 by train, for the latter, half were in each direction. 15,100 people commuted every day and 8,000–9,000 did it by train meaning that out of the 32,100 train journeys 17,000 were from daily commuters making two trips during a day. 93 % of the 15,100 commuters: 14,000 commuted to Sealand and back, meaning that very few live in Denmark and work in Sweden. The 15,100 commuters can be compared to 18,200 commuters between Stockholm and Uppsala, two cities with longer traveling distance but on land.<sup>29</sup> There is a conflicting source for the region, stating that in 2011, 20,000 Swedes commuted regularly and that only 9,000 Danes lived in Sweden.<sup>30</sup> All these effects creates value and a study from 2012 estimated that the socioeconomic benefits between 2000–2010 indicated that over 50 years the IRR from the project could be 9% from the DKK 29.5 billion the project costed to build.<sup>31</sup>

Residential prices in particular have been important for the region and according to the Orestat data summaries, families while maintaining jobs in Copenhagen moved to Malmö for a larger, better residence for the cost. During the period 2000 to 2011, 13,000 people moved permanently in this direction, which also meant that they constituted half of the daily commuters in the opposite direction. It is clear from the graph on the excess prices of residences in Copenhagen and the curve for people moving across the strait to Scania, that there is a clear correlation. According to this graph as well as the graph of movers between the two sides, it is seen that around the time of the financial crisis this situation changes to a decline in the growth of moving and in the end of the measurement period, some people even move back to the Danish side.<sup>32</sup> Interpretations of this in the context of integration could be both about cyclicity and natural stabilization.

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<sup>26</sup> Orestat, Tillgänglighet och mobilitet – Flyttning.

<sup>27</sup> Wichmann Matthiessen, The Øresund Area: Pre- and post-bridge cross-border functional integration.

<sup>28</sup> Orestat, Tillgänglighet och mobilitet – Flyttning.

<sup>29</sup> Øresundsinstittutet: <http://www.oresundsinstittutet.org>, Fakta: trafiken över Øresund 2015, downloaded: February 26, 2017.

<sup>30</sup> Malmö Municipality, Malmö (City of), April 3, 2013, Standard & Poor's RatingsDirect, [www.malmo.se](http://www.malmo.se), downloaded: March 30, 2017.

<sup>31</sup> Knudsen, M.A., Rich, J, Ex post socio-economic assessment of the Oresund Bridge, *Transport Policy*, v. 27, pp. 53–65, 2013.

<sup>32</sup> Orestat, Tillgänglighet och mobilitet – Flyttning.

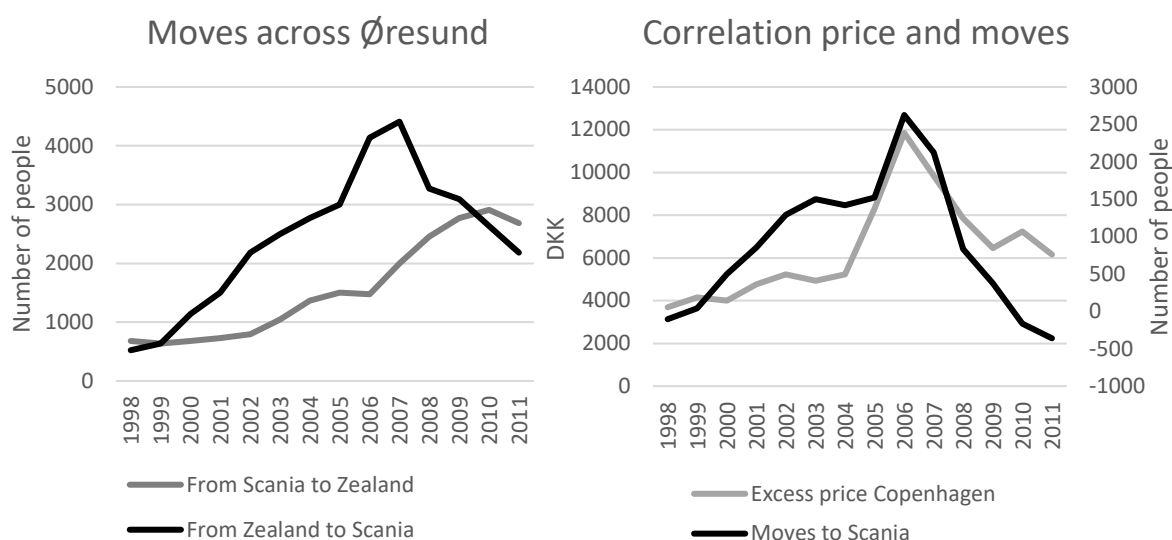


Figure 4 & 5: The first figure from the left shows the number of people that have annually moved across the sea in the respective directions. The second figure shows the excess cost per square meter for residences in Copenhagen over Malmö. The figures have been recreated here similar to the original source. Original source: (Orestat, Tillgänglighet och mobilitet – Flyttning)

For this to occur however, political cooperation between the two countries has likely been helpful. In a bill from 2000 it was made clear that VAT was going to be split equally between the countries, but that employers still could deduct the entire value of the VAT in the country of origin. In 2003 a treaty was signed between Sweden and Denmark that added additional conditions for the existing Nordic tax treaty, created rules for deductibility of pensions in the other country, as well as a special system where the state where the person works pay the state where the person lives a “repayment charge”.<sup>33</sup> No matter if these systems creates further incentives or not, the clarity ensures that people can decide to reside and work more freely in the region.

The cost of commuting in the area is not negligible. As of May 2017, the cost of each single trip on the Øresund Bridge is SEK 205 for the first 16 trips each month and then SEK 46 for trip 17–50 and then SEK 205 for more trips during a month. At 20 monthly working days going round-trip, a commuter would pay SEK 4,384 or SEK 45,000–50,000 annually (up to EUR 5,100).<sup>34</sup> In some cases this might be paid by the employer as a benefit and there could be deductibility for the VAT as described. Prices for commuting across the strait using the Helsingborg–Helsingør passage where ferries operate are harder to estimate on a yearly basis since 50 single trips can be used during a 2-month period for SEK 4,939<sup>35</sup> (EUR 505), but prices should be similar to those of the Øresund Bridge. As a comparison, prices for annual season tickets with Swedish state railroad operator SJ starts at SEK 43,300 (EUR 4,400).<sup>36</sup> An annual period ticket at SL for the city of Stockholm costs SEK 8,720<sup>37</sup> (EUR 890).

Other characteristics of Øresund can also be found in the literature. Hall describes the situation in the region from the perspective of political cooperation and notes that the Øresund region

<sup>33</sup> Dahlberg, Mattias, Önder, Ali Sina, Taxation of Cross-Border Labor Income and Tax Revenue Sharing In the Öresund Region, Uppsala Center for Fiscal Studies, Department of Economics, August, 2014.

<sup>34</sup> Oresundsbron, Pendlarnas Pristrappa, [www.oresundsbron.com](http://www.oresundsbron.com), prices as of May 7, 2017.

<sup>35</sup> Scandlines, Pendlarklubb, [www.scandlines.se](http://www.scandlines.se), prices as of May 7, 2017.

<sup>36</sup> SJ, Pendlarbiljetter & årskort, [www.sj.se](http://www.sj.se), prices as of May 7, 2017.

<sup>37</sup> SL, Periodbiljetter, [www.sl.se](http://www.sl.se), prices as of May 7, 2017.

takes part in INTEREG funding. The author cites Blatter, who concluded that this funding is very important for cooperation, not only because of the money but for symbolic reasons. Further it is suggested that the Øresund cooperation works because it is natural to govern at different levels, even if EU requirements stipulate what the funding can be used for. Further it is argued that most cross-border regions came to be after the INTEREG program started and that cooperation could stop if funding disappeared.<sup>38</sup> Political collaboration is mentioned here as it is proposed to be seen of a good sign of regional integration. Löfgren in writing about “Regionauts,” people in border regions like Øresund or Svinesund who explore the other side, notes that some cultural differences spur even more cooperation because of national competition.<sup>39</sup> Hall continues to write about Øresund as a functional region where politicians are going from democratic to managerial for the region and that this is free of controversy. Regional identity is mentioned but rather as consumerism than traditional nation-building.<sup>40</sup> In a media study from 2005 investigating the way the Øresund region was mentioned in media after the construction of the Bridge, Falkheimer notes that discourse is mainly about big topics like national growth. Three categories seemed to have been the major ones, stereotypes about the nationalities, scenarios for the region and the large visions of integration, used to promote the region in global branding.<sup>41</sup>

Matthiessen in a paper published before the completion of the Øresund Bridge used a method to assess the changes in distances that would occur in North Europe as consequences of the project and other infrastructure projects in this part of Europe. This method distorts maps to account for the traveling time between places using ground transport including transport on water, while air travel is not included.<sup>42</sup> This technique called time-space maps is described in detail by Spiekermann and Wegner in a paper about accessibility and networks. The maps are created using data about time to each major city to other cities in Europe. Circles indicating different travel time are drawn and then cities are placed on those for the specific city, then the same thing is done for other cities and the map is drawn in a way to still be recognizable. The conclusions by the authors were that High Speed Rails across Europe had created “substantial” effects on travel time and thus accessibility.<sup>43</sup>

First an image was created with the method for the year 1991, showing the distance map based on data from that point in time. Then an expected map was created for the year 2018 when the region was expected to have been if not fully, then more integrated and included how changes would occur in other parts of northern Europe. No follow-up study that draws such an image seems to have been created by the original author after the events, but indeed the time travelled in the Øresund region has been proved to have been reduced.

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<sup>38</sup> Hall, Patrik, Opportunities for Democracy in Cross-border Regions? Lessons from the Øresund Region, School of Technology and Society, *Regional Studies*, v. 42, Issue 3, pp. 423–435, October, 2006, p. 427 and p. 427.

<sup>39</sup> Löfgren, Orvar, Regionauts: The Transformation of Cross-Border Regions in Scandinavia, *European Urban and Regional Studies*, v. 15, issue 3, pp. 195-209, 2008.

<sup>40</sup> Hall, Opportunities for Democracy in Cross-border Regions? Lessons from the Øresund Region.

<sup>41</sup> Falkheimer, Jesper, Formation of a region: Source strategies and media images of the Sweden–Danish Öresund Region, Department of Service Management, Lund University, February 1, 2005.

<sup>42</sup> Wichmann Matthiessen, Christian, Bridging the Öresund: potential regional dynamics Integration of Copenhagen (Denmark) and Malmö-Lund (Sweden) A cross-border project on the European metropolitan level, *Journal of Transport Geography*, v. 8, Issue 3, pp. 171-180, 2000.

<sup>43</sup> Spiekermann, Klaus, Wegener, Michael, Trans-European Networks and Unequal Accessibility in Europe, *European Journal of Regional Development (EUREG)*, v. 4, pp. 35-42, 1996.

The maps are not reprinted here but clearly shows how the region grew together to be a single node with minimal temporal distance. See the original source for the figures.<sup>44</sup>

Integration is a process that takes time. Matthiessen in the same paper wrote about five different phases of integration and that before the Øresund connection was even completed the first three steps were completed, including a shift in attitude to positivity. At the time of the inauguration the region was in a fourth phase of identification and removal of integration barriers and then after a longer time the fifth phase of integration would play out.<sup>45</sup> Note once again that this is described as a gradual process.

### **Dover–Calais**

There are many other infrastructure projects in the world that has taken place to connect different cities, across countries or within them, especially interesting is projects that enables faster crossing across water between two countries. One example is France and Great Britain with the Channel Tunnel beneath the English Channel and between the cities Dover and Calais. Similar to the Øresund region the strait had previously been crossed using boats but could afterwards be accessed by train or car (on trains). Heddebaut researched the region in 2002 as a bi-national city link and could not conclude that Dover–Calais truly was a binational city, but that there had been progress on cross-border cooperation. When posing the question if the cities have been brought closer to each other, it is recounted that the cities aren't truly connected but rather many vehicles just pass through the city to access the highways. The travel time since the inauguration has improved with the Eurostar trains in the tunnel completing the journey in 20 minutes.<sup>46</sup> Some of the hovercraft and catamarans travelled that journey in 35–45 minutes,<sup>47</sup> whereas traditional ferry crossing would take up to 90 minutes.<sup>48</sup> Volume compared to just the existence of fast modes of transport is something that will be discussed later for the proposed Hyperloop compared to airplanes. Further about integration, it is stated that despite the connection the physical border of the sea still make sure that the cities are separated. There are also actions to collaborate in different areas including public policy and there have been large scale forums arranged to improve collaboration. In terms of numbers of travelers, the ferry riders remained roughly the same while total traffic including the tunnel doubled from 1994 to 1998 to over 35 million passengers.<sup>49</sup>

The connection was not without controversy either, there was opposition from many different actors, religiously there was the old conflict between Protestants and Catholics, politically there were security concerns in Britain, and culturally Brits saw Francs as indecent.<sup>50</sup> Church and Reid goes further into the so called INTERREG program, one of the European Commission's larger programs of which the Dover–Calais area received funding. This paper describes the cooperation in the area and more specifically between Kent in which Dover is situated and the

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<sup>44</sup> Wichmann Matthiessen, Bridging the Øresund: potential regional dynamics Integration of Copenhagen (Denmark) and Malmö-Lund (Sweden).

<sup>45</sup> Ibid, p. 178.

<sup>46</sup> The Guardian, How long does it take to get from Dover to Calais?, [www.theguardian.com](http://www.theguardian.com), July 31, 2003, downloaded: May 6, 2017.

<sup>47</sup> Heddebaut, Odile, The binational cities of Dover and Calais and their region, *GeoJournal*, v. 54, Issue 1, pp. 61–71, 2001, p. 62.

<sup>48</sup> The Guardian, How long does it take to get from Dover to Calais?.

<sup>49</sup> Heddebaut, Odile, The binational cities of Dover and Calais and their region, *passim*.

<sup>50</sup> Colley, Linda, An island only in the mind: The Channel Tunnel has connected us to France, but we were never really cut off, *The Independent*: [www.independant.co.uk](http://www.independant.co.uk), May 7, 1994, downloaded: April 23, 2017.

entire Nord Pas de Calais and the cooperation is described to often be driven by local authorities' self-interest. Local governments in South East England depended very much on relationships between the central government and the local governments for the outcomes in the region, further showing that it is about the region and not the source of the funding. After the construction but not necessarily due to it, cooperation commenced in the entire strait area in a network called the Arc Manche, cooperation there was difficult due to diversity and officers of local authorities were not very committed and could easily adapt involvement based on success for optimized self-interest.<sup>51</sup>

Then there are the other effects on traffic: both tourism and excursion travel have increased. The first defined as nights stayed and excursion as number of visits for less than 24 hours. For the Nord-Pas-de-Calais region in general, tourism slightly decreased from 1994 to 1996 from 2.6 to 2.2 million stays, without other explanations by the author than the tunnel, tourism also increased from Belgium from 1994 to 1996, from 2.4 million to 4.7 million nights. For the Calais region only, Brits make up 70% of tourists, meaning that Belgians travel elsewhere in Nord-Pas-de-Calais. For excursions, the traffic across the channel increased from 6.5 million passengers in 1985 to 19 million passengers in 1997. Excursions from Kent mostly have Calais as the destination for shopping, city tours and food, from the Nord-pas-de-Calais region most go to Belgium, perhaps because of the less formal customs between those countries compared to France and Britain or the lack of language- and historical cultural barriers.<sup>52</sup>

### **Research on domestic infrastructure projects**

There is another form of literature than the border region literature that also often mentions infrastructure projects, but rather mentions constructions of domestic means of transportation such as highways, High Speed Rails (HSR), and railways. The HSRs in particular is the most similar solution to the Hyperloop that currently exists and when they stretch shorter distances that enables commuting the rails are even more relevant for the current research question. In this thesis, this literature is used to show effects of connecting regions in cities to achieve higher speeds and higher travel volumes. This is done for two reasons, firstly the investigated KPMG study mentioned building domestic economic benefits from Hyperloop systems before connecting the routes, secondly it adds understanding to connecting regions when there are less lingual and cultural barriers.

In an article about HSRs in Eastern Australia from 2013 the authors addressed that there is growing interest in finding research of benefits of transportation technologies and that the authors wanted to consider effects on employment and accessibility. The approach included to think of reduced travel time as reduced distance, similar to the Matthiessen method for Øresund, so that economic activities with a shorter traveling time in-between mirrored cities that was positioned closer to each other. Their findings with a mathematical approach were that benefits from HSR would be much larger for non-work-related activities than work-related activities and this based on GDP.<sup>53</sup> This either means that non-work-related travel is a much larger activity or that it has higher impact, regardless it highlights, like in other literature for other

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<sup>51</sup> Church, Andrew, Reid, Peter, Cross-border Co-operation, Institutionalization and Political Space Across the English Channel, *Regional Studies*, v. 33, Issue 7, pp. 643–655, August 18, 2010, p. 648.

<sup>52</sup> Heddebaut, Odile, The binational cities of Dover and Calais and their region.

<sup>53</sup> Hensher, David A, Ellison, Richard B, Mulley, Corinne, Assessing the employment agglomeration and social accessibility impacts of high speed rail in Eastern Australia, *Transportation*, v. 41, Issue 3, pp. 463–493, May 15, 2013.

regions that most use of long transport is not for work. There are many pieces of literature on HSRs in Australia because the topic has been discussed for a long time without any rail being built. Currently the CLARA tries to make a HSR happen between Sydney and Melbourne, but there is yet no empirical evidence to observe from Australia.<sup>54</sup> There also exists literature from Japan and the Netherlands, mostly with other focuses.

The Øresund Bridge is not the only major bridge in Denmark. There is also the Great Belt Fixed Link which during the year of inauguration in 1998 carried 3.8 million motor vehicles across a strait between two Danish islands. In 1999 the first full year of operation that number had grown to 6.9 million vehicles and in 2016, 12.4 vehicles travelled across the link.<sup>55</sup> This is an interesting project in the context as it is a domestic connection being made without any concerns of cultural differences and instead it is an example of how more people can have business in the other region or just cross the route while traveling past. The project cut times significantly, by rail from 60 minutes to 7 minutes and by car from 90 minutes to 11 minutes. By rail over 9 million people were predicted to be traveling across the strait in 1997.<sup>56</sup> Knowles in a paper wrote about the large effects the fixed link would have on transportation and noted that such projects are often not built until there is enough demand to ensure that toll fees pay back the investment cost.<sup>57</sup> A Scottish–Danish paper modelled the region before its completion and predicted relatively small economic effects in that it could reduce the number of unemployed with 2,200 people.<sup>58</sup> The Great Belt Fixed Link is often forgotten compared to the Øresund Bridge but was as shown also a large project that resulted in much more traffic.

### **Utility research about commuting**

The literature on commuting faces the topic in different ways, but tend to mention similar quantitative statements. In a British study on commuting the human aspects and well-being was researched to draw conclusions on aspects such as economic and financial benefits. The background of this research was that the average Brit spends 139 hours annually commuting, 4% travel more than 100 km daily and 10 % spend more than 2 hours daily commuting. Improving the travel experience making it cause less fatigue was found to have economic benefits. Workers minimize their costs of travel regarding mainly monetary cost and time, while the authors also researched health and psychologic costs. The paper then puts prices on commuting in pounds. These are based on the average wage of workers hourly that are using those transports, but between GBP 20–37 from busses to trains. Work by Levinson and Wu found that commuting time has increased over time and that businesses do not locate perfectly where workers are and vice versa and workers seem to be willing to make the trade-offs of commuting to get other life comforts. Van Ommeren et al. in a Dutch study in the 90s found that people tend to look for a new job if the commuting time exceeds 50 minutes. Another study in the 90s in California showed that people turned from satisfied to dissatisfied as commuting time exceeded 46 minutes. There is also evidence that except for the disutility there are also

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<sup>54</sup> News.com.au, Why it's the right time for an Aussie fast train, [www.news.com.au](http://www.news.com.au), October 9, 2016, downloaded: May 14, 2017.

<sup>55</sup> Store Bælt, Trafiktal fra Storebælt, [www.storebaelt.dk](http://www.storebaelt.dk), downloaded: May 13, 2017.

<sup>56</sup> Francke, Nils, Feature: Big Project Financing - Bridging Scandinavia - Part 1. The Great Belt Fixed Link, *Japan Railway & Transport Review*, No. 11, pp. 40–45, April, 1997.

<sup>57</sup> Knowles, Richard, The Great Belt Fixed Link and Denmark's Transition from Inter-island Sea to Land Transport, *Geography*, v. 85, Issue 4, pp. 345–354, 2000, p. 345.

<sup>58</sup> Jensen-Butler, Chris, Madsen, Bjarne, Modelling the Regional Economic Effects of the Danish Great Belt Link, *The Journal of the RSAI*, v. 75, Issue 1, pp. 1–21, 1996.

utilities like productivity and relaxation during commutes and those have improved since the dawn of the information age.<sup>59</sup>

Putting monetary values on commuting time compared to leisure appears in more studies and would certainly depend on the point in time and the studied region, but numbers could guide how commuting time should be valued. In 1966 bringing in space and time into consumer choice theory, Johnson wrote that people act both under a monetary and time budget constraint and choose between work and leisure.<sup>60</sup> In a Canadian study from 1978 about Labor Supply, it was concluded that the cost of commuting on average in a situation with 10 % elasticity of housing price on commuting, was about two thirds of the wage for the time spent. Most people in that study was on their backward bending labor supply curves,<sup>61</sup> meaning that people considered themselves having high enough wages to sacrifice paid work hours for more leisure.

There is also the fact that historically for sociological reasons women have commuted shorter distances than men.<sup>62</sup> This should be disclaimed with that there could be differences in different parts of the world and could have become more equal since the cited study from 1977. Interesting is however that the author writes that women seemed to choose to live close to work and implies that low residential costs has a tradeoff against higher costs of commuting and that decisions are based on those factors.<sup>63</sup> This was also what occurred in the Øresund region where people started going further and paying for tolls to get lower costs of living.

When considering how far people would be willing to commute or change habits, there is a concept called the “commuting time paradox,” which says that commuting time has not changed over time. Van Ommeren and Rietvald created a model of wage bargaining and along with increases in productivity, both commuting costs and wages increase. Given their model the paradox holds as long as the ratio of vacancy rate and employment remains the same.<sup>64</sup> This could mean that conclusions later about the Stockholm–Helsinki region with the Hyperloop should assume that the project itself should not affect the average time choices of commuters, even if it is unknown if this new transportation mode could create other effects.

In a study on commuting time compared to property prices, that is the disutility of a larger commuting time, in Hong Kong by Tse and Chan, economic distance in that region using mass transit prices was used as a measurement. In Hong Kong because of automobile taxes and few parking spaces among other reasons, most people use public transit, which enabled the researches to estimate the monetary cost of transport. One result was that the negative correlation between housing cost and commuting time often found, only held when commuting time was longer.<sup>65</sup> Richardson in a 1997 study had pointed at such effects being due to positive

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<sup>59</sup> Lyons, Gleen, Chatterjee, Kiron, A Human Perspective on the Daily Commute: Costs, Benefits and Trade-offs, *Transport Review*, v. 28, Issue 2, pp. 181–198, July 5, 2007.

<sup>60</sup> Bruce Johnson, M, Travel Time and the Price of Leisure, *Economic Inquiry*, v. 4, Issue 2, pp. 135–145, March, 1966.

<sup>61</sup> Wales, Terence J, Labour supply and commuting time: An empirical study, *Journal of Econometrics*, v. 8, issue 2, pp. 215–226, October, 1978.

<sup>62</sup> White, Michelle J, A Model of Residential Location Choice and Commuting by Men and Women Workers, *Journal of Regional Science*, v. 17, Issue 1, pp. 41–52, April, 1977, p. 41.

<sup>63</sup> Ibid.

<sup>64</sup> Van Ommeren, Jos, Rietvald, Piet, The commuting time paradox, *Journal of Urban Economics*, v. 58, Issue 3, pp. 437–454, June 1, 2005.

<sup>65</sup> Yi Tse, Chung, Chan, Alex W.H, Estimating the commuting cost and commuting time property price gradients, *Regional Science and Urban Economics*, v. 33, Issue 6, pp.745–767, September 30, 2002.

values from living outside of the city.<sup>66</sup> In the Hong Kong study, it was concluded that commuting time was valued to 24–48 % of the wages. In a broader study from 1983, Small had concluded of a rate of 20–50 %.<sup>67</sup>

The Øresund region had great potential in that wages and housing costs differed and that there was a common language. In a study on four border regions where no special infrastructure projects had been done, a model helped researchers identify that regions would have more commuters if there was a larger difference in income per capita, that a common language was shared, unemployment differed and the travel times were short. In their model a shared language generated 3 300 extra commuters and one extra minute of travel reduced the number of commuters by 450.<sup>68</sup>

### **Conducted research on the Hyperloop concept**

Studies on the Hyperloop are focused on assessing the feasibility of the system, either from a technical or an economical perspective, as the technology is new and not fully developed. An undergraduate study went into detail to investigate the original white paper and believed that the original stated costs were too conservative but that the system could revolutionize transport.<sup>69</sup> Another paper discussed the history of fast train systems and how the Hyperloop distinguished itself.<sup>70</sup> A study in Arizona argued why the system would be ideal in that US state given certain factors.<sup>71</sup> Werner et al. concluded that a Hyperloop in Northern Germany could provide cargo benefits worth EUR 660–900 million.<sup>72</sup> Otherwise there seems to be a lack of literature on potential economic effects as a result of the Hyperloop, if constructed in a region.

## **Method**

The literature review and the empirical evidence have shown qualitative and quantitative outcomes and established how border regions and infrastructure projects work and what can be expected in such situations. This will guide the understanding of what might be the effects of a Hyperloop system in the region of interest.

The framework by Schack based on Giaoutzi et al. described in the literature section on border studies uses similar parameters as other papers, but provides a framework of thinking around the quality of different layers in border regions that is much more specific for this research question in regards to other such qualitative frameworks.

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<sup>66</sup> Richardson, H, On the possibility of positive rent gradients, *Journal of Urban Economics*, v. 4, Issue 1, pp. 60–68, 1977, (secondary source through Tse et al.).

<sup>67</sup> Small, K, The incidence of congestion tolls on urban highways, *Journal of Urban Economics*, v. 13, Issue 1, pp. 90–111, 1983, (secondary source through Tse et al.).

<sup>68</sup> Mathä, Thomas, Wintr, Ladislav, Commuting flows across bordering regions: a note, *Applied Economics Letters*, v. 16, Issue 7, pp. 735–738, May 1, 2009.

<sup>69</sup> Hallin, Brooks, The Hyperloop: A Top-Down Systems Engineering Evaluation of the Technical and Economic Feasibility, Department of Mechanical and Aerospace Engineering, 2014.

<sup>70</sup> Sakowski, Mark, The Next Contender in High Speed Transport Elon Musks Hyperloop, *The Journal of Undergraduate Research at the University of Illinois at Chicago*, v. 9, No 2, 2016.

<sup>71</sup> Martin, Sean Joseph, Creating Shared Economic Value for Arizonans by Proliferating Solar through the Hyperloop Project, Barrett, The Honors College, Arizona State University, May, 2014.

<sup>72</sup> Werner, Max, Eissing, Claus, Langton, Sebastian, Shared Value Potential of Transporting Cargo via Hyperloop, Helmut Schmidt University, Hamburg, August 2, 2016.

The research question posed aims for a qualitative approach, but a quantitative approach could be a precise way of understanding passengers in the region. In the literature section *ex ante* and *ex post* methods are mentioned to have been used. *Ex post* approaches would be interesting for the region after the potential construction, but only *ex ante* approaches would fit the purpose of this thesis. The generally used quantitative approach, gravity models, are not limited to commuting and results could be very uncertain given that the project would become completed very far in the future. For example, predicting the city GDPs of the two cities might be even more unpredictable than national GDPs throughout the period as different factors could affect how people relocate domestically before the project. Furthermore, the capitols would not be the only stations which could complicate and invalidate gravity models. Only studying the effect of commuting and making room for other traffic might then be a better choice.

Although a circle argument given the idea to use a network approach, a paper about political and geographical barriers in the Øresund region argued that to understand network interaction, gravity models could be less relevant.<sup>73</sup> The greatest assumption in the chosen method will be that gaps in networks has a casual negative effect on commuting.

In short arguments for not using a quantitative approach are:

- There is strong uncertainty when predicting so far in the future and even putting numbers then might be misplaced.
- The system would not only have the two nodes as the only connected cities.
- Such models only take into consideration the potential between the cities and does not specify the barriers to network interaction, which also as yet unexplored might be necessary to do first to construct such models.

To answer the research question the Stockholm–Helsinki region will be compared to the previous regions that have been studied and the quality of the border region if the Hyperloop connection was built, will be assessed from different perspectives. This will be done according to the model of the spatial layer defined by Giaoutzu et al. later refined by Schack, capturing all aspects including and beyond the purely economic driving forces. This should enable qualitative predictions of how the border region may function with different overlaps of perceived borders, while integration conclusions of those aspects are drawn. While a clear understanding of the region and likely specific outcomes can be predicted, outcomes depending on all aggregate aspects can be more diverging, why three scenarios of different speed of integration and commuting volumes will be presented. Concluding remarks will then present lessons learned in this study and answer the research question.

## Implications for the Stockholm–Helsinki region with Hyperloop

With large amounts of empirical evidence and theories built in previous studies of different regions, conclusions should be possible to make for this Hyperloop project that could create a more integrated region. Meanwhile it should be possible to determine a projected impact of commuting for the total number of trips necessary for economic feasibility and thus the research question can be answered. First the region will be described to set the stage in comparison to other regions mentioned:

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<sup>73</sup> Batten, David, Törnqvist, Gunnar, Multilevel Network barriers – The methodological challenge, *The Annals of Regional Science*, v. 24, Issue 4, pp. 271–287, December, 1990.

## Description of the region

Sweden and Finland has a long history together. Finland was a part of Sweden until 1809 when it became part of the Russian empire, until the country became independent in 1917. Today Swedish and Finnish together are the official languages of the country and not only are 5.4 % of the population Swedish-speaking Finns, but all Fins are taught Swedish in elementary school (age 12–15) and most public information is shown in both languages. Swedish Finns are mostly prevalent in some of the western parts of the country and in the south including Helsinki<sup>74</sup> where 6 % or 38,000 are Swedish-speaking Finns.<sup>75</sup> Research has concluded that this Swedish-speaking minority meets the criteria of being a separate ethnicity. Interestingly, despite demographic similarities Swedish-speakers are healthier and have less mortality than Finnish-speakers in the country.<sup>76</sup> Furthermore 8,000 Swedes live in Finland.<sup>77</sup>

In 2013, 712,000 people with Finnish origin lived in Sweden and 426,000 people lived in Sweden who had parents from Finland or were born there themselves. In Stockholm alone excluding nearby municipalities, the number of people with Finnish origin was approximately 74,000 and in Uppsala Municipality 15,000 people resided. The number was 7,000 in Norrtälje.<sup>78</sup> 65,000 Swedish-speaking Finns reside in Sweden.<sup>79</sup> In Finland in general 5.4% or 291,000 were Swedish-speaking in 2011.<sup>80</sup>

In a book on urban governance German researcher Giersig writes that Stockholm and Helsinki does not have cooperation that could be detected. However, both cities have experienced significant growth and functional regions does not correspond with administrative regions forcing both cities in their regions into new cooperation and mergers of regions.<sup>81</sup> Further developing on how the Helsinki region is not characterized by a common identity and that political or administrative regions might be different ways to define the region, one definition is Helsinki city and another is all the municipalities in the proximity as the region.<sup>82</sup>

For language, from a Swedish perspective language at work might not be something ever questioned. In Finland, however, Finnish, English and Swedish are all used for different purposes. Swedish speakers could often be used to do tasks outside their scope because of their language skills, Swedish as a standalone language would not work as Finnish speakers rarely practice their Swedish. In retail, employees might have badges with flags to indicate their language proficiencies. Finnish is the overall language, although English becomes even more common with time. Often in large cooperation the official outward language can be English, while daily communication is done in Finnish. The situation in large Swedish companies is

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<sup>74</sup> Network to Promote Linguistic Diversity, Language Report Swedish in Finland (2016), [www.npld.eu](http://www.npld.eu), downloaded: May 6, 2017.

<sup>75</sup> Statistics Finland, Population according to language and the number of foreigners and land area km2 by area as of December 31, 2008, [www.stat.fi](http://www.stat.fi), link broken when attempting download: May 6, 2017.

<sup>76</sup> Hyypä, Markku T, Why do Swedish-speaking Finns have longer active life? An area for social capital research, *Health Promotional International*, v. 16, issue 1, pp. 55–64, March 1, 2002.

<sup>77</sup> Statistics Finland, Population, [www.stat.fi](http://www.stat.fi), downloaded: May 6, 2017.

<sup>78</sup> Sveriges Radio, Fler med finsk bakgrund i Sverige, [www.sverigesradio.se](http://www.sverigesradio.se), downloaded: May 6, 2017

<sup>79</sup> Finlandssvenskarnas riksförbund: [www.fris.nu](http://www.fris.nu), downloaded: May 6, 2017.

<sup>80</sup> Statistics Finland, Tabellbilaga 1. Befolkningen efter språk 1980–2011, [www.stat.fi](http://www.stat.fi), downloaded: May 6, 2017.

<sup>81</sup> Giersig, Nico, Multilevel Urban Governance and the 'European City': Discussing Metropolitan in Stockholm and Helsinki, 2008.

<sup>82</sup> Bäck, Henry, Debatten om Helsingforsregionen: Mot en flerkärning storstad eller en samlad metropolkommun, *Kommunal ekonomi och politik*, v. 13, No. 1, pp. 7 – 32, downloaded: May 6, 2017.

similar.<sup>83</sup> Knowing languages in Finland can be a door opener and while English is growing, knowing all three languages could be of even greater benefit in the future.<sup>84</sup>

Regarding transport, 7 million passengers use the ferries annually between Sweden and Finland,<sup>85</sup> while multiple direct flights depart daily between the airports of the cities. In a sample test for the date: 31 May, 2017, 22 direct flights departed from Stockholm airports to Helsinki and 24 from Helsinki to Stockholm.<sup>86</sup> If carrying 100 passengers and departing at the same rate daily, then 1.7 million passengers would travel annually between the cities by direct flights. It should be accurate that 7 to 10 million passengers currently travel between the cities or to and from Turku.

Stockholm and Helsinki has similar unemployment rates<sup>87 88</sup> even though the unemployment rate in nationwide Finland is slightly higher.<sup>89</sup> Numbers regarding the monetary realities will help guide some of the outcomes in the region. Inhabitants report that as of May 2017 rent costs are 6–17 % lower in Helsinki city center than in the center of Stockholm, depending on the number of bedrooms. For a one-bedroom apartment that means a difference of approximately EUR 200 per month. Prices per square meters for purchased apartments are 33 % lower in central Helsinki. Prices for daily purchases are in general slightly lower in Helsinki, for example is milk 10 % cheaper.<sup>90</sup> Other sources also confirm that housing prices in central Helsinki are lower than in Stockholm.<sup>91</sup> Normal VAT in Finland is 24 %<sup>92</sup>, while similarly 25 %<sup>93</sup> in Sweden. Income taxes along with social fees are higher in Sweden<sup>94</sup> than in Finland<sup>95</sup> and because of this average net income after tax in Stockholm is reported to be 2,359.45 € compared to 2,475.94 € in Helsinki, a 5 % difference.<sup>96</sup> All these numbers could change significantly until the completion of the project, but still provides insight into what the region is like. In general, the situation can be summarized as that income is similar in the cities, but that costs of living are higher in Stockholm. In the simplest case where individuals pay tax where they work, both Swedes and Finns would benefit from living in Helsinki and working in a country of chose, given that the transportation costs are low enough. More about this will be covered in the parts about the economic layers.

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<sup>83</sup> Tandefelt, Marika and the Institute for the languages of Finland, VII Svenskan i företagsvärlden, [www.kaino.kotus.fi](http://www.kaino.kotus.fi), 2005, downloaded: May 11, 2017.

<sup>84</sup> Borenius, Andrea, Ett företag – men hur många språk? En kartläggning av den språkliga vardagen på internationella företag i Finland med fokus på tvåspråkighet, Helsinki School of Economics, 2009.

<sup>85</sup> Hufvudstadsbladet, Vision: Tåg Finland-Åland-Sverige, [www.hbl.fi](http://www.hbl.fi), downloaded: May 6, 2017.

<sup>86</sup> Momondo: [www.momondo.se](http://www.momondo.se), searches conducted: May 11, 2017.

<sup>87</sup> Roden, Lee, This map shows where you're most likely to be unemployed in Sweden, The Local: [www.thelocal.se](http://www.thelocal.se), February 13, 2017, downloaded: May 11, 2017.

<sup>88</sup> Trends in the Helsinki region, Unemployment rate, [www.helsinginseudunsuunnat.fi](http://www.helsinginseudunsuunnat.fi), downloaded: May 11, 2017.

<sup>89</sup> Eurostat European Commission, Unemployment statistics, [www.ec.europa.eu/Eurostat](http://www.ec.europa.eu/Eurostat), March, 2017, downloaded: May 11, 2017.

<sup>90</sup> Numbeo, Cost of Living Comparison Between Stockholm and Helsinki, [www.numbeo.com](http://www.numbeo.com), downloaded: May 11, 2017.

<sup>91</sup> Helsinki Times, Helsinki's house prices kept in check by unprecedented construction boom, [www.helsinkitimes.fi](http://www.helsinkitimes.fi), June 29, 2009, downloaded: May 14, 2017.

<sup>92</sup> Eurostat European Commission, Unemployment statistics.

<sup>93</sup> Skatteverket, Momsbroschyren SKV 552, [www.skatteverket.se](http://www.skatteverket.se), downloaded: May 11, 2017.

<sup>94</sup> Skatteverket, Svar på vanliga frågor - Inkomst av tjänst, [www.skatteverket.se](http://www.skatteverket.se), downloaded: May 11, 2017.

<sup>95</sup> Vero Skatt: [www.vero.fi](http://www.vero.fi), Income taxation of individuals, downloaded: May 14, 2017.

<sup>96</sup> Numbeo, Cost of Living Comparison Between Stockholm and Helsinki.

In the described region, a Hyperloop system would need enough capacity. Assuming only one tube in each direction and the 10 second or 3,000 meter distance the pods would need at full speed, and 30 people per pod would mean 10,800 passengers in one direction or 21,600 in both directions between Norrtälje and Turku. All commuters would want to ride at the same time, during approximately 3 hours. That means up to 64,800 commuters from both sides or with 500 rides each, 32.4 million passengers annually. It is unlikely that the system would run at such full capacity, but it can be concluded that given the assumptions, one tube in each direction could be enough, but with peak demand and risk for need of maintenance, more might be used. Ramböll did not explain anything further about the number of tubes during the presentation. Capacity is what distinguishes a Hyperloop system from air travel as the latter is more expensive to operate and departs more seldom. The case is similar to how catamarans in Dover–Calais were fast but could take less volumes of people.

What could be successful integration? Getting to the numbers the question becomes if the total number of riders after a desired investment period can justify the construction of the link including the mainland branches. In previous studies, it could be observed that daily commutes was an important part of the total amount of ridership and in order to be sure that a project like this can be successful, the potential to have a similar amount of commuters must be determined. For the Øresund Bridge approximately 1/5 of all riders on an average day were daily commuters and for the trains specifically, half of them were. For the proposed numbers of 42.7 million total passengers, with commuters traveling 500 times per annum and 1/5 of the total number being commuters, then 17,080 people would have to commute daily. Even having a tenth of the total traffic being commuters would mean 8,540 people. Those numbers have no other ground than being a similar share of total trips as for the Øresund Bridge, but should give an indication of what would be required.

It does seem like KPMG has put the number of travelers based on the mostly domestic time savings so that are assumptions that people would ride the Hyperloop if it saved them time at a fair cost. It is not certain however if commuters would pay EUR 17–25 to go between Uppsala and Stockholm, especially if having to pay for intra-city commutes as well, and what prices would be to Helsinki versus the higher volume travels on the mainland. If that is the approach then only the 18,200 people who commute between Stockholm and Uppsala would mean 4.5 million trips per year, a significant amount towards the total estimated number of trips, if people would pay the ticket price. To focus the scope deeper calculations on possible travelers between Stockholm–Arlanda–Uppsala have been refrained from as focus is on the cross-border region.

The KPMG report quoted that the system could be operational in 15 years from now,<sup>97</sup> some proponents believe that it could be finished much earlier and then there are the sceptics that may very well believe in the solution but that it something that could be finished much further ahead.<sup>98</sup>

Putting a Hyperloop system in the region would mean that transportation in the region would change completely, but it might have other effects as well. It might have influence on the language in the region and it might have effects on definitions of the cities. Since both regions as mentioned are not obviously defined, it is possible that the proximity to the Hyperloop system itself will broaden the region, in similarity to how usually traveling to an Airport makes that

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<sup>97</sup> KPMG, Enabling the Stockholm – Helsinki super region.

<sup>98</sup> Hufvudstadsbladet, Vision: Tåg Finland-Åland-Sverige.

city the home city of the person. Some such effects will be captured when society in the semi-new border region will now be analyzed according to the potential for the quality in the spatial layer:

### **The Cultural layer: Swedes, Finns, and language**

The Nordics in general have quite similar culture and regarding the quality of the emerging border region, the networks in the cultural layer would not mean a very strong border between the countries. However, something that still is a large hindrance is the language and this will be the main discussion in this section. In the Øresund region, many Swedes understand Danish and even more Danes understand Swedish and this enables easy cooperation in the respective mother tongues. Between the capitals, a border would exist in that much conversation would have to take place in English. At least some 100,000 Swedish-speakers live in the regions that would be connected by the Hyperloop stretch and these might be more likely to have higher interaction with the Swedish side due to less language constraints. It is also true that all Finns today are taught Swedish throughout their education, which could enable Finns to understand swedes, but there would unlikely be mutual Swedish-speaking in Finnish workplaces. For non-Finnish speakers, English is then probably a better unifying language.

The English language also affects how some professions could more easily relocate. Both Stockholm and Helsinki are known to have a tech scene and while Stockholm employed 36,000 programmers (2014)<sup>99</sup> and Helsinki had 87,000 programmers (2016)<sup>100</sup> in the workforce both have shortages of programmers.<sup>101 102</sup> Many of these companies are international and handle much internal conversation in English. Such professions could have more exchange between the countries, while the region could also attract even more talent to a bi-national market. This would be less likely in healthcare or daycare where the operational activities impossibly could be handled in any other languages than the service user's mother tongue. On a positive note, English proficiency is very high in the countries, especially among younger people and with the project taking place in the future, the setting would be that most in the workforce could switch between their mother tongues and English effortlessly.<sup>103</sup>

As described hundreds of thousands of people with Finnish origin lives in Sweden and for the ones with proficiency in Finnish, there could be many that would relocate to Finland, especially since the Hyperloop could help stretch the cultural border to include both sides for those people. Another aspect is comfort. A non-Finnish speaking Swede could manage everything in English in Finland, but it is not certain that people would chose that further effort. It is thus concluded that language is something important in this region that could affect the situation strongly, the obstacles that exists are surmountable although sometimes at the expense of comfort, and opportunities are large. Overall people with Finnish origin in Sweden, and Finns that speaks Swedish in Finland might together be the big commuting group, with hundreds of thousand

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<sup>99</sup> Computer Sweden, Så många knackar kod i Stockholm, [www.computersweden.idg.se](http://www.computersweden.idg.se), June 18, 2014, downloaded: February 22, 2017.

<sup>100</sup> Helsinki Business Hub, ICT in the Helsinki region, LinkedIn Slideshare: [www.slideshare.net](http://www.slideshare.net), September 14, 2016, downloaded: May 12, 2017.

<sup>101</sup> Geektime, Helsinki: The next big startup hub?, [www.geektime.com](http://www.geektime.com), September 24, 2016, downloaded: May 12, 2017.

<sup>102</sup> Invest Stockholm, How Stockholm is solving the talent shortage long-term, [www.investstockholm.com](http://www.investstockholm.com), November, 2016, downloaded: May 12, 2017.

<sup>103</sup> Global Europeans, English in the Nordic Region – Why are they so good?, [www.globaleuropeans.com](http://www.globaleuropeans.com), November 8, 2015, downloaded: May 13, 2017.

people on both sides that could move or have jobs at the other side of the sea. People with Finnish origin in Sweden might for example be able to move to Finland while maintaining jobs in Sweden and being able to easily visit friends and relatives residing in Sweden.

This would be an even larger point of interest for Europe as a whole if Hyperloops were to stretch everywhere and people would start to commute to other countries with other languages. If the solution proves cheap enough and this would occur, then language could be one of the first things to be questioned in border regions and in the long term a larger shift to for example English or more bilingualism might be necessary.

### **The Political Layer: Administration and potential opposition**

Regarding the political layer, it is important that the physical border is overlapped by both cooperation to some extent administratively, but also that the political opinions among the population has other borders than the physical border.

The administrations in most of the border regions has seen some cooperation, mostly when receiving funding like that from INTERREG, but regarding administrative borders, the jurisdictions are of course limiting. However political administrators might certainly talk about the border region as a special region and make decisions based on that mental picture. The Stockholm–Helsinki region will probably suffer from that there is focus on the entire Nordics or the Baltic Sea area, but the specific regions might also sometimes be referred to.

Regarding political opinions, as discussed in the sections on language there is opposition towards the Swedish language and the historical closeness to Sweden from right-wing parties. There is however possibilities that the high amount of Swedish-speaking Finns in the Helsinki area could lead to that this political border would stretch to include the Stockholm region. This could be backed by the fact that today the Finnish nationalist party the Finns Party or True Finns has about 17% of the vote in the parliament but only 6.7% in the local administration in the capital.<sup>104</sup> There could of course still be nationwide opposition towards the infrastructure investment, but traffic flows and the number of commutes could be higher if the border is not perceived as clearly for the city inhabitants. The example with Schleswig that the minority would fear losing their status could occur here as the Swedish-speaking Finns have benefits and is a separate ethnicity in Finland. These could also oppose processes towards integration.

A clear point of overlap would be the funding for the entire project, both public and private where even administrative bodies would consider the layer overlapping the entire region and would together work together in a geographically larger area. The CEO of the Finland Chamber of Commerce, an organization part of the political network, has expressed that Sweden and Finland together should seek financing from the EU to plan the project.<sup>105</sup> This should give credibility and could lead to actual cooperation of this kind.

Dover–Calais had political opposition just like the Finland–Sweden language integration might have, but as mentioned in the literature section about Øresund, one phase is a change in attitude

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<sup>104</sup> Svenska Yle, Resultatet klart: Samlingspartiet vinnare i Helsingfors, [www.svenska.yle.fi](http://www.svenska.yle.fi), April 20, 2017, downloaded: May 6, 2017.

<sup>105</sup> Finlands Utrikesministerium, Fast förbindelse mellan Finland och Sverige i framtiden?, [www.finland.se](http://www.finland.se), December 9, 2015, downloaded: May 12, 2017.

in the population. This could occur despite previous opinions if the construction completion would make people excited to ride in the system.

### **The Economic layer: Markets, distances, and costs of commuting**

The economic border description after the completion of the project would probably be described by different currencies and markets with borders at the physical borders. However, this separation in markets and prices is what initially could drive some of the behavior to move if there are perceived financial incentives. The method Matthiessen used in the geographical study about Øresund, was to draw a map based on the speed of ground transport. Done for this region with the Hyperloop this would make Stockholm and Helsinki, including Turku situated in close proximity. As long as the Hyperloop can be considered ground transport and would be accounted for in such a map, then the perceived physical distance will in fact have been reduced. Drawing such a map would mean that Finland essentially is moved closer to Sweden and the rest of Scandinavia.

One might even decide to draw Stockholm–Helsinki as one larger region like in the map for Malmö and Copenhagen in the 2018 illustration. The distances in such a case would mean that they were considered negligible compared to traveling across a city or within a city region. Indicated on the 2018 map was the distance between Stockholm and Uppsala that corresponds to about 40 minutes,<sup>106</sup> where, as mentioned 18,200 people commute. Thus, despite the longer duration than the Hyperloop route it is a common daily commute route for people working in the other city. These cities would probably be described in the context of the applied literature as cities as a domestic region, that however is not branded as one integrated region and rather is a functional region, mostly because of the commuting and the location of the mutual airport.

Distances regarding the commuting and willingness to travel the route, should not be an issue. The literature indicated that people would be willing to commute as long as the distances did not exceed 46–50 minutes and most of the commuting that would come from within Stockholm or Helsinki to the final destination in one of the cities would with the suggested solution take shorter time than that.

Overall the literature and empirical evidence in other regions seems to indicate that as originally hypothesized, the time duration is short enough to allow for daily commutes. This conclusion leads to the point of determining the definitive potential when considering all factors.

In terms of wellbeing regarding commuting and its negative effects, there is both advantages and disadvantages with Hyperloop systems and some of the latter would have to be mitigated. Initially the travel would probably be considered very exciting, especially if this project would end up becoming one of the first ones of its kind in the world. A modernly designed travel pod could also likely be more comfortable than economy air travel, with a history of cost reductions and price discrimination. Air travel also suffers from a loading problem and according to Hyperloop One co-founder Josh Giegel at a KTH lecture, loading of passengers and pod handling at the stations is their biggest intellectual property secret.<sup>107</sup> Later the “Hyperportal” was revealed for Dubai–Abu Dhabi as a solution for the loading of passengers.<sup>108</sup> A problem

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<sup>106</sup> Rome2Rio, search words: “Stockholm,” “Uppsala”, [www.rome2rio.com](http://www.rome2rio.com), downloaded: May 12, 2017.

<sup>107</sup> Giegel, Josh, Quote from: Hyperloop Technical Presentation, Integrated Transport Research Lab, KTH, Drottning Kristinas Väg 40 Stockholm, November 23, 2015.

<sup>108</sup> Lambert, Fred, Hyperloop One unveils the design of its terminal or ‘Hyperportal’[Gallery], Electrek: [www.electrek.co](http://www.electrek.co), November 11, 2016, downloaded: May 12, 2017.

might be that travelers would feel claustrophobic inside the pod without windows. No final solution has been presented, but it is likely that producers of Hyperloop pods would create some form of screen in the roof to create the feeling of openness.

Regarding the costs of commuting there is the ticket cost, indirect costs, and opportunity costs. The KPMG study indicated an average cost of EUR 17–25 for a single trip, but just like in Øresund there might be special prices for commuters. If commuters would however pay EUR 17, then their annual cost of using the Hyperloop would be around EUR 8,500. This cost together with opportunity costs might have to be exceeded in financial gain for many people to do the behavior. Here is an example: If a person values time at 2/3 of the hourly income, earns EUR 25 per hour and spends 10 minutes extra for the Hyperloop commute compared to their previous commute, then their opportunity cost would be EUR 1,389 annually, for a total cost of EUR 9,889. If a person could be productive during what would otherwise be a 20 minute commute of being non-productive on the subway, then the opportunity cost for the 10 minutes would be zero and the remaining 20 minutes would be a benefit, putting the annual cost at EUR 5,722. The gain in less costs of rents could be EUR 2,400 per year and then the subway card for EUR 970 might not be necessary. This would still put the example-person's decision to move to Finland at a loss and as this example might be a common tale, the case would have to be saved by even lower commuter prices, or by people having other incentives to move and commute like language or being able to find a higher paying job for their expertise. At a cost similar to commuting at Øresund or EUR 5,000 per year, the situation could be better.

#### **The Legal layer: Homogeneity for the necessary interaction**

The Øresund region provided clear examples of which legal stretches of the border is necessary to have a functioning border region with large traffic flows, as the tax systems got exceptions that allowed inhabitants to easier live as cross-border inhabitants seamlessly. This is a question of what could be done to make the integration of the regions successful, by having the legal layers overlap. However, when considering the likely outcome then with a project of this magnitude, it should be almost certain that the border region will be characterized by such cooperation to provide exceptions at the border to enable the region to function better.

#### **The Social layer: Potential for exchanges**

When defining the border for the social layer, most people would likely not have significant amounts of friends and relations on the other side of the sea meaning that the social border could be at the physical border. For Øresund however, over 25,000 Danes lived in Scania, so people would know people of other nationalities, but only where they live themselves. In the studies, it was found that people had started moving back across the strait. When a neighbor moves back after having been a friend, that creates a social contact across the physical border and with time that would mean that the social borders could overlap more. For some people in Stockholm or Helsinki, the social layer might be widened by the Hyperloop so that they could visit friends and relatives at any side of the sea. When assessing what will happen in Stockholm and Helsinki this more than anything would depend on what is the driver of moving and how it will take place, but it could take time until the border region would exist in an overlap of the social layers, but in the long term it could be a driver of commuting.

#### **Other economic effects as results of the project**

There are many economic effects related to commuting that could be studied empirically if the Hyperloop system is built. In terms of classical international economics there are many potential

effects that could occur. The unemployment rates were similar in the cities, but labor market pooling that would occur, there could be creation and distribution of jobs, which could also on the other hand drive even more commuting and other functional travel. This pooling of not only labor supply but also labor opportunities could be an additional driver of commuting. This would lead to more wage equalization over time as the region from a purely economic standpoint would become more integrated. One interesting aspect to be researched is that normally when labor pooling leads to labor migration by the connection of two regions, people move and “landowners” are hurt in the country they move away from, here many would stay, but commute to work which could create interesting effects. From the perspective of macroeconomics, the so called “Bathtub model” of unemployment could help explaining the situation regarding jobs that could occur in the region. The job separation rate could see a quite large increase during the initial period as things occur, but the job finding rate would most certainly improve in the long term along with the labor market pooling.

Housing prices might be an important driver of commuting just as seen in the Øresund case where people lived in Scania while earning higher wages in Copenhagen. As a result of the connection, housing prices in Norrtälje for example might increase as it would be the “harbor” to Finland in a way and a station of its own and the same thing could occur in Turku. Just like Øresund, the system would help create much more trade and transported goods, allowing for further specialization for firms that could export but don’t have global ambitions. Also noted, should be that for freelancers and commission-based service people like photographers, salespeople, and hairdressers, it might be possible to trade services in a wider way. Thus, some untradeable industries could become more tradeable.

The region could also be analyzed from the perspective of external economics where the Stockholm and Helsinki tech clusters are examples of clusters that could merge, grow and create a much stronger eco-system that could attract talent, researchers and investments to the region and create both financial wealth, but also faster integration and larger effects on commuting and travel volumes.

Another economic factor to consider is the game theoretical and especially about signaling to approve credibility that a game will look a certain way in the future. What was observed in the researched regions, especially in the Øresund case was that the total amounts of traffic increased significantly before the link opened. This could be explained by arbitrary reasons such that there were cyclical events in the economy, that demand for shopping trips in general increased or that currencies created demand on one side of the strait. Likely is that instead this was due that it had been communicated that a bridge was going to be built and then that a bridge was being built. For consumers making choices it might be more desirable to start going to the other city more when knowing that it soon will be possible to travel faster, even though it currently still takes quite long time. With this view the first game has already been played so that the individual can make decisions for the next round, when the first one is given. A Swede who has never went to Finland might consider it, knowing that it will soon be commonplace to do it and a Finn wanting to work in Sweden might move knowing that it soon will be much easier to go home and visit relatives. A company with headquarters in Gothenburg, might decide before the completion to relocate to Stockholm to have proximity to two capitals. The initial signaling that has been done already should have some effect but if construction would commence then larger effects should be possible to observe.

One additional driver of travel rather than commuting could be cheaper prices when shopping across the border, but many of those differences could quickly equalize. Friberg and Asplund researched “Finlandsfärjor” proving that menu cards price setting ensures that there often is some arbitrage to be earned, but that people don’t tend to exploit them out of convenience.<sup>109</sup> This is the result of so called sticky prices, but also wages, where it always takes time for a change to occur and then such problems ensues.

### **Making sure the integration is successful**

Now two things have been stated, first empirical evidence of different infrastructure projects and effects on commuting and overall integration of the regions have been described. Secondly these areas have been analyzed in comparison with the previous regions together with statistics for the Stockholm–Helsinki region, to determine the probable success of attempts of integration. However not yet described is the actions that can be taken to increase the likeliness of achieving success. There a few points that can be listed:

- Virtual roofs to improve wellbeing for commuters and other travelers
- Political and legal cooperation, those who decide can improve the probabilities of success for the project
- Applying for INTERREG funding

Certainly, trying to commence political collaboration is something that would be helpful for the integration of the regions. Collaboration similar to that of the Øresund regarding taxes could enable more people to move across the Baltic Sea. When constructing different scenarios as outcomes of a potential construction of the project, this is something that can be seen probabilistically and have major effects on the outcome.

The literature indicates that it would be important to have political cooperation and that such cooperation would commence more easily as the result of INTERREG funding. It is not obvious if the connection of these cities would entail this funding as Stockholm and Helsinki is not a historic border region. There is however the Baltic Sea Region for all the countries around the Baltic Sea.<sup>110</sup> Here the Øresund or English Channel cases, are not enough to be able to tell if the program would apply, as these regions already were considered border regions before the connected transportation after the infrastructure projects commenced.

### **Three scenarios of speed of integration**

Given the uncertainty of economic effects as it is still far in the future until the link could be open it would not be valuable to create scenarios with made-up numbers of how many people would commute. Furthermore, as other regions showed, travel volumes do rise quickly after an inauguration, but volumes continue to rise over a period of time and only does so if there are strong enough economic incentives, enough overlap in layers and enough cooperation to ensure that the border region becomes more integrated. In the end, any connected region would become integrated by long term globalization. This means that what is important is neither the travel volumes the first year after the construction, nor the very long term possibilities, but which speed the integration has and how fast the travel volumes increase. Speed in this context would mean that given the quality of the entire spatial layer, the integration could have differences in

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<sup>109</sup> Krugman Paul R, Obstfeld, Maurice, Melitz, Mac J, International Economics Theory and Policy, Tenth Edition, Pearson, 2015, pp. 467–468, 2015.

<sup>110</sup> Interreg Baltic Sea Region: [www.interreg-baltic.eu](http://www.interreg-baltic.eu), downloaded: April 30, 2017.

strength depending on this quality and actions taken to make sure to improve the situation. Three different scenarios are expanded upon:

**The slow scenario:** The slowest case would mean that differences between the countries at the point in time of connection are strong. This could mean that there is a lot of opposition to the project because the budget might have been exceeded and that some Finns fear the Swedish language and its influence. Especially there might not be strong economic incentives to work in one place and live in the other, because of similarities in wages and not enough differences in housing prices compared to the ticket prices as given in the example, or tax systems might not allow for earning income in the other country. Swedish-speaking Finns or Finns in Sweden might have no incentive to move as they don't want to leave their current homes. All such things might make the integration process very slow and then travel could be more biased towards excursions, shopping, and vacations. Domestic travel with the Hyperloop network for the suggested stations might work well but travel across the sea is smaller than expected and less pods than estimated will depart. With time the region becomes more integrated so that people move and commute more, but it takes considerable time.

**The general scenario:** All conclusions from analyzing the spatial layer and writing about those aspects in relation to integration, leads to this general case where things occur as expected. In this scenario, the political opinions amongst people from the slower case would mostly be resolved as people as part of the integration would in time become more positive towards the project. Meanwhile tax systems are adapted to allow for easier commuting. The costs of transportation might be lower than in the example or current Swedish residents might see other incentives creating labor streams towards Helsinki while there are labor streams towards Sweden or a tendency for people to keep their jobs there when they move. Most commuters could be people that keep jobs in Sweden but move to Finland because of their Finnish background. Language would be an important factor. In this scenario, the travel volumes immediately increase and even if there currently are no daily commutes taking place, this trend starts immediately. It is not a perfect scenario though and when assessing the social benefits compared to the investment the movement in the region during the first years might seem underwhelming, but as the integration progresses more people see the value in commuting in the region.

**The fast scenario:** The Hyperloop system is a new and exciting technology and it is possible that the simple analogy estimations from other projects that have improved traveling speed, still underestimate the potential in a region. An "Internet of transportation" might have more effects on the integration, so that different societal layers reinforce the integration process. This scenario would be like the optimistic view by Hyperloop One and KPMG during the presentation. At least the initial hype could make sure that the project is on to a stronger start despite the lack of extensive travel between the cities today. Then longer times of getting used to the system could be mitigated regarding things like confusions of which language to use, as they are resolved in a brief initial period so that more would seek jobs across the border earlier and commuting would increase faster. People might see economic benefit in moving especially eastwards or people in Finland get jobs in the growing tech industry in Stockholm. When comparing the integration with the process in Øresund, the analysis might be that despite that there were stronger economic incentives in Øresund, travel grew as fast in this region to likewise have the project pay off quickly. This could be due to the perceived speed of the Hyperloop, the comfort, and the excitement aspect that could last for a long time.

No matter which case would become true it could be said regarding the pre-feasibility study that integration takes time and that the presented numbers are either simplified for the sake of communication or that the estimations for the potential are not based on economic realities. The gradual integration process must be taken into consideration and it might be the case like hinted at during the presentation, that the pre-feasibility study travel volumes were only based on the people that could see time benefits from their current travels. Not only would the integration take some time but it would also take some time to achieve higher travel volumes as people today do not consider it a possibility to commute between the cities.

## Conclusions

What can then be concluded? The original question was: *If this proposed transportation system was built in the region, what would be the sources for cross-border daily commutes and could these indicate a justification of the investment?*

After having assessed studies in other regions and the empirical outcomes that came from them and then having anticipated the quality of different layers of society or the spatial layer in the border region and then having summarized three cases of different speeds of integration, the expectations of what might happen with a Hyperloop system in the region is much more clear. It will not be possible to know for sure which scenario would occur or if the conditions are similar in the future when the system would be completed.

For the pre-feasibility study, even if it is the case that there are assumptions that takes some new commuting into consideration but were not explained, it has still been possible to assess the region with an economics focus in this thesis as the KPMG study postulated estimated costs of construction, a targeted average ticket price, and travel volumes accompanying those numbers. Commuting as a measurement is not precise as there naturally are other forms of travel as well, but it is a measurement that can be very telling as it very connected to the total integration and it is something that could be modelled in a simulation based on wages, housing prices, opportunity costs adjusted with simple comfort coefficients for language and culture. The author of this thesis hopes that simulations are made by capable econometricians to assess the quantitative aspects, while wider aspects beyond economic incentives have been considered here.

For Tornio–Haparanda the region was established on immigration, for Dover–Calais the region was established on the political cooperation on making the project happen and then continued cooperation, for Øresund it was similar languages combined with housing prices in Scania and the higher wages in Denmark. As established in previous sections, for Stockholm and Helsinki it can be important how costs of living differ, but the most important is the common history that has led to many Swedish- and Finnish-speakers on both sides of the Baltic Sea. Depending on the strength this will prove to have, an infrastructure project with the Hyperloop technology could have different outcomes in performance, but it will be driven by this cultural connection and language proficiency.

The sources of cross-border daily commutes would when they would exist thus be driven by having chosen to separate the location of work and residence because of factors like the economic incentive to have lower living costs while earning similar wage and by people being able to choose to relocate to a place where their language still is useful, while still having easy access to friends and relatives on either side of sea.

This commuting is when stemming from all kinds of people with reason to move to the other side, hard to predict, but when considering the commuters who have a lingual and heritable connection to the other side, a better understanding can be formed. With the hundreds of thousands in the region with such attributes, the region is unique and without being able to definitely predict that enough people would move or change working place, the region certainly has untested potential for such commuting activities. Thus, the second part of the research question is answered with a careful statement, that there are many factors in the region that seem to indicate that the Hyperloop investment as proposed could be a justified investment.

The Hyperloop connection between Stockholm and Helsinki would if ever built have effects that would be interesting to study afterwards and hopefully this thesis have given a small contribution to the literature, by focusing on economic incentives for commuting, but also for evaluations of Hyperloop systems in border-regions, a type of literature that could become much wider if Hyperloops become widespread and if studied further this literature could provide detailed insights in the future.

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