41st European Transport Conference 2013, ETC 2013, 30 September – 2 October 2013, Frankfurt, Germany

Effects of longer lorries and freight trains in an international corridor between Sweden and Germany

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Abstract

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Keywords: Type your keywords here, separated by semicolons ;
1. Introduction

1. In the government commission Long Lorries’ effect on the transport system VTI\(^1\) concluded that the use of, longer and heavier Lorries in Sweden than in most other European countries is economically profitable (Vierth et al, 2008). This paper analyses for an intermodal corridor that stretches from central Sweden to the Ruhr area in Germany if/how the transport system can be improved by using longer road and rail vehicles on their own and in combination. Today Sweden allows longer heavy goods vehicles (HGV) than Denmark\(^2\) and Germany do while the reverse applies to freight trains. The actual situation is compared to scenarios where longer HGV and/or longer freight trains can be used in the international intermodal corridor. Simulations are carried out with the Swedish national freight model Samgods. The effects on the distribution of the freight flows on different routes, the modal split, firms’ logistics costs and CO\(_2\) emissions are calculated and a simplified cost benefit analysis (CBA) is carried out. We do not analyse the political feasibility of the scenarios. In chapter 2 previous reports that study the socio economic impacts of using larger road or rail vehicles for international freight transports are presented. In chapter 3 the intermodal corridor central Sweden-Ruhr is described. In chapter 4 the results of the simulations and the simplified CBA are presented. In Chapter 5 some conclusions are drawn.

2. Earlier studies

2.1 Transport & Mobility

The European Commission engaged Transport & Mobility to analyze the impacts of changing the regulations of the dimensions for HGV in Europe (Transport & Mobility, 2008). Three different scenarios are analysed assuming A) Europe-wide permission of max 25.25 m and 60 tonnes HGV, B) permission of max 25.25 m and 60 tonnes HGV in six countries\(^3\) and C) Europe-wide permission of max 20.75 m and 44 tonnes HGV. These scenarios are compared to the business as usual scenario with max 16.5 m/18.75 m and 40/44 tonne HGV in 2020. The three scenarios are calculated to give overall positive effects on society in the European Union. Scenario A) gives greater benefits than Scenario B) and Scenario C). The longer/heavier HGV are calculated to be more cost effective than the current HGV, as society has to spend less for transporting the same amount of goods. According to the decrease of road-vehicle-km, less accidents and emissions are predicted. However, the road infrastructure costs increase as there is a need for additional investments and more maintenance. Transport & Mobility concludes that the reduced costs for society exceed the additional investment costs.

2.2 International Union of Railways (UIC)

The International Union of Railways (UIC) engaged PANTEIA-NEA to study the impacts of using longer and heavier trains on the rail infrastructure, capacity and operations as well as economic implications, (UIC, 2013). PANTEIA-NEA compare the use of longer/heavier trains to the today typically used trains in Europe of max 750 meters and max 22.5 tonnes per axle. The analysis is carried out for several corridors based on information obtained from rail operators and infrastructure managers completed with own assumptions. The calculations indicate that the use of longer or heavier trains leads to lower per-tonne-transport costs as the same amount of goods can be transported with fewer trains. The cost reductions are typically larger for longer trains than for heavier trains.\(^4\) The infrastructure costs are not quantified.

2.3 K+P Transport Consultants and the Fraunhofer Institute

K+P Transport Consultants and the Fraunhofer Institute investigated how the introduction of longer and heavier HGV affects the rail transports (K+P Transport Consultants in co-operation with Fraunhofer ISI, 2011). The study, we call it henceforth K+P study, was conducted on behalf of the Community of European railway and infrastructure companies (CER). The impact of longer and heavier HGV on the combined transports and wagon load transports in six rail corridors in Europe is analyzed. We focus on the 894 km long corridor Scandinavia-Denmark-Ruhr with 4.8 billion tonne-km wagon load and 2.4 billion tonne-km combined transport in 2008.

The K+P study is limited to transports over 200 km as it is assumed that there is no competition between rail and road for shorter transports. System trains are excluded as they have much lower per-tonne-costs and are assumed not to compete on the same market. High density commodities, petroleum products, chemicals and hazardous goods are not taken into account either because these transports are not considered to be appropriate for HGV. K+P compare a reference-HGV with max 16.5 m and 40 tonnes\(^5\)

\(^{1}\) In 2008, a from the beginning three-year trial, with longer and heavier HGV than in most of the other European countries, was started in Denmark. In 2011, this trial was extended for another five years.

\(^{2}\) Finland, Sweden, Denmark, Germany, The Netherlands and Belgium

\(^{3}\) resp. 44 ton för transporter till/från combi terminals
i.e. to investigate HGV with max 25.25 m and 40 tonnes resp. 60 tonnes. 25.25 m long HGV have a 50% higher volume capacity than the reference-HGV. The transport costs are assumed to be about 22% (for 40-tonne-HGV) and 28% (for 60-tonne-HGV) higher than for the reference HGV. For the 60-tonne-HGV 10% extra costs for additional security measures are anticipated and a €0.20 higher toll on the motorways. In all cases 100% capacity utilization is assumed. The K+P: s study applies the cross-price elasticities presented in Table 1.

Table 1 Cross price elasticities in the K+P study

<table>
<thead>
<tr>
<th>Cross price elasticities: primary competition effect</th>
<th>Cross price elasticities: secondary volume effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined transport (light container)</td>
<td>1.0</td>
</tr>
<tr>
<td>Combined transport (heavy container)</td>
<td>0.8</td>
</tr>
<tr>
<td>Combined transport (swap bodies)</td>
<td>1.0</td>
</tr>
<tr>
<td>Combined transport (swap bodies)</td>
<td>1.4</td>
</tr>
<tr>
<td>Wagon load (200-400 km)</td>
<td>1.3</td>
</tr>
<tr>
<td>Wagon load (over 400 km)</td>
<td>1.46</td>
</tr>
<tr>
<td></td>
<td>0.58</td>
</tr>
</tbody>
</table>

Source: K+P Transport Consultants in cooperation with Fraunhofer ISI (2011)

K+P: s cross-price elasticities of 1.0 (for the competition effect, see left column in Table 1) for general cargo transports, i.e. in light containers and swap bodies, are in the same order of magnitude as the elasticities in other studies. Due to higher fixed costs for wagonload, the cross-price elasticities for wagonload are generally higher than the elasticities for combined transports. The secondary volume effect (right column of Table 2) describes the downward spiral for wagonload transports due to the fact that volumes “disappear” that ensure the exploitation of economies of scale and low per-tonne-costs. The premise is that the carriers pass cost savings or increases to the shippers. Table 3 compiles the by K+P forecasted goods volumes in the rail corridor Scandinavia-Ruhr. The rail tonne-kilometers are expected to double between 2008 and 2030; the increase is much higher for combined transports (150%) than for the wagon load (18%). The transfers from rail to road are calculated to be larger for 40-tonne-HGV than for 60-tonne-HGV as the cost savings per tonne are greater for 40-tonne-HGV than for 60-tonne-HGV. This is due to the assumed extra costs for security measures and higher tolls on the German motorways. The secondary effects for wagonload lead to higher reductions for wagonload than for combined transports.
Table 2: In corridor Scandinavia – Ruhr forecasted rail volumes and reductions for combined and wagon load transports 2015, 2020, 2030

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billion tonne-km combi – without longer/heavier HGV</td>
<td>2.392</td>
<td>3.467</td>
<td>4.376</td>
<td>6.194</td>
</tr>
<tr>
<td>n reductions 25.25 m / 40 tonne HGV</td>
<td>-11.62%</td>
<td>-12.06%</td>
<td>-13.32%</td>
<td></td>
</tr>
<tr>
<td>25.25 m / 60 tonne HGV</td>
<td>-9.53%</td>
<td>-9.89%</td>
<td>-10.91%</td>
<td></td>
</tr>
<tr>
<td>Tonne-km reductions wagon load – without longer/heavier HGV</td>
<td>1.609</td>
<td>1.699</td>
<td>1.766</td>
<td>1.905</td>
</tr>
<tr>
<td>n reductions 25.25 m / 40 tonne HGV</td>
<td>-21.37%</td>
<td>-21.37%</td>
<td>-21.37%</td>
<td></td>
</tr>
<tr>
<td>25.25 m / 60 tonne HGV</td>
<td>-20.04%</td>
<td>-20.04%</td>
<td>-20.04%</td>
<td></td>
</tr>
</tbody>
</table>

Source: K+P Transport Consultants in co-operation with Fraunhofer ISI (2011)

3. Intermodal corridor central Sweden – Ruhr Area

3.1 Trade flows between Sweden and Germany

Germany is one of Sweden’s most important trade partners. In 2010, 14% of Swedish exports and 9% of imports, measured in tonnes, went to/from Germany. About 30% of the exports and about half of the imports were transported by road and rail (including road and rail ferries). The number of combined transport lines in the corridor has increased over time which confirms the high increase for combined transports in K+: s forecast in Table 2. The demand for combined transport services increased to such an extent that the transport companies had to carry parts of the freight volume on the road. Therefore, one starting point in our project was to use longer trains to meet the high demand for combined transports. The intermodal corridor central Sweden-Ruhr includes a road (sub) corridor that uses the shortest route between central Sweden and Hamburg. The road corridor follows main roads the E4/E6 in Sweden via Malmö/Trelleborg and Travemünde and includes a ferry service. From Travemünde the corridor continues via Hamburg, Bremen and Osnabrück to the Ruhr area. The rail (sub) corridor goes via the Southern Main Rail Line, the Öresund Bridge, Jutland, Hamburg, Bremen and Osnabrück to Herne. See Figure 1.

3.2. Corridor central Sweden – Ruhr/Germany

The intermodal freight transport corridor that stretches from central Sweden to the Ruhr area is one of the main corridors between Scandinavia and main land Europe. The number of combined transport lines in the corridor has increased over time which confirms the high increase for combined transports in K+: s forecast in Table 2. The demand for combined transport services increased to such an extent that the transport companies had to carry parts of the freight volume on the road. Therefore, one starting point in our project was to use longer trains to meet the high demand for combined transports. The intermodal corridor central Sweden-Ruhr includes a road (sub) corridor that uses the shortest route between central Sweden and Hamburg. The road corridor follows main roads the E4/E6 in Sweden via Malmö/Trelleborg and Travemünde and includes a ferry service. From Travemünde the corridor continues via Hamburg, Bremen and Osnabrück to the Ruhr area. The rail (sub) corridor goes via the Southern Main Rail Line, the Öresund Bridge, Jutland, Hamburg, Bremen and Osnabrück to Herne. See Figure 1.

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6 See (Trafikanalys, Lastbilstrafik, 2012), (Trafikanalys, Utländska lastbilstransporter i Sverige, 2012). The remaining foreign trade volumes are transported intrasport chains that comprise sea or air.
7 The corridor Norrköping-Herne was applied in the Marco Polo project Scandinavian Shuttle, UBQ (2012). http://ec.europa.eu/transport/marcopolo/
Table 4 shows the approximate limitations of the rail infrastructure in the corridor. The maximum train length is with 650 m shortest in Sweden. The maximum permissible axle load (tonnes per axle) and meter weight (tonnes per meter) is lowest on the bridge over the Kiel Canal in Rendsburg. The gauge profile is lowest south of Bremen. Since the end of 2012, it is possible to run 835 m long trains between Hamburg and the Danish German border.  

Table 4 Rail infrastructure in the corridor central Sweden – Ruhr area

<table>
<thead>
<tr>
<th></th>
<th>Ca max train length (m)</th>
<th>Max axle load (tonnes/axle)</th>
<th>Gauge profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>650</td>
<td>22.5</td>
<td>G1</td>
</tr>
<tr>
<td>Oresund Bridge</td>
<td>735</td>
<td>22.5</td>
<td>G1</td>
</tr>
<tr>
<td>Denmark</td>
<td>835</td>
<td>22.5</td>
<td>G1</td>
</tr>
<tr>
<td>Border to Rendsburg</td>
<td>740 (835 since Dec 2012)</td>
<td>22.5</td>
<td>G1</td>
</tr>
<tr>
<td>Bridge over Kielkanal</td>
<td>740 (835 since Dec 2012)</td>
<td>20</td>
<td>G1</td>
</tr>
<tr>
<td>Hamburg Central station</td>
<td>740 (835 since Dec 2012)</td>
<td>22.5</td>
<td>G1</td>
</tr>
<tr>
<td>South of Bremen</td>
<td>740</td>
<td>22.5</td>
<td>G2</td>
</tr>
<tr>
<td>Germany</td>
<td>740</td>
<td>22.5</td>
<td>G1</td>
</tr>
</tbody>
</table>

Source: (Troche, G, 2009)
4. Effects of longer lorries and trains

4.1. Simulations

The use of longer HGV and/or trains in the corridor central Sweden-Ruhr is simulated with the help of a preliminary version of the Swedish national freight transport model Samgods.\(^9\) The model minimizes the annual logistics costs for the goods transported in, to, from and through Sweden, divided into 33 commodity groups. The trade-off between inventory costs and transport costs as well as the exploitation of economies of scale and the consolidation of shipments from different shippers are modeled.\(^10\) As in the K+P study it is assumed that the carriers pass cost savings (or cost increases) to the shippers. The transport demand matrix for 2006 is assumed (Edwards, Bates & Swahn, (2008)) agrees reasonably well with today’s demand. Our analysis comprises both goods that are transported on the corridor and goods that are “attracted” to the corridor. The results are shown for the Swedish transports inside and outside Sweden. The international perspective is necessary as we study a border crossing corridor and conditions for freight transports change both inside and outside Sweden.

We assume a base scenario with max 18.75 m long HGV in Germany and max 25.25 m long HGV in Sweden and max 650 m long trains in the rail corridor.\(^11\) The eight investigation scenarios presented in Table 5 are compared to the base scenario.

Table 5: Investigation scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road 1</td>
<td>25.25 m long HGV are allowed in the corridor; access via terminals</td>
</tr>
<tr>
<td>Road 2</td>
<td>25.25 m long HGV are allowed in the corridor; access via terminals and direct</td>
</tr>
<tr>
<td>Rail 1</td>
<td>750 m long freight trains allowed in the corridor</td>
</tr>
<tr>
<td>Rail 2</td>
<td>1000 m long freight trains allowed in the corridor</td>
</tr>
<tr>
<td>Rail 3</td>
<td>1500 m long freight trains allowed in the corridor</td>
</tr>
<tr>
<td>Road 1 + Rail 1</td>
<td>25.25 m long HGV, that have access via terminals, and 750 m long freight trains are allowed in the corridor</td>
</tr>
<tr>
<td>Road 1 + Rail 2</td>
<td>25.25 m long HGV, that have access via terminals, and 1000 m long freight trains are allowed in the corridor</td>
</tr>
<tr>
<td>Road 1 + Rail 3</td>
<td>25.25 m long HGV, that have access via terminals, and 1000 m long freight trains are allowed in the corridor</td>
</tr>
</tbody>
</table>

Scenario Road 1 assumes that max 25.25 m long HGV are allowed in the road corridor and that the HGV can access the corridor in Germany via terminals.\(^12\) Scenario Road 2 assumes that the HGV also can drive directly between sender/receiver and road corridor. In the light of the experience from Sweden and the trial in Denmark,\(^13\) Scenario Road 1 is more realistic than Scenario Road 2. The scenarios Rail 1, Rail 2 and Rail 3 refer to different max train lengths in the corridor. Short term Scenario Rail 1 with a train length of max 750 m is most realistic, also in the light of the objectives of the Trans European Networks for Transport (TEN-T). Scenario Rail 2 with max 1000 m train length and Scenario Rail 3 with max 1500 m train length require major infrastructure investments and adaptations. The combined scenarios Road 1 + Rail 1, Road 1 + Rail 2 and Road 1 + Rail 3 assume that both longer HGV and longer trains can be used in the corridor. The combinations Road 2 + Rail 1, 2, 3 are not systematically presented in order to keep down the number of analyses.

It is assumed that the overall freight demand matrix is constant. This assumption is considered to be realistic in the short term. However, more long term lower transport costs would influence the firms’ transport demand and localization. We calibrated the freight flows on the ferries between Sweden and Germany and the Öresund Bridge. Due to lack of statistics we use the base, including our calibrations and corrections in form of additional transshipment possibilities for containers between road and rail.\(^16\)

The longer and heavier lorry type can easily be activated on the German part of the corridor and the ferry links. In Germany, to describe the tonne-km and vehicle-km related to Swedish transports inside and outside Sweden,\(^14\) the transport demand matrix for the goods transported between Inventory costs and transport costs as well as the exploitation of economies of scale and the consolidation of shipments from different shippers are modeled.\(^10\) As in the K+P study it is assumed that the carriers pass cost savings (or cost increases) to the shippers. The transport demand matrix for 2006 is assumed (Edwards, Bates & Swahn, (2008)) agrees reasonably well with today’s demand. Our analysis comprises both goods that are transported on the corridor and goods that are “attracted” to the corridor. The results are shown for the Swedish transports inside and outside Sweden. The international perspective is necessary as we study a border crossing corridor and conditions for freight transports change both inside and outside Sweden.

The Samgods model contains a lorry type at max 18.75 m and 40 tonnes and a lorry type at max 25.25 m and 60 tonnes (allowing in Sweden).\(^15\) The longer and heavier lorry type can easily be activated on the German part of the corridor and the ferry links. In Sweden does not have inland waterway transports.

\(^9\) For more information about the model see (de Jong, G.; Ben-Akiva, M.; Baak, J, 2008) and (Vierth, I; Lord, N; McDaniel, J, 2009). The model version from September 2012 has been used.

\(^10\) The load factor (use of vehicle capacity) is calculated within the model. The actual version of the Samgods model assumes consolidation within the 33 commodities and not across the commodities, which is a shortcoming especially for rail and sea.

\(^11\) It is assumed that it is not profitable to run with 25.25 m vehicles in Sweden and change to 18.75 m long vehicles at the border.

\(^12\) In Lübeck, Hamburg, Bremen and Hems.

\(^13\) In Denmark ca. 90 % of the transports with 25.25 m long HGV are to/from terminals, ports and rest stops. (Grontmju & Tetraplan, 2011).

\(^14\) We are though aware of the fact that the road and sea transports in Sweden and the combined transport inside Sweden are somewhat overestimated in the Samgods-base. According to the statistics the rail share inside Sweden (measured in tonne-km) is about 23 per cent, road and sea have nearly 40 % each. Sweden does not have inland waterway transports.

\(^15\) The Danish trial with max 25.25 m and 60 tonnes HGV that continues to the end of 2016 is not included in the model.
contrast to the road vehicles, the model does not have rail vehicle types with different capacities\textsuperscript{16}. Therefore we have instead reduced the link costs in the rail corridor by 8\% for the max 750 m long trains in Scenario Rail 1, by 17\% for the max 1 000 m long trains in Scenario Rail 2 and by 26\% for the max 1 500 m long trains in Scenario Rail 3 to express the difference in costs compared to the base scenario. The cost decreases are taken from on a study performed by the consultancy TRANSRAIL (Eriksson, 2009). The same rates are applied for combined transport trains, wagon load trains and system trains in Sweden. The transfer costs in terminals are calculated per tonne (and hour) and do not take into account any additional costs for longer HGV or trains in terminals. The current version of Samgods model does not contain lorry terminals outside Sweden (as assumed in scenarios Road 1 and Road 2 to get to/from the corridor). Therefore, we have introduced an additional charge of 17 € 235 for the transfer from 18.75 m long HGV to 25.25 m long HGV at the sender/receiver.

4.2 Effects of longer trucks and trains singly and in combination

As expected, the permission of max 25.25 m long HGV in the road corridor in Scenario Road 1, leads, all else equal, to shifts from rail to road. The competition between the rail route via Jutland and the road route via Travemünde becomes clear in the difference-map in Figure 2 (first map). The fact that the reduction of the rail transports is calculated to be less south of Bremen than north of Bremen confirms that rail is more competitive over long distances. The road corridor is expected to “attract” goods from other roads.\textsuperscript{18} Some increase is expected for the road transports using the ferry Trelleborg-Rostock. This can be explained by the decreasing rail transports between Sweden and mainland Europe that lead to higher per-tonne-costs for rail and shifts from rail to road. Road transports in Denmark are affected marginally. The effects are calculated to be higher in Scenario Road 2 than in Scenario Road 1, which illustrates that the access to the road corridor is important for the outcome.

\textsuperscript{16} except for three wagon load trains of different length and system trains that can be used on specific parts of the Swedish network

\textsuperscript{17} 1 Euro = approx. SEK 8.5

\textsuperscript{18} The accuracy is lower in Germany, with a less dense road network in the model, than in Sweden
The difference maps in Figure 2 show the tonnes goods transported. The red colours relate to road transports, the green colours to rail transports and the blue colours to sea transports. The dark nuances demonstrate increases and the light nuances decreases. The same scale is used in the maps.
Figure 2 Calculated effects in terms of tonnes on links compared to base for Scenario Road 1, Scenario Rail 1 and Scenario Road 1 + Rail 1

The competition between the rail route and road route is also illustrated in the Scenario Rail 1 (See Figure 2, second map.) The lower costs in the rail corridor are expected to "attract" goods along the entire route Sweden-Ruhr as well as the south and west of the Ruhr area. The competitiveness of the rail mode increases with the transport distance (as was also seen in the road scenarios). The impacts are greater in the Scenario Rail 2 and Scenario Rail 3, where a bigger shift from rail to sea is expected.

In Scenario Road 1 + Rail 1 both the road and rail transports to/from the Öresund region, that is connected to the road/ferry route and the rail route, increase. The ferry transports on the Travemünde route are expected to increase while the vessel transports decrease. The difference map in Figure 2 (third map) shows that the road and ferry transports mainly increase for the relatively short distance transports between Sweden and Northern Germany. South of Hamburg the growth is larger for rail transports than road transports. The results indicate that the effects that are calculated for Scenario Road 1 and Scenario Rail 1 are largely additive. The sea transports are computed to be reduced in all combined scenarios because the land transport modes improve their competitiveness.

The sea transports are influenced almost exclusively in the scenarios that include rail. In the rail scenarios (Rail 1, Rail 2 and Rail 3) the amount of rail-tonne-km increases with the train length although the growth rate decreases. This indicates that it becomes more difficult to find sufficiently large freight volumes i.e. to fill the 1500 m long train, which is a requirement for the exploitation of economies of scale. In Scenario Road 1 + Rail 1 a small rail transport increase is computed, mainly due to transfers from 18.75 m HGV. The tonne-km performed by 25.25 m HGV are calculated to increase in all three combined scenarios. It is obvious that road and rail are complementary but also compete.

The road-vehicle-km are calculated to be constant in Scenario Road 1 and increase slightly in Scenario Road 2. The constant amount of road-vehicle-km in Scenario Road 1 indicates that road safety is not affected, provided that the risk is only dependent on the number of road-vehicle-km performed. In all other scenarios less road-vehicle-km than in the base scenario are calculated.
We calculate the amount of CO₂ emissions based on the vehicle-km for the different vehicle types, emission factors for road transports from the ATREMIS-project, Sjödin et al (2009) and rough assumptions for sea transport emissions, Viert & Mellin (2008). Following the Swedish CBA-guidelines we do not calculate CO₂-emissions from rail transports. In all scenarios except for Scenarios Road 1 and Scenario Road 2, the CO₂ emissions from road transports are reduced. In Scenario Road 1 the decrease of the CO₂ emissions due to the shift to longer HGV is slightly less than the increase due to the shift from rail to road. The CO₂ emissions from sea transports are computed to drop in all scenarios and the reported magnitudes need to be interpreted with caution.

The utilization of economies of scale for HGV and freight trains individually and/or in combination is calculated to result in reduced logistics costs in all scenarios. The use of max 25.25 m long HGV in the road corridor with access via terminals in Scenarios Road 1 is computed to lead to cost savings of about € 8 million per year for the industry. The cost savings are estimated to be greater in Scenario Road 2 than in Scenarios Rail 1. The cost savings in the combined scenarios are calculated to be at least as large as the sum of the savings for the individual road rail scenarios. The lower logistics costs dominate the economic benefits in all scenarios. The benefits resulting from reduced CO₂ emissions are estimated to be less than 1 % of the benefits due to reduced logistics costs.

4.3. Uncertainties

Although we receive consistently intuitively expected results we want to emphasize that the figures in tables 6 to 8 above have to be seen as indications of the impacts of the change of the dimensions for the land based vehicles in the corridor central Sweden-Ruhr rather than precise quantifications. The results are broadly consistent with the effects that Transport & Mobility compute for the use of longer/heavier HGV and PANTEA-NEA for the use of longer/heavier trains. The effects concerning the competition between rail and road are also largely consistent with the results in the K+P study. However different assumptions and delimitations do not allow direct comparisons; the K+P study excludes transports under 200 km and specific commodities and analyses the impact on rail corridors in future years while our study comprises all today performed freight transports in, to/from and through Sweden. The

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19 ARTEMIS = Assessment and Reliability of Transport Emission Models and Inventory Systems (We use emission factors for 40-tonne-HGV and 60-tonne-HGV.)

20 The effects on the logistics costs (and not the transport costs) are presented. The reason is that the trade-off between transport costs and inventory costs is modeled and that it is possible that the firms’ transport costs can decrease (due to the exploitation of economies of scale) and that the inventory increase.

21 Validated according to the Swedish CBA guidelines (Trafikverket, 2012)
modal shifts in our study, addressing changed dimensions in an international long distance corridor, are as expected larger than the shifts calculated in the government commission that studied smaller HGV in Sweden, Vierth et al (2008).

4.4 Simplified CBA

The results presented in section 4.2 indicate that a “financial potential” is generated that (at least to some extent) can be used for infrastructure measures. Therefore we performed a rough cost benefit analysis. The analysis cannot be as complete as the analyses in the government commission (Vierth et al (2008)) as we do not have detailed information about other traffic than Swedish import and export flows in the corridor which is needed to calculate the impact on i.e. the travel time for other travelers. Neither do we have information about the distribution of the residents along the corridor (which is needed to calculate the impact on noise and air pollution) nor the need for infrastructure measures outside Sweden. As the road scenarios are constructed no infrastructure investments are required in Sweden. The permission of up to 25.25 m long HGV in the corridor is calculated to lead to annual cost savings for the industry of about € 8 million. In Scenario Road 2 about € 27 million less logistics costs and less CO₂-emissions worth € 8 352 are calculated.

The premise is that only investments in the Swedish rail infrastructure are required and that the existing Danish and German infrastructure is already developed for the 750 m long trains. The removal of the bottleneck in Sweden is calculated to generate cost savings for the entire route. The Swedish Transport Administration (Ekmark, 2012) estimates that infrastructure investments of € 23 million (short term) - € 117 million (long term) are required to upgrade meeting and bypass tracks to be able to operate 750 m long trains between central Sweden and the Öresund Bridge. The benefits of Scenario Rail 1 are calculated to be about € 18 million due to reduced logistics costs and about € 11 764 costs due to reduced CO₂-emissions. This means that the investments in the rail infrastructure are expected to be repaid after about one year (costs around € 23 million, benefits around € 18 million per year) respectively around five years (costs around € 117 million, benefits around € 18 million per year). Our rough calculations indicate that the profitability of rail investments does not decrease if longer HGV and longer trains are simultaneously used in the corridor.

4.5. Needs for development

Our calculations suggest the need for in-depth analyzes of the costs and benefits that are not included above (e.g. transport time for other travelers or noise). There is also a need to proceed in steps to align the Swedish rail network and the TEN-T network to a minimum train length of 750 m. Another issue, which we have not dealt with in this paper, is the weight restrictions that would apply for at least a share of the longer HGV:s and trains. A further question is how the access to the corridor should be developed. More detailed investigations should also include in-depth analysis for sea transports. We showed that sea transports are both complementary and competitive to land transports. An example of the latter is the relatively large increase of transit traffic through the county of Skåne in the South of Sweden that is calculated in Scenario Road 1 + Rail 1.

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22 As mentioned above, we calibrated the freight flows on the ferries between Sweden and Germany and the Öresund Bridge. To test how the model’s sensitivity is affected by this we calculated the respective scenarios with the calibrated model and the uncalibrated model and the results are quite stable.

23 On the roadside, especially investments in bridges and parking/rest areas are needed. (Irzik, 2009).

24 valued according to the Swedish CBA-guidelines (Trafikverket, 2012). In Scenario 1 the CO₂-emissions are more or less the same as in the reference scenario.

25 for 835 m long trains in Denmark and between the Danish/German border and Hamburg.

26 According to the calculations that the National Rail Administration (since 2010 Swedish Transport Administration) made in connection with the Infrastructure Master Plan 2010-2021, investments in meeting and bypass tracks between Hallsberg and Malmö/Trelleborg and Hallsberg and Gothenburg to allow traffic of 750 m long trains are profitable. (Banverket, 2008). It is not explicitly stated in the report, but we assume that the Rail Administration only includes savings on Swedish territory. Our calculation, however, includes benefits in Sweden and abroad.
5. Conclusions

The project has been studying the effects of enabling the use of longer HGV and freight trains in an intermodal freight corridor that stretches from central Sweden to the Ruhr area in Germany. Today the transports are assumed to be designed based on the smallest vehicle dimensions along the corridor: 18.75 m for HGV in Germany and 650 m for trains in Sweden. Road transports typically use the shortest route that includes a ferry service from Malmö/Trelleborg to Travemünde while rail transports typically use the route via Öresund/Jutland.

In total eight investigation scenarios are assumed and compared to the base scenario that assumes a maximum length of 18.75 m for HGV and of 650 m for trains in the intermodal corridor:
- **Scenario Road 1** where max 25.25 m long HGV are permitted in the corridor and have access to the corridor via terminals, **Scenario Road 2** where max 25.25 m long HGV are permitted in the corridor and have access to the corridor via terminals and direct, **Scenario Rail 1** where max 750 m long freight trains are permitted in corridor
- **Scenario Rail 2** where max 1000 m long freight trains are permitted in corridor, **Scenario Rail 3** where max 1500 m long freight trains are permitted in corridor.
- **Combined Scenarios Road 1 + Rail 1**, **Combined Scenario Road 1 + Rail 2**, **Combined Scenario Road 1 + Rail 3**

The scenarios were analyzed using a preliminary version of the national freight model Samgods that includes all Swedish goods transports in, to/from and through Sweden. The model assumes constant demand. Economies of scale, consolidation of shipments are modeled and the firms’ annual logistics costs are minimized. The permission of longer HGV and/or freight trains affects the relative cost differences between different transport solutions.

It is shown that the transport system can be enhanced by using longer HGV, longer freight trains or both. The cursory CBA for investments in Sweden indicates
- that the permission of up to 25.25 m long HGV in the corridor is calculated to generate a about € 8 million reduction of the firms’ logistics costs per year **Scenario Road 1** (no investments in Sweden are needed and we do not have detailed information about the need for infrastructure measures in Germany)
- that the use of 750 m long trains in the corridor in **Scenario Rail 1** leads to a about € 18 million reduction of the logistics costs and less CO₂ emissions worth about € 10 000. The investments in the Swedish rail infrastructure, that are needed, are expected to be repaid after around one year resp. five years. (no major investments in Denmark and Germany are needed)
- that the profitability of the rail investments does not decrease if longer HGV and longer trains are simultaneously used in the corridor.

Our rough calculations suggest that there is a need for in-depth analyzes of the costs and benefits that are not included above, such as air pollution, noise and the impacts on the travel time of other travelers in the corridor. Another issue, which we have not dealt with in this paper, is the weight restrictions that would apply for at least a share of the longer HGV:s and trains. More detailed investigations should also include in-depth analyses for sea transports. In light of the development of trans-European networks, Green Corridors etc. we see a need to improve the evaluation methods and models for international policies and infrastructure projects.

Acknowledgements
The paper is based on a subproject in the so called Co-modality project that was funded by the Swedish Governmental Agency for Innovation Systems VINNOVA, the Swedish Transport Administration and the Swedish Energy Agency. The authors would like to thank these authorities.
References


