

ESTIMATION OF THE IMPACT OF LONG AND HEAVY VEHICLES ON FUTURE EUROPEAN TRANSPORT DEMAND AND MODAL SHIFT

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Abstract

This paper assesses the potential impacts of adjusting the current 96/53/EC directive of the European Union with respect to allowing the use of Long and Heavy Vehicles (LHV) in the 27 members States of the European Union. We have estimated the impacts of LHV use on future European road transport demand and modal split for the year 2020, also taking into account the potential effects on the use of rail and Inland Water Ways (IWW) transport. To make these estimations and come to conclusions, the TRANS-TOOLS model has been used. The main conclusion of the research is that an enlargement of the vehicles' weight and dimensions to 60 ton gross weight and 25,25 meter length would most probably increase the total road goods flow in Europe, while at the same time reducing the number of vehicle kilometres. The rail and IWW transport sectors may lose a few percent of goods flow volume as a result.

This paper is based on inputs for a study that was conducted for the European Commission in 2008 (TML, 2008).

1. The use of LHVs in Europe: what is at stake?

Currently, the directive 96/53/EC sets the rules and guidelines over Heavy Goods Vehicles (HGV) weights and dimensions in Europe. The limits on HGV vehicle size and weight in the European Union are the following: the maximum length is 18.75 meters and maximum weight 40 tonnes gross; in case of intermodal operations the weight maximum is 44 tonnes. Nonetheless, individual Member States can still set their own national limits on HGV weights and dimensions, the directive governs just the pan-European standards. In practice, several EU Member States are currently using more extended limits. Sweden and the Netherlands, for example, both use LHVs with a length of up to 25.25 meters and weight up to 60 tonnes, but these vehicles are limited in use to the Member State's boundaries and cannot cross the borders. Most of the other Member States have not adjusted their national regulations, such that the maximum dimensions of the 96/53/EC directive still apply in these countries.

The EU Member States that allow the operation of road freight vehicles with higher weights and/or dimensions within the national borders are on the whole positive about the use. In Sweden, more than 50% of all road tonne-kilometres are transported by LHVs (VTI, "The effects of long and heavy trucks on the national transport system", 2008), while in the Netherlands almost 400 exemptions for using an LHV have been given out to road transport companies by November 2009. Taking these results into account, there is a discussion concerning a possible extension of the maximum weights and dimensions for road transport in Europe. The benefits of such an extension are among others that LHV operators could perform cross-border operations, and improve road transport efficiency and sustainability. On the other hand, such an enlargement of the EC directive could change the European transport playing field, especially in respect to transport demand, modal split, safety, infrastructure, energy efficiency and emissions.

This paper focuses on mapping the potential effects of using LHVs on an Europe-wide scale, and provides information over the estimated economic impact of using LHV on European transport demand and modal split. It deals with the issues of road transport generation, the impact on road traffic intensity and on modal split, namely road, rail and Inland Water Ways (IWW) transport volumes. The presented results are based on input for a study commissioned by the European Commission on effects of adapting 96/53/EC directive (TML, 2008, see for complete study <http://ecstudy.hvwd.free.fr>).

What are the most important mentioned effects on the use of LHVs by the stakeholders? On the one hand, LHVs can transport up to 50% of volume extra and therefore can lower transport cost substantially. On the other hand, there are strong fears among combined transport operators and environmental groups that LHV could substantially change the transport market and affect the rail and IWW transport market, thus making land transport in Europe less sustainable. The paper addresses the issue of future road transport volume generation and the impact on modal split in the year 2020, when LHVs could be implemented on a large scale throughout Europe.

2. The Future Use of LHVs in Europe: Contrasting Opinions

Many European stakeholders have strong and diverging opinions on the possible impacts of the large-scale use of LHVs in Europe in the future. In order to give room for their opinions

over the use of LHVs, several workshops and stakeholder meetings were organized. The following stakeholders have put forward their arguments during the study in 2008:

The opponents of LHVs are mainly:

- Rail & combined transport operators or associations;
- Several governments or administrations in charge of transport and/or infrastructure;
- Associations defending the protection of the environment, directly or indirectly.

As to supporters of LHVs, they are essentially:

- Road hauliers (through their trade unions, if not hauliers themselves);
- Shippers/manufacturers (automobiles, telematics, tires, etc.).

The main arguments of supporters in favour of LHV use are:

- Fuel consumption and CO₂ emissions: at least -10 %.
- Road safety: no impact or even beneficial when assuming that the total number of trucks on roads decreases.
- Road congestion: an efficient way to decrease congestion. Expectations: 7 to 10 % fewer trucks on roads, 33 % fewer trips needed to transport the same amount of goods since 2 LHVs would replace 3 traditional trucks.
- Transport costs: -10 to -25 % depending on vehicle combinations.
- Payload: +30 to +50 %.
- Modal shift: a limited modal shift of maximum 5% overall on the opposite it is possible that intermodality is encouraged because the use of LHVs can be combined with existing intermodal units.
- Road longevity and road wear: +15 % road longevity, -22 % road wear.

The main arguments of opponents against LHV use are:

- Fuel consumption and CO₂ emissions: modal shift would cause an increase in fuel consumption and CO₂ emissions, from 5 to 10%. Empty runs with LHVs would worsen this problem. There would be a contradiction between these results and the EU targets for sustainable mobility.
- Transport demand and road congestion: road transport being more competitive, 3 smaller trucks would be replaced by 3 longer trucks; "Low-cost" road transport will generate extra demand and thus will not be able to reduce congestion.
- Combined transport volumes: -14 % to -55 % tonne-km according to studies; loss of market shares in long distance transport.
- Single wagonload volumes: -12 to -25 % tonne-km according to studies; single wagon transport services may be stopped.
- Road safety: the severity or even the number of accidents may increase with longer and heavier vehicles.
- Infrastructure: bridges and tunnels would be at risk. As road networks were not designed for more than 40t vehicles and/or underdeveloped in certain countries, allowing LHVs would require very large investments.
- Country planning: imbalances between territories where LHVs would operate and the others could occur. There could be competition to implement "swap" stations near the main roads.

When it comes to comparing the positions of the various stakeholders with reference to their country of origin, Stakeholders in Europe can be roughly divided in two parts:

- *LHV supporters*

North European countries are mostly in favour of LHVs. If not already users of LHVs, they (Denmark and Norway) are considering trials in the near future. Certain German regions and the Netherlands have already gathered experience concerning LHVs, thanks to their experiments and could therefore be associated to this first group of countries.

- *Cautious or opponents*

The most Central and Western Europe countries seem to be much more cautious regarding LHVs. Countries such as Austria and Hungary have made official statements to show their opposition to any adaptation of directive 96/53. Some Länder in Germany have experimented with longer and/or heavier vehicle combinations but on a Federal level, Germany has clearly expressed its opposition to LHVs on the German roads. For this reason, Germany also fits in the group of countries with reservations about LHVs. Since France has not yet made a decision on organising trials, it may be regarded as part of the group of "the cautious".

Therefore, the stakeholder meetings and workshops showed a wide range of arguments exchanged, mainly dependent on affiliation of the parties expressing their opinion. To clarify the impact of LHV in a methodologically sound way in the study, we employed two methods: the first one is an analytical approach which used transport price elasticities and the second one, a modelling approach, which used the comprehensive transport model TRANS-TOOLS.

3. Using LHVs in Europe: an Analytical Approach

In order to assess the possibilities in a general way, first an analytical study of the changes in European transport systems due to the introduction of LHVs was made. This allowed a first validation of the estimated impacts of LHVs on European transportation demand flows, conceptualising the opportunities at an aggregate level. In this analytical approach, we have identified the following most important factors that are of relevance. Below we briefly describe these factors:

1. *Share of LHVs in total transportation* is expressed as a number of tonne-km carried out by LHVs.
2. *The LHV cost discount* is fixed at 20 % on a tonne-km basis (based on pilot results in The Netherlands, Sweden and Finland)
3. *LHV extra capacity* in comparison to HGV is fixed at 50% (60 t and 25.25 m LHV versus 18.75m and 40 tonne normal HGV).
4. *The rail transport demand price cross-sensitivity* shows how rail transport demand is sensitive in respect to road transport cost. The cross-sensitivity shows what happens with rail transport volumes as a result of change in road transport price.
5. *Road transport demand price elasticity*. This variable is responsible for generation of extra transport demand if price of transport decreases. Actually there is no single literature source that can unambiguously identify this parameter. For the purpose of the study we looked at values of -0.3, -0.6, -0.9 and -1.2.

3.1. Estimation of Impact of LHV Use on Road Transport Demand and Flow

The figure below illustrates the estimated level of transport demand generation as the result of the use of LHVs in Europe and the impact on the infrastructure. The result of the figure should be read in the following way. The base situation is that 100 % of road transport de-

mand and vehicle kilometres are made when there are no LHVs on the roads. When the share of LHVs in use in Europe goes up, there will be extra generated demand for road transport but also (for selected elasticity values) fewer vehicle-kilometres made in total. It should be noted that road price demand elasticity is strongly related to tonne-km of cargo transported (as opposed to volume expressed in tonnes).

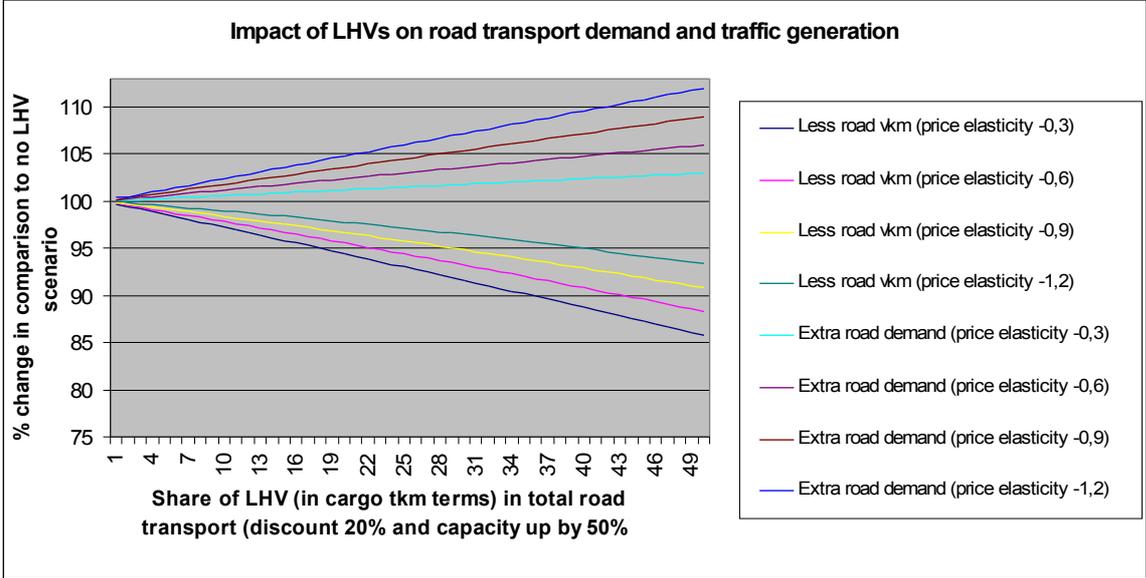


Figure 1 — Extra road transport demand and traffic generation

The conclusion is that the higher (in absolute terms) the road price sensitivity is, the more transport demand is generated. On the other hand, there is also a substantial decrease in the total number of vehicle kilometres driven because the LHVs can take 50% more freight. There is a substantial decrease in the total number of vehicle kilometres within the range of plausible road transport price elasticity values. Thus, the conclusion from this analytical exercise is that the use of LHVs would lead to more goods transported (up to 11% more with road transport price elasticity of -1.2), while at the same time there will be fewer vehicle kilometres (down to 14 % with road transport price elasticity of -0.3) , in other words less traffic and less congestion.

3.2. Estimation of Impact of LHV Use on Rail Freight Transport in Europe

The same analytical approach has been used to estimate the impact of LHV on rail transport volumes in Europe. The figure below shows the dependencies between rail freight transport demand and the use of LHVs in Europe, expressed in tonne-km (Y-Axis) on the share of road transport done by LHVs, given road price demand sensitivity and corresponding rail cross-sensitivity. The “BASE” situation refers to 2005 transport volume levels, the “2020” situation starts from the increased volume in 2020, assuming a growth of total transport by some 60% between 2005 and 2020, based on TRA.

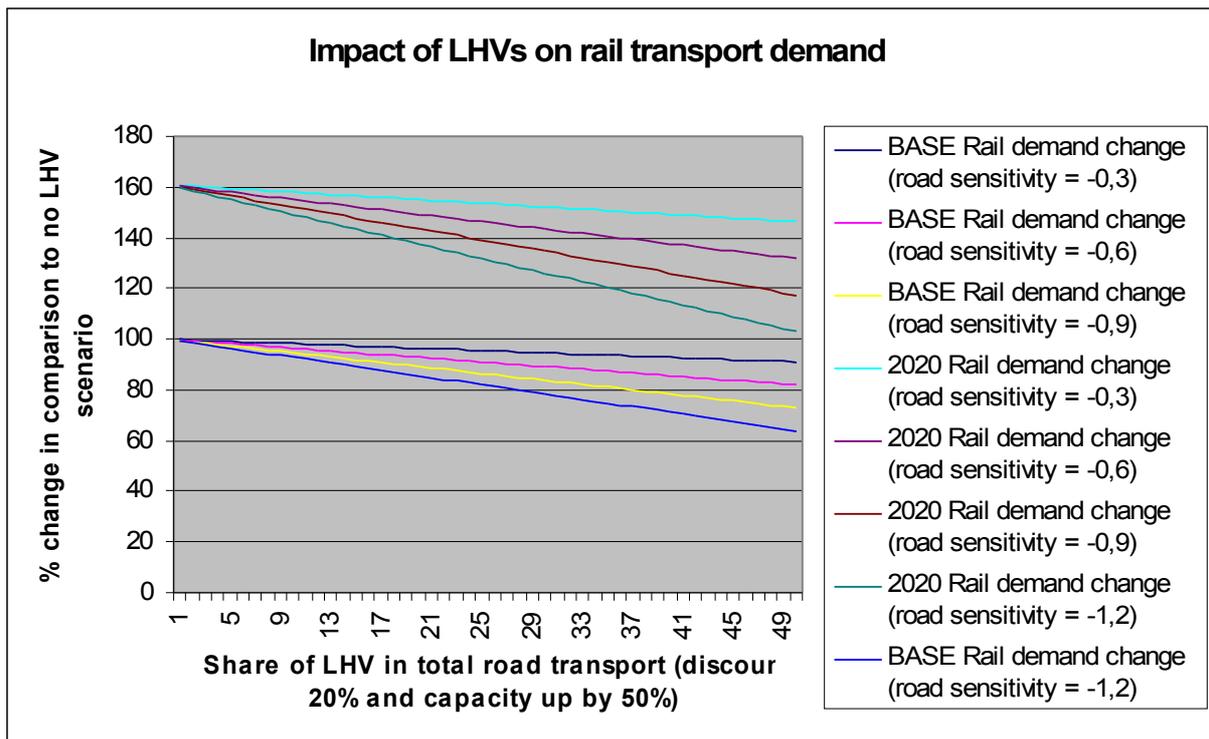


Figure 2 — Impact of LHVs on rail transport demand, base year 2005 and future year 2020

The conclusion from this analytical approach is that the use of LHVs in Europe negatively influences European rail freight volumes. As the figure shows, a reasonable range of impact is a 5 - 15 % decrease of tonne-km in rail transport in comparison to the situation with no LHVs. However, it should be taken into account that the projected growth of rail freight transport in Europe is 60.8 % between 2005 and 2020 (based on TRANS-TOOLS projections). If this projection is taken into account, then there will still be substantial growth of rail transport, even if LHVs are allowed throughout Europe. In practice, we talk about somewhat slowed-down growth of rail volumes, from some 3 - 4 % per year without LHV to 2.5 - 3.5 % per year with LHV.

This concludes the results of the analytical approach that were used for a first estimation, and have been based on the use of transport demand price elasticity and other assumptions. The next section presents the more detailed results for the economic effects of LHV use where the comprehensive European transport model TRANS-TOOLS is applied.

4. Using LHVs in Europe: the TRANS-TOOLS Modelling Approach

The recently set-up TRANS-TOOLS model forecasts the macro freight transport flows in Europe based on global economic trends. The model was commissioned by the European Commission and plays an important role in calculating the effects of future European transport policies. To employ the model for this research question, assumptions were made in the following categories:

1. Road transport demand price elasticity
2. Commodity groups and their share in LHV transport

3. LHV extra capacity in comparison to currently used vehicles
4. LHV transport cost discount factor
5. Average vehicle load factors
6. Determination of LHV share in transport flow.

More details over assumptions can be found in the study report (TML, 2008). TNO has modelled four scenarios in TRANS-TOOLS:

1. *Scenario 1: "Business as usual"*. This the reference scenario which assumes no changes to the road transport equipment constraints that were valid in 2000. It means that this scenario excludes any type of LHV from European transport networks; however, it includes national extensions on permitted weight, up to 44 tonne gross, which were applicable in 2000.
2. *Scenario 2: "LHV Full option": Europe-wide permission of 25.25 m 60 t trucks*. These LHVs trucks are allowed on all European motorways (i.e. backbone roads). The usage of LHVs on regional roads may be restricted: the restriction does not have a big influence on economics of LHV operation, i.e. there is a limited set of roads where LHVs are forbidden.
3. *Scenario 3: "Corridor/Coalition": LHVs of 25.25 m 60 t are allowed in some countries, while Europe-wide only 18.75 m 40 t trucks are allowed*. This scenario is a mix of scenarios 1 and 2. There is a group of countries that permit LHVs on their motorways, possibly putting some restrictions for the usage of regional roads, while the rest stick to the current restrictions (40t 18.75m). We include into the coalition 6 European countries: The Netherlands (NL), Belgium (BE), Germany (DE), Sweden (SE), Finland (FI) and Denmark (DK).
4. *Scenario 4: "Intermediate": Europe-wide permission of up to 20.75 m 44 t trucks*. This scenario represents a gradual increase in vehicle constraints, namely 10% of carrying capacity. The choice of dimensions and constraints is "realistic" and reflects wishes of car transporters and chemical industry.

In this paper, we present the results of Scenario 2, which estimates the situation when LHVs are allowed in all EU countries. This scenario presents the largest impacts of LHVs on transport demand and modal split in Europe, while the results of the scenarios 3 and 4 represent outcomes between the results of scenarios 1 and 2. The results are presented as percentage changes in comparison to the Business as Usual reference scenario 1. For the results of other scenarios we refer the reader to the full study report (TML, 2008).

The following figure presents the results of scenario 2 calculations in TRANS-TOOLS for the impact of LHV use in 2020 in respect to two parameters per EU Member State: tonne-kilometre volume growth and change in traffic intensity expressed in vehicle-kilometres. The parameters are presented in relative form, reflecting percentage change in respect to the reference Scenario 1.

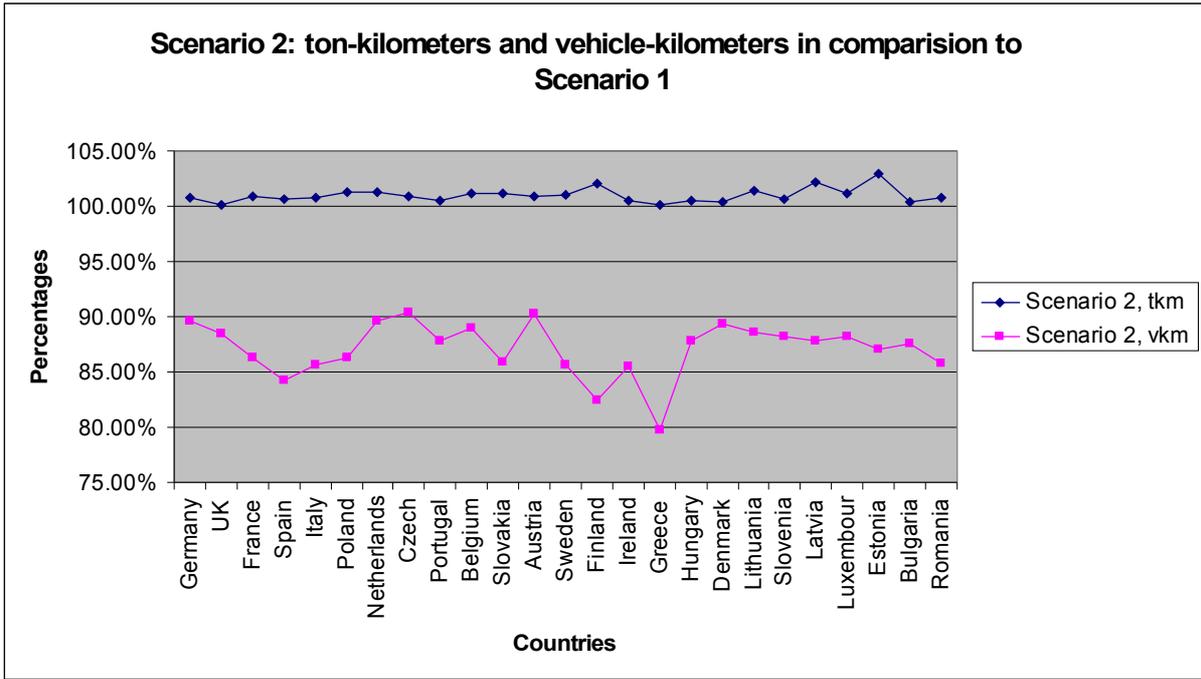


Figure 3 — Results of scenario 2 modelling on road transport volumes

The main conclusion from this figure is that European road transport volumes are only modestly affected by the use of LHVs. However, there will be a substantial decline in vehicle-km travelled since approximately 13% of HGV trips become redundant due to the fact that LHVs can take up to 50% more loads.

The next figure below shows the possible maximum impact of LHVs on rail and Inland Water Ways (IWW) transport volumes in Europe in respect to tonne volumes carried. The parameters presented in relative form, reflecting percentage change in respect to the reference Scenario 1.

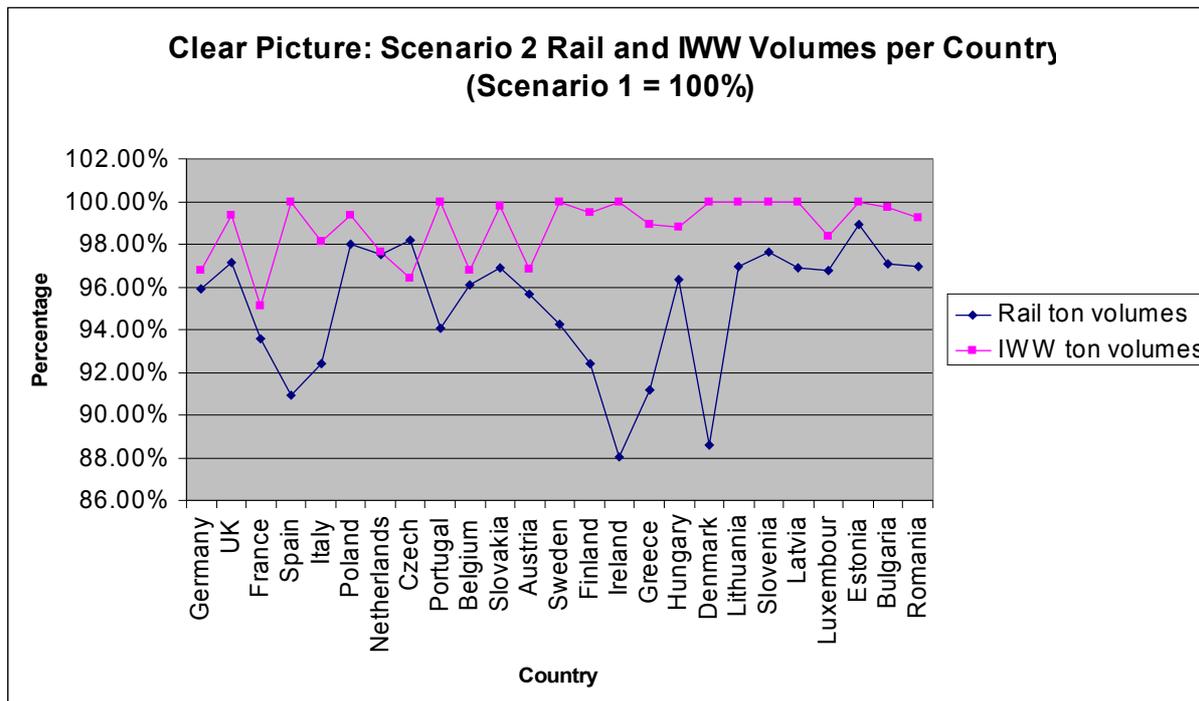


Figure 4 — Results of scenario 2 modelling: impact on modal split

Note: the countries such as Spain, Portugal and some other do not have noticeable IWW transport volumes. For these countries, the share of IWW does not change (i.e. the change is from negligible to negligible), but these countries are an intrinsic part of algorithm executions.

The main conclusion from this figure is that the total aggregate effect of LHV use in Europe on the European rail and inland waterway tonne volumes is a modest 3.8 % reduction in rail tonne-volumes and 2.9 % decrease in inland waterway tonne-volumes (weighted averages). The largest European transport markets, which are on the left side of the figure, are affected somewhat more than average in respect to rail: of the largest 5 European markets, only in the UK is rail affected less than the average of 3.8 %. Big countries with clear aggregation centres such as Spain, Italy and Finland are affected more than smaller and more uniformly developed ones (in terms of geographical distribution of economic activity).

5. Conclusions

In this paper, we discussed the effects of a possible adjustment of the European directive 96/53/EC that governs heavy vehicles' weights and dimensions in the European Union . The European stakeholders are strongly divided over the overall effects of a possible increase in vehicle weights and dimensions for trucks in Europe. Broadly speaking, shippers, manufacturers of trucks and road transport operators are in favour of LHVs, while combined transport operators and environmental groups are strongly opposed to it.

As there was and is no consensus over the impact of the use of LHVs on European transport volumes and for society at large, we calculated the possible impacts of LHV use with two methods: a general analytical and a detailed modelling approach. Both methods show a rather

limited impact of the use of LHVs on road transport demand generation and modal split in Europe. In other words, we expect that with using LHVs in Europe the transfer of rail freight and IWW volumes to LHVs will be limited, while the price decrease in road transport due to the possibility of using LHVs will generate only 1 to 3% of new road volumes as well. On the other hand, LHVs will substantially decrease the number of annual vehicle-kilometres in Europe and thus road traffic, as these vehicles have some 50% more carrying capacity in comparison to “normal” HGV.

All in all, the results of this study are positive about the economics and societal impact of LHV use in Europe. However, there are some caveats. LHVs are long and heavy, and their impact on infrastructure should be considered carefully, as some bridges for instance may require reinforcement. Also, the operation of big vehicles demands extra safety measures and precaution. Roads must be certified for the usage of LHV. Thus, the use of LHVs can not be allowed throughout Europe without a framework of additional policy measures.

What do the results of this study mean for Europe? On the basis of our calculations and seen from the European viewpoint, we propose a harmonization of European policies in respect to allowing LHV to operate borderless in Europe. In this way, the most important benefits of LHV operations can be realized in practice. According to our calculation, the rail and IWW sector will not suffer much from LHV use, however the use of LHV's would apply extra competitive pressure on these sectors. The integral societal benefits of LHV, expressed in the form of price decrease for road transport, fewer heavy vehicles on the roads and less congestion, less energy consumption and emissions should justify the adjustments of the directive from an economic viewpoint.

6. Main References

- TML, Effects of adapting the rules on weights and dimensions of heavy commercial vehicles as established within Directive 96/53/EC, 2008, see for complete study <http://ec-study.hvwd.free.fr>
- VTI, “The effects of long and heavy trucks on the national transport system”, 2008