Noise-Differentiated Track Access Charges for Rail Infrastructure - an Approach towards an adequate pricing for Externalities in the Railway Market?

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1 Introduction: Noise-externalities as a particular problem of rail-freight transport

Rail freight in Europe has regained essential strength after the sector had lost both volumes and market share during a steep decline in the early 1990ies.[1] The overall rail freight volume in EU 15 states grew from 205.4 billion tonne-km in 1993 to 292.4 billion tonne-km in 2008 by 42.3%.[2] As a result environmental externalities associated with rail freight transport grew at almost the same rate as transport volumes, most notably noise, which is widely regarded as the most dominant environmental externality of rail freight:[3] An estimated 10% of EU-population is exposed to rail-noise above the threshold of 55 dB Lnight – a level which has detrimental effects on health.[4]

Technically, there are several approaches to tackle rail-noise: During the last decade 15 EU-member states introduced several noise-abatement programmes most of which concentrated on passive noise-protection measures such as constructing noise-barriers along the main rail corridors and fund the improvement of noise-insulation in private households.[5]

More recently, several studies have revealed that noise abatement measures 'at source' deliver a benefit-cost-ratio 2-4 times higher than passive measures do:[6] Among such 'at source' measures the retrofitting of the existing freight-wagon fleet with composite brake blocks (K-block or LL-block) has been found to be most effective and efficient with regard to reduce noise-

[1] The reversed trend in rail freight is most likely a result of EU and member state policies to gradually introduce liberalisation and competition via several packages of directives. The first services to be liberalised were international freight services on the Trans European Rail Freight Network, followed by other international freight services and domestic freight services.

[2] European Commission- Mobility and Transport 2010: Statistical Pocketbook 2010.

[3] KCW/Steer Davies Gleave / TU-Berlin 2009: Analyses of Preconditions for the Implementation and Harmonisation of Noise- Differentiated Track Access Charges

[4] European Environment Agency 2009: TERM 2008 3/2009 Transport at a Crossroad.

[5] Pricewaterhouse Coopers 2007: Impact Assessment Study on Rail-Noise Abatement Measures addressing the existing fleet.

[6] EU-UIC ‚STAIRRS' 2006.

emissions. Both technologies decrease the roughness of wheel and rail-surface[7] and hence reduce the sound level of the pass-by-noise of a train to up to 15 dB (A). This translates into a perceived noise-reduction of up to 50%.[8]

However, the main obstacles against replacing the currently used Cast-Iron brakes with K or LL- brake block are the commercial constraints that exist in the rail freight sector. Due to the competitiveness of the freight market stakeholders (Wagon Owner, Wagon keepers and Railway Undertakings) do not have sufficient resources or incentives to finance the retrofitting of their fleets.

Hence, the EU favours a coordinated approach at the European level: As some 50% of rail freight transport is international, national abatement strategies – as already applied in Switzerland or the Netherlands – could have a negative impact on cross-boarder corridors and give some Railway Undertakings a competitive advantage over others who are not able to receive any benefits by their respective government.

Command and control approaches such as access or speed restrictions for non-retrofitted vehicles or noise-emission regulation for existing vehicles[9] have been ruled out by the Commission at a relatively early stage of the evaluation process; so was the fiscal instrument of direct funding. Instead, the Commission favoured a Noise-Differentiated Track Access Charge (NDTAC) where a mileage related bonus and/or penalty – dependent on whether or not wagons have been retrofitted – should be incorporated in the existing Track Access Charge.

The political discussion regarding the introduction of a NDTAC currently held on the EU and member state level reveals that the introduction of noise-externality charges is more complex than theory may suggest. Aim of this paper is to

- briefly describe the theoretical concepts regarding noise-externality charges against the background of externality-charges in general;
- contrast these concepts with the technical and institutional constraints of the implementation of a NDTAC for rail freight traffic;

[7] The main cause for wheel and rail roughness is the brake system: Wheels in the brake block system are at the same time wheel surface and immediate contact pressure elements which have to hold the braking power. When such brakes are used, the brake block frequently overheats and as a result, small particles come off the brakes and melt onto the rail and wheel surfaces. This mostly occurs when cast iron (CI) brake blocks are used. This type of brake is currently in use on the majority of freight wagons. Composite brake blocks (K- and LL-blocks) represent a possible solution to this problem. When they are used, no particles bond to the rail and wheel surfaces.

[8] Carlsson,Ulf (2003): Noise and vibration aspects on railways goods transportation.

[9] It is important to distinguish between existing and new vehicles at this point as the TSI Noise regulates since June 2006 noise-emission limits for new freight wagons in accordance with directive 2001/16/EC. Wagons put in service after this date have to be equipped with K-Block Brakes or similar technologies. For wagons put into operation before the above mentioned date, the TSI Noise does not apply.

- describe the NDTAC which has been developed by a consortium of KCW, Steer Davies Gleave and TU Berlin for the European Commission in 2010; and

- identify the gaps between theoretical approaches and 'practice'.

Subsequently the analysis will lead to the question, whether the approach of vehicle-differentiated track access charges could be used for other purposes within the charging regimes of Infrastructure Managers.

2 Theoretical approaches towards noise-externality charges in the rail freight sector

In economic theory externalities are seen as a form of market failure where the market fails to achieve an 'efficient equilibrium' with marginal social cost being lower than marginal social benefits. The most important externalities allocated to the transportation sector are accident costs, damage to the infrastructure, scarcity (congestion) costs and environmental costs – subcategorised into noise, air-pollution and climate change.[10] For freight-rail it is usually argued that both, accident costs and infrastructure damage costs are widely internalised through insurance payments and gross-tonne differentiated track access charges respectively.[11] The concept of scarcity-externalities is often – and sometimes imprudently – borrowed from road-transportation where any additional user imposes cost on other users in case the network is congested. It is arguable whether or not this applies for scheduled freight-rail services or not.[12] The most notably remainder are environmental externalities.

EU directive 2001/14/EC generally allows the IM to charge the operator for environmental costs. In case these charges increase the revenue of the IM they can only be charged if applied to competitive modes of transport on a comparable level though.[13] Only two countries in the EU currently charge for environmental externalities: Finland and Sweden (both following a marginal cost approach in setting rail infrastructure charges) charge for air-pollution and climate change respectively by levying different fees for diesel and electric traction (per gross-ton-kilometre). The Netherlands and Switzerland have introduced a bonus in order to reward 'silent' wagons utilising their rail infrastructure. The bonus is paid to Railway Undertakings as a multiple of the

[10] Cf. Santos et al. (2010): Externalities and economic policies in road transport, Research in Transport Economics 28 (2010) 2-45.

[11] Nash (2007): Infrastructure Charging – Theory and Practice, in: Competition in Europe's Rail Freight Market.

[12] Scarcity externality refers to undesirable repercussions from shared use of a scarce resource. This principle does not apply to scheduled freight rail services, where congestion is not the effect of demand for an additional train-path as such. The element of social cost to which this gives rise is the scarcity value of the train path is the next best use; and only if borne by another operator (cf. Nash, Sansom 1999: Calculating Transport Congestion and Scarcity Cost, Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging)

[13] Benedikt (2006): Rail Infrastructure Charging in the Europen Union.

number of 'silent' axles per kilometre. Eligible axles need to be equipped with K-block, disc or drum brakes. However, the bonus is not embedded into the regular track access charge; wagon owners need to send an application to the Infrastructure Manager on a regular base.[14]

Most other approaches towards charging for noise-externalities discussed are of theoretical nature and follow the idea of Pigovian taxes in the sense that they look at marginal social costs imposed on society rather than looking at costs associated with retrofitting of freight-wagons. In essence there are two key concepts of charging: The first one follows an overall social marginal cost approach by broadly estimating the total number of people affected by rail-noise, then applying monetarisation factors either used in national appraisal guidelines or derived from other studies and finally assigning the cost to different train/service types (e.g. regional passenger train, high-speed rail and freight train) per train kilometre.[15] The second concept is looking in more detail at the number of people being exposed to rail-noise within certain time-bands (differentiation by time of the day), by route (spatial or route-specific differentiation) and/or the distribution of affected population according to different levels of exposure (by classifying so called 'sound pressure level classes).[16] Aim of this differentiation of noise charges by time and route is to achieve a higher allocative efficiency by incentivising railway undertakings to either use routes with lower number of inhabitants exposed to rail noise and/or use these routes at a different time of day.

Overall objective of both concepts is to penalise those operators which are not using quiet technologies and hence to incetivise them to run quieter wagons by setting the charge in accordance with social marginal costs of running 'noisy' wagons.

3 Noise-externality charges in practice – the EU approach towards introducing a Noise-Differentiated Track-Access Charge

This section gives an overview of the elements of a noise-differentiated track access charge (NDTAC) scheme which was developed by a consortium of KCW ltd. Berlin, Steer Davies Gleave ltd. London and the University of Technology Berlin on behalf of the European Commission. It is a European approach to translate the political ambitions of pricing for external effects into the reality of the rail freight market.

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[14] In Switzerland only foreign Wagon Owners are eligible to apply for the bonus. Domestic Wagon Owners are compensated through a direct funding scheme.

[15] Cf. for instance Andersson / Ögren 2007: Noise Charges in Railway Infrastructure: A Pricing Schedule based on the Marginal Cost Principle, Transport Policy 14 (2007) 204-213: For Sweden for example marginal social cost of rail noise have been estimated to be EUR 0.026/ train-km for commuter trains, EUR 0.099/train-km for high-speed trains and EUR 0.89/ train-km for freight trains.

[16] Cf. Pricewaterhouse Coopers (2007), pp.55.

In a first step the framework conditions which constrain the characteristics of a NDTAC will be explained; in a second step characteristics of the developed NDTAC scheme will be outlined.

3.1 Framework conditions for a Noise-Differentiated Track Access Charge on a European level

Despite the rise in volumes the rail freight sector has seen within the last decade, margins generated remained low. Moreover, the economic crises in 2008/09 pushed many companies in a loss area. Any additional burden – such as a penalty paid for use of 'noisy' wagons – would compromise the sector in two ways: The intermodal position of rail freight would be weakened, notably in comparison with road haulage. Furthermore intramodal competition would be at risk as rail companies with market power could refinance such burden easier than smaller businesses. Additionally rail freight is inhomogeneous: While segments such as combined traffic are competitive, other segments such as non-bulk traffic have a high risk of being substituted by road haulage. Consequently an NDTAC must consider all different kinds of rail freight. Contrariwise the scheme couldn't account for the complexity of the market.

As there is a relatively low-cost technology in place which allows to significantly reduce noise-emission by an estimated 50% the commission prefers a charge which is set in order to compensate wagon owners for the costs associated with the retrofitting of wagons with either K-blocks or LL-blocks. As a result the accounting system needs to work on the basis of wagon-mileage rather than train-mileage and hence needs to address wagon owners rather than railway undertakings.

However, simple business relations as they existed in former times of the railways are gone. The largest share of rail freight volume is carried by Railway Undertakings which lease just as many freight wagons as required. Particularly private Railway Undertakings do not own freight wagons any more. The wagons are often kept and owned by separate (leasing) companies. Furthermore, some services are organised by operators or shippers but run by a third party (Railway Undertaking). The main challenge for an NDTAC is to consider this structure in order to incentivise the wagon keeper, as this party is carrying the financial risk of the retrofitting.

Furthermore the incentive level (the bonus level) needs to be defined. The bonus must not only refund retrofitting costs, but also additional operational costs are to be compensated. The additional costs of the new brake blocks should not be underestimated. If there is no chance of getting these costs refunded, wagon keeper will not retrofit their wagons. This also implies that the level of bonus paid per wagon km or axle km respectively may need to be higher than an externality charge.

Apart from constraints resulting form the market structure, there are constraints within existing track access charging scheme. However, none of the European track access charge – except the UK – has set charges based on kilometric performance of wagons. Charges are imposed on entire trains and not on a wagon basis. A conversion of all European track access charging schemes is not a feasible option: This would require a complete new system of data exchange between Infrastructure Manager and Railway Undertaking in most member states. A NDTAC requires a precise wagon recording in order to calculate the mileage-based bonus. This applies for silent wagons at least. If a bonus and malus is raised, all wagons must be recorded.

Recording and consequential complexity is increased enormously if further differentiation of bonus is implemented. Indeed, this could be a good option of pricing for externalities. But dispatching trains is not as easy as it seems. In the daytime train paths are often blocked by passenger trains. It is unlikely that freight trains would be shifted from night to day time simply to get hold of a relatively small noise-related bonus. Furthermore, using different routes is also hard to manage. Most of the European rail freight is operated on very few corridors. Divert these freight services would require very good reasons for Railway Undertakings. Beside these operational arguments against differentiation by time and route, the effort to monitor such a complex system should not be undervalued.

Finally stakeholder's fear of high costs for the systems has to be considered. Wagon owners are afraid of the risk of undercompensating their investments while Railway Undertakings a worried about increased track access charges. Finally the Infrastructure Manager struggle against additional transaction costs for infrastructure pricing.

These framework conditions shape the constraints for a noise-differentiated TAC. In the course of the European study the consortium defined the recommended NDTAC based on these constraints. The main elements will be outlined in the following section.

3.2 The recommended NDTAC

Objective of the proposed NDTAC was to secure retrofitting of the majority of the freight wagon fleet within a time horizon of 5-7 years by prioritising those vehicles with the highest annual mileage. At the same time, the level of complexity and administrative costs should be kept to a minimum. Furthermore, the incentive system should neither weaken the overall market share of the freight sector nor disadvantage any freight market player. Finally the benefit of decreasing external effects of rail freight was the ultimate target.

Thus the study recommended a system which is more like an add-on of existing TAC schemes. The regular train path will be charged within the existing systems. The noise bonus will be charged separately. A malus for noisy wagons is not recommended, as it implies complexity and high implementation costs. Also any differentiation by time or route is not recommended due to its impact on the complexity of the NDTAC.

The level of bonus is calculated on the basis of the costs of retrofitting and the additional operational costs of new brake blocks. Furthermore the bonus is based on the number of axles per wagon in order to refund stakeholder's investment accurately. The total time of funding a single wagon should be restrained to six years at least and twelve years at the most.

The recommended level of incentive including a surcharge for administrative costs is EUR 0.032/ wagon km for a 4 axle wagon retrofitted with K-Blocks and is EUR 0.012/ wagon km for a 4 axle wagon retrofitted with LL-Blocks respectively. It must be noted that these values are significantly higher than the external costs imposed by 'noisy' wagon; however they would apply for a six year programme period only.

The charging of bonus is quite the same as the charging process for ordinary trains – between IM and RU. The difference is that RU has to apply for the bonus on basis of a list of train composition (at least a simplified list). This is the basis for the IM for calculating and finally transferring the bonus to the RU. How to transfer the bonus to the wagon owner, who is responsible for the investment, is still an unsolved problem. But the complexity of the rail freight market make it almost impossible to implement a common structure for bonus transfer. Due to different business models the stakeholders will find specific ways to transfer the bonus: Either through direct transfer or indirect transfer by factoring the bonus into the renting or leasing price.

4 Main gaps between theory and practice

The previous chapter revealed the main problems of charging for externalities. There are ambitious political issues on one hand and practical challenges for such a pricing on the other hand. The major finding is that charging for externalities based on social marginal costs approaches is not a feasible option for the rail freight sector. The only practical solution is to define the bonus subject to retrofitting costs and additional operational costs. This would set the best incentive to wagon keeper. If this incentive leads to a faster retrofitting, it is the best incentive for making rail noise more silent. Indeed, this is not a text book approach for charging of externalities as theory would suggest. But at least the effects of pricing should be important. Any additional pricing in a complex, inhomogeneous and fragile market like the rail freight market, could lead to effects that no one wants. The worst case scenario would be a modal shift from rail to road due to higher costs for

rail freight. Additionally the administrative costs for changing charging schemes or relationships between stakeholders should not be underestimated. Thus the consortium proposed in his analysis a simple system without to many specifications in order to keep the costs low.

In general this applies for any approach of pricing externalities in the rail sector. Avoiding negative external effects in the rail market succeeds best if there is an incentive for stakeholders. Furthermore also equal treatment of all modes of transport has to be ensured. In the end a win-win situation for all parties are possible. Politics is able to limit or even avoid negative effects. This also applies for Infrastructure Managers. Due to the costs of infrastructure they have their own interest that Railway Undertakings use track-friendly and fail-safe rolling stock in order to avoid operational disturbances or track damages. And Railway Undertakings and most notably wagon keeper get an incentive for modernisation and renewal of their wagon fleets.