Peer review of Network Rail's indicative charges proposal made as part of its Strategic Business Plan

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1 Introduction and Summary

1.1 The Institute for Transport Studies (ITS), University of Leeds, has been commissioned by the Office of Rail Regulation (ORR) to conduct a short peer review of the charging proposals put forward by Network Rail in its Strategic Business Plan (SBP) (Network Rail, 2007a, 2007b).

1.2 The structure of this report is as follows. Following this introduction, we first discuss the appropriateness of the overall charging package. Then we discuss the likely incentive issues surrounding the move to route based charging. We also comment on the possible incentive issues resulting from certain charges being more geographically disaggregated than others. We offer some economic comments on the way Network Rail proposes to measure variable cost and finally contrast the results of Network Rail's variable cost modelling and implied charges with evidence from other European countries.

1.3 We conclude that the overall charging package represents a step forward in terms of providing incentives to Network Rail, train operators, ROSCOs, train manufactures and industry funders. However we do believe that there are a number of ways in which charges could be made more cost reflective, for instance by means of a simple scarcity charge, by including environmental costs and by changes to the calculation of the fixed charge, which could be better aligned to avoidable cost in order to give funders better appreciation of the costs of providing sets of rail services. Aligning fixed charges to avoidable cost would allow transparency between what Government and the media perceives groups of individual rail services to cost the taxpayer and the true opportunity cost of such services. We also think that consideration of the degree to which the costs to passengers and train operators of possessions are part of variable cost, given that additional traffic reduces the period between maintenance and renewal activities, could usefully be investigated.

1.4 We consider that route based charging would be more cost reflective and so improve incentives to various parties. We do recognise that these benefits may be reduced or even outweighed by the extra administrative burden and so we would advocate only introducing this refinement where evidence shows that the differences between routes are large, but the evidence presented by Network Rail suggests that this is the case. In terms of having different geographical disaggregation of charges for different elements of charge, we do not foresee any major problem with this in terms of incentives with the exception of congestion and scarcity charges. In particular, we do note that route based variable access charging should be accompanied by congestion and/or scarcity charge of sufficient disaggregation to prevent any undesirable movement away from freight or secondary lines to main lines.

1.5 Regarding specifically the variable access charge, we are surprised that the overall proportion of track maintenance and renewals costs deemed variable with usage is found to be approximately 8%,[1] given evidence from other European countries which show the variability proportion on average is much higher. We are also surprised that the variability of cost proportion is found to be so low given how Network Rail calculate it, via looking at a 5%-10% increment in traffic. This could be viewed as a step change in usage rather than a marginal change and therefore be expected to yield a higher variability proportion. We do note however that while the variability of cost proportion is low relative to European comparators, the fact that average costs are so much higher in Britain implies that the movement to a lower variability results in marginal costs more in line with, but nevertheless still above, other European countries.

2 Overall Charging Package

2.1 Optimal incentives as to the number, route and time of trains are given by variable charges equal to the short run marginal social cost of use of the network. This would ideally include wear and tear costs, congestion, scarcity, environmental and marginal external accident costs. Obviously such charges have a limited impact on the decisions of franchised passenger operators given that these decisions are heavily influenced by the franchise agreement, although we believe that variable access charges are regarded as the best available estimate of the resource cost of additional services, and thus influence the decisions of franchising bodies via the appraisal process. They are more important for freight and open access operators.

2.2 The current proposals cover wear and tear and congestion only. Ideally other costs would also be included. We are aware that reservation charges and scarcity costs have been examined and rejected for the time being, but we believe that these do warrant further examination. Whilst a congestion charge reflects the knock-on effect on delays of operating at a higher capacity utilisation level, a scarcity charge reflects the opportunity cost of capacity in a situation in which some operators simply cannot get the paths they want. A scarcity charge should be levied as a reservation fee whenever the fact that a path is reserved for one operator means that others cannot use it. Whilst existing research on scarcity costs has used complicated models to produce detailed estimates of these opportunity costs (see for instance Deliverable 3 of the GRACE project – www.grace-eu.org), we believe that a simplified approach could be developed. Whilst the Route Utilisation Study approach may lead to appropriate planning of passenger franchises, and general allocation of paths for open access and freight, these studies are only undertaken periodically (every ten years in the case of freight). The precise demands of those sectors cannot be known for so many years ahead, and it is in these sectors that a scarcity charge,

[1] Calculated as the sum of the expected passenger and freight revenue in 2009/10 given on page 9 of Network Rail (2007b) and electrification asset wear costs given on page 13 (total variable cost) divided by the sum of the 2009/10 expenditures for maintenance and renewals in Figures 6.2 and 6.3 in Network Rail (2007a) (total cost).

levied as a reservation charge, may be most effective. It is particularly important to avoid counter productive incentives from a differentiation of wear and tear charges which involves much higher charges for secondary routes than for main lines.

2.3 A simplified scarcity charge might be estimated from a spreadsheet model which estimated the loss of passenger or freight traffic from the non availability of paths by time of day, according to traffic volumes, and took typical diversion factors between modes, and road external costs.

2.4 Whilst it may be argued that environmental costs should not be charged for rail when they are not explicitly charged for road, it remains the case that an environmental charge would encourage energy efficiency and lower noise and emissions, including the use of electric traction where possible. Moreover there is a substantial tax on fuel for road vehicles which may be seen as a crude environmental charge, and where taxes and charges do not fully cover externalities of road use, for heavy goods vehicles, there are explicit grants available to contribute to rail track access charges. On the other hand, there is already a low rate of tax on diesel fuel for rail traction, and this could be adjusted to reflect the shadow price of carbon and typical air pollution costs. Electricity production is already part of the European Emissions Trading Scheme. So it is only really noise costs that may be most easily reflected in track access charges, which would obviously need to be differentiated by vehicle type, location and time of day.

2.5 There is a shortage of research on the degree to which accident costs are external. To the extent that the rail industry bears most of its own accident costs directly, or through insurance, it may be argued that these costs are already internalised. However, to the extent that some costs (e.g. medical) are borne by the state, or by individuals, there may be an element of external accident cost. Moreover, level crossings are a clear case where additional trains may raise the accident risk for road users (Sweden explicitly charges for this in its track access charges). But given the high safety record of rail, the external cost of accidents is likely to be low.

2.6 We believe in principal that the incorporation of horizontal forces into the estimation of wear and tear costs should lead to improved incentives, although the issue of how accurately this has been achieved lies outside our area of expertise. We also note that a lot of the ICM modelling which determines the size of the variable charge, realise on the use of equated gross tonne-km which may contain factors that require updating, especially considering the work on horizontal forces. We also believe that the proposed modification of the congestion charge represents a substantial improvement over the crude implementation of this that has taken place to date.

2.7 However, there is an argument that charges based solely on short run marginal cost, with or without mark-ups, do not provide appropriate signals for the development of the network in the long run either to operators or to the infrastructure manager. Operators may argue for enhancements to the infrastructure for which they will not have to pay (it is only generally in the case

of modest enhancements which do not form part of the High Level Output Specification that operators contribute to the costs). Infrastructure managers may have an incentive to limit capacity in order to profit from high congestion and scarcity charges.

2.8 To the extent that in Britain decisions on infrastructure capability are taken on social cost benefit grounds, this risk is minimised. However, we still believe that the cost implications of changes in services which imply changes in infrastructure capability would be more transparent if the fixed charges levied on franchised passenger operators were explicitly related to the long run avoidable cost of their set of services, including the fixed cost of infrastructure which would not be required if those services did not run. Aligning fixed charges to avoidable cost would allow transparency between what Government and the media perceives groups of individual rail services to cost the taxpayer and the true opportunity cost of such services, and provide funding agencies with valuable information. Fixed costs over and above the sum of the avoidable costs of the different passenger franchises might be best paid as direct government support to Network Rail; given the approach taken to passenger franchising, this will simply affect franchise bids and should be neutral in its overall effect on government finance. If there are public finance reasons for a larger proportion of costs to be covered by fixed charges, then this could be separately identified as a contribution to joint costs.

2.9 We accept the argument of Network Rail that the approach taken to this issue in the report by AEAT (2005) aimed at measuring avoidable cost relies too much on subjective judgement, but believe this to be an area where more research on objective statistical methods of estimating avoidable cost would be valuable. We would advocate building on the existing AEAT approach by undertaking new research to verify the robustness of some of the modelling assumptions. Further statistical analysis would be useful both in areas of the model which have adopted the technique but in a rather simple way (for example the modelling of S&C units) and in areas of the model which currently rely on judgement. In particular a statistical relationship between track-km per route km and the number and mix types of train could be developed as an alternative to the highly subjective way that the change in running lines resulting from a reduction in services is determined, which is central to the allocation of costs in the model.

2.10 In the freight sector, there is a similar argument that if specific operators require enhanced capability of the network, they should be willing to sign a long run contract including a fixed charge representing the avoidable cost of this capability. However, there is a clear problem then of what other operators wishing to use the facility should pay. Arguably they should be admitted on the basis of short run marginal cost pricing, unless they are directly competing with the operator paying the fixed cost, in which case they should take over that part of the fixed cost representing the reduction in profits to the operator in question that they cause (Baumol, 1983). However, this would be difficult to implement in terms of information requirements, and might lead to game playing in terms of one freight operator waiting to see if another will bear the fixed cost.

2.11 Thus we do not see this as a feasible approach for freight operators. We do support Network Rail's proposals that major renewals and enhancements (including catering for step changes in traffic volumes) should be subjected to cost benefit analysis, and if desirable financed through the RAB. The proposed additional charge for coal and nuclear waste operators to reflect the cost of freight only lines, should be seen purely as a mark-up designed to reflect the problem of funding such lines given the unwillingness of the government to do so. As such it is inevitably distorting in that it raises the variable charge above short run marginal cost, and may therefore discourage some traffic at the margin, but we believe that the way in which this is being implemented is probably the least distorting way possible in the circumstances.

3 Route based charges and other geographical disaggregation

3.1 Network Rail has calculated marginal usage costs by both route type (primary, London & South-East, secondary, freight and rural) and by different curvatures. The basis of analysis is from the results of the ICM (for the route type distinction) and engineering modelling of horizontal forces undertaken by TTCI (UK) (for the curvature distinction). In general, the more charges reflect variations in marginal costs the better incentives the charge gives for train operators, Network Rail, ROSCOs, train manufactures and funders to make decisions in an optimum way, through trading off the overall marginal benefits with the overall marginal costs. As such route and curvature based charging would seem to have benefits.

3.2 However adopting this regime adds to the charging complexity. Already, charges are differentiated by vehicle type; differentiating further by route type and curvature would add considerably more charges to the menu. There may be costs to doing this, such as administration costs. We would not expect these to be large relative to the improved incentives, but they do suggest only adding further differentiation where it is likely to have a significant impact.

3.3 We do note that the range of proposed charges varies from £1.10 per thousand gross tonne-km for straight primary lines to £9.58 per thousand gross tonne-km on curvy rural lines. This difference is quite large which increases the likelihood that the benefits from improving incentives will outweigh the extra administration costs resulting from their implementation.

3.4 Differentiating charges by England and Wales on one hand and Scotland on the other (irrespective of whether then further disaggregating by curvature) is a less complex way of breaking down charges and would be more cost reflective than not breaking down at all but less than breaking down by individual routes.

3.5 In general the incentive properties of variable charges are maximised when they reflect accurately marginal cost. Thus we would not expect that all elements of charges should be disaggregated in the same way as they reflect different marginal costs driven by different factors. Potential disincentives arise where disaggregating one charge further causes operators to behave in an undesirable way due to another charge not being sufficiently disaggregated.

3.6 One example may be that the introduction of route base charging may encourage an operator to switch routes from a lightly used route to a route with severe scarcity problems, because a scarcity charge is non existent or not cost reflective enough. This might be a concern especially for freight services which can have a choice of routes.

4 Variable cost measurement

4.1 The methodology used by Network Rail to calculate the proportion of cost variable with traffic has been to consider the cost change resulting from a 5-10% increment in traffic. Network Rail alludes to the fact that as the increment increases, so the proportion of cost deemed variable with usage may increase. This is because the cost function for each track section is modelled as non-linear and in particular there are step changes such as when the extra usage is sufficient to change the inspection regime.

4.2 We are surprised that 5%-10% is seen as appropriate given that this seems to stretch what can be considered as a marginal change in traffic. Network Rail justify the 5%-10% increment by saying that it is small enough not to lead to a change in capability of track, and so is consistent with the principle of short-run marginal cost, and that it is sufficiently large to smooth out individual cost components.

4.3 We would agree that for a given track section the cost function is non-linear with discrete step changes. However we would expect that when the same increment is applied to a large number of or all track sections, the overall cost function would be smooth, since some sections would hit the steps in the cost function whilst others would not. We understand that Network Rail has applied this increment system wide, which should then give a reasonable estimate of marginal cost with a lower increment.

5 Review of proposed variable cost against evidence from other European countries

5.1 In this section we review the evidence from other European railways as well as from other studies of Great Britain, regarding the level of variability of cost to usage by train operators.

5.2 Table 1 shows the results of several studies in various EU countries. There have been a number of studies which have considered maintenance cost only and a smaller set of studies that have considered maintenance and renewals costs.

5.3 We report the elasticity of cost with respect to usage (equivalent to proportion of cost variable with traffic) given in the studies. This must be viewed with caution since different studies have considered different cost elements. A more meaningful comparison is to scale the elasticities from the individual studies (downwards) by multiplying them by the proportion of cost considered in each

study (referred to in the table as the "Scaled Elasticity")[2]. For comparison, the overall variability of maintenance and renewals costs indicated by Network Rail's ICM analysis, is approximately 8% (calculated as in footnote 1). For maintenance only the figure is approximately 14%[3].

5.4 It can be seen that the variability proportion (usage elasticity) estimated by Network Rail is much lower than for those studies that have considered both maintenance and renewal costs (scaled elasticities between 0.18 and 0.3). The European estimates are more consistent with the work undertaken by Booz Allen Hamilton (2005) for the 2005 Structure of Cost and Charges (SOCC) review by ORR and the proportion adopted in the 2000 Periodic Review (similar to the overall variability indicated in the SOCC review).

5.5 As for maintenance only (for which there are more studies), the range of scaled usage elasticities is 0.07 and 0.26. Therefore 0.14 estimated for Network Rail fits into this range. However it is still on the low side relative to all studies and in particular the study by Booz Allen Hamilton (2005) and the econometric study by Wheat and Smith (forthcoming) both of which consider exclusively Great Britain.

5.6 Table 2 shows the cost variability breakdown by activity for Network Rail's charging proposal and compares this to the figures determined at the 2000 Periodic Review and the 2005 Structures of Charges Review. The main reason for the fall in the overall variability is due to a reduction in the proportion of plain line track and S&C track renewal cost deemed variable with usage[4]. Another reason for the difference, not highlighted in the table, is that the other studies concluded that some other elements of cost such as signalling renewal had small usage related variabilities.

5.7 Table 1 also contains estimates of (average) marginal costs from the studies. For countries other than Great Britain average marginal costs are between 0.22 and 0.55 Euro per thousand gross tonne-km for maintenance and 0.79-0.97 for maintenance and renewal. The studies for Great Britain show substantially higher marginal costs than for other countries, between 1.25 and 1.78 Euros per thousand gross tonne-km for maintenance and 4.99 Euros per thousand gross tonne-km for maintenance and renewal. We note that given the fall in the proportion of cost variable with traffic implied by the new analysis by Network

[2] For this to be a perfectly valid comparison this assumes that there is no variability in the elements of cost not considered in the studies and also that the constituents of maintenance and renewal are the same across countries. The first requirement is likely to hold, especially for maintenance only cost, given that track expenditure (rail, sleepers and ballast) is shown to be the most variable component of cost and is considered in all studies. The second requirement is less likely to hold given the different definitions of maintenance and renewal expenditures between countries. However without undertaking a very detailed audit of definitions per country, the scaled elasticity measure represents a good comparator.

[3] Calculated by taking the 2009/10 variable expenditures for "Track – Maintenance" and "Signalling – Maintenance" reported in Figure 4.3.3 in Halcrow (2008) and adding in the £2.3 million reported variable for electrification maintenance on page 14 in Network Rail (2007b) and dividing by the 2009/10 total maintenance expenditure given in Figure 6.2 of Network Rail (2007a).

[4] While the proportion variable for electrification renewal is very different from the 2005 work (but roughly in line with the 2000 review proportions), the overall expenditure share is low for electrification and so this does not affect the overall usage elasticity very much.

Rail, marginal cost will be much lower. Using the system-wide estimate of £1.79 per thousand gross tonne-km and assuming a rough exchange rate of 1.4 Euros/£, then this implies an overall (maintenance and renewals) marginal cost of 2.5 Euros per thousand gross tonne-km. This is lower than from other studies for Great Britain but still substantially higher than in other countries.

5.8 Other studies provide support for the conclusion that more lightly used routes (e.g. rural routes) have greater marginal costs. This is because in all econometric studies (with the possible exception of the French study (Gaudry and Quinet, 2003 and 2007)) marginal costs have been found to fall at least initially with increasing usage (see for example Figure 1 reproduced from Wheat and Smith (forthcoming)).

6 Conclusion

6.1 This report has reviewed the charging proposals put forward by Network Rail in its Strategic Business Plan (SBP). We conclude that the overall charging package represents a step forward in terms of providing incentives to Network Rail, train operators, ROSCOs, train manufactures and industry funders. However we do believe that there are ways in which the charges could be made more cost reflective, particularly by introducing simplified scarcity charges and environmental charges. Also we believe that the fixed charge could be better aligned to avoidable cost in order to give funders better appreciation of the costs of providing sets of rail services.

6.2 We consider that route based charging would be more cost reflective and so improve incentives to various parties. We do recognise that these benefits may be reduced or even outweighed by the extra administrative burden and so we would advocate only introducing this refinement where evidence shows that the differences between routes are large. In terms of having different geographical disaggregation of charges for different elements of charge, we do not foresee any major problem with this in terms of incentives bar one particular issue, that of scarcity. We consider that route based variable access charging should be accompanied by a scarcity charge of sufficient disaggregation to prevent any undesirable movement away from freight only and secondary lines to main lines.

6.3 Regarding specifically the variable access charge, we are surprised that the overall proportion of cost deemed variable with usage is found to be approximately 8%, given evidence from other European countries which show the variability proportion on average is much higher. We are also surprised that the variability of cost proportion is found to be so low given how Network Rail calculate it, via looking at a 5%-10% increment in traffic. This could be viewed as a step change in usage rather than a marginal change and therefore be expected to yield a higher variability proportion.

6.4 We do note however that while the variability of cost proportion is low relative to European comparators, the fact that average costs are so much higher in

Britain implies that the movement to a lower variability results in marginal costs more in line with, but nevertheless still above, other European countries.

References

AEA Technology (2005). *Recovery of Fixed Costs – Final Report.* A report for the Office of Rail Regulation

Andersson, M. (2006a), "Case study 1.2D I: Marginal railway infrastructure cost estimates in the presence of unobserved effects", Annex to Deliverable 3 of GRACE (Generalisation of Research on Accounts and Cost Estimation), Funded by the European Commission Sixth Framework Programme. ITS, University of Leeds, Leeds.

Baumol WJ (1983). *Some subtle pricing issues in railroad regulation,* International Journal of Transport Economics.

Booz Allen Hamilton/TTCI (2005). *Review of Variable Usage and Electrification Asset Usage Charges: Final Report.* A report to the Office of Rail Regulation.

Gaudry, M., and Quinet, E (2003). *Rail track wear-and-tear costs by traffic class in France,* Universite de Montreal, Publication AJD-66. Also available as a WCTR paper, 2007.

Halcrow (2008). *Independent Reporter A: Reporter Mandate – Variable Usage Costs, Final Report.* Report for the Office for Rail Regulation.

Johansson, P. and Nilsson, J. (2004). "An economic analysis of track maintenance costs". *Transport Policy* **11(3),** pp. 277-286.

Link, H., Becker, A., Matthews, B., Wheat, P., Enei, R., Sessa, C., Meszaros, F., Suter, S., Bickel, P., Ohlau, K., de Jong, R., Bak, M. and Lindberg, G. (2007) "Monitoring Pricing Policy Using Transport Accounts", Deliverable 5 of GRACE (Generalisation of Research on Accounts and Cost Estimation), Funded by the European Commission Sixth Framework Programme. ITS, University of Leeds, Leeds.

Munduch, G., Pfister, A., Sogner, L. and Stiassny, A. (2002). "Estimating Marginal Costs for the Austrian Railway System". Working paper 78. Department of Economics Working Paper Series. Vienna University of Economics & B.A., Vienna.

Network Rail (2007a). *Strategic Business Plan Control Period 4.* Available at www.networkrail.co.uk.

Network Rail (2007b). *Strategic Business Plan, Supporting document: Structure of charges.* Available at www.networkrail.co.uk.

Tervonen, J., Idström, T. (2004). *Marginal Rail Infrastructure Costs in Finland 1997-2002.* Report from the Finnish Rail Administration. Available at www.rhk.fi accessed 20/07/2005.

Wheat, P.E. and Smith, A. S. J. (forthcoming), "Assessing the marginal infrastructure wear and tear costs for Great Britain's railway network", Forthcoming in Journal of Transport Economics and Policy. Available from the authors on request

Table 1 Results of studies in European countries

Study	Country	Proportion of Maintenance cost considered in the studies	Reported Total Usage Elasticity (Average)	Scaled Elasticity	Average Marginal Cost (Euro per thousand gross tonne-km)(**)
Maintenance only					
Wheat and Smith (forthcoming) Model VI	Great Britain	45%	0.378	0.17	1.775
Booz Allen Hamilton (2005)	Great Britain	60%	0.28	0.17	1.768
Andersson (2006a)	Sweden	100% *	0.204	0.204	0.35
Marti and Neuschwander (2006) Model type 1	Switzerland	Not stated – 70% assumed	0.200	0.14	0.45
Marti and Neuschwander (2006) Model type 2	Switzerland	Not stated – 70% assumed	0.285	0.20	0.38
Tervonen and Idstrom (2004)	Finland	55% (of basic and special maintenance)	0.133-0.175	0.07	0.22
Munduch et al (2002)	Austria	Not stated (for track maintenance 70% assumed)	0.27	0.19	0.55
Gaudry and Quinet (2003, 2007)	France	Not stated (for track maintenance 70% assumed)	0.37	0.26	Not reported
Maintenance and Renewals					
Andersson (2006a)	Sweden	100% *	0.302	0.302	0.79
Booz Allen Hamilton (2005)	Great Britain	100%	0.19	0.19	4.99
Marti and Neuenschwander (2006)	Switzerland	Not stated – 70% assumed	0.265	0.19	0.97
Tervonen and Idstrom (2004)	Finland	66%	0.267-0.291	0.18	0.83

Note: Where the proportion of total maintenance cost considered in the respective study has not been provided in the paper a judgement was made as to the most appropriate proportion based on the description of costs in the paper and correspondence with the authors.
* From correspondence with author. This study, unlike Johansson and Nilsson (2004), examined maintenance/maintenance and renewal and not maintenance and operations/ maintenance, renewals and operations hence the 100% cost used
** 2005/06 prices

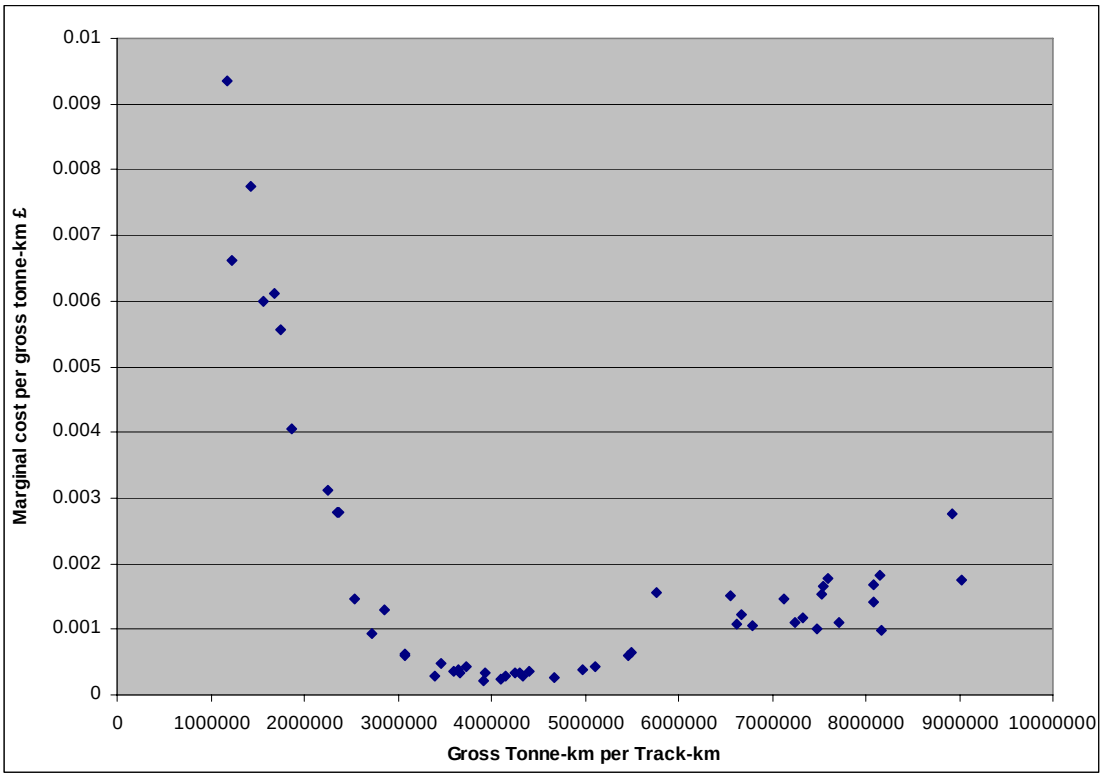
Source: Link et al (2007), updated using Wheat and Smith (forthcoming)

Table 2 Cost categories reported in the 2000 Periodic Review and Structure of Costs and Charges (SOCC) Review and Network Rail's charging proposals in the Strategic Business Plan

Cost Category		% variability with traffic 2000 Periodic Review	% variability with traffic SOCC analysis	% variability with traffic Network Rail's SBP
Maintenance				
Track		30%	28%	29%
Signalling		5%	3%	5%
Electrification		10%	9%	10%
Renewals				
Track	Plain line	36%	44%	25%
	Switches and crossings	25%	47%	17%
	Metallic			
Structures	Underbridges	10%	16%	20%
	Embankments		5%	6%
Electrification	AC	35%	11%	40%
	DC	41%	6%	40%

Source: Halcrow (2008) Figure 4.3.3, amended with information on electrification variability from Booz Allen Hamilton (2005) and Network Rail (2007b) p. 14

Figure 1 Behaviour of the estimated marginal usage costs for Great Britain from Wheat and Smith (forthcoming)



Source: Results from Model VI. Reproduced from Figure 4 in Wheat and Smith