

## Independent Regulators' Group – Rail

### Working group Charges

# Overview of the application of market segments and mark-ups in consideration of Directive 2012/34/EU

November 2021

#### Introductory Remarks

This overview provides an overview of market segmentation and mark-up calculations as they stand at the time of writing. IRG-Rail intends to review it as further information becomes available. This document is complemented by an appendix containing some case studies on the country specific implementation.

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## Introduction

The basic charging principle for the minimum access package is set out in Article 31(3) of Directive 2012/34/EU. This Article states that charges should be set at the “cost that is directly incurred as a result of operating the train service”. IRG-Rail has issued five position papers aimed at clarifying its interpretation of the concept of “cost that is directly incurred”.<sup>1</sup> Article 32(1) sets out an exception to the basic charging principle that allows, under certain conditions, the infrastructure manager to obtain “full recovery of the costs incurred” by levying mark-ups on different market segments.

This paper aims to provide an overview on market segmentation and mark-ups. As such, this document first details the economic and legal backgrounds of these concepts and explains how they are currently applied by infrastructure managers across Europe. It sets out different pricing methodologies in monopolistic environments and focuses in particular on the Ramsey Boiteux approach as one possible practice whilst acknowledging that other methodologies can be applied to respond to specific characteristic of the relevant market.

Then, the paper lays out some initial considerations, focusing on the obstacles that may arise from the application of the Article 32(1) and detailing some solutions that have been identified to circumvent these problems. Since market segments and mark-ups are complex issues and the implementation of the Directive is incomplete or recent in most countries, this paper further contributes to the discussion from IRG-Rail. It is thus important to underline that the developments included in this paper establish IRG-Rail’s current understanding and practices with regard to market segmentation and the assessment of mark-ups.

Regulatory expertise as well as relevant data are acquired over time and practice, therefore more sophisticated techniques and methodologies are expected to be developed in the coming years as the experience of regulatory bodies (RB) on the matter grows. Moreover, the regulatory framework of each country represented in the document is an expression of the national law transposing the Recast. Therefore, the paper is complemented by an appendix in which some RBs provide case studies on the national implementation of their segmentation and mark-up calculation.

This paper may be of interest to railway infrastructure managers (IM), railway undertakings, national regulators and, more generally, to any party interested in these issues.

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<sup>1</sup> The four position papers are: (1) Position paper on the concept of « cost that is directly incurred », October 2012, (2) Position paper on the European Commission’s upcoming draft implementing act on the modalities for the calculation of the cost that is directly incurred as a result of operating the train, October 2013, (3) Position paper on the forthcoming implementing act on the modalities for the calculation of the cost that is directly incurred as a result of operating the train service, November 2014 and (4) Second position paper on the European’s Commission upcoming draft implementing act on the modalities for the calculation of the cost that is directly incurred as a result of operating the train service, May 2014. (5) Position paper on Guidelines to the calculation of direct costs in respect of Implementing Regulation 2015/909, November 2016.

## 1. Legal Background

Currently, the European legal basis of market segmentation and mark-ups relies on Directive 2012/34/EU. It should be noted that the principles set out in Directive 2012/34/EU may also apply to some non-EU Member States which have chosen to transpose some or all of its provisions (e.g., Switzerland, Norway and GB). Article 32 provides exceptions to the basic charging principle for the minimum access package. In relation to mark-ups, Article 32(1) states that: *“In order to obtain full recovery of the costs incurred by the infrastructure manager a Member State may, if the market can bear this, levy mark-ups on the basis of efficient, transparent and non-discriminatory principles, while guaranteeing optimal competitiveness of rail market segments. The charging system shall respect the productivity increases achieved by railway undertakings. The level of charges shall not, however, exclude the use of infrastructure by market segments which can pay at least the cost that is directly incurred as a result of operating the railway service, plus a rate of return which the market can bear (...)”*.

The preceding paragraphs imply that, as an exception to the provisions of Article 31, infrastructure managers can be allowed by Member States to impose charges above the cost that is directly incurred. The mark-ups above direct costs should consider the competitiveness of the market segments and should be levied based on efficient, transparent and non-discriminatory principles, while guaranteeing optimal competitiveness of these segments.

In order to recover these mark-ups, Article 32(1) specifies the concept of market segments in the following way: *“Before approving the levy of such mark-ups, Member States shall ensure that the infrastructure managers evaluate their relevance for specific market segments, considering at least the pairs listed in point 1 of Annex VI and retaining the relevant ones. The list of market segments defined by infrastructure managers shall contain at least the three following segments: freight services, passenger services within the framework of a public service contract and other passenger services. Infrastructure managers may further distinguish market segments according to commodity or passengers transported. Market segments in which railway undertakings are not currently operating but may provide services during the period of validity of the charging system shall also be defined. The infrastructure manager shall not include a mark-up in the charging system for those market segments. The list of market segments shall be published in the network statement and shall be reviewed at least every five years. The regulatory body referred to in Article 55 shall control that list in accordance with Article 56”*. Annex VI-1 to Directive 2012/34/EU states that: *“The pairs to be considered by infrastructure managers when they define a list of market segments with a view to introducing mark-ups in the charging system according to Article 32(1) include at least the following:*

1. *passenger versus freight services;*
2. *trains carrying dangerous goods versus other freight trains;*
3. *domestic versus international services;*
4. *combined transport versus direct trains;*
5. *urban or regional versus interurban passenger services;*
6. *block trains versus single wagon load trains;*
7. *regular versus occasional train services. “*

Finally, Recital 41 provides further insights on the definition of market segments: *“When levying mark-ups, distinct market segments should be defined by the infrastructure manager where the costs of providing the transport services, their market prices or their requirements for service quality differ considerably”*.

It can therefore be concluded that Directive 2012/34/EU allows to recover the costs incurred by the infrastructure manager through the implementation of a transparent, efficient and non-discriminatory charging system which the market can bear and applied to a set of market segments which have to be defined by the IM and controlled by the regulatory body.

In order to define the market segments, the Recast specifies three basic segments which should be distinguished (freight services, passenger services within the framework of a public service contract and other passenger services) as well as a list of pairs, opposing different types of services. The Recast also sets out further criteria which should be taken into account to regroup services into market segments, both on the offer side (homogeneity in costs and prices for the service, types of passengers and commodities transported) and on the demand side (homogeneous requirement for service quality).

Furthermore, judgments from the Court of Justice of the European Union regarding the interpretation and understanding of the articles about charges, market segmentation and mark-ups in directive 2001/14/EC and directive 2012/34/EU serve as further legal basis. For instance, the Court of Justice recently passed a judgement in case C-144/20, where in paragraphs 57-60 it is elaborated upon what is meant by *“competitiveness of rail market segments”* in article 32.1 of directive 2012/34/EU. Another example is the judgement in case C-556/10, where in paragraph 87 it is written that the system provided for in Article 8(1) of Directive 2001/14/EC may be used only if the market can bear this, a market study being required in order to verify whether that is the case.

## 2. Economic Background

Under the assumption of competitive markets, prices would be set at marginal costs.<sup>2</sup> In this context, marginal cost prices are optimal prices as they are cost-covering, transparent and lead to the maximization of social welfare. They are also called first best outcome.<sup>3</sup>

However, the railway network is a natural monopoly, i.e. it is less costly for a single firm than it is for two or more to produce the level of output demanded by the market (sub additive cost function). Due to high fixed costs, the duplication of facilities is inefficient, because it would not allow a full exploitation of the economies of scale. This market structure widely differs from perfect competition with the consequence that prices are not set at marginal costs. It is a well-known result that in the absence of economic regulation, the market outcome

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<sup>2</sup> IRG-Rail's October 2012 position paper on the concept of the “cost that is directly incurred” defines marginal cost as the *“change in variable cost as a result of an increase in output of one unit. In rail transport (for the use of track), the unit could be the train.km or the tonne.km”*.

<sup>3</sup> Pindyck/Rubinfeld (2015), Mikroökonomie; pg. 485ff.; Stole, L.A. (2007), Price discrimination and Competition, in: Handbook of Industrial Organization, Vol. 3, Chapter 34, pg. 2223-2302.

of natural monopolies is not socially optimal. Prices are likely to be too high and output too low.<sup>4</sup> An unregulated monopolist would set prices at its profit-maximizing quantity.

From an economic perspective, social welfare can be defined as the sum of producer and consumer surplus. The individual consumer surplus is the difference between the amount that a customer is willing to pay for a good and/or a service and the actual market price for that good and/or service. The sum of all individual consumer surpluses is the general consumer surplus. The individual producer surplus is defined as the profit of an undertaking, which is defined as the difference between revenues and total cost of the undertaking. All profits of all undertakings together sum up to the total producer surplus.<sup>5</sup> However, as the railway infrastructure sector is a natural monopoly, the total producer surplus equals the profit of the monopolistic infrastructure manager. In a regulated industry, such as the operation of a railway infrastructure, second-best solutions aim at maximizing the net social surplus, under the constraint that the economic and financial equilibrium of the infrastructure manager is preserved.

If regulated prices of the monopolist were based on marginal costs – a condition that is still optimal for the demand side (and therefore a first-best solution) - the monopolist would not receive any rent. Applied to the railway sector this means that the network user (in this case, the railway undertakings) would pay, for example, for the wear and tear of switches and crossings as a result of the operation of the rail service. In this context, marginal cost prices are not cost covering due to the specificities of natural monopolies, therefore, absent an ad hoc public transfer, the monopolist would suffer a loss amounting to the fixed costs.<sup>6</sup>

As second-best options, one possibility for loss coverage and for price-setting in natural monopolies is to set prices at average costs. Those prices are cost covering and then no subsidy needs to be paid to the monopolist. Nevertheless, average cost pricing does not lead to an optimal allocation of inputs and the exchanged quantities are smaller than compared to a marginal cost price setting. The average cost approach is simple and cost-covering but it results in lower social welfare compared to other approaches and it is not cost-reflecting as it does not reveal the real costs (computed at the margin) for the users. As such, the average cost approach is unlikely to set the right incentives for the economy as a whole. The application of average costs would not minimize the social welfare loss as it would not allow to vary the price in consideration of different willingness-to-pay for different services by users. As a result, the most price-sensitive traffic, which can potentially pay the marginal cost but not the average cost, could no longer have access to the network, thus restricting the supply of rail transport.

Another possibility to cover the loss of the monopolist is calculating charges accounting for different market segments' ability to bear and willingness to pay mark-ups. One possible approach for achieving this is through

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<sup>4</sup> Tirole, J., (1988), *The Theory of Industrial Organization*, vol. 1, 1 ed., The MIT Press; Netz, J. (1999), *Price Regulation: A (non-technical) overview*, Department of Economics, Purdue University

<sup>5</sup> Braeutigam, R.R. (1989): *Optimal Policies for Natural Monopolies*. In: *Handbook of Industrial Organization*, Vol. II, pg. 1289-1346. Further reference: Willig, R.D. (1976) *Consumer's Surplus Without Apology*. In: *American Economic Review*, Vol. 66, No. 4, pg. 589-597.

<sup>6</sup> Armstrong, M.; Sappington, D. E. M. (2007): *Recent developments in the Theory of Regulation*, in: *Handbook of Industrial Organization*, Vol. 3, Chapter 27, pg. 1560-1700.

the application of Ramsey-Boiteux prices.<sup>7</sup> The Ramsey-Boiteux pricing formula derives mark-ups from the solution to the problem of finding the access price that maximizes social welfare, subject to a break-even constraint for the regulated firm. The resulting optimal access price is positively related to the inverse demand price elasticity<sup>8</sup> of the identified demand segments. Therefore, as mark-ups are designed according to inverse elasticities, less price-sensitive consumers have to cover higher mark-ups.

Regarding railway services, this approach considers the level of substitution, which depends on various elements such as value of time and price differences, with other options (other railway services or other transport modes) on the demand side. Market segments with homogenous price elasticity within are identified. Fixed costs are spread among rail market segments according to their relative price elasticity. Indeed, if there are viable transport alternatives for consumers, they are likely to be very sensitive to price changes. One example of this would be railway undertakings charging a higher price to passengers travelling at peak hours than those travelling off peak hours.<sup>9</sup>

The losses that result from marginal cost pricing by the monopolist can be completely subsidized. In the case of financed railway infrastructure, infrastructure managers often receive some public funds. When fixed costs can't be completely supported by public funds, the remaining costs may be covered by mark-ups if possible – even including a reasonable profit for the monopolist, if the market can bear and the mark-ups are charged in a non-discriminatory manner. The IM can levy these mark-ups on the marginal costs in order to contribute to cover its total costs.<sup>10</sup> By doing so, it is still possible to optimize total welfare, although reaching a second-best solution in comparison to marginal cost prices.<sup>11</sup>

The two second-best solutions described above are not exhaustive of the possibility of addressing the issue in the railway sector. As further explained in section 5, any methodology compliant with the principles set out in article 32(1) of the Recast directive could be used by IM to define mark-ups.

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<sup>7</sup> Armstrong, M.; Sappington, D. E. M.. (2007): Recent developments in the Theory of Regulation, in: Handbook of Industrial Organization, Vol. 3, Chapter 27, pg. 1560-1700. Braeutigam, R.R. (1989): Optimal Policies for Natural Monopolies. In: Handbook of Industrial Organization, Vol. II, pg. 1289-1346.

<sup>8</sup> The price elasticity of demand is defined as the percentage change of quantities due to a percentage change of prices.

<sup>9</sup> This charge should not be confused with charges related to capacity, which aims to reflect the scarcity of capacity. For more details, see the paper : IRG-Rail (2019), A survey of congested infrastructure, priority criteria and capacity charges in Europe. IRG-Rail (19) 4.

<sup>10</sup> Another way to recover full costs besides mark-ups can be found in the regulation framework of the Telecom Industry where a long-run incremental cost (LRIC) approach together with bottom-up modelling is recommended as a primary model (Commission recommendations 2009/396/EC and C(2013) 5761). The full efficient cost recovery is enabled, because it is assumed that in the long run, all costs become variable and all assets are replaced. The approach enables full efficient cost recovery of an individual service (LRIC model) to which the common and joint costs may be added (LRIC+ model). The framework also allows benchmarking as an alternative method to determine charges. The objectives of the rail sector price regulation, however, include optimal use of the infrastructure and optimal competitiveness of rail market segments, which considerably limits cost recovery. Consequently, public funding is commonly needed in the rail sector in order to recover full costs.

<sup>11</sup> Braeutigam, R.R. (1989): Optimal Policies for Natural Monopolies. In: Handbook of Industrial Organization, Vol. II, pg. 1289-1346.

## 3. Segmentation

Annex VI-1 of the Recast states that the list of market segments shall be defined by the infrastructure manager *“with a view to introducing mark-ups in the charging system”*. Among other objectives, the definition of market segments could pursue the following three objectives.

First, market segments can help ensuring that the charging system does not create undue discrimination or distortion of competition within homogeneous services. By regrouping comparable services, market segments enable controlling that these services are subject to the same charges. Defining market segments is thus needed to prove that the charging system complies with the principle of non-discrimination under Articles 29(3), 32(1), 32(5) and 56(2) of the Recast.

Second, market segments are an essential prerequisite for the implementation of mark-ups to implement different prices for different market segments (a segmentation of consumers into groups with different willingness to pay). Market segments should thus regroup comparable services to allow the implementation of mark-ups. The Recast identifies factors to identify different markets segments. Recital 41 for instance states that services included in a given market segment should be homogenous either in terms of *“the costs of providing the transport services, their market prices or their requirements for service quality”*.

Third, market segments can constitute a vector through which the infrastructure manager provides information on the current and potential use of the infrastructure. Indeed, on the latter, Article 32(1) states that: *“[m]arket segments in which railway undertakings are not currently operating but may provide services during the period of validity of the charging system shall also be defined”*. This dissemination of information is crucial to help railway undertakings decide on the services they will be providing. In this sense, market segments help fulfil the objective set out in Recital 44 which states that *“[r]ailway undertakings should receive clear and consistent economic signals from (...) charging schemes which lead them to make rational decisions”*.

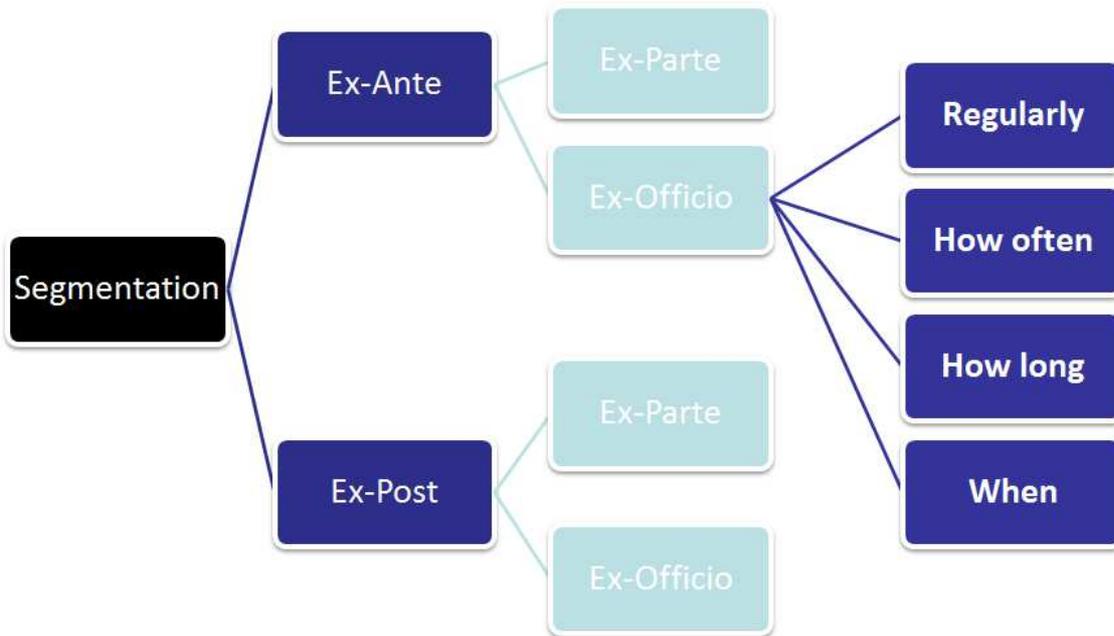
### 3.1.Process

The process of reviewing the market segmentation and mark-up calculation is generally analyzed jointly, because if mark-ups are charged, the regulatory body is responsible for controlling the list of market segments that is identified in the network statement of the IM (Article 32 (1) of Directive 2012/34/EU). IRG Rail updated the Overview of Charging Practices for the Minimum Access Package in Europe in 2020 and added an analysis of the process for some of the most important review areas for RBs.<sup>12</sup>

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<sup>12</sup> <https://www.irg-rail.eu/download/5/743/IRG-Rail2010-OverviewofChargingPracticesfortheMinimumAccessPackageinEurope.pdf>

Based on the paper, the process of the segmentation review is structured across three different dimensions as illustrated by Figure 1 in a schematic way. The branching thereafter is the same for ex-ante and ex-post but it is only shown for ex-ante.



**Figure 1: Schematic Illustration of Review Process of RBs for Segmentation and Markups**

### **Ex-Ante vs. Ex-Post**

The first main cut off point is whether the RB has a competence to review the segmentation before it is put into force. When RBs conduct a review after the implementation of the segmentation, this is considered as an ex-post review. E.g. the RB reviews the current segmentation, while the segmentation and mark-ups are already applied. Given that this is the main cut off point, the following tables are split between these two different regimes.

### **Ex-Parte vs. Ex-Officio**

A review can be triggered, ex-officio, out of the own accord of the RB or because it is mandated by the law (that could also imply that the IM starts the review process by handing in an application). For instance, the law may require a review of the segmentation methodology every five years. This could also imply a declaration of conformity. Furthermore, RUs or other market participants and entities can have the possibility to request a review (Ex-Parte). There may also be differences between countries where parties may request an ex-parte review. We consider four possible answer categories. 1.) "IM" as the concerned IM of the review 2.) "Other IM" if another IM can request a review, 3.) "RU" for any RU able to request a review 4.) "Other" for any other entity, e.g. a local authority or an association representing RUS or other groups. Furthermore, all groups may have rights to appeal reviews or decisions.

## Time dimension

In case the RB is doing an ex-officio review<sup>13</sup>, the paper explores the timing of this review. This is why the table includes four columns to structure the time dimension of the ex-officio review:

- Regularly: A Yes/No column, if the review is done regularly or not
- How often: A column indicating the periodicity of the review, for instance, annually or every 5 years.
- How long: A column indicating the amount of time the RB usually needs for the review. This could for instance be a time period of 4 weeks or 2 months.
- When: A column indicating that some RBs conduct a review always at the same point in time with respect to the beginning of an upcoming timetable period as defined by Annex 7 (2) of the Directive 2012/34/EU. For instance, the review could take place 12 month before the start of the time table period, indicated by "X-12Month".
- Extension possible: A Yes/No column, if the review can be extended if need be.<sup>14</sup>

There are no questions about the timing of the ex-parte reviews or complaints because Article 56 (9) already sets a maximum limit for these kind of complaints. The following two tables show the process of the review of segmentations & mark-up calculation by RBs. It is important to underscore that national specificities remain.

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<sup>13</sup> We focus on the time dimension of the ex-officio review, because we expect this to be more structured as these would not depend on another party to kick off a review.

<sup>14</sup> We do not discuss the process concerning who could request the extension and who could grant it, because this is out of the scope of the current analysis.

**Table 1: Ex-Ante Review Process of Market Segmentation & Mark-up Calculation by RBs**

| Country   | Ex-Parte |          |    |       | Ex-Officio | If Ex-Officio applies |   |               |  |           |
|-----------|----------|----------|----|-------|------------|-----------------------|---|---------------|--|-----------|
|           | IM       | Other IM | RU | Other |            | Regularly             | How often   | How long      | When   | Extension |
| Austria   | ✓        | ✗        | ✓  | ✓     | ✓          | ✓                     | Market segments at least every five years<br>Mark-up annually |               |  |           |
| Belgium   | ✗        | ✗        | ✗  | ✗     | ✗          | ✗                     |   |               |  |           |
| Finland   | ✗        | ✗        | ✗  | ✗     | ✓          |                       |   |               | Before imposing mark-ups   |           |
| France    | ✗        | ✗        | ✗  | ✗     | ✓          | ✓                     | Every 3 years   | 2 months      | X-12 months  | ✗         |
| GB        | ✓        | ✓        | ✓  | ✗     | ✓          | ✓                     | Every 5 years   | undetermined  | X-18 months  |           |
| Germany   | ✓        | ✗        | ✓  | ✓     | ✓          | ✓                     | Annually  | 2 Months      | X- 14 M  | ✓         |
| Germany   | ✓        | ✗        | ✓  | ✓     | ✓          | ✓                     | Every 5 years   | undetermined  | X- 2-3 years   | ✓         |
| Hungary   | ✓        | ✓        | ✓  | ✓     | ✓          | ✗                     |   |               |  |           |
| Italy     | ✗        | ✗        | ✗  | ✗     | ✓          | ✓                     | Every 5 years   | 4/5 months    | X- 12/18 months  |           |
| Italy     | ✗        | ✗        | ✗  | ✗     | ✓          | ✓                     | Every 5 years   | 2/3 months    | „Bridge year“ (i.e. one year before the implementation of the new charging system) |           |
| Lithuania | ✓        | ✗        | ✗  | ✗     | ✓          | ✗                     | The defined list of market segments is reviewed               | Not specified | Not specified  | ✗         |
| Poland    | ✓        |          |    |       | ✓          | ✓                     | Annually  | 90 days       | X-9 Months   | ✗         |
| Romania   | ✓        | ✗        | ✓  | ✓     | ✓          | ✓                     | When the IM proposes a new segment                            | undetermined  | X-18   |           |
| Slovakia  | ✓        | ✗        | ✗  | ✗     | ✓          | ✓                     | At need.  |               |  |           |

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| Country         | Ex-Parte |          |    |       | Ex-Officio | If Ex-Officio applies |  |          |            |           |
|-----------------|----------|----------|----|-------|------------|-----------------------|--|----------|------------|-----------|
|                 | IM       | Other IM | RU | Other |            | Regularly             | How often  | How long | When       | Extension |
| Spain           | ✗        | ✗        | ✗  | ✗     | ✓          | ✓                     | Segments are reviewed every time the IM proposes a new segment and if circumstances change. If so, annually. | 3 months | X-7 months |           |
| The Netherlands | ✓        | ✗        | ✗  | ✗     | ✓          | ✓                     | List of market segments reviewed after maximum five years or when the IM adds a new segment                  | 6 months | X-21       | ✓         |

**Table 2: Ex-Post Review Process of Market Segmentation & Mark-up Calculation by RBs**

| Country         | Ex-Parte |          |    |       | Ex-Officio | If Ex-Officio applies |   |               |                            |           |  |
|-----------------|----------|----------|----|-------|------------|-----------------------|---|---------------|----------------------------|-----------|--|
|                 | IM       | Other IM | RU | Other |            | Regularly             | How often   | How long      | When                       | Extension |  |
| Belgium         | ✓        | ✗        | ✓  | ✗     | ✓          | ✗                     | At need   | 3 months      | At need                    |           |  |
| Finland         | ✗        | ✗        | ✓  | ✓     | ✓          | ✗                     | At need   |               | At need                    |           |  |
| France          | ✓        | ✓        | ✓  | ✓     | ✗          |                       |   |               |                            |           |  |
| Germany         | ✓        | ✗        | ✓  | ✓     | ✓          | ✗                     |   | As required   | At need                    |           |  |
| Hungary         | ✓        | ✓        | ✓  | ✓     | ✓          | ✗                     |   |               |                            |           |  |
| Italy           | ✓        | ✗        | ✓  | ✓     | ✓          | ✗                     |   |               |                            |           |  |
| Romania         | ✓        | ✗        | ✓  | ✓     | ✓          | ✗                     | At need. Segments and marks-up are reviewed every time the IM proposes a new segment. | Not specified | Not specified              |           |  |
| Lithuania       | ✓        | ✗        | ✓  | ✗     | ✓          | ✗                     | At need   | Not specified | Not specified              | ✗         |  |
| Norway          | ✓        | ✓        | ✓  | ✓     | ✓          | ✗                     | Not specified   |               |                            | ✓         |  |
| Poland          |          |          | ✓  |       | ✓          | ✓                     | Annually  | -             | After the timetable period | ✗         |  |
| Portugal        |          |          |    |       |            |                       |   |               |                            |           |  |
| Slovakia        | ✓        | ✗        | ✗  | ✗     | ✓          | ✓                     | At need.  |               |                            |           |  |
| Spain           | ✓        | ✗        | ✓  | ✓     | ✓          | ✗                     |   | Three months  |                            | ✓         |  |
| Sweden          |          |          |    |       | ✓          | ✗                     | Not specified   | Not specified | Not specified              |           |  |
| The Netherlands | ✗        | ✗        | ✓  | ✓     | ✓          | ✗                     |   |               |                            | ✗         |  |

14 countries have provided information about the ex-ante review of market segmentation and mark-ups (

**Table 1)** and 15 countries about the ex-post review (Table 2). Germany and Italy appear twice because there is one process for the annual review and a different bigger review process every five years. In Finland, there is no market segmentation nor mark-ups, but if there were mark-ups, the IM would have to report every five years to the Ministry of Transport and Communications and to the RB on the mark-ups and whether the mark-ups have encouraged RUs to improve their productivity and competitiveness within the meaning of the Directive 2012/34/EU.

Some IMs are able to initiate or appeal either an ex-ante or ex-post review of the market segmentation and mark-ups. There are only a few cases where another IM can initiate or appeal a review and some cases where RUs or other entities can do so. This seems to be more often the case for ex-post reviews.

The ex-ante reviews are mostly conducted on a regular basis and usually either annually or every three or five years. In some countries, they are also done when needed. In contrast, ex-post reviews are rarely performed (2 countries). In most countries ex-officio reviews are conducted when needed and it is not specified how often they are done (7 countries).

For ex-ante reviews, some countries have a predefined time length ranging from two months to 6 months. The reviews can take from several months to up to almost two years before the beginning of the next timetable period. Some countries such as GB and Germany do not have a predefined time length and the reviews start several years before the affected timetable period. Given that not many countries do regular ex-post reviews of market segmentation and mark-ups, there are few examples where the duration and the timing is predefined.

## 3.2.Criteria

This section discusses different criteria that are used for segmentation in some countries. This is not to be confused with an evaluation of specific segments or segment pairs as requested in Article 32 (1). Criteria refer to a broader understanding of characteristics that might be used to segment the market. The aim is not to look at different segments, but to show which criteria the different IMs use or consider using to define segments, regardless of the final segmentation. There appears to be, at least, five different cases of how a criterion can be considered by IMs:

- **Applied**  
The criterion is directly or at least partly used for the definition of one or more segments. For instance, dangerous goods to define a freight segment
- **Discussed not applied**  
The criterion is discussed in the network statement or other documents issued by the IM, but the IM argues that it is not necessary or reasonable to use it. This might change in the future.  
For instance, the IM could discuss the use of ad hoc as a criterion to segment services but come to the conclusion that it is not necessary to use it, because there is no demand for it.
- **Discussed not practical**  
The criterion is discussed in the network statement but the IM argues that he cannot use it or observe it. For instance, commodities (except dangerous goods) could be discussed but not used for segmentation because the IM claims that he cannot observe the content of wagons.
- **Not discussed**  
There is no discussion about this criterion in the network statement of the main IM. This can also be an indicator that there is no segmentation at all, if this is the case for all criteria.

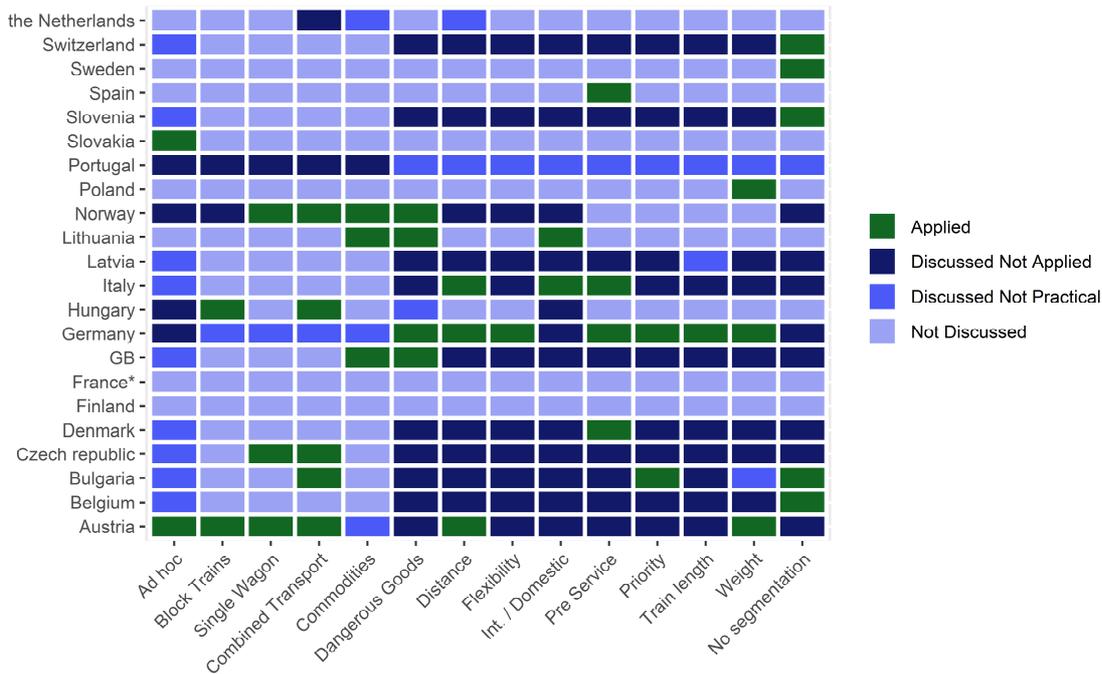
The analysis is split between freight and passenger services, even though some criteria are used in both services. When they are used in both services, the characteristics can be different for each service, e.g. weight as factor might be accounted for differently for freight services compared to passenger services. Sometimes a criterion is used to define an entire segment (e.g. weight for heavy trains), but sometimes several criteria are used to define one segment (e.g. distance and dangerous goods for a short distance dangerous good segment in Germany).

Using the previously discussed approach to classify the segmentation among countries, the following heatmaps summarize the responses of 17 countries. This allows a quick understanding of the used criteria in one country (horizontally) and a comparison of one criterion across countries (vertically). The specific criteria are discussed in the following (first for freight and then for passenger services) and some further examples and cases are presented if available.

- Overviews of freight segmentation criteria

The following graph presents the used criteria for the segmentation of freight across countries.

**Figure 2: Heatmap of Segmentation Criteria in Freight**



\*France does not apply markups for freight.

### Ad hoc

Demand may differ for scheduled services compared to un-scheduled or occasional train services and different charges could be applied because of the respective ability to bear mark-ups. In Germany this was considered, but not applied in practice because the IM argued that the markets of scheduled and unscheduled services are mostly homogenous with respect to cost, price, and market demand. A differentiation would set incentives to needlessly order scheduled services if prices for ad hoc services were higher or vice versa to order ad hoc services for actually scheduled services if prices for ad hoc service were lower. Nevertheless, the definition of “ad hoc” also matter. In Italy ad hoc means special (reduced) charges in case a new service is launched.

### Block Trains

Block trains, also called unit trains, are trains that run as a unit from the loading point to the unloading point without intermediate stops. They are trains in which all wagons load the same commodity and have the same origin and destination, without being rearranged en route. This differentiates from wagonload trains (ie trains made of single wagon consignments of freight). In Germany, this is implicitly recognized in the “Standardtrain”

segment for which block trains make up roughly 25%. According to the German RB, block trains have a higher ability to bear mark-ups than single wagon trains and combined traffic services<sup>15</sup>.

## **Wagonload**

In contrast to block trains, wagonload trains are rearranged en route and can carry different types of goods in different types of wagons. In Germany, this is implicitly recognized in the "Standardtrain" segment for which wagonload trains make up roughly 25%. Different studies<sup>16</sup> have shown that wagonload trains have a lower ability to bear mark-ups. In Austria, the single wagonload trains receive a subsidy for the first and the last mile and do not bear mark-ups. Articles 31 - 32 of the Directive 2012/34/EU are not properly transposed in to CZ legislation. The IM provides discounts for the Single Wagon and Combined Transport.

## **Combined Transport**

Combined transport can be seen as sub category of wagonload traffic including a switch to another transport mode, usually for the "last mile", e.g. a container landing at a port then put on a train and finally shipped to its destination by road. Usually combined transport services have to compete more with other transport modes, because containers can be easily transported by whatever transport mode. Therefore, the ability to bear mark-ups is expected to be lower. Austria specifically has a segment that considers services that are "manipulated" more than once between starting the service and finishing it.

## **Commodities**

Different goods have different demand elasticities or can be more or less easily transported with different transport modes. Hence, types of commodities could be used to differentiate segments. For instance, Great Britain uses different freight commodities for which different abilities to bear mark-ups are estimated based on an economic model. The model has indicated that only ESI coal, spent nuclear, biomass and iron ore have the ability to bear mark-ups, whereas the other commodities (such as construction materials and intermodal) are found to not be able to bear mark-ups. The German IM discusses commodities, but claims that it is not able to check what goods the RUs transport on their trains. That is why, it discards this criterion as not practical.

## **Dangerous goods**

Dangerous goods can be seen as just another type of commodity, but are explicitly mentioned in Annex VI (1) b). Generally, services transporting dangerous goods are under pressure (legal and public) to use trains as safer mode of transport and hence might have a different ability to bear mark-ups. The German IM explicitly introduces a segment for dangerous goods in line with the national dangerous goods regulation (GGVSEB, Annex 1 § 35) and estimates that dangerous goods trains have a higher ability to bear mark-ups.

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<sup>15</sup>

[https://www.bundesnetzagentur.de/SharedDocs/FAQs/DE/Sachgebiete/Eisenbahn/Unternehmen\\_Institutionen/Gutachten/Elastizitaet2018\\_FAQ.html](https://www.bundesnetzagentur.de/SharedDocs/FAQs/DE/Sachgebiete/Eisenbahn/Unternehmen_Institutionen/Gutachten/Elastizitaet2018_FAQ.html)

<sup>16</sup>

[https://www.bundesnetzagentur.de/SharedDocs/FAQs/DE/Sachgebiete/Eisenbahn/Unternehmen\\_Institutionen/Gutachten/Elastizitaet2018\\_FAQ.html](https://www.bundesnetzagentur.de/SharedDocs/FAQs/DE/Sachgebiete/Eisenbahn/Unternehmen_Institutionen/Gutachten/Elastizitaet2018_FAQ.html)

In GB, commodities are already considered as the main factor of segmentation. Nuclear transport could be seen as a dangerous good, so one could say that dangerous goods are subsumed into the “commodity” criterion in GB.

## **Distance**

Rail freight services become more viable the longer the distance, because average costs per km become much lower. Hence the ability to bear mark-ups for short distance services might be lower, due to stronger competition with other transport modes. The German IM introduces a general short distance segment and one for dangerous goods, for which the ability to bear mark-ups is estimated to be comparatively lower.

## **Flexibility**

Some services are more flexible concerning their departure or arrival time for which the IM may grant a reduction of the charges. The German IM offers a discount for services if they accept a deviation to their requested time of +/- 120 minutes.

## **International vs. Domestic**

Annex VI (1) of the Directive 2012/34/EU includes ‘international vs. domestic’ in the list of market pairs to be considered. Some IMs differentiate between domestic and international services, some others do not.

## **Pre Service**

Locomotive runs and empty rides can be seen as intermediate input or a pre service for the real services of transporting goods. That is why, some systems allow for lower mark-ups for these services. Germany only accounts for locomotive rides but not empty wagons. Spain has a specific segment for empty rides and also test rides. In accordance with the former Regulation, which despite not being in force is being used in this transitional period. Portugal has a specific segment for freight empty rides and locomotive runs. In Italy technical services are defined as the runs that are necessary to the provision of a commercial service and they are charged less.

## **Priority**

This would indicate different disposition rules for services within a priority segment. The German IM has an extra mark-up for all freight segments if they want to have priority in case of deviations from the planned schedule.

## **Train length**

Trains would be segmented differently according to their length. This could be an attempt to differentiate between wagonload and block trains. The German IM only classifies trains with a length of less than 370m as short distance trains and charges a penalty if the RU violates this rule.

## **Weight**

IMs may have two reasons to use weight as a criterion. On the one hand weight can be used to identify different demand for very heavy goods that are prone to be transported by train and therefore the ability to bear mark-ups might be higher. On the other hand, there may be higher marginal costs of wear and tear for track infrastructure. The German IM introduces a segment for heavy freight train (> 3000t) where the mark-up is set

at a relatively higher level. In Poland mark-up is paid for trains weighing more than 660 tonnes, but intermodal trains are excluded.

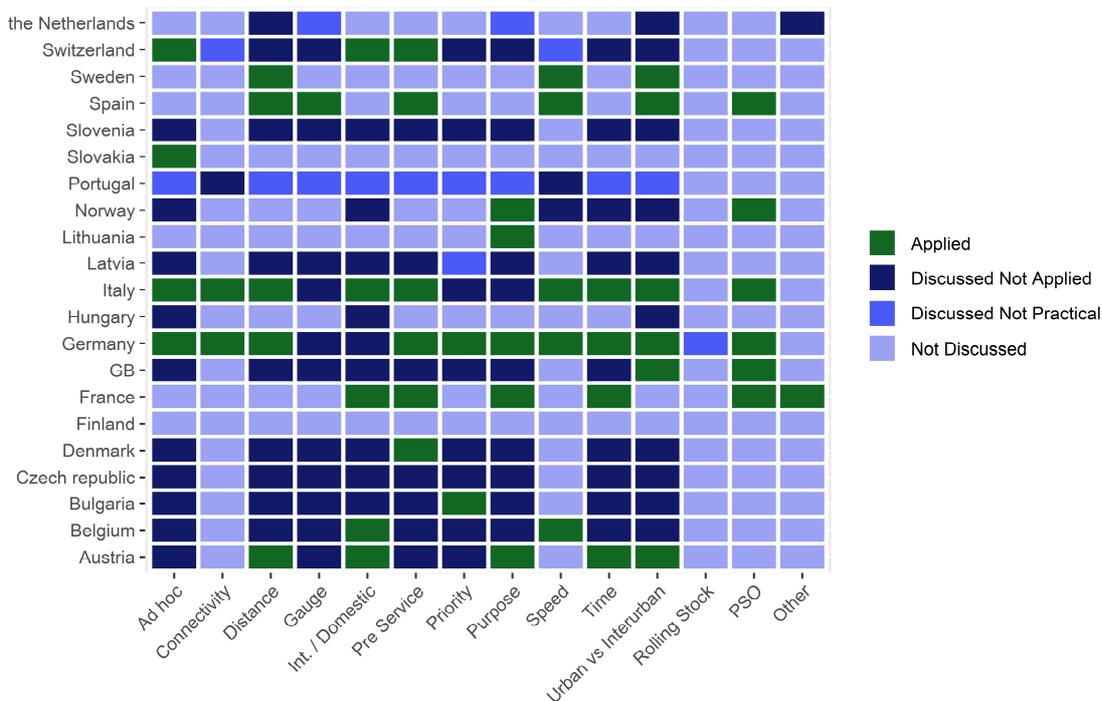
### No further segmentation

The heatmap shows that a number of countries do not use any criteria for the segmentation of freight services. This might be because it is more difficult to observe differences in demands in freight trains as they tend to carry combined loads and sometimes the differences are unknown to the IM. Also freight services only have a small share of the market (see figures before), so IMs may spend less effort to create further segments for freight services. In The Netherlands, the IM has considered further segmentation, but has come to the conclusion that further segmentation is not necessary, possible or appropriate.

- **Overviews of passenger segmentation criteria**

As for freight, the following heatmap offers a quick overview of the application of segmentation criteria in passenger services. Compared to freight, there are more countries using two or more criteria for their segmentation. In addition, the number of countries that have no segmentation at all (indicated by a grey row) is smaller (Slovenia and Finland). The specific criteria are discussed below.

**Figure 3: Heatmap of Segmentation Criteria in Passenger Services**



## **Ad hoc**

As for freight services, demand may differ for scheduled compared to un-scheduled or occasional train services and different charges could be applied because of the respective ability to bear mark-ups. The German IM uses this criterion for its segmentation of charter and nostalgia services (e.g. historic steam engines or museum rides). Switzerland and Italy use this criterion for their segmentation. In Italy “ad hoc” refers to special (reduced) charges in the case a new service being launched.

## **Connectivity / Network**

Large train networks derive value from their size and can allow customers to choose connections every hour or change trains easily at their convenience. This network effect provides an advantage over services that only offer few connections or just point to point services, which may lead to a different ability to bear mark-ups. The German IM introduces a specific point to point segment with lower mark-ups. This segment only allows up to 4 connections per day, no direct links of connections, and RUs have to be more flexible when requesting tracks. Additionally, the average speed between metropolitan areas may not exceed 130 km/h.

The Italian IM, within the PSO regional services, considers the train service which serves a node having a higher traffic level than service which does not serve a node. Moreover, the Italian IM differentiates between hub and no hub node depending on connection with city centers and presence of subway.

## **Distance**

The distance of a service might warrant different mark-ups because long distance passenger services might attract different group of customers that are able to bear higher mark-ups. Competition might be higher for short distance services where customers would shift to cars or bus services if mark-ups were higher. The German IM implicitly uses distance to differentiate between PSO and Non-PSO services. It is assumed that customers of a PSO service do not on average travel more than 50km. In Spain there is one segment “VL3” for services that run more than 700 km (excluding stops in Madrid) and one for less than 300 km excluding PSO, international or other long distance trains. This helps to identify services with different commercial features, which should be treated differently. In Sweden, distinction is made between a long-distance passenger segment, where the average trip length of passengers is above 100 km, and a regional passenger segment where the average length is below 100 km. High-speed trains are not a part of these segments, but form their own segment (see below).

## **Gauge**

Historically, some countries used different gauges to avoid interoperability and risks in times of war. New infrastructure usually uses the 1435 mm international gauge, but there are still some cases of different gauge and some IMs have designed specific segments for services running on these tracks. Spain historically used the Iberian gauge (1668 mm), but the new high speed infrastructure has been built using the international gauge (1435 mm). There is also a third gauge in Spain, the metric gauge (1000 mm). Generally, the gauge is not an indicator for special purpose, because there are passenger and freight train running on all different kinds of gauges, however lines running on different gauges normally bear higher costs derived from the use of gauge changers and tend to run at a lower average speed, what affects their ability to bear higher charges. Portugal uses the Iberian gauge (1668 mm) for the entire railway infrastructure, with the exception of Vouga and Tua lines, for which the gauge is 1000 mm.

## **International vs. Domestic services**

Annex VI (1) of the Directive 2012/34/EU includes 'international vs. domestic' in the list of market pairs to be considered. Some countries differentiate between domestic and international services, some do not.

## **Pre Service**

Locomotive runs and empty rides can be seen as intermediate input for the actual services of transporting passengers. That is why some systems allow for lower mark-ups for these services. Germany only accounts for locomotive rides but not empty carriages and also implicitly considers a higher share of empty rides for charter services. Portugal has a specific segment for empty trains in accordance with the former Regulation, which despite not being in force, is being used in this transitional period. Spain has a specific segment for empty rides and also test rides.

## **Priority**

End users might appreciate a guarantee that their train will be prioritized in case of any deviation within the system. So the IM might decide he will charge a premium for this. The German IM used to have an express segment for PSO traffic, which has been abolished under the new system introduced in 2018. The IM claims that there is no difference in demand for these services. Some non-PSO services can pay extra to be prioritized in case of traffic conflicts. In Bulgaria, some train categories are prioritized without affecting the charging.

## **Purpose**

Some services are tied to a specific purpose or event. These services are usually more ad hoc and uncertain. Hence, their ability to bear mark-ups might be lower. The German IM defined specific segment for charter services (soccer trains) and old-timer / heritage services (museum runs / steam engines), which have to pay relatively lower mark-ups. This is also the case in France for historical and tourist trains, which do not pay mark up.

## **Speed**

Trains become more competitive with increasing average speed. Hence their ability to bear mark-ups might increase. Generally, many countries have specific segments for high speed trains. The German IM uses speed to classify train service into a metropolitan segment for which the mark-ups increases with average speed. Speed is also a secondary criterion for point to point services that are not allowed to run faster than 130 km/h on average between metropolitan areas, because they would compete with other long distance services.

The Italian IM uses speed to differentiate segments for regional transport services; those with a speed of over than 75 km/h pay a higher charge. In Spain, the network comprises different types of lines that, depending on their technical features, allow for higher speed. Besides lines devoted to mainly "pure" HS services, other lines allow for trains circulating at up to 200 km/h, and as such, they constitute another type of service. In Sweden, a number of specific train types are grouped into a high-speed segment. These run on lines between major urban areas.

The French infrastructure manager also makes a distinction between high-speed and conventional lines for passengers' activities not under contract. However, the criterion "Speed" has not been indicated as "applied", as

this distinction serves more to reveal the different classes of passengers according to their willingness to pay than the characteristics of the infrastructure.

## **Time**

Demand depends on time. There are peak and off peak periods of demand and studies can show demand curves differ over time. Based on a study on mobility in Germany, the Germany IM identified a peak / day (06:00 – 20:00) and of an off peak / night period (20:00 – 06:00) with more and respectively less demand for traffic. There is a specific segment for night traffic for which the ability to bear mark-ups is assumed to be lower. Austria allocates short distance services during peak time to a high demand segment. The Italian IM uses time to identify a segment for night traffic. This segment has charges lower than day trains; lower charges are applied also on Saturday (OA services) and Sunday/holidays (PSO services). The main Swedish IM charges a “passage fee” based on time of day. The charge is applied for train paths on certain tracks in the three largest cities in Sweden during weekday mornings and afternoons (6-9 and 15-18). France, the price for the high-speed line market charge for the passenger activities not under contract is raised or lowered according to the theoretical time of departure of the train and according to the market segments concerned.

## **Urban vs. Interurban**

Demand is usually focused on population or industry centres. Hence, these services might be able to bear higher mark-ups than services in less populated areas. The Austrian IM differentiates for demand centres and for short distance PSO traffic, because of different demand. In Spain there is a specific segment for urban and interurban trains, which is mainly used by PSO services. The German IM has identified a set of metropolitan stations with more than 50 000 passengers per day. Train services in between these stations are classified as metropolitan and have to pay relatively higher mark-ups. In Sweden, commuter trains in the three largest population centres of Stockholm, Gothenburg and Malmö make up their own segment.

## **PSO**

In some cases, the characteristic of a service based on a PSO contract might be put it into a different segment. This is for instance the case in Norway and Germany. In Germany all PSO services belong to a specific segment and the prices are differentiated by region. Even though there is no specific segment for PSO in Spain, the IM justifies higher mark-ups for the urban/interurban trains on the ground that these services are used primarily by PSO trains, for which the market ability to bear higher charges follow different patterns compared to the rest of passenger services. Therefore, although there is no segment, it is a criterion used for assessing mark-ups.

## **Rolling stock**

The rolling stock of a train service might be used to identify its market segment as the rolling stock is an indicator of the demand structure. E.g., one could argue that night trains might be identified by their use of sleepers.

## **Other**

Some countries also looked at other segments. In The Netherlands for instance, segmentation was considered depending on the part of the day: morning peak hours, off peak hours and evening peak hours. This segmentation was not applied, because the difference in end user's elasticities was too small to justify segmentation. Segmentation of train class was also considered. However, the use of train class is strongly

correlated with travel purpose and therefore it was not considered appropriate to apply segmentation per train class.

In France, the characterisation of the domestic segments for passenger activities not under contract is based on an economic analysis of the downstream passenger market through 2 criteria: size of the market (potential defined according to population) and the size of the rail or road competition (according to the respective journey times of each mode).

From the previous heatmaps one can see that the application of segmentation criteria is very different. Each IM has some flexibility to use the criteria to define a final market segmentation depending on their ability to observe them, the criteria's practicality, or other reasons related to the country specific situation. However, market segmentation used by the different IMs should still be founded upon well-established economic theory and practice and be non-discriminatory. It seems that IMs usually use more criteria for the segmentation of passenger than freight services. There are only a few countries that use an elaborate segmentation for rail passenger traffic based on more than two criteria (Austria, Bulgaria, France, Germany, Italy). It should be noted again, that using one of the criterion is not equal to defining a market segment based on this criterion. Instead, IMs have some flexibility to combine and merge criteria to define market segments that fit their specific environment.

### 3.3. Guidelines for segmentation

In some countries, general guidelines have been developed to evaluate the proposed segmentation. Based on these guidelines, more specific criteria can be derived to operationalize the segmentation. Two examples are GB and Germany.

For GB, the RB<sup>17</sup> has provided guidance on how market segments should be differentiated. The German IM's approach is described in Annex 6.1. of its network statement. One could summarize both approaches as follows:

- definition of market segments should be practical, comprehensive and objective;
- market segments should, as far as possible, have common characteristics (materially, spatially, or temporally) of some kind that place them, as a class, in a different commercial position against another identifiable class; and
- choice of market segments should not distort incentives.<sup>18</sup>

These guidelines may help to develop more specific criteria to define practical segments.

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<sup>17</sup> ORR Periodic Review 2008 – Consultation on Caps for Freight Track Access Charges p. 84

<sup>18</sup> By this we mean that RUs would change their behaviour to be categorised within a certain segment, because it is cheaper, although they would have originally fit into another segment.

## 4. Mark-Up Calculation

Article 31(3) of the Recast states that charges for the minimum access package “shall be set at the cost that is directly incurred as a result of operating the train service”. By definition, non-eligible costs that are not direct are excluded<sup>19</sup>. A first objective of levying mark-ups according to Article 32(1) is thus to recover these non-eligible costs, net of public subsidies, and therefore, obtain full recovery of the cost incurred by the IM.

It should however be noted that a variety of charging schemes could enable the infrastructure manager to recoup these costs. As a general principle, levying mark-ups according to Article 32(1) leads to apportioning the costs incurred by the infrastructure manager to market segments on the basis of efficient, transparent and non-discriminatory principles, if the market can bear these, while guaranteeing the optimal competitiveness of the market segments and respecting the productivity increases achieved by railway undertakings. This enables to pursue the general objective of charges set out in Article 26: “Member States shall ensure that charging and capacity-allocation schemes for railway infrastructure (...) allow the infrastructure manager to market and make optimum effective use of the available infrastructure capacity”.

The legal framework for setting mark-ups gives rise to the concept of a ‘market can bear’ test to determine whether levying a mark-up on a given type of traffic (or “market segment”) would be compliant with Article 32(1); in other words, whether it would result in the exclusion of the use of infrastructure by that market segment. As a minimum requirement, market segments which would be significantly impacted by a mark-up should not be subject to mark-ups. Whether an impact of a mark-up is significant will depend on the characteristics of the segment’s demand and the methodology implemented by the IM.

The methodology adopted to define mark-ups must then identify appropriate weights in order to calibrate the fees applied to the different types of service (e.g. passengers, freight, open access, PSO) in compliance with all principles set by the Recast, namely the principles of effectiveness, transparency and non-discrimination, optimal competitiveness of the railway market segments, sustainability for each market segment, as well as compliance with the productivity increases achieved by railway companies.

### 4.1. Ramsey Methodology

As already presented in Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**, one possibility to cover the total costs of the monopolist, if prices are set at marginal cost, is the application of Ramsey-Boiteux prices.<sup>20</sup> In order for the monopolist to recover its cost in a natural monopoly setting, prices need to be set above marginal costs. However, prices being set above marginal costs also implies a loss in social welfare for the

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<sup>19</sup> Implementing Regulation (EU) 2015/909 includes a list of possible non-eligible costs of the rail infrastructure in its article 4. These costs have in common, as stated by recital (8), that they are not directly triggered by the operation of a train service, a condition which is associated with not being variable with traffic.

<sup>20</sup> Armstrong, M.; Sappington, D. E. M.. (2007): Recent developments in the Theory of Regulation, in: Handbook of Industrial Organization, Vol. 3, Chapter 27, pg. 1560-1700. Braeutigam, R.R. (1989): Optimal Policies for Natural Monopolies. In: Handbook of Industrial Organization, Vol. II, pg. 1289-1346.

consumer as consumer surplus is reduced. Nevertheless, Ramsey-Boiteux shall be applied in a way respecting the objectives of Directive 2012/34/EU, especially the optimum effective use of the available infrastructure capacity provided at article 26 of that Directive

The Ramsey-Boiteux approach seeks to maximize the social welfare of consumers, while still allowing the monopolist to break-even. Ramsey-Boiteux prices therefore allow covering the total costs of the monopolist, but considers an optimized reduction of producer and consumer surplus by taking price elasticities of consumer groups (*i.e.* market segments) into account.

Formally, Ramsey-Boiteux prices imply maximizing the profit of the monopolist while considering direct costs  $DC$ :<sup>21</sup>

$$\text{Max: Profit}(TAC, q) = \sum (TAC_i - DC_i) * q_i \quad (1)$$

Table 3 below contains a description of all variables used in the rest of the chapter.

| Variable     | Description  |
|--------------|--|
| $TAC, TAC_i$ | Track access charge as a vector for all segments or for segment i      |
| $q, q_i$     | Track output as a vector for all segments or for segment i             |
| $\Pi$        | Revenue target based on the amount of non-eligible costs to be covered |
| $DC_i$       | Direct cost for segment i  |
| $\epsilon_i$ | Track price elasticity for segment i                                   |
| $k$          | Constant to substitute for $k = \frac{\lambda}{1+\lambda}$             |
| $\lambda$    | Lagrange multiplier  |

**Table 3: Description of variables of Ramsey-Boiteux optimization**

At the same time, the monopolist is subject to the constraint that revenue minus direct cost should not exceed a certain target ( $\Pi$ ) reflecting the non-eligible costs.

$$\Pi = \sum (TAC_i - DC_i) * q_i \quad (2)$$

This type of constrained optimization is done using the Lagrange multiplier technique. The solution in equilibrium boils down to the following equation for each segment.

$$\frac{TAC_i - DC_i}{TAC_i} = \frac{k}{\epsilon_i} \quad (3)$$

<sup>21</sup> Even if economic theory uses the term of marginal cost, which is not exactly the same as the direct cost. It is usually assumed that demand in each segment is independent with demand function  $q_i(TAC_i)$  and an inverse demand function  $TAC_i(q_i)$ .

The left-hand side of the equation is an expression of the mark-up (price above direct costs) also referred to as the price margin. The right-hand side is the inverse track price elasticity of demand multiplied by  $k$  (which is a function of  $\lambda$ ).  $\lambda$  is the so-called Lagrange multiplier, a constant optimized such that the equality of equations (2) and (3) allows for total coverage of the revenue target. The Lagrange multiplier is often interpreted as the shadow price, meaning how much welfare (revenue) would change if the constraint was relaxed by a small amount. In this example if more non-eligible costs were to be covered.

Hence, equation (3) tells us that in the situation where the regulator tries to maximize revenue subject to the constraint that the monopolist does not lose money, the optimal mark-up for each market segment is a function of the price elasticity of demand of that segment. More specifically, the price margin is inversely proportional to the elasticity of demand. The price margin is defined as share of the mark up on the total track access charge.

$$Price\ Margin_i = \frac{TAC_i - DC_i}{TAC_i} = \frac{Mark-up_i}{TAC_i} \quad (4)$$

Taking the ratio of two price margins shows that the ratio of the price margins is also inverse to the ratio of the elasticities.

$$\frac{Price\ Margin_i}{Price\ Margin_j} = \frac{\epsilon_j}{\epsilon_i} \quad (5)$$

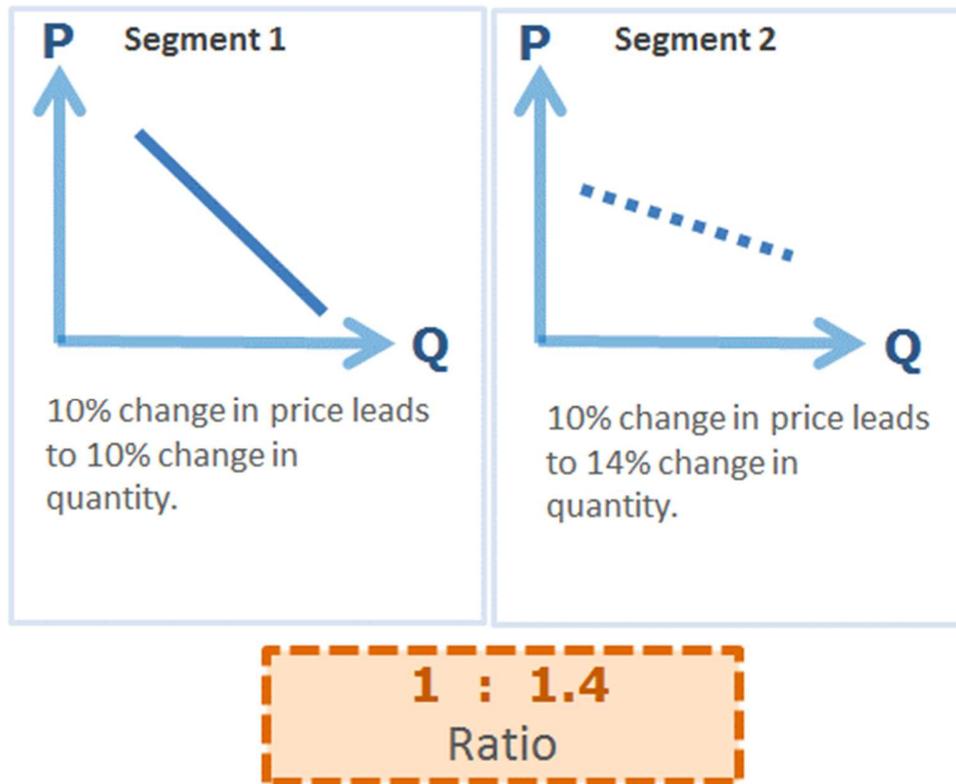
In theory, mark-ups based on the Ramsey-Boiteux methodology would not exclude any segment as the model would yield prices and quantities with respect to each segments demand function and track price elasticity reflecting what the market can bear. For instance, the demand of a segment with low ability to bear mark-ups would be very elastic resulting in a very low or a mark-up close to zero. The Directive suggest to also look at other factors (e.g. productivity). Also, one could still consider the development of the segments over time and whether traffic within the segments is shrinking over time.

In the following a simple toy example is used to explain the intuition of the methodology. The following table summarizes the values used within the example and their final value in equilibrium (in particular for the elasticities).

| Variable           | Segment 1 | Segment 2 |
|--------------------|-----------|-----------|
| $q_i$              | 1         | 1         |
| $\epsilon_i$       | 1         | 1.4       |
| $\Pi$              | 14        |           |
| Non-eligible costs | 9         |           |
| $DC_i$             | 3         | 2         |
| $k$                | 0.7       |           |

**Table 4: Overview of toy example of Ramsey-Boiteux optimization**

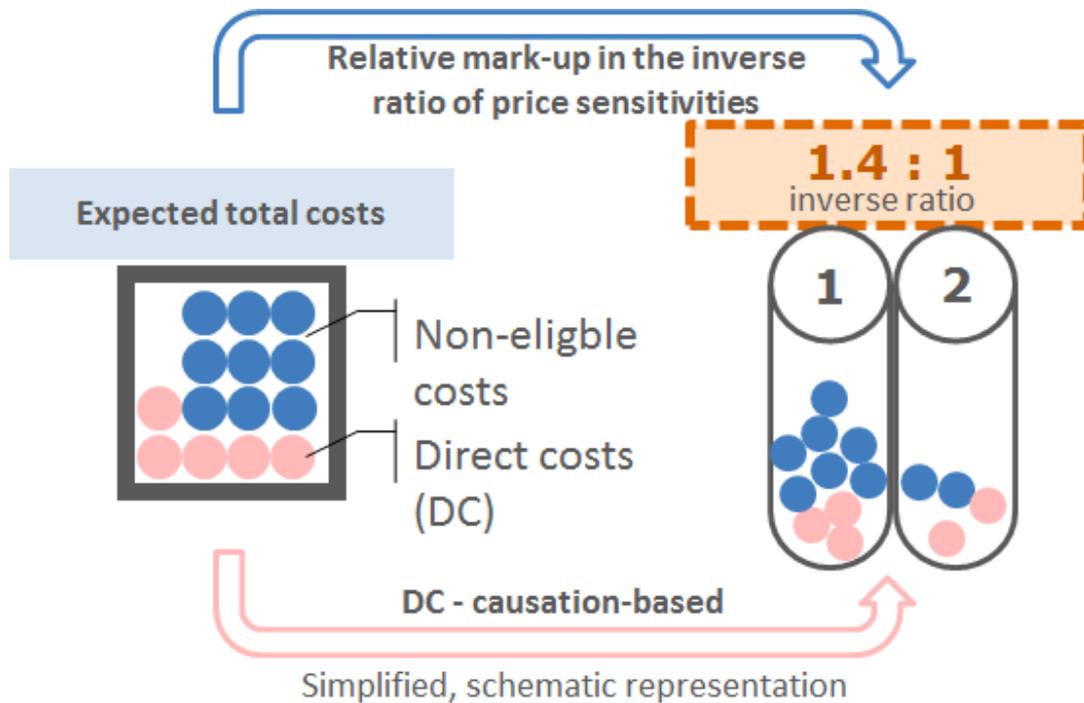
There are only two segments, and their output is fixed at 1. The first segment is relatively less price elastic than the second segment, as shown in **Figure 4**<sup>22</sup>. In equilibrium, the ratio is 1:1.4, specifically  $\epsilon_1 = 1$  and  $\epsilon_2 = 1.4$ .



**Figure 4: Price elasticities for toy model example**

**Figure 5** illustrates how the expected total costs on the left-hand side are ultimately allocated to the segments using Ramsey-Boiteux on the right-hand side. On the left-hand side, total costs are expected to be 14 cost units. Of these costs, 5 units are direct costs ( $DC_i$ ), the purple balls, and 9 units are non-eligible, the blue balls. By assumption, segment 1 is causing more direct costs than segment 2. Hence, the direct allocation of 3 purple balls to segment 1 and only 2 purple balls to segment 2. The tricky part is now to find the solution for the mark-ups. As stated before, in equilibrium the ratio of price margins is inverse to the ratio of 1:1.4 of the elasticities. This is the case if segment 1 pays a mark-up of 7 units and segment 2 of only 2 units. Then the relative mark-up is 70% and 50% for each segment. Multiplied by 2 the ratio is indeed 1.4:1.

<sup>22</sup> The graph is just meant to show the fact the segment 2 is more elastic than segment 1. For linear demand function like shown here, the elasticity is different at each P and Q combination.



**Figure 5: Cost allocation according to Ramsey in a simple toy model of two segments**

In order to obtain full recovery of non-eligible costs, the constant should be derived from the optimization. In this case, it is equal to 0.7. Plugging this into equation (3) yields the following:

$$\frac{TAC_i - DC_i}{TAC_i} = \frac{k}{\epsilon_i} \quad (3)$$

|                  | Left-hand Side   | Right-hand Side                                |
|------------------|--|--|
| <b>Segment 1</b> | $\frac{TAC_1 - DC_1}{TAC_1} = \frac{10 - 3}{10} = 0.7$ | $\frac{k}{\epsilon_1} = \frac{0.7}{1} = 0.7$   |
| <b>Segment 2</b> | $\frac{TAC_2 - DC_2}{TAC_2} = \frac{4 - 2}{4} = 0.5$   | $\frac{k}{\epsilon_2} = \frac{0.7}{1.4} = 0.5$ |

As it is shown in the table above, the main ingredient for the Ramsey-Boiteux methodology are the price elasticities for each segment. The price elasticity of demand is defined as the percentage change of quantities due to a percentage change of prices. Therefore, the major challenge for the implementation of the Ramsey-Boiteux methodology is the derivation and estimation of segment specific demand functions and elasticities.

There is a wide range of literature to evaluate price elasticities for different kinds of markets. These studies have to be carefully designed and can become very costly. Given their empirical nature, results may differ depending

on the time of the study, where it was conducted, and on a range of other factors of which we discuss some in the following.

Demand price elasticities do not only depend on the railway market itself but also on the intermodal competition of other transport modes like road transports and other general developments like economic growth. This increases the complexity of the design and how to interpret results. To collect data, different methodological approaches can be used. Two of them are:

1. Stated-preference (SP)
2. Revealed-preference (RP)

SP examines demand using fictitious situations in contrast to RP, which analyses past decisions, sales, or transactions. For SP, a respondent usually has to select one alternative from a set of alternatives. These alternatives are designed and optimized to reflect the situation of the market and to test specific hypotheses. In some designs, an outside option of other transport modes is not explicitly given but respondents can simply choose one option that is not exactly defined but is not rail or the analysed transport mode. RP studies either have to ask respondents about past situations and their decisions or use market data. The advantage is that the collected data reflects real decisions, but it can be very costly to collect. It can become very tedious to collect all necessary data on all other transport modes and their prices and the data can be biased due to bad or incomplete reporting. In practice, SP seems to be used more often because it is easier to collect data that way and RP data is not easily available or very costly.<sup>23</sup>

Based on the market modelling and the collected data, many different econometric models can be used to estimate the elasticities. SP models mostly use binary or multinomial selection models based on Logit or Probit distribution functions.<sup>24</sup> Some use parametric survival regression models.<sup>25</sup> Depending on the quality and quantity of RP data, one could also estimate classic demand functions for the entire market or segments of the market. For any model, the specification of the model is subject to the domain knowledge of the authors and can be guided by statistical significance and other indicators like the Akaike information criterion (AIC).<sup>26</sup>

A further problem is that most studies determine price elasticities for end customers, e.g. passengers or freight forwarders, and not RUs. This is because it is easier to conduct studies among end customers, as there are many more end customers than RUs and track access charges tend to remain constant during a timetable period. The end customer price elasticity should be more elastic as track access charges are only a part of all costs of for the offered train services. Depending on the market situation, RUs pass on the costs of the track access charges

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<sup>24</sup> Train (2009), *Discrete Choice Methods with Simulation*, Cambridge University Press, or Koppelman and Bhat (2006), *A Self Instructing Course in Mode Choice Modeling: Multinomial and Nested Logit Models*

<sup>25</sup> See Klein, J. P. & Moeschberger, M. L. (1997). *Survival analysis*. Springer, New York; Lawless, J. F. (2003). *Statistical Models and Methods for Lifetime Data*. 2nd ed. John Wiley and Sons, New Jersey.

<sup>26</sup> Aho, K.; Derryberry, D.; Peterson, T. (2014), "Model selection for ecologists: the worldviews of AIC and BIC", *Ecology*, **95** (3): 631–636

directly to end customers. In some countries, the end customer elasticity is transformed to the track price elasticity by assuming the track price elasticity to be proportional to the end customer elasticity according to the share of the train path costs on total costs or revenues.

The literature also makes a distinction between short and long-term elasticities. Litman (2017), for example, distinguishes between short (up to 2 years), medium (2 to 5 years) and long (more than 5 years) elasticities for passenger transport.<sup>27</sup> Axhausen (2012), on the other hand, refers to the literature according to which short-term elasticities are distinguished from long-term elasticities at one year.<sup>28</sup> Some studies expect that the medium- and long-term elasticity is higher than the short-term elasticity, because customers have more opportunities to change their behaviour in the medium- or long-term.<sup>29</sup>

From a practical point of view, there can be uncertainty determining the level of the variables that influence demand and the price elasticities. This plays a role while conducting the study, as the study might need an average price level for the analysed segment and other variables, and also after conducting the study when calculating the price elasticities using the resulting demand function of the study. To calculate the price elasticities for each segment, the RB has to make assumptions on the average price level or the market share of the segment and possibly many other factors.

It should be noted that one should not focus too much on the resulting point estimates of a certain study. As explained before, what matters for the calculation of the mark-ups is the ratio within the segments. That makes a direct comparison of different studies very difficult, or even pointless, as, in practice, elasticities should be estimated in a particular rail network and in each context. A study by the Germany RB<sup>30</sup> proposes different approaches to present its results. First, results are shown as the absolute or relative deviation from a selected reference segment. To allow a comparison to another study, the results are scaled by the average elasticity of the study to be compared with. The scaling makes it possible to see whether the results - apart from the different absolute values of the elasticities - have an influence on the resulting track access charges and impacts the relative competitiveness of segments.

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<sup>27</sup> Litman (2017), Transit Price Elasticities and Cross-Elasticities

<sup>28</sup> Axhausen (2012), Overview of Stated Preference studies in Switzerland and estimation of total elasticities, p. 8 f.

<sup>29</sup> Studies show that long-term elasticities are twice as high as short-term elasticities (cf. Puwein (2009): Preise und Preiselastizitäten im Verkehr, p. 785).

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[https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Eisenbahn/Unternehmen\\_Institutionen/VeroeffentlichungenGutachten/GAElatizitaeten2018/GutachtenElastizitaet2018.pdf?\\_\\_blob=publicationFile&v=2](https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Eisenbahn/Unternehmen_Institutionen/VeroeffentlichungenGutachten/GAElatizitaeten2018/GutachtenElastizitaet2018.pdf?__blob=publicationFile&v=2)

## 4.2. Other methodologies to assess what the market can bear and calculate mark-ups

As explained in the previous sections, the Ramsey-Boiteux pricing principle is a second-best solution to set charges that reflect the “ability to bear” of market segments. It does come with difficult practical issues in its application though. First of all, a rigorous estimation of demand price elasticities, meaning end customers demand, requires gathering extensive data, not only for the rail service from the various RUs offering similar services, but also for other modes of transport which can be considered as substitutes from the point of view of consumers. Econometric techniques for demand elasticity estimation, as illustrated, are complex, therefore the availability and reliability of the baseline data is even more fundamental for a rigorous analysis, most of all if it has to be used in setting regulated charges. It can be very difficult for a regulator to gather all the necessary data, due to the typical asymmetry of information, which is worsened by the need to include more than one mode of transport. Thus, in the absence of appropriate data, regulators might resort to an approximation of a Ramsey-Boiteux-inspired methodology to identify what the “market can bear” (e.g. market interviews). Furthermore, the need to also take productivity increases into account prompts some regulators to not only consider the Ramsey-Boiteux pricing principle alone when deciding upon mark-ups, or their updating.

Thus, other criteria may be considered by regulators - potentially alongside the application of the Ramsey-Boiteux pricing principle (or approximated versions of it) - in particular taking into account aspects such as the quality of services offered by railway companies to users, both with regard to traveling times and comfort level, the economic performance of operations, the level of competition in the market, the productivity of services, the level of integration of the offer with respect to the other segments. All these criteria substantiate the actual ability of RUs to bear the level of charges. However, just as with regard to the difficulty mentioned in the above sections concerning demand estimation, a multi-criteria approach may as well prove to be complex to apply, due to the difficulties that may be encountered in developing models for assessing companies’ ability-to-pay due to the lack of the necessary information. Nonetheless, a well-reasoned consideration of all aspects of a RU’s ability to bear an increase in charges might need to include not only determinants based on substitutability from the point of view of demand, but also other determinants, such as the presence and tightness of competition in the market, or income and social factors such as those affecting the demand for PSO regional services which, in some markets, tend to be less elastic than other services due to the strong presence of commuters..

In GB, a range of approaches have been used to carry out a ‘market-can-bear’ test and assess the ability to bear a mark-up within individual market segments. The approach taken depends heavily on the availability of information. For freight, ORR primarily uses segment-specific (i.e. commodity-specific) estimates of the elasticity of demand to inform a binary judgement as to which segments can realistically bear a mark-up. Only those commodities where demand is highly inelastic are liable to pay a mark-up. ORR has generally interpreted ability to bear as equivalent to a mark-up that results in a less than 10% modelled reduction in the gross tonne miles shipped by rail (taking account of likely substitution to road haulage). Mark-ups have then been calibrated on this basis. For non-PSO passenger services, demand elasticities are not used as they are not available for individual market segments. Instead, ORR has primarily used measures of operators’ profitability when running different services to assess of the ability to bear and to set mark-ups.

In Spain, the IM has not developed a complete methodology to estimate mark-ups and the market ability to bear them, so the RB came up with an ad-hoc analysis of the mark-ups proposed by the IM. Until recently, the Spanish rail passenger market was not open to competition and the information regarding market prices and demand was restricted to the service provided by the incumbent RU. In this scenario, the RB agreed to allow the IM to levy mark-ups in certain lines where the incumbent RU presented a positive and significant return. Nevertheless, the Spanish RB also clarified that this solution could be applied until the market finally opens to competition because, in a competitive market, returns by themselves, although can still be taken into account, might not clearly reflect the market ability to bear. In this regard, the Spanish RB is working on providing guidelines on how to interpret mark-ups and segmentation and will analyse the application of methodologies that account for the market segments' ability to bear, such as Ramsey pricing. In the meantime, the IM can still levy mark-ups on the ground of an analysis of the global impact of charges on the market, the situation of the RUs operating the lines and the demand and financial situation of the main corridors.