courtesy translation - only the Italian text is authentic

ASSESSMENT REPORT

Decree Law No 201/2011 - Art. 37 (2) (g) - Definition of optimal management areas of toll motorway sections - Conclusion of proceedings - Approval of regulatory measure.

1. INTRODUCTION

Pursuant to Article 37 (2) (a) of Decree-Law No 201 of 6 December 2011, converted into Law No 214 of 22 December 2011, as amended, the Authority *"(...) ensures fair and non-discriminatory access to motorway (…) infrastructures (...) according to methods that encourage competition, management production efficiency and cost containment for users, businesses and consumers"*.

Paragraph 2(g) identifies the specific functions which the Authority is entrusted with in the field of toll motorway concessions[1].

In particular, according to the second-last sentence of paragraph 2(g), the Authority is entrusted, *inter alia*, with the task of *"(...) defining optimal management areas of toll motorway sections so as to promote plural management thereof and foster competition by comparison; (…)"*.

2. PRELIMINARY ACTIVITIES

In order to implement the above-mentioned provision, in early 2014 the Authority started activities aimed at identifying the factors that could best represent the trend in the production costs of motorway concessionaires (both small- and medium-large), so as to determine the so-called "efficient cost frontier"; this "frontier" is the set of points that identify the minimum cost of production for each output level (e.g. traffic volume or length of the section under concession), given the prices of inputs and the quality/quantity features of existing technology.

The curve formed by said points ("cost frontier curve") allows, *inter alia*, to determine the minimum optimal production size (i.e. the size below which there clearly appear significant "*diseconomies of scale*")

As part of this activity, the Authority initiated discussions with the management of AISCAT association representing motorway concessionaires, followed by discussions with the Association itself, aimed at launching a survey on the data useful for the construction of the "*cost efficient frontier*". The survey has been based on a record format provided by the Authority with reference to technical, economic and financial data for the 2005 - 2013 period, subsequently forwarded to the concessionaires for input of the relevant data.

The survey, which ultimately also concerned 2014 figures, was concluded in June 2015.

Meanwhile, in the first months of 2015, meetings were held with representatives of the main motorway concessionaires, Autostrade per l'Italia S.p.A. (hereinafter ASPI) and SIAS S.p.A. (parent company of seven subsidiaries, being the concessionaires of motorway infrastructures located in the northwest of the

---

[1] In addition to paragraph 2 (a) and (g), other competences of ART in the motorway sector are based on letter (b) of the same paragraph, under which the Authority shall: *"(...) define, if deemed necessary based on the existing competition conditions in the individual markets of national and local transport services, the criteria for the determination of charges, fees, tolls by the competent entities, taking into account the need to ensure the economic balance of regulated companies, the management production efficiency and the cost containment for users, businesses, consumers; (...) "*.

country), in order to explain the methodology and the econometric model parameters provided by the Authority for the cost analysis of motorway concessionaires and their connection with technical and management parameters (primarily, the connection with the overall length of the motorway sections under concession). Later, on 24 March 2015, the above companies were asked to submit comments to improve the model.

The model originally developed by the Authority provided for the estimation of a production cost function with a functional form of Cobb-Douglas type, as follows:

$$C = f(V, L\_Km, P_i, H)$$

where

- C = total costs, including all operating costs (labour, materials, services), depreciation, financial charges and other cost items attributed to management activities;

- V = traffic volumes (in terms of number of kilometres travelled by paying vehicles);

- L_Km = length of network measured in kilometres;

- P_i = prices of inputs i. The factors considered are as follows: labour, capital, maintenance and other complementary items (materials and services);

- H = a series of control variables (for the internalisation of environmental/geographical aspects).

The cost function of Cobb-Douglas type has following formula:

$$lnC = \alpha + \sum_i \beta_i ln\, x_i + \varepsilon_i$$

where C = costs of production, x_i = explanatory variables (prices of inputs, outputs and other control variables), β_i = value of cost elasticity with respect to x_i factor and ε_i = error term of the estimate.

More in detail, as regards the prices of inputs/ production factors, in the stage of initial application they have been calculated as follows:

- *PL = Annual cost of labour/number of employees at year-end;*

- *PM = Maintenance costs/km travelled;*

- *PK = (Depreciation + Finance expenses)/network (km);*

- *PS = total amount of other costs for materials and services = (total production costs less labour costs, maintenance costs, amortization and financial expenses)/network length.*

Finally, in order to take into account the potential influence of external factors, variables have been introduced to capture a number of geographical, territorial and environmental features (H) including:

- time trend (by indexing at time *t*),

- number of major works (viaducts, bridges and tunnels),

- existing sections of network with 3 or more lanes (network (km) with 3 and 4 lanes/network (km)),

- indicators of service quality (i.e., IPAV index - road surface quality indicator).

On 3 April 2015, the company ASPI submitted comments concerning the methodology developed by the Authority and proposed the adoption of an alternative cost function. The company SIAS made no observations.

In particular, the comments submitted by ASPI on the model referred to the following aspects:

1. calculation of the price of labour, to be determined by normalizing with respect to the annual average number of employees, rather than the number of employees at year-end;

2. calculation of the price of capital, whereby different policies regarding depreciation and management of financial charges adopted by concessionaires could lead to inadequate values for two reasons:

   ✓ very different depreciation policies among Italian concessionaires and level of depreciation depending on different residual lives of concessions;

   ✓ financial charges strongly influenced by the different decisions/financial strategies of concessionaires;

3. number of major works, to be transposed into the model taking into account the total length (km) of these works, to be later related to the overall length of the network under concession;

4. robustness of data, so that it would be necessary to use functional forms other than the Cobb-Douglas function (used in the first version of the model), by applying a translog-type function, which incorporates both the above variables and their quadratic values and interactions for each pair of variables.

Finally, ASPI argued that the benchmarking model should not be based on costs broken down according to their nature, but rather on production activity-related costs.

3. INITIATION OF PROCEEDINGS

In light of the useful elements resulting from the above preliminary activities, with Decision No 32 of 23 April 2015 the Authority initiated proceedings for defining the optimal management areas, setting the deadline of 30 June 2015 for their conclusion.

Given that the acquisition of data for 2014 - aimed at a thorough preparation of the proceedings - was completed only on 10 June 2015 and on account of the need to submit to public consultation the document containing the analysis methodology in order to acquire useful background information from the entities concerned, with Decision No 52 of 30 June 2015 the deadline for completing the proceedings was extended to 31 December 2015.

On 13 July 2015 the Authority received a report produced on behalf of AISCAT by the company The Brattle Group[2], which substantiated the above-mentioned observations with a quantitative analysis. The report highlights in particular:

- the need to consider, in the model, alternative variables to complement the analysis of the price of capital;

- the need to test the robustness of the results by means of translog functional forms;

- the use of an alternative definition of the unit price of raw materials and services, with reference to traffic volumes and not to network (km) of the infrastructure under concession.

In the document it is further underlined that the use of different estimation models can lead to very different results, except in cases where a frontier estimation with *time invariant* and *time varying decay* panel data is applied, namely by using estimation methodologies that consider inefficiency and technical progress to be respectively constant or changing over time.

---

[2] The Brattle Group, "Analisi dei costi efficienti per il settore autostradale italiano" (Efficient cost analysis for the Italian motorway sector), drafted for AISCAT, 10 July 2015.

In view of the above, it was considered it appropriate to carry out a structural revision of the econometric model, together with a re-calibration thereof and an overall re-calculation of results. By Decision No 113 of 17 December 2015 the proceedings were further extended until 30 April 2016.

The structural revision and recalibration of the model was carried out by varying the definition of the price of materials and services as suggested and by including new variables that could better represent the different depreciation policies and the different debt exposure of concessionaires.

In particular, this advanced version of the estimation model developed by the Authority substantially incorporates all comments received by the concessionaires and by the industry association mentioned above, being structured as described here below.

Prices of inputs (P_i) are defined as follows:

- *Price of labour (PL)*: total labour costs/average annual number of employees[3].

- *Price maintenance (PM)*: total maintenance costs/traffic volumes.

- *Price of other services (PS)*: cost of other services/network length.

- *Price of capital (PK)*: (total depreciation + financial charges)/network length.

With regard to outputs, the following variables were used:

- *traffic volumes (Vol)*: total km travelled by paying vehicles.

- *network length (L_km)*: length (km) in flat areas + length (km) in hilly areas.

In order to adequately represent in the model further temporal, geographical, territorial and environmental features of motorway infrastructures, which typically affect the costs of concessionaires, the following control variables were applied:

- *percentage of network with three or more lanes (Lanes3/L_km):* (km of three-lane motorways + km of four-lane motorways)/network length. This variable allows to capture the higher costs characterising concessionaires managing routes with three or more lanes.

- *Km percentage of major works* (Km_majorworks/L_km): (km of tunnels + km of bridges and viaducts)/network length. This variable allows to capture the higher cost incurred by concessionaires managing routes with major works (tunnels, bridges and viaducts). The reference measure used in this case is the length (km) of such works, compared to the overall length of the motorway infrastructure under concession which they are part of.

- *Quality level (Ipav)*: IPAV (road surface quality indicator). This variable allows to consider the higher costs incurred to maintain a high quality level of the road surface.

- *Percentage of the remaining years until the end of the concession (Remaining_Years_perc)*: Remaining_years/total life of concession. This variable assumes values being the higher (maximum value = 1) the farther the expiry of the concession, and viceversa closer to zero the closer the expiry of the concession. It allows to take into account the fact that some concessionaires may adopt different depreciation policies depending on the residual life of the concession, i.e. initially low depreciation increasing as the expiry of the concession gets closer, with a clear impact on service costs structure.

- *Debt to equity ratio (Deb_eq)*: Debt/Equity. This variable takes into account the different propensity to use the financial leverage to cover investment costs, where a greater debt exposure involves higher costs in terms of financial charges.

---

[3] The average number of employees (for collection, maintenance and safety, offices, other, both with fixed-term and open-ended employment contract) was calculated as the average number of employees at the 31st of December of a two-year period.

- *Time Dummy (dumT, for years T = 2005, …, 2013)*. These dichotomous variables allow to represent in the model the features that each year may have on traffic development and, consequently, on the efficiency of concessionaires.

The estimations have also taken into account additional factors characterizing the different concessionaires, such as type of charging schemes adopted and type of control exercised by a corporate group. This was accomplished by introducing, among the regressors, the following additional dichotomous variables:

- *Dummy charging scheme (dum_schemeN, where N = 1, …, 6)*. These dummies allow to take into account any different impact on costs generated by the different (6) charging schemes currently in place.
- *Dummy group controlling the concessionaire (dum_group)*. These binary variables allow to control any efficiency differential between concessionaires belonging to different industrial groups (for example, Atlantia or SIAS) or under Government control.

The econometric estimates have been performed by using the Cobb-Douglas type functional form as defined above, together with a translog function, which is more flexible especially with reference to the economies of scale that may vary with outputs.

The following translog function has been used:

$$lnC = \alpha + \sum_i \beta_i ln\, x_i + \sum_i \sum_j \gamma_{ij} ln\, x_i\, ln\, x_j + \varepsilon_i$$

where coefficients γ_{ij} represent the variation in cost elasticity with respect to x_i factors upon their variation. Through these coefficients, with this functional form it is possible, unlike that of Cobb-Douglass, to take into account the interactions between different factors, thus enabling economies of scale to adapt, for example, upon variation of the length (km) of motorway sections for each concession.

The models have been estimated by using both a *time-invariant* lay-out (i.e. assuming the term of inefficiency has a normal truncated distribution), and a *time-varying decay* lay-out (i.e. assuming that inefficiency levels and technical progress are changing over time). The two above-mentioned modelling lay-outs have been selected because they were found to be more robust and less sensitive compared to the existence of outliers in the sample considered, as it was also indicated in the above-mentioned analysis performed by The Brattle Group on behalf of AISCAT.

With regard to the remarks submitted by ASPI, according to which the benchmarking model should be based on the costs broken down by activity rather than by nature, the Authority considers that the benchmarking analysis is aimed at defining specific economic regulatory measures and for this reason it can only be conducted on the costs broken down by type. On the other hand, the analysis by activity is an analytical tool typical of industrial accounting and, as such, it is considered to be inappropriate for the regulatory purposes at issue.

The Authority has drawn up a number of estimations in which the various control variables are inserted at first one by one, and later together, to check the resilience of the model. Further, tests with different levels of normalization of economic variables were carried out, by normalizing input prices both compared to the price of a reference input and to the median values of the variables.

In brief, the analyses were performed as described below:

- Estimates through Cobb-Douglas function, with:
  - entire sample;
  - sample without ASPI;
  - variables related to quality and type of the charging method applicable to each concessionaire
  - normalization with respect to product prices and median of values.
- Estimates through translog function, with:
  - entire sample;
  - sample without ASPI;
  - variables related to quality and type of the charging method applicable to each concessionaire
  - normalization with respect to product prices and median of values.

The results obtained by the Authority have led to the identification of an **optimal area**, expressed in terms of length in kilometres of the motorway infrastructure assigned to a single concessionaire, which lies above **a minimum threshold of 180 km and below a maximum threshold in the region of 315 km. This implies that, in order to take advantage of economies of scale and remove production inefficiencies due to reduced length (km)** of a motorway assigned to a single concessionaire, the length of the motorway infrastructures included in a single concession should not be less than 180 km. In the range between 180 km and 315 km, the analysis has shown there can still be possible benefits linked to the increased size of the length under concession, nonetheless highlighting that these benefits are progressively reduced and finally disappear, as the length approaches values in the region of the upper limit of the range (i.e. 315 km).

4.   CONSULTATION PROCEDURE

By Decision No 1 of 14 January 2016, a document containing the regulatory measure under Annex A of the Decision was submitted to consultation. This document provides as follows.

Definition of optimal management areas for toll motorway sections

1. Based on the methodology set out in Annex 1, the "optimal management areas" of toll motorway sections, as referred to in article 37 (2)(g) of Decree Law No 201 of 6 December 2011, converted into Law No 214 of 22 December 2011, as amended, correspond to lengths (km) falling, for a single concession, in the range between 180 and 315 kilometres.

2. Significant structural inefficiencies are observed for lengths (km) of less than 180 km, greatly increasing with length reduction. As for lengths (km) exceeding 315 km, no additional structural benefits are reported.

3. In the procedures for the award of motorway concessions as well as the modification of essential elements thereof, the authority awarding the concession acts so as to ensure the structural efficiency levels deriving from the compliance with above paragraphs 1 and 2 of the measure, by appropriately identifying the length (km) of each individual concession.

Pursuant to paragraph 2 of the Decision stakeholders could submit, no later than 15 February 2016, comments and proposals on the regulatory measure, as specified in Annex B to the Decision.

Within the aforementioned deadline comments were received from the following entities:

1) FILT CGIL – Federazione Italiana Lavoratori Trasporti[4]

According to this trade union organization the model proposed by the Authority to identify optimal areas of toll motorway sections disregards or omits some variables that, as part of a possible kilometre "consolidation", should be taken into consideration, even with a view to homogenise the following factors on the entire motorway network: quality, safety, labour protection.

Quality means service rendered to users and the analysis should not be limited only to "road conditions" and infrastructure works, albeit important, but should evaluate also the services offered along the network, in terms of manned toll booths, timeliness and quality of road workers interventions (road conditions and maintenance), efficiency of radio facilities and amount of internalised work.

For labour protection, FILT CGIL considers fundamental to apply the relevant national collective labour agreement for concessionaires' and contractors' workers, be they construction workers, service station personnel or catering staff.

With regard to safety, FILT CGIL refers to the safety of users travelling on motorways, that of concessionaires' workers and especially that of contractors' workers, which should be adequately guaranteed also in compliance with inter-ministerial Decree of 4 March 2013.

FILT is also concerned that any pooling of concessionaires would only take into account variables relating to cost reduction, nonetheless necessary when considering the current significant fragmentation of the motorway network management, and would not focus on equally important factors, which cannot be disregarded and could rather find positive solutions in a larger economy of scale, without this turning into the centralization of powers in a sector which is naturally monopolistic.

Further, FILT would be interested in understanding how the current concessions could be affected in case of a significant change in the existing production structures and in the workforce employed today.

According to FILT a new regulation would be decisive at that point, as well as the inclusion of a social provision for labour protection.

ART'S ASSESSMENT:

It should be firstly pointed out that the analysis was carried out on the basis of the technical and economic data related to a number of Italian concessionaires and provided by the concessionaires themselves.

The "quality" of the service offered by concessionaires to users has been taken into account through the most important factor, i.e. quality of the road surface, due to the fact that other quality indicators linked to the provision of services intended for the access to infrastructures (manned toll booths, timely interventions, etc.) are not currently available. Should these indicators be available, the model could certainly be updated accordingly.

As regards safety and labour protection, while it is true that a measure concerning these issues is not currently provided for in the model, it should be noted that, since safety and protection of workers fall within the so-called "legal obligations", it may be reasonably assumed that all concessionaires comply with the relevant regulations in force. Therefore, although not directly measured, they are in fact already included - under the item concerning labour costs - in the model developed by the Authority. Similarly, with regard to any contracts to third parties, these charges are already included under the item "*Total costs of other services*".

---

[4] Italian transport workers federation

2) CISL RETI[5]

The trade union organization has submitted the following comments:
- the Authority's model is not considered appropriate to a Pareto optimal sizing, as it does not contain, neither as an input nor as an output, the economic, social, aggregate and agglomeration effects, which the application of this definition may have on the economic region generated by the very existence of the infrastructure and its "form";
- further reflection is called upon to adopt a measure truly characterized by effects of compliance to a public function, and useful to the awarding authority for determining positive and beneficial effects on the served human environment;
- this latter option is generally characterized as a trade-off, thus implying a partial waiving of market efficiency, while achieving greater equity for market access and greater freedom for individuals; these goals are recalled vividly by Italian fundamental law, together with the foundation of work, in the first articles of the Republican Constitution.

ART'S ASSESSMENT:

It is necessary to highlight that the benchmarking model developed by the Authority is aimed at studying the cost structure of Italian concessionaires and determine which reference length (km) could minimize these costs. This aim is realized by looking at the concessionaires' cost structure, which is duly analysed on the basis of econometric models that are standardised in the economic literature. Obviously, it is a business perspective, rather than a collective welfare approach (i.e. the view of a public decision-maker), although it should be underlined that minimizing costs - subject to the compliance with legal obligations by the concessionaires - is the main pre-requisite to achieve the welfare optimization objectives of the majority of the community involved, namely the motorway users.

However, the pursuit of collective welfare in the broader sense would require the quantitative consideration of specific policy objectives (such as the quantification of the social value of labour protection) and of the impact produced by motorway services on the community as a whole, which fall essentially within the remit of the awarding authorities. Although it is of undoubted social relevance, the above-mentioned impact analysis falls outside the purposes of the specific survey at issue, as provided for by art. 37 (2) (g) of Decree Law No 201/2011.

3) AISCAT – Associazione Italiana Società Concessionarie Autostrade e Trafori[6]

Following an internal analysis, conducted on the documentation made available during the consultation, the Association reported that its members were concerned about the results obtained from the econometric model provided by the Authority, and therefore also about the optimal management areas as defined by the Authority.

AISCAT warned against the risk that such regulatory measure may even result in increased inefficiencies, rather than in the reduction thereof.

With respect to the Authority's econometric model, the Association underlined the following:

➢ the model might lack a critical assessment of the methodology used. AISCAT notes that ART does not provide any argument in support of the methodology used, nor does it consider alternative estimation methods. On the contrary, the Association points out that according to the best practices followed by other European regulatory bodies, static econometric estimates in conjunction with the evidence

---

[5] Trade union organization pooling workers in the communication, energy and transport sectors.

[6] Italian association of Toll Motorways and Tunnels Operators

arising from qualitative assessments should be considered as well, together with the results of engineering studies, rather than only activity-based cost models;

➢ a critical comparison among the different model specifications seems to be missing. AISCAT notes that ART's document does not provide sufficient evidence to assess the choice of the model specification, nor it presents an accurate analysis of the results arising from the different specifications. Moreover, results are reported only for 8 out of the 280 regressions carried out by ART and neither explanations are provided on the possible representativeness of the selected results, nor a quantitative comparison of the results of the regressions;

➢ the results - obtained with different models - would seem to be divergent. According to AISCAT the different model specifications lead to different definitions of optimal management areas, but the Authority does not seem to take these differences into account in the regulatory measure;

➢ reduced sample size. AISCAT finally notes that the dataset used by the Authority has a limited number of observations (i.e. about 180) and appears to be objectively inadequate to accurately estimate the economies of scale and, therefore, the optimal management areas.

In summary, the regulatory measure would appear to be based on an analysis which is to be completed in some respects, and to be improved in some others.

The Association stated its availability to send factual evidence useful to highlight the above remarks and, in this respect, considers it essential to carry out a discussion and a thorough examination with the Authority in an absolutely constructive spirit and with the aim of ensuring the implementation of a fully efficient motorway system.

ART'S ASSESSMENT:

As to the first remark, AISCAT considerations refer to two aspects:
➢ in the first place, it is stated that a critical assessment of the methodology used seems to be missing and that the regulator does not provide any argument in support of the methodology used;

➢ secondly, it is stated that regulatory best practices provide that static econometric estimates should be considered in conjunction with the evidence arising from qualitative assessments, as well as with the results of engineering studies, rather than activity-based cost models.

On the first issue it should be noted that Annex A to Decision No 1/2016 expressly provides that

"As to the definition of the Model (briefly described in Annex 1 to the regulatory measure), the Authority has applied the principles inspiring the most recent economic literature on benchmarking, drawing on scientific work, both methodological and applied, concerning, in particular, the motorway sector.

and that

"A similar method is applied by other regulatory authorities (including, for example, the British Office of Rail and Road - ORR in the transport sector and, at the national level, the Authority for Electricity, Gas and Water in the energy sector) and is normally used to support policy decisions concerning the optimal dimensional range of services."

Furthermore, in Annex 1 to the regulatory measure submitted to consultation, the Authority has made available a detailed description of the econometric model used to estimate the scale and cost efficiency of Italian motorway concessionaires.

As to the second issue, it should be noted that AISCAT provides no evidence of the so-called "*best practices followed by other European regulators"*.

As to the substance, it should be emphasized that the possibility of considering "*the evidence arising from qualitative assessments as well as [the] results of engineering studies rather than activity-based cost models*" is to be assessed according to the specific regulatory goals; in particular, such an approach may be used - and has been adopted by the Authority - when it comes to determining efficient prices for a specific service (for example, rail charges) or levels of efficiency to be applied in the charging dynamics (e.g. as provided for in airport charges regulatory models). In the case at issue, the objective of the analysis was different and is derived directly from Article 37 (2) (g) of Decree Law No 201/2011, which provides for the definition of optimal management areas of toll motorway sections, namely the size limits of the length (km) outside which there appears to be no optimization of production costs. For this purpose, the cost analysis can only be conducted on the costs divided by nature. The analysis by activity proposed as an alternative is typical of an industrial accounting analysis and is not useful for the purpose of ours.

As for the second and third issue (critical comparison and variance of the results), the Authority has submitted two estimation models appropriately commented in the aforesaid Annex 1 to the consultation document: the first model applies a Cobb-Douglas type cost function, which assumes a constant elasticity of substitution among inputs and allows to define a simple and intuitive function from the point of view of the interpretation of coefficients, with some restrictions on their values; on the other hand, the second model uses a translog-type function, which is more flexible especially with reference to the economies of scale that may vary with the output, but requires a greater number of observations, since the estimate of numerous parameters consumes many degrees of freedom. Both models are the most used in the economic and regulatory environment; however, in our case, they provide results in line with one another, taking into due account the different underlying methodologies.

Given the substantial statistical stability of the estimates, the Authority decided to include only an abstract in Annex 1 to the Decision (Econometric model for evaluating the scale and cost efficiency of Italian toll motorway concessionaires), taking also into account that the issue under consultation is the proposed measure rather than the cost analysis model developed by the Authority.

As for the results achieved, it must be emphasized that these (with respect to the optimal lengths in km) are absolutely in line with what is reported in the economic literature currently available and specifically referred to Italy, i.e. the survey by Benfratello et al., 2009 quoted below[7]; this survey uses time series of the Italian concessionaires' data referred to the period from 1992 to 2004 and evidences a minimum optimal size of the length (km), assigned to a single concessionaire, equal to approximately 300 km.

With regard to the number of available data, it should be emphasized that, while it is true that the number of available observations is not particularly high, they represent the data of the universe of concessionaires and not those of a more or less representative sample extraction. As a matter of fact the Authority's survey includes all concessionaires currently operating in Italy. It should be noted that in 2010 the British Office of Rail and Road, another regulatory body of consolidated experience, estimated - with reference to a panel of international comparables - the efficiency rate which the Infrastructure Manager *Network Rail* has been later subjected to; in its report ORR used a number of observations (156) lower than that used by the Authority in the present case.

Finally, it is worth to point out that, while it is true that the translog method requires many observations, the same method has been suggested both by ASPI and AISCAT in previous reports delivered to the Authority[8].

---

[7] Benfratello, L., Iozzi, A., Valbonesi, P. (2009), "Technology and incentive regulation in the Italian motorways industry", *Journal of Regulatory Economics*, 35(2), 201-221.
[8] Reference is made to the report drafted by The Brattle Group on behalf of AISCAT ("Efficient cost analysis for the Italian motorways industry", 13 July 2015) and to ASPI letter dated April 3rd, 2015.

4)   ATIVA – Autostrada Torino – Ivrea – Valle d'Aosta S.p.A.

As a result of an initial analysis of the available documents, ATIVA submitted only general comments, including some concerns about the results and the definition of optimal management areas adopted by the Authority, mainly in connection with the distinctive features characterizing the infrastructure managed, and with particular reference to Turin Ring Road ("Sistema Autostradale Tangenziale di Torino", SATT).

Without getting into specific considerations, ATIVA reserved to submit observations concerning the methodology used, the model chosen, the nature and type of data used, and considered it necessary, in addition to **an additional focus on the study** also with respect to the issues mentioned above, **to hold discussions** with the Authority in an absolutely constructive spirit, for the purpose of achieving the objectives underlying the consultation aimed at ensuring a fully efficient motorway system model, which takes into account the characteristics of specific infrastructures.

*****

With regard to the comments received following the consultation, the Authority's offices noted they had also highlighted that the goal set by the Authority with regard to "optimal areas" was to be better defined and that, accordingly, complementary approaches were to be outlined in order to strengthen those already employed.

In the first place, the Authority confirms that the "optimal management area" should be interpreted as an adequate "dimensional range" of the length (km) of the motorway sections managed under each concession, so as to ensure an optimal level of structural efficiency. The identification of such "dimensional range" must be pursued by means of suitable models that allow to associate the evolution of costs with the overall length (km) of motorway sections, in order to verify the existence of economies of scale.

In this framework, the most relevant aspect is the identification of the minimum threshold of the dimensional range, below which significant structural inefficiencies are observed; the relevance of this threshold derives from the fact that it may be assumed that such inefficiencies are greatly increasing with the length reduction.

The models submitted to consultation, based on the method of the "stochastic frontier cost analysis", allowed to highlight the overall shape of the efficient cost curve according to the length (km) and, in particular, the existence of a "bend" located in a specific kilometre range (i.e. in the region of 180 km), which therefore identifies the dimensional range below which significant structural inefficiencies are certainly determined.

Moreover, since the goal is to achieve robust correlations between the cost evolution and the overall length in kilometre of toll motorway sections in order to verify the existence of economies of scale, and since it is likely that economies of scale (which are evidenced by the presence of a "bend" located in a specific kilometre range) are observed not only considering the "efficient costs", but also the "average costs", the Authority's offices have considered it appropriate to support the analysis already carried out, based on the estimation of a cost *frontier*, with an analysis based on the simplest cost *function* to process the average costs observed.

In fact, although the estimate of a cost *function* does not allow (by its nature) to measure the relative efficiency of the companies operating in the sector, it still allows to make assessments on the correlation between costs and company size, and entails, for its greater simplicity, some benefits at the operational level compared with the cost *frontier*. In particular, the estimate of a cost *function* allows to obtain statistically more accurate estimations of technology, improving the accuracy of the following policy

indications. Further, this approach has been used in the major economic study on the technology of this sector in Italy, published in 2009 in the *Journal of Regulatory Economics* by Benfratello, Iozzi and Valbonesi (see above.)

In a nutshell, while the Authority's models firstly submitted to consultation were aimed at determining an *"efficient cost" frontier*, to be later associated with the existence of economies of scale and, consequently, the optimal size of the service, the estimate of a *cost function* is only aimed at determining the existence of economies of scale through the estimate of a mean cost function (which inevitably considers costs per output unit which are higher compared to *efficient* costs). Taking into account that both methods are directed at estimating the economies resulting from the technology underlying the service, they are both able to identify the existence of a "curvature" of the estimated cost functions and hence allow assessments of the kilometre range below which significant structural inefficiencies are certainly determined.

As to the comments received on the inclusion of a variable concerning the cost of capital and thus the estimate of the total cost function, the Authority's offices have found it useful to integrate the analysis with the estimate of a variable cost function not including *capex*, but only the operating costs incurred by a concessionaire; this further approach can, in fact, be useful in perspective, by differentiating the considerations on *opex* (a significant aspect for all concessions) from those on *capex* (a more significant aspect for those concessions aimed at the building of new motorways or sections of significant length). This involves the estimate of *function* and *frontier* models based only on *variable* (and not *total*) cost.

In light of the above and considering it appropriate to carry out further analysis and insights for consolidating the model used, it was necessary to further extend the deadline for conclusion of the proceedings (until 30 June 2016) as defined by the Authority's Decision No 42/2016 dated April 14, 2016.

5) FURTHER INSIGHTS - ASSESSMENTS

In view of the outcome of the consultation and as a result of the extension of the deadline for closing the proceedings at issue, based on Decision No 42/2016 as above, the Authority's offices (in cooperation with Prof. Luigi Benfratello of *Politecnico di Torino*) have conducted further investigations concerning both the analysis of the data received and the critical issues raised by the Brattle Group on behalf of AISCAT, on the econometric model provided by the Authority.

In addition, it was decided to estimate other models which were similar to those already developed, but based on both total and variable cost functions (rather than on frontiers).

Further analysis carried out on the preliminary procedures has led to the identification of a marginal error, consisting in not having considered - for one concessionaire - that its operating period in a specific year was shorter than 12 months. In order to standardize the data to the usual duration of 12 months, it was therefore deemed appropriate to "linearize" the flow data as if the operation period had lasted 12 months.

Finally, it has been verified how in the case of two concessionaires the procedure previously used, which considered as missing data values that could instead be reasonably considered as equal to 0, led to a non-marginal reduction of the set of available observations (about 10%). Although the previous procedure has been deemed correct, it was also considered appropriate to re-estimate the models by using these "adjusted" observations.

In a nutshell, it was decided to create two different datasets: the first corresponding to the dataset already used by the Authority and based on the data sent by concessionaires, and the second characterized by a greater number of observations obtained thanks to the above adjustments.

The next step consisted in estimating the cost frontier models, not only by incorporating the linearization of flow data for that concessionaire having an operating period of 6 months only, but also by imposing a "price homogeneity of degree one" for all estimated models, as underlined in the aforesaid document drafted by The Brattle Group.

In some of the models already in place account has been taken of such control (the models with normalization compared to the price of a factor), but these estimates had been later left out of Annex 1 to ART's Decision No 1/2016.

The results of these further analyses have basically confirmed the results previously obtained by the Authority, in particular those concerning economies of scale.

Similarly, it was decided to apply the models developed by the Authority also on an expanded panel of concessionaires (i.e. containing the two concessionaires whose data can be considered equal to 0 and not missing). Even in this case, the results previously provided by the Authority appear to be confirmed.

Finally, the estimate was performed on models similar to those already in place, but based on both actual total and variable cost functions (rather than on "cost frontiers"). As already mentioned, the use of these functions is alternative to the frontier-based method and allows to obtain a representation of the technology of the sector and the measures connected thereto, such as the economies of scale. In addition, the estimate of variable cost models also responds to criticisms raised in the foregoing document by The Brattle Group, namely that the simultaneous presence of the network and the associated costs in the specification adopted by the Authority would not be explicitly supported in theoretical models.

The estimations of both total and variable cost functions have again confirmed the results of the models developed by the Authority.

Ultimately, the overall results show that, regardless of the method used (whether frontier estimation or cost function) and of the estimated cost (whether total or variable), there are significant production and structural diseconomies for lengths below 180 kilometres, corresponding to the 75th percentile of the distribution in the sample.

Not only the exact value of the elasticity of scale corresponding to this dimensional range, but also a confidence interval for the elasticity of scale has been estimated (i.e. the range that contains the "real" - but unknown - value of the parameter at issue with a certain probability). In almost all the estimated models, the 95% confidence interval does not contain the value 1 for the elasticity of scale, but rather includes values above 1 (indicating the existence of significant economies when switching from low values of the length (km) to a value of 180 km).

Therefore, it can be concluded that the result concerning the existence of economies of scale is, from a statistical point of view, a reliable result.

In summary, for motorway lengths (km) of toll motorway sections assigned to single concessionaires which are below 180 km, diseconomies are observed which may be attributed to the reduced size thereof .

The result concerning the existence of significant economies of scale does not appear to be limited to the range between 0 and 180 km, as it may be observed even above the threshold of 180 kilometre. However, beyond this threshold, the result does not appear to be so unequivocal, especially when approaching a length value in the neighbourhood of 315 km (in fact, it should be noted that, for some models, some of the estimated confidence intervals contain values equal to or less than 1). However, the economies of scale seem to progressively disappear for values of the network ranging from 315 to 500 km, where in most of the estimated models value 1 falls within the range for the elasticity of scale.

Finally, it was decided to re-estimate the models by excluding the concessionaire Autostrade per l'Italia from the sample, because of its extremely different size compared to other concessionaries (about 25 times larger than those corresponding to the "median concessionaire").

The results still show the existence of economies of scale for median values of the network (113 km), but it appears that economies of scale are exhausted more quickly, i.e. for smaller size of the network compared to the case when the entire sample is used. Indeed, for a network length of about 180 km, it is observed that, especially with cost function models, there remains evidence of the existence of economies of scale, while they seem to be exhausted when considering frontier-based estimates.

Based on this evidence, the optimal range for the size of the concessionaire or of the sections under concession - while having the same lower level of reference (180 km) - reasonably appears to be much less extensive than that obtained with the whole sample.

6) CONCLUSIONS

In conclusion, it is confirmed that the value of 180 km, which is considered as the minimum **threshold value for the optimal length (km) of the motorway infrastructure under a single concession** in the consultation document referred to in Authority's Decision No 1/2016, corresponds with an extremely robust analytical result.

This finding comes from the fact that any model used (function- or frontier-based) and any specification used (with and without time dummy, with or without controls) shows the existence of possible efficiency gains for size increases up to at least 180 km of the network.

On the other hand, as regards any maximum threshold to be considered for the optimal length (km) of the motorway infrastructure under a single concession, it should be noted that, while such threshold varies depending on model and sample used, a threshold in the neighbourhood of 315 km seems a reasonable one, whereas no further efficiency gains linked to industrial and structural features of the motorway concessionaires are observed for lengths (km) above this threshold.

Other technical and strategic factors, which are external to the econometric model developed by the Authority, could be relevant for contracting authorities in the exercise of their functions.

Among these, by way of example:

    a.   degree of proximity of the concession at issue with other concessions;

    b.   presence of network economies/density and purpose, supplementary to the economies of scale;

    c.   integrated and attractive traffic management policies, as well as policies aimed at traffic safety

    d.   mobility management policies through remote- and centralized- control technologies.

> **In consideration of the above, based on the findings arising from the analyses described above concerning the existence of economies of scale at the production and structural level for various dimensional ranges of motorway sections, the proceedings at issue can be concluded with the adoption of the following regulatory measure, which is submitted to the Board for approval.**

REGULATORY MEASURE

Definition of optimal management areas of toll motorway section

1. With reference to the production and structural aspects of motorway concessions, significant cost inefficiencies are observed for lengths (km) of less than 180 km of the infrastructures under concession, such inefficiencies greatly increasing with length reduction. On the other hand, for lengths (km) exceeding a value of approximately 315 km, no additional significant economies of scale are reported.

2. With reference to the production and structural aspects, the "optimal management areas" of toll motorway sections, as referred to in article 37 (2)(g) of Decree Law No 201 of 6 December 2011, converted into Law No 214 of 22 December 2011, as amended, correspond to a length (km) of not less than 180 km, for each concession, basically falling within the range from 180 to 315 km.

3. In the procedures for the award of motorway concessions or for the modification of essential elements thereof, the authority awarding the concession shall take into account the structural efficiency levels deriving from the compliance with above paragraphs 1 and 2 of this measure, by appropriately identifying the length (km) for each concession.

Turin, 20 June 2016

The Officer
Enrico Tramaglino

Head of Unit   The Secretary General
Roberto Piazza   Guido Improta