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BETWEEN PRIVATIZATION AND REGULATION: AN EMPIRICAL ANALYSIS OF THE ITALIAN MOTORWAY INDUSTRY PERFORMANCE DURING THE 1997-2018 PERIOD

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ABSTRACT

The Italian Motorway Industry has never enjoyed the public spotlight it should, given its significant contribution to the GDP, directly through toll motorways and indirectly as part of the national transport infrastructure, and its intrinsic monopoly attributes. The aim of the present work is to investigate the evolution of the sector, while providing a critical analysis of its performance.

After its birth in the post-World-War I period, the industry experienced a substantial development, leading to the construction of most of the existing Italian motorway network, through the mechanism of concession. However, in the 1970s and 1980s, the precarious financial condition of the concessionaires and the litigation with the concession-granting-body, the A.N.A.S., made it necessary a radical reform, following two main drivers: the privatization of the sector and the introduction of a price-cap based regulatory regime. In the following years, the productivity of the concessionaires benefited from the privatization process. However, on the other side, the regulatory regime left grey

areas, mainly related to the determination of the concessionaire-productivity-related factor X in the price-cap formula, the arguable incentive system determined by the quality-related adjustment component in the same formula, and the absence of a unique and independent regulatory authority.

The uncertainty associated to the convention renewal, resulting in the issuance of multiple legislative acts, and the heterogeneity created by the diversification of the original price-cap formula into six different ones, each one to be applied to different concessionaires, led to another sector reform. The latter provided for a redistribution of roles within the A.N.A.S., the Ministry of Infrastructure and Transport, and the CIPE, as well as for the institution of the Regulatory Authority of Transport, in 2011, having specific competences in the motorway industry. The Authority, along with the identification of the concessionaire optimal size, in terms of kilometers of the under-concession motorway, developed an alternative homogeneous toll-determination mechanism.

The last chapter of the paper presents econometric estimations about the industry performed making use of an original dataset, containing information on 25 Italian motorway concessionaires over the 1992-2017 period. The results obtained highlight the significant technical progress experienced by the sector, and the presence of sizeable economies of density and scale. A comparison between the performance of private-owned firms and public ones is then provided.

1. THE BIRTH AND THE FIRST STEPS OF THE ITALIAN MOTORWAY INDUSTRY

1.1 The first motorways

Beginning in the early 20's, the massive use of lorries along with the bombings of the first world war had completely ruined the already crumbling roads. Once peace was reached, the need for a smooth circulation of motor vehicles and for the tourism development made the mobility a central issue for the domestic economy. Since citizens denounced the intense traffic in the existing infrastructure, the construction of larger and more comfortable roads became necessary. In this context, the Italian Touring Club came forward with the first proposal. The idea was to design an "Autovia", meaning a motor-

vehicles-reserved toll road for improving the connection between Milan and Venice.

In April 1922, Piero Puricelli, a civil engineer from Milan and the owner of a big road-construction company, drew up the project for building a motorway between Milan and Laghi with a length of 84 kilometers. Puricelli founded "Società Anonima Puricelli Strade e Cave" on December 1st, 1922. The company was granted the concession for the construction and the management of the planned motorway. In 1925, the opening of this motorway section fixed the birth of the Italian motorway industry.

The construction process proceeded in the following years. In September 1927, a 50-kilometers-long motorway was built between Milan and Bergamo, in October 1928, the 20-kilometers-long one connecting Rome and Ostia, in June 1929, the 23-kilometers-long one between Naples and Pompei, in August 1931 a 48-kilomters-long section between Bergamo and Brescia, in October 1932, a 127-kilometers-long motorway between Milan and Turin, in August 1933, the 81-kilometers-long section "Firenze-Mare", and in October 1933, the 25-kilometers-long one between Padova and Mestre.

Nevertheless, the extension of the network remained limited until the end of the Second World War, because of the slow start-up of the motorization in Italy and the economic crisis that encouraged the development of the railway system.

A concrete incentive for the boost of the Italian motorways system lied in the foundation of the "Azienda Nazionale Autonoma delle Strade Statali" (A.N.A.S.), on June 27th, 1946.

Decree-Law No 547/48 entitled A.N.A.S. to the construction of additional motorways both directly and indirectly, through the instrument of concession to public or private bodies.

Decree-Law No 463/55 (Romita Law) ratifies the launch of the First Motorways National Plan for the above-mentioned construction projects and aiming at promoting an employment and economic national recovery. Specifically, this multiannual plan for the development and improvement of the motorway network, enclosed with the Law, laid the groundwork for the planning of strategic connection, longitudinally from Milan to Reggio Calabria and from Bologna to Bari, transversally from Turin to Trieste. Moreover, the same Decree set the initiation of the work for the motorways between Brescia and Padova and between Milan and Naples. Simultaneously, the existing motorway from Padova to Mestre was doubled, and the building projects for the sections Serravalle – Milan, Ceva – Savona, Turin – Ivrea – Quincinetto, and Naples – Salerno were accomplished.

Legislation allowed freedom in the choice of the construction-terms arrangements and in the selection of concessions for the only construction purpose or for the construction and management one. The progressive extension

of the motorway network occurred by the implementation of the latter and the chosen concessionaires were mainly publicly-owned firms.

Therefore, most of the existing motorways network was built between 1960 and 1975.

1.2 The legislative definition of motorway

The first draft of a legislative definition of motorways appeared in Decree Law No 547/48: “motorways are transport routes, reserved for the toll transit of motor vehicles, built and managed by A.N.A.S. or by private entities”.

Decree Law No 59/61 clarified the notion, stating: “a transport route reserved for the selected, generally toll, transit of cars or motor vehicles, devoid of unattended track crossing”.

Finally, Council Directive 93/89/EEC of October 25th, 1993, contained a precise and detailed definition. “Motorway means a road specially designed and built for motor traffic, which does not serve properties bordering on it, and which:

I. is provided, except at special points or temporarily, with separate carriageways for the two directions of traffic, separated from each other either by a dividing strip not intended for traffic or, exceptionally, by other means;

II. does not cross at grade with any road, railway or tramway track, bicycle path or footpath; and

III. is expressly referred to as motorway."

1.3 The mechanism of "concession"

The instrument of concession has been largely chosen and implemented in the transport sector as the best toll for the construction and management of railways, tramways, airports, harbours, and motorways. In general, a concession agreement grants the concessionaire with the right to implement the building projects and, often, to provide citizens with the services collecting the resulting revenues, within the limits set by the provisions of the specific contract or set by Regulations.

Concerning the motorway industry, construction or construction-and-management concessions to enterprises has been introduced and, firstly, regulated by Law of June 24th, 1929, No 11372. The latter approved the possibility of assigning the execution of public works to private entities and consortia, other than provinces and municipalities. Therefore, the first motorway concessionaires have been established by private companies, and thanks to a contribution by the State, they obtained the right to build specific motorway sections, and operate and manage them for a pre-determined fixed period. The contribution of capitals came from private undertakings as "Società Anonima

Puricelli Strade e Cave", FIAT, Edison, Italcementi, Banca Commerciale Italiana, and Credito Italiano.

However, the limited development of the Italian motorization and the economic crisis quickly decreased the financial attractiveness of this business and following projects were suspended. Thus, in the 1930s, the management shifted from private firms to the State.

Once the Second World War was over, the need for a reconstruction of the country, for a reinstatement of the conditions for a smooth mobility of people and goods along the ruined roads, as well as for sustaining the automotive industry, driver chosen for the economic rehabilitation, led to the decision of both an upgrade and an extension of the motorway network. The already-known mechanism of concessions resulted to be the most efficient instrument for reaching the objective of a second-generation motorway system. Delegating to fully-trusted undertakings the realization, and often the management, of the work as well as the collection of the necessary assets, represented the preferred option.

The duty for the construction of new motorways as well as for the negotiation of concession contracts with private bodies was assigned to A.N.A.S. by Decree Law No 547/48. Therefore, three scenarios were allowed by the existing Legislations:

- Motorways built and operated directly by the State through A.N.A.S.;
- Motorways built by private or public bodies through concessions and managed by A.N.A.S.; and

- Motorways built and operated by public or private bodies through concessions.

In all the cases, the ownership of the network was retained by the State, to whom the concessionaire had to return the motorway at the end of the concession period.

Article 3 of Romita Law defined the characterizing features of a concession and the requirements for the concessionaires. The maximum duration for the concession was set to thirty years, starting on the date of the actual opening of the motorway. Any potential concessionaire was obliged to disclose a Financial Plan to A.N.A.S., for prior assessing if the management by a concessionaire of a motorway occurred in a condition of economic and financial balance. On order to streamline the development of the network, construction-and-management concessions were the mainly used. The contribution paid by State was set to a maximum share of 40% of the total construction cost. Implicitly, the remaining 60% should have been returned to the concessionaire by the collection of tolls, over the lifetime of the concession. The participation of the State in the building expenditure should be considered a direct funding, which the commissionaire was committed to partially reimburse, depending on the conditions imposed by Law. Moreover, it was established that, starting from the fifth year after the opening of a motorway, amounts exceeding the 10% of the toll level provided for in the financial plan should have been paid back to the State by the concessionaire. Indeed, the aim of the Legislation was to prevent

concessionaires from making an operating income greater than the one contemplated at the time of the issuance of the concession. Therefore, any additional revenue was received by the State and used to finance new construction projects. Concessionaires could be private or public bodies. However, all conditions being equal, preference should have been given to public entities, consortia of public entities, or joint-stock companies whose major shareholders were public entities. Aside of being a "favor" granted by the legislator, the advantage of this solution concerned in the guarantee by the State for the reimbursement of the capital and the interests of the loan contracted for the construction projects by the sole public concessionaires. This is the reason why, until the 1990s, most of the motorways were operated by publicly-owned concessionaires.

1.4 The renewal of the concession contracts

Decree Law No 287/71 arranged for the renewal of all the existing concessions upon presentation of a new Financial Plan, and the unification of the conventions reporting to the same body. Quoting article 2: "A new concession should be concluded with each motorway concessionaire asking for it within six months from the date of entry into force of this Decree- whatever is the law underlaying the agreement-excluding those included in article 16 of Decree Law No 729/61 and following supplementations and modifications". Moreover, article 6 states: "In case the same concessionaire is or becomes owner of various concessions relating to motorway sections that are contiguous,

complementary, or otherwise connected, then these concessions will be integrated in a new concession, having a unique expiration date not exceeding the one of the last granted concession".

The updated Financial Plan, mandatorily added in the annexes of the renewed agreement together with an overall of the new proposed project, should set out data concerning the total investment cost-including the borrowing costs-, the operational expenditure, the level of traffic, and the consequent amount of income registered.

Any change in the initial conditions, provided for in the Financial Plan and likely to cause the concessionaire a financial or economic imbalance, could lead to a review and upgrade of the agreement, in terms of negation of an adequate extension of the concession, but maintaining unaltered the State contribution.

By renewing the contracts with all the concessionaires, the issuance of concessions for the construction of motorways was blocked. Decree Law No 492/75 ratified this situation. No additional concessionaires were instituted, and the effort of the existing ones focused on the adjustment and improvement of the motorways operated by them (as additional lanes) or infrastructural interventions for special needs.

1.5 The role of the State

The State played a central role in the early developmental years of the Italian motorway industry, as straightforwardly deducible from what explained in the previous paragraphs.

The construction projects implemented until the early 1980s, accounting for a substantial portion of the existing motorway network, were largely financed by the State, and through concessions granted to publicly-owned firms. However, regardless the nature of the concessionaire – private or public - and the kind of concessions awarded - for the only construction purpose or for the construction and management one – the ownership was retained by the State, to whom the concessionaire had to return the motorway at the end of the concession period.

Decree Law No 463/55 (Romita Law) fixed the contribution by the State to a maximum share of 40% of the total construction cost, amount that concessionaires were obliged to partial reimburse. Moreover, starting from the fifth year after the opening of a motorway, concessionaires should devote to the State amounts exceeding the 10% of the toll level provided for in the financial plan, based on a rate not lower than the contribution percentage.

Decree Law No 287/71 established that the State should guarantee for the refund of the capital and the payment of the interests for the loans contracted by publicly-owned concessionaires, up to the entire amount of the investment of

the latter for the realization of the work. To accomplish this duty, Decree Law 382/68 instituted the Guarantee Central Fund for the motorways, which should intervene anytime a publicly-owned concessionaire was unable to repay its debts. Concessionaires were obliged, by the same Law, to return to the State, as concession fee, the income derived from the toll, after deducting the operational expenses, amortization, depreciation, and the resources needed for the reserves and for distributing dividends lower than the 8% of the nominal capital.

At the end of the 1970s, several public concessionaires experienced a deep financial crisis. Therefore, the State was forced to repay for their debts making use of the above-mentioned fund. Article 1 of Decree Law No 389/80 states: "The Guarantee Central Fund for motorways and railways, referred to in Decree Law No 382/68, and following modifications, without prejudice to the obligations of the concessionaires and the related guarantee, is entitled to intervene in the payment of instalments of contracted loans, obligations and coupons, expiring in 1980".

The Fund was initially financed directly through resources coming from the public budget, then, as expressed in Decree Law No 531/82, by an increase in the toll charges.

However, the existence of various provisions preventing the toll adjustment – from the levels firstly provided for in the agreement – worsened the financial difficulties of the concessionaires, determining a the emerging of a litigation between the latter and A.N.A.S.

1.6 The ownership structure

In the early 1990s, all the concessionaires were publicly owned, except for the Satap (Turin-Piacenza) and the Turin-Milan. In this context, the "Autostrade Group" controlled by the "Institute for the Industrial Reconstruction" (IRI) prevailed in size. The Group consisted of six concessionaires – Tangenziale di Napoli, Autostrade, Raccordo Autostradale Valle d'Aosta, Società Autostrade Meridionali, and Turin-Savona. Almost all the other concessionaires were owned by public bodies of different nature, as municipalities, provinces, regions, public banks, and chambers of commerce.

In the mid-1990s, the Gavio Group, a family business active in the transport industry, acquired one of the main construction companies of the country, the "Grassetto Lavori", and diversified its activities entering the market of the motorway concessions, taking over the Satap – Turin-Piacenza motorway – and the ASTM – owner of the motorway concession Turin-Milan.

Finally, A.N.A.S. operated the following motorways: Grande Raccordo Anulare; Autostrada Rome-Fiumicino; Autostrada Salerno-Reggio Calabria, Palermo-Catania; Palermo-Mazara del Vallo; Alcamo-Trapani; Catania Nord-Catania Centro; Salerno-Avellino; Siena-Florence; Raccordo di Reggio Calabria; Scalo Sicignano-Potenza; Bettolle-Perugia; Ferrara-Porto Garibaldi; Raccordo di Benevento; Turin-Aeroporto di Caselle; Ascoli Piceno-Porto d'Ascoli; and Chieti Pescara. Specifically, the motorways Salerno-Avellino; Siena-Florence; Raccordo di Reggio Calabria; Scalo Sicignano-Potenza;

Bettolle-Perugia; Ferrara-Porto Garibaldi; Raccordo di Benevento; Turin-Aeroporto di Caselle; Ascoli Piceno-Porto d'Ascoli; and Chieti Pescara were defined toll-free motorways from Law No 1197/65.

The ownership structure on December 31st, 1992 is synthetized in Table 1 below.

Ownership on December 31st, 1992	Concessionaires	Group	Local Authorities	A.N.A.S.	Others
Autostrade Group	Autostrade	88,7	0	0	0
	Rav	58	42	0	0
	Sam	59	5	0	0
	Sat	68,7	1	0	27,3
	Strada dei parchi	0	0	100	0
	Tangenziale di Napoli	100	0	0	0
	Turin-Savona	99,9	0,1	0	0
Total		**474,3**	**48,1**	**100**	**27,3**
Gavio Group	Ativa	11	72,7	0	0
	Cisa	10,6	70	0	5,1
	Fiori	20,3	16,7	0	4
	Salt	7	26	0	0
	Satap	0	25	0	0
	Sav	32	0	0	8,3
	Sitaf	0	20,8	35,3	0
	Turin-Milan	50,11	0	0	13
Total		**131,01**	**231,2**	**35,3**	**30,4**
Publicly operated	Autovie Venete	0	94,1	0	0
	Brennero	0	82	0	4,2
	Brescia-Padova	0	70	0	1
	Consorzi Siciliani	0	100	0	0
	Milan-Serravalle	0	98,5	0	0
	Padane	0	80,1	0	10
	Venezia Padova	0	54	0	8,4
Total		**0**	**578,7**	**0**	**23,6**
Grand total		**605,31**	**858**	**135,3**	**81,3**

Table 1, Ownership structure on December 31st, 1992

1.7 The toll-determination dynamics

Tolls were set to grant revenues enough to cover the concessionaires' construction, maintenance and investment costs.

Revenues and costs were evaluated based on an evaluation and a forecast covering the whole concession period and contained in the Financial Plan. Therefore, the Financial Plan acted as a preventive financial and income statement and as a balance sheet, but also as an instrument for determining the toll charges for any concessionaire, always aiming at reaching a financial and economic balance in its business management.

Toll charges were agreed upon at the beginning of the concession period and reviewed annually by a mistrial decree, specifying the rate of increase to be applied uniformly across concessionaires and vehicle classes.

However, anti-inflationary purposes prevented the allowed adjustments in the toll levels on different occasions. As consequence, the already precarious financial conditions of many concessionaires worsened and a litigation between the latter and A.N.A.S. emerged, as deeper explained in the following paragraph.

1.8 The financial crisis of the concessionaires and the delayed toll-level adjustments

During the '70s and the '80s, the already-mentioned financial crisis experienced by the concessionaires led the Guarantee Central Fund to taking a

series of measures. Thus, the necessity for a modification in the methods of financing of the Fund became a central issue too. Decree Law No 531/82 defined that additional resources should derive from a surcharge on the tolls. This situation resulted in a complex litigation between the concessionaires, A.N.A.S., and the Ministry of Treasury, to whom the rights of creditors had been transferred after the interventions of the Fund.

Concessionaires claimed the earnings relating to the failure of the toll adjustment and, at the same time, showed an outstanding debt exposure, because of the measures taken by the Fund and the funding of the latter.

2. THE NEW CYCLE OF THE ITALIAN MOTORWAY INDUSTRY AFTER THE SECTOR REFORM IN 1992

In 1992, Legislators opted for a radical reform of the sector, made necessary by the financial crisis of the concessionaires and the arisen litigation between them, A.N.A.S., and the Ministry of Treasury.

2.1 Regulations No 498/92 and 537/93

The sector reorganization started with Legislative Decree No 498/92. The Inter-ministerial Committee for Economic Planning (CIPE) was entitled to the issuance of directives for the granting of the guarantee by State, to the revision

of the existing motorway conventions, and, since 1994, tolls. In accomplishing this, attention should be focused on the Financial Plans, variations in the cost of living, traffic volumes, and productivity indexes.

According to the mandate, the CIPE established the updated criteria for the review through the Resolution of September 21st,1993. Specifically, the toll level should be defined at the time of issuance or revision of the concession, as for the charges of the other public services. Moreover, they should be evaluated based on the Financial Plan showed by the concessionaire and audited every five years, unless substantial changes occurred with respect to the initial parameters provided for. When revising the convention, potential economic or financial un-balances, deriving from the failure in the toll adjustment, should be identified and the litigation between the concessionaire and the granting body solved. Finally, the Financial Plan should comply with a specific Unified Model, subject to a subsequent approval.

Regulation of December 24th, 1993, No 537 recognized, for the first time, the private nature of the business carried out by the motorway concessionaires. Immediate consequence was the abolition of the guarantee by the State on the loans contracted by publicly owned concessionaires, and the obligation for the IRI to be the major stakeholder of Società Autostrade S.p.A. Concessionaires were no longer obliged to transfer to the State the exceeding income. Indeed, concession fee began to be computed in relation to the revenues, a share of 0,5% in the first three years and of 1% in the following ones.

2.2 The privatization program and the new ownership structure

Since 1993, a remarkable privatization process took place. In November 1999, the IRI sold the Autostrade Group, through a public offer for sale. The Benetton Group acquired the relative majority – 30% – that turned into absolute majority through a takeover bid in November 2002. At the same time, the Gavio Group, starting from the original participation into the Turin-Milan, bought shares from local authorities, credit institutions, and to a lesser extent, from private investors. On December 31st, 2004, the Gavio Group controlled 7 concessionaires and managed a considerable number of shares for other two of them.

The privatization process, even though never stopped, slackened since 2005. Indeed, different public bodies tried to strengthen their ownership through shareholders' agreements or the acquisition of shares from other public or private entities – for instance, in July 2005, the Province of Milan bought the 15% of the capital, reaching the absolute majority, of the Milan-Serravalle from the Gavio Group.

The data contained in Table 2 below and derived from the annual financial statements of the concessionaires prove the substantial privatization process undertaken by the industry, leading to significant changes in the overall ownership structure. Moreover, it is evident the dimensional asymmetry between the motorway operators: the Autostrade Group managed more than the half of

the entire network, the Gavio Group and the A.N.A.S one third per each, and the others with extremely smaller shares.

	Ownership, 31/12/1992, Group	Ownership, 31/12/1992, Local Authorities	Ownership, 31/12/1992, A.N.A.S.	Ownership, 31/12/1992, Others	Ownership, 31/12/2004, Group	Ownership, 31/12/2004, Local Authorities	Ownership, 31/12/2004, A.N.A.S.	Ownership, 31/12/2004, Others
Autostrade Group								
Autostrade	88,7	0	0	0	52	0	0	0
Rav	58	42	0	0	58	42	0	0
Sam	59	5	0	0	59	5	0	0
Sat	68,7	1	0	27,3	93	0,4	0	27,3
Strada dei parchi	0	0	100	0	60	0	0	0
Tangenziale di Napoli	100	0	0	0	100	0	0	0
Turin-Savona	99,9	0,1	0	0	99,98	0,02	0	0
Total	**474,3**	**48,1**	**100**	**27,3**	**521,98**	**47,42**	**0**	**27,3**
Gavio Group								
Ativa	11	72,7	0	0	80,2	17,7	0	0
Cisa	10,6	70	0	5,1	84,1	12,1	0	2,6
Fiori	20,3	16,7	0	4	60,8	16,7	0	0
Salt	7	26	0	0	86,7	10,4	0	0
Satap	0	25	0	0	99,9	0	0	0
Sav	32	0	0	8,3	69,1	28,7	0	0
Sitaf	0	20,8	35,3	0	37,6	19,3	31,7	0
Turin-Milan	50,11	0	0	13	0	0	0	0
Total	**131,01**	**231,2**	**35,3**	**30,4**	**518,4**	**104,9**	**31,7**	**2,6**
Publicly operated								
Autovie Venete	0	94,1	0	0	0	93,3	0	5,6
Brennero	0	82	0	4,2	0	83,2	0	9,7
Brescia-Padova	0	70	0	1	0	70	0	1
Consorzi Siciliani	0	100	0	0	0	100	0	0
Milan-Serravalle	0	98,5	0	0	0	73	0	27
Padane	0	80,1	0	10	0	86,8	0	13,4
Venezia Padova	0	54	0	8,4	0	54	0	41,3
Total	**0**	**578,7**	**0**	**23,6**	**0**	**560,3**	**0**	**98**

Table 2, Ownership structure on December 31st, 2004

2.3 The transition-consolidating resolutions taken by CIPE in 1996

After several transitional measures, the CIPE issued a Resolution on April 24th, 1996, defining the new guidelines for the regulations of those

industries that offer public services and lack a regulatory authority. The following Resolution, taken on December 20th, 1996, fixed the timing for the fulfilment of all the requirements for the renewal of the conventions and the construction of new motorways, ending the temporary phase of reconstruction of the sector.

Concerning the renewal of the concessions, the Financial Plan continued to be recognized as the instrument for defining the institutional framework of the relationship between the concessionaire and the A.N.A.S., and for computing and verifying the operating cost. In this regard, it should contain detailed information for the calculation of the net present value of the proposed investments – so the operating cash flows and the realization costs – as well as forecasts of the potential evolution of the scenario analysed. The proposed unified model, with whom the Financial Plans of all the concessionaires should comply, was approved by a Decree issued by the Ministry of Public Works, together with the Ministry of the Budget and Economic Programming, on April 15th, 1997.

A revision of the toll-determination dynamics was another main topic of the Resolution of December 20th,1996. Specifically, the toll-determination should depend on the concessionaires, but their annual adjustment should derive from the implementation of a price-cap-based mechanism. Indeed, based on the convention provisions, concessionaires could select the structure of the tolls, differentiate the charges between the different motor-vehicle classes, as well as

accounting for variables as the route, the service-fruition period, the payment methods, and others.

The definition of the parameters of the formula, having quinquennial duration, was also provided for, as well as, the circumstances for their extraordinary revision. Therefore, the Resolution fixed the transition from a rate-of-return-based regulation to a price-cap-based one. A deeper insight into the new regulatory regime is reported in the next chapter.

Finally, concessionaires were obliged to maintain separate account for the activities regulated by the convention and those managed under condition of free-market.

2.4 The action of the anti-trust authority

The renewal of the conventions, formally unblocked by the Resolution of the CIPE in 1996, was hindered at the first trial of implementation. In fact, the European Commission intervened when negotiating the concessions with Società Autostrade S.p.A. in 1997, judging the extension of the conventions as a mechanism distorting the free-competition rules. Moreover, according to the Commission, concessions should be granted through a restricted tender.

Upon request by the A.N.A.S., the Italian Competition Authority showed disagreement with the extension of the construction-and-management concessions up to 2038 in favour of Autostrade S.p.A., and with the intention of the A.N.A.S. of doing the same with the other concessionaires. The Authority

underlined as the automatic renewal of the conventions was inconsistent with the principles of Law No 287/1990, specifically: “the extension had the result of keeping the management of a substantive portion of the motorway network away from competition, which could be implemented through open-bidding procedures”. According to this view, a tender for obtaining the temporary right of serving the market in that field was the best way to ensure artificial competitive behaviour in natural monopolies, as the motorway industry. Moreover, the Authority clarifies that the compensation for the debts was not a valid reason for claiming long-lasting conventions or their extension. The proposed option was to tender for the management of every single motorway with an opening bid equal to the amount of debt of the concessionaire. This alternative could balance the interests of the concessionaires and the compliance with the principles of free competition.

Therefore, the Competition Authorities exhorted the A.N.A.S. to resort to these procedures, adding that: “in case the concession, object of the renewal, can be divided into different sections, then these can be managed by different bodies, selected through tenders.

2.5 The Costa-Ciampi Directive

A clarification of the regulatory framework derived from Directive of October 20th, 1998, the so-called Costa-Ciampi Directive. In fact, in article 1, the common drivers for the revision of the conventions were clarified.

Specifically, it established that the new conventions, stipulated according to the Resolution of the CIPE in 1996, maintained their original duration, and that:

1. The only reason for an extension of the concession period is to solve the previously-arisen litigation. The litigation should relate only to the failure to comply with Law of August 23rd, 1988, No 373 and Law of May 29th, 1989, No 205 – for instance for the amortization of the expenses for the realization of the new infrastructures for the World Cup in 1990, and the Colombian Events in 1992 – and to the toll adjustments for anti-inflationary purposes.
2. The existence of works whose amortization is likely not to be concluded within the concession lifetime does not constitute a reason for an extension. At the time of the natural conclusion, the succeeding concessionaire has the obligation to indemnify the previous one for the difference between the total cost of the works and its already-amortized amount.
3. The evaluation of the debt of the concessionaires with the Guarantee Central Fund must include the interests on the amounts payed by the Fund.

Moreover, the Directive stated that the dispute relating to the unimplemented toll-adjustment should be computed as the difference between the income from the toll-collection provided for in the Financial Plan – effective traffic times the planned toll charges – and the effective one – effective traffic

times the actually-applied toll charges. Then, the resulting amount is converted in years or fractions of years of extension of the concession, considering the gross operating margin – operating revenues minus operating costs, including retained earnings but excluding amortizations - of the concessionaire in the last three years of operation.

In the following years, almost all the conventions were renewed: the one with Società Autostrade S.p.A. in 1997, the others were perfectioned between 1999 and 2000, except for two that presented specific problems and were revised later.

2.6 The institutional stakeholders

In this complex settling years of the Italian Motorway Industry, the action of three institutional players can be pointed out, they are the A.N.A.S, the CIPE, and the NARS.

2.6.1 The A.N.A.S.

The A.N.A.S. was instituted in 1946 to replace the "Azienda Autonoma Statale", in charge of managing the Italian road network since 1928. In the problematic post-war period, it played a central role for the national reconstruction in that field, while experiencing several juridical and jurisdictional transformations.

In 1994, after a period of external administration, the A.N.A.S became a public commercial institution. In the late 1990s, it lost the jurisdiction of 25,000 kilometers-long motorways, in favour of Regional Authorities. Finally, in January 2003, it was converted from a public body into a joint stock company wholly owned by the Italian State. Therefore, the tasks of management, maintenance, improvement, road and motorway network enlargement, as well as of surveillance on the construction projects and the administration of the motorways in concession are now granted to the A.N.A.S. through a convention stipulated with the Italian Ministry of Infrastructure.

In more detail, the A.N.A.S. directly operated on 1,200 kilometers – 900 km of toll-motorways and 300 km of toll-free ones - over a total of 6,800 kilometers of motorway network. Concerning the remaining 5,500 km, the A.N.A.S. was the concession-granting body. Finally, it was the supervisory authority of the entire network, monitoring, for each concessionaire, the compliance with the implementation of the investments provided for in the Financial Plan, the observance of the quality standards, the fulfilment of both ordinary and extraordinary maintenance, performing also statistical analysis of on the traffic.

2.6.2 The CIPE and the NARS

The role of the of the other two bodies was initially restricted to the toll regulation and the convention renewal.

The CIPE joined the Italian Motorway Industry after the issuance of Law No 498/92, as extensively explained in the previous paragraphs.

The NARS was instituted by Resolution of May 8th, 1996, taken by the CIPE, as technical body supporting the sector regulation. It consisted of one Coordinator, assisted experts, and of several representatives of the Administrations, having rate-related expertise. It participated in the definition of the price-cap based regulatory regime, it formulated directives for the toll-adjustment in 1997 and played an important role in the concession-renewal process.

2.6.3 Law No 47/04

Decree Law No 443/01 empowered the CIPE to approve the Plan of the major strategic works, aiming at speeding the adjustment of the network to the need of the community. The duties concerned the evaluation of the proposals, the approval of the best projects, and the monitoring of their realization.

Thus, in December 2001, the CIPE approved the Plan for modernizing the part of the network and for constructing 700 km of new motorways, contemplating a total investment of EUR 17,472 million and a timetable of 10 years (from 2002 to 2012).

On the occasion of the first revision of the price-cap-formula parameter X for the Società Autostrade S.p.A., a dispute emerged between the CIPE and the NARS on one side and the A.N.A.S on the other, regarding the right on the

toll-regulation and the determination of the factor X. Specifically, the subject matter of the conflict related to the necessity of presenting a new Financial Plan, after substantial variations in the variables observed and provided for in the original Plan. The discussion mainly focused on the need for a new computation of the prevision on the traffic levels, since the previous estimations showed to be largely inferior to the actual ones, guaranteeing extra-profits to the concessionaires.

The NARS and the CIPE voted for a reduction of the tolls, whereas the A.N.A.S. and the Ministry of Infrastructure claimed that a revision of the factor X should occur only in case of additional productivity improvements.

Law No 47/04 settled the litigation establishing that, in case of additional investments with respect to the ones provided for in the original plan, then X can be identified for a 10-year period instead of one of 5 years. Moreover, it conferred the A.N.A.S the jurisdiction in the toll determination, stating that modifications to the existing conventions, related to variations of the investment plan or adjustment of the parameter X, should be approved through a Decree by the Ministry of Infrastructure and Transport, together with the Ministry of Economy and Finance. Coherently, the Amendment No 4 to the convention with Autostrade per l'Italia, including a remarkable plan of extra investments and the value of X for the following decade, was approved.

3. A DEEPER INSIGHT INTO THE PRICE-CAP-BASED REGULATORY REGIME

3.1 The price cap formula

As seen in the previous chapter, a new regulatory framework was introduced in the Italian Motorway Industry in 1996 – and later modified in 2004 and 2007. Firstly, it removed any discrimination between concessionaires based on their ownership and introduced an incentive regulation. Indeed, the initial toll level was determined at the beginning of the concession period, ensuring that the expected revenues cover the expected costs during the convention life-time. Conversely, the toll dynamics, for the upcoming years, was ruled by a rather-standard Laspeyers-type price cap constraint. The parameters of the formula should be reviewed every five years, with a subsequent-agreed-upon exception

for the factor X, whose duration, under certain circumstances is extended to ten years. As better explain later, the regulation accounted for a customary adjustment for inflation, quality standards, and expected productivity gains.

It came into force with the renegotiation of all the conventions between 1997 and 2000. The renewal of the concession to Società Autostrade S.p.A. represented the first implementation of a price-cap based regulation for a company that, once released from the control of the State, started to operate following the market criteria.

3.2 The parameters of the formula

The formula is as follows:

$$\left[\frac{\sum_i p_i^t \times q_i^{t-1}}{\sum_i p_i^{t-1} \times q_i^{t-1}} - 1\right] \times 100 \leq \Delta RPI - X + \beta \Delta Q \qquad \text{(I)}$$

Precisely:

- p_i^t and p_i^{t-1} are the toll per kilometre paid by a vehicle of type i in the year t and in the preceding one t-1;
- q_i^t and q_i^{t-1} are the total kilometres travelled by vehicles of type i in year t and in the preceding one t-1;
- ΔRPI is the variation in the retail price index;
- X is the offset productivity index;

- βΔQ reflects the change in the quality index Q modulated by the scaling factor β.

3.2.1 The productivity index X

The parameter X is computed specifically for any concessionaire every five years, considering the variations of the expected productivity in the sector while ensuring the economic and financial balance of the concessionaire.

The determination of index should be performed based on the prospective-evaluation of the following key factors:

- A fair return on the invested capital;
- Future investment projects;
- The objectives of variation in productivity;
- The expected variations in the demand and the resulting development of competitive conditions in the markets the company is active on.

The adequacy of the return on the invested capital is evaluated comparing the internal rate of return indicated in the Financial Plan and the average profitability of the invested capital (the return on investment, ROI) in the previous over the five previous years.

Law No 47/04 modified the mechanism for the calculation of the fair return of the invested capital concerning the additional investments with respect to the ones originally provided for. In fact, it should be equal to the weighted

average cost of capital - the WACC. The same Law stated that, in case of relevant extra investments, the time interval between two consecutive revisions could be extended to ten years.

Concerning the objectives of variation in productivity, several standard indicators are used and derived from the pattern of the operating costs and the kilometers travelled in the previous five-year period. These indicators, computed for both the entire industry and every single concessionaire, allow a synthetized evaluation of the productivity, in terms of:

- Organization of the production process and deployment of the resources;
- Technological development;
- Increase in the traffic leading to higher operating costs.

3.2.2 The quality indicator Q and the coefficient β

While the rest of the introduced regulatory formula is a standard example of a Laspeyres-type price cap, the quality component is quite an unusual feature.

In general, it links the quality provided by the regulated firm and its allowed toll-charges.

Specifically, the synthetized-composite-index Q is the weighted average of two quality-related factors. One measures the number of accidents per kilometres ($I_{accidents}$), under the assumption that the better is the security system adopted for the motorway, the smaller is the amount of accidents. The other

($I_{surface}$) accounts for the structural state of the surface, positively connected with the safety and the comfort of the journey. Q is then obtaining by the formula:

$$Q = w_{accidents} I_{accidents} + w_{surface} I_{surface} \qquad \text{(II)}$$

where $w_{accidents}$= 0,6 and $w_{surface}$= 0,4. The choice of considering only these two variables is due, apart from the lack of other data, to the idea that the structural state of the surface is both an index for the level of maintenance and safety of the motorway. Moreover, the rate of the accident density seemed to be explanatory of the overall infrastructural and managerial results of the concessionaire, in case of modern roads and vehicles, as well as drivers confident with highways. The surface-related indicator is in turn the weighted average of the surface-roughness index (I_{s1}) and surface-regularity one (I_{s2}), whose value varies from 0 to 100 and is deducted through a standardized and repetitive measuring or from data and documents drafted and certified by third parties. Thus:

$$I_{surface} = 0{,}6 I_{s1} + 0{,}4 I_{s2} \qquad \text{(III)}$$

$I_{accidents}$ is computed based on the Global Accident Rate, meaning the total number of accidents happened along the motorway weighted at 100 million km travelled on homogeneous motorways with different morphologies. It identifies several classes in relation to the climate, the slope, and the winding.

Furthermore, each class has different value for motorways on level ground (I_{aLG}) and mountainous ones (I_{aM}), as shown in Table 3.

CLASS	"LEVEL GROUND"	"MOUNTAIN"
A	GAR ≤ 50	GAR ≤ 60
B	50 < GAR ≤ 65	60 < GAR ≤ 80
C	65 < GAR ≤ 78	80 < GAR ≤ 100
D	78 < GAR ≤ 95	100 < GAR ≤ 120
E	95 < GAR ≤ 115	120 < GAR ≤ 140
F	115 < GAR	140 < GAR

Table 3, The different classes of the Global Accident Rate

Where:

$$I_{aLG}, I_{aM} = A\% + 0{,}75B\% + 0{,}5C\% + 0{,}25D\% \qquad \text{(IV)}$$

Then, an annual indicator $I_{surface,annual}$ is computed weighting I_{aLG} and I_{aM} for the respective lengths of the level ground and the mountainous sections of the motorway. The average of this annual index over the precedent five-year period determines the $I_{surface}$ to be used in (II). Finally, Q varies between 0 and 100, following this ranking and being 60 the objective operating standard:

- Q ≤ 40, MEDIOCRE;
- 40 < Q ≤ 50, INSUFFICIENT;

- $50 < Q \leq$ **60,** SUFFICIENT;
- $60 < Q \leq 70$, FAIR;
- $70 < Q \leq 75$, GOOD;
- $Q > 75$, EXCELLENT.

The variation ΔQ is computed yearly with respect to a basic value ($\bar{Q}$), not including the improvements of previous years. For the first five-year period of application of the price-cap formula, the basic value was the arithmetic average of the quality levels of the services offered in the previous five year.

The coefficient β modulates the variation in the quality level - ΔQ – into the allowed change in the average toll-level. Its continuously-varying value depends upon and it is positively correlated to the initial level of quality offered by the concessionaire. The higher is the initial quality level – lower, respectively - the higher is β in case of an improvement – worsening – in the concessionaire quality performance. Moreover, it increases – decreases – more rapidly, the higher is the initial quality supplied. Therefore, β, whose value varies between 0 and 0,5, follows two formulas, depending on the sign of the variation of Q. Specifically,

- $\Delta Q > 0$, $\bar{Q} < 60$, then $\beta = \frac{0,25}{60}\bar{Q}$;
- $\Delta Q > 0$, $\bar{Q} \geq 60$, then $\beta = 0,25 + [\frac{0,25}{40}(\bar{Q} - 60)]$;
- $\Delta Q \leq 0$, $\bar{Q} < 60$, then $\beta = 0,50 - \frac{0,25}{60}\bar{Q}$;
- $\Delta Q \leq 0$, $\bar{Q} \geq 60$, then $\beta = 0,25 - [\frac{0,25}{40}(\bar{Q} - 60)]$.

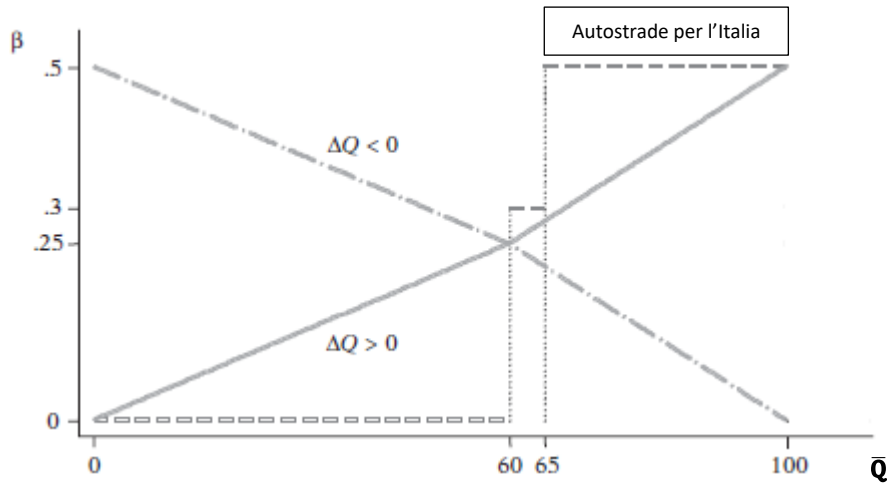

Table 4, the pattern of β

In other words, the quality adjustment term in the formula grants a premium - increased tolls — which is higher the higher is the improvement in the quality of the services offered, and more rewarding for the already well-performing concessionaires.

The correlation between the toll-levels and the service quality relates to the costs - generally rising with the quality level at an increasing rate - borne by the concessionaire for reaching those standards, rather than to the benefits enjoyed by the customers – generally rising with quality level at a decreasing rate. Therefore, it represents a cost-plus element in the price cap formula.

3.3 The main standing issues

An analysis on the financial statements of the concessionaires across the 1994-2003 period identifies several points of the reform, which need a deeper consideration.

First, there was an increase in the maintenance costs, with a substantial increment since 1998. Autostrade per l'Italia determined almost half of the total expenditure.

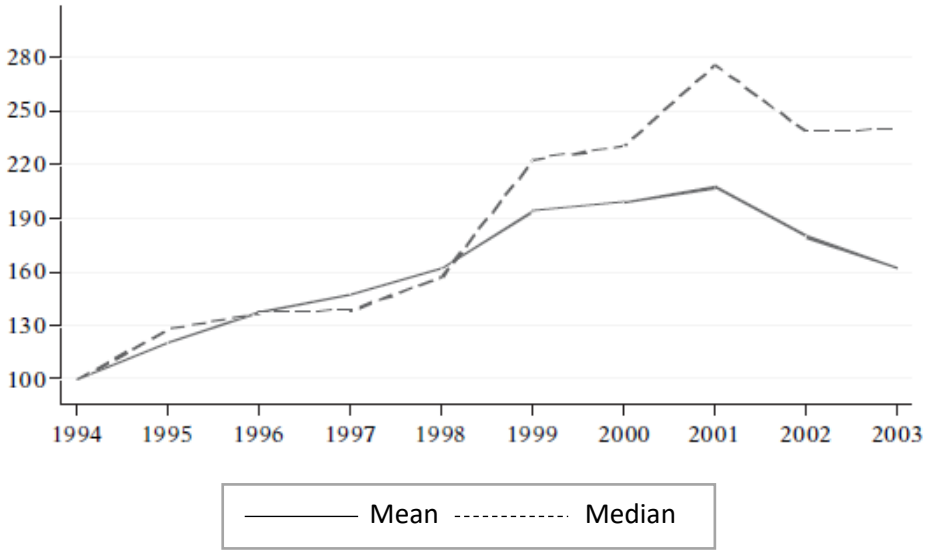

Table 5, Maintenance Costs

This pattern, apart from the intrinsic cyclic nature of the maintenance expenditure, is likely to relate to introduction of the Quality-adjustment term in the price-cap formula.

Second, the earnings before interests and taxes (EBIT) of all the concessionaires present an increasing trend too. Looking at the average earnings, they experienced a six-fold rise in the examination period. Autostrade per l'Italia, given its extremely bigger dimension with respect to the other concessionaires, was the main contributor to this result. Analysing the pattern of the median, there was an increment of 2300 % over the whole 1994-2003 time-

frame, and of 260 % since 2001, year in which the price-cap regulation mechanism came into force for approximately all the concessionaires.

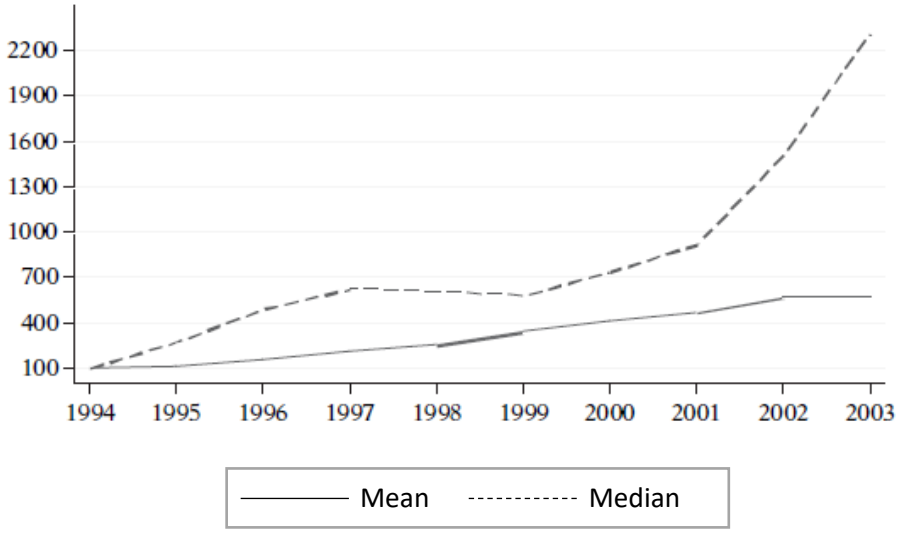

Table 6, The Earnings Before Interests and Taxes

Finally, the Global Accident Rate remained relatively constant and decreased in 2003 and in 2004, probably because of the introduction of the penalty-points driving license in August 2003. Whatever the reason, the result

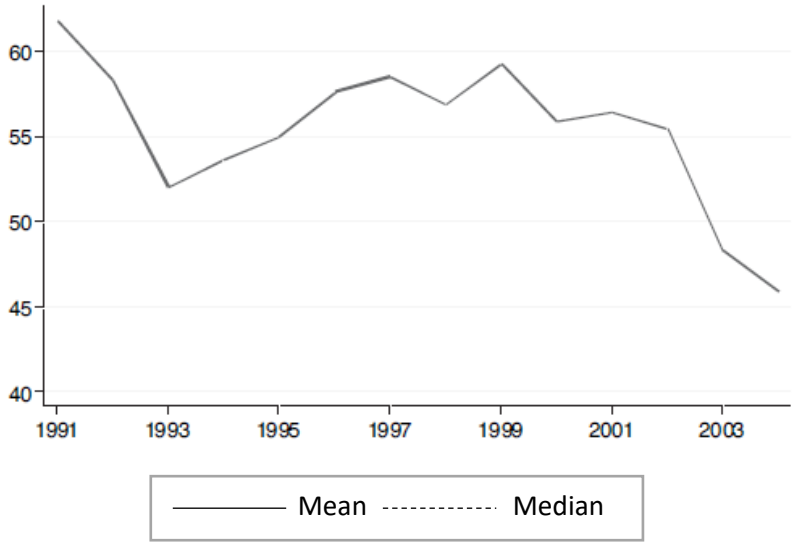

Table 7, The Global Accident Rate

was an increase in the toll-level, because of the premium assured by the formula to a reduction of the index.

Therefore, the sector radical reform was characterized by successful elements, but, in the meantime, left grey areas, above all the financial performances registered by the concessionaires – incompatible in the long term with an adequate regulatory activity.

The following paragraphs address those that, from our perspective, are the main issues.

3.3.1 The eligibility of ANAS as industry-regulator

Various problems emerged in the industry since its birth. All of them, although different in nature, presented a common factor: the absence of a unique independent regulatory authority, having proper technical and economic knowledge, with enforcement competences, operating transparently in a stable and certain normative framework. Indeed, the power fragmentation underlay the long and complex convention-renewal process in the late '90s, the delay in X-factor determination for Autostrade per l'Italia – concluded in 2004, one year later the concession natural expiration – as well as for the second five-year period. The conflict surrounding the toll-related competence between the A.N.A.S, the NARS, and the CIPE required a legislative intervention to be solved.

Simultaneously, the same historical events suggested the inadequacy of the A.N.A.S. to be the sector regulatory authority. Two are the main reasons: its legal form and its dual role of sector regulator and motorway direct operator.

Regarding the former, its being a Ltd. enables the A.N.A.S. to sign private juridical acts, exempted from the transparency and disclosing obligations, which should be proper of a regulatory authority and crucial in discretionary regulatory mechanism, as the price cap. To confirm this, it is important to highlight that the A.N.A.S. has never disclosed the information leading to the X-factor adjustment for the second five-year period of the conventions.

Concerning the latter, the concurrent roles of the A.N.A.S. of Regulatory Authority, Concession Granting Body, and Ltd. management-concessions holder for several motorways appear incompatible. As shown before, the A.N.A.S. operated more than 1,000 km of the Italian motorway network, second only to Autostrade per l'Italia. The proposal, made by the A.N.A.S. itself in 2005, for "the deconsolidation of the company from the perimeter of the public administration" and for "the absolute separation between the structures dedicated to the concession granting and monitoring from the ones in charge of the motorways management" is a clear acknowledgment of the existing conflict of interests.

The reshaping of the A.N.A.S. competences should be one of task of the regulatory authority, together with the focus on assuring an optimal number and

dimension of the concessionaires proper of a regulated sector. In fact, the sector consolidation processes should aim at guaranteeing the minimum efficient dimension of a concessionaire, as well as a sufficient number of independent operators to allow a better functioning of the market competition at the time of the issuance of the conventions, but also the performance of benchmarking analysis and yardstick competition by the regulatory authority,

3.3.2 The actually-in-placed toll dynamics

The available information on the methodology used by the A.N.A.S. for the X determination is extremely poor. An interpretative simulation of the NARS (Coco, 2004, p.19) suggests that the prevision of the potential productivity gains was approximated to "an average of a linear estimation and semi-log variable" of the operating costs times the kilometers travelled. This method reflects a basic knowledge of the business costs, shallowly related only to the kilometers travelled. Deeper studies could lead to the identification of the different variables of the productive process – network length, number of lanes, ongoing works, toll-collection modalities, etc. - and the computation of their individual contribution to the overall cost, showing the business potential growth in efficiency margins.

Moreover, this methodology seems to have been used for determining a sector indicator X. Information diffused by the Autostrade Group and the Gavio Group demonstrate that the same X was applied to all the concessionaires belonging to them, between 2005 and 2009. In the precedent five-year period,

something similar happened. A set of values of X was computed for a wide range of concessionaires, different computations was performed just in case of special conditions (as the presence of significant investments).

The definition of an index X valid for the entire sector is contrary to the Resolution taken by the CIPE, providing for the determination of the value of X for each concessionaire, and prevents the implementation of a fine-tuning of price-cap formula parameters. In addition, all the companies are treated equally, regardless the profitability levels, allowing the more efficient ones to gain an economic advantage. On the other side, the regulator is not able to use the information obtained by the comparison between the costs and the quality of the services offered by the different undertakings - yardstick competition -, to transfer the efficiency gains of them to consumers.

3.3.3 The presence of externalities

The price-cap based regulation is *per se* an effective instrument for determining a toll-structure efficient in allocative terms. In fact, the incentives of the concessionaire can be re-aligned to the ones of the community, and the concessionaire itself can be led to fix a toll-level maximizing the social welfare.

However, the realignment of interests operates imperfectly, because of the presence of externalities on the consumption side. Nonetheless, the externalities of congestion are generated by low-price-sensitive behavior, which encourage concessionaires to increase tolls. Thus, although the price-cap is not

able to solve the problem of the optimal toll-determination in the presence of externalities, it incentivizes the concessionaire to determine a toll-structure, considering and, partially, reducing them.

As studied in economics, the inefficiencies generated by the existence of externalities are not due to a failure of the market, but to the absence of a market and a property-right definition for them. Two types of externalities are proper of the transport industry: air pollution and congestion.

The air pollution deriving from the transport activities is an external cost – negative externality – that who performs the transport activity imposes to third parties, without being asked for a compensation for the damage. The resulting allocation of resources is not Pareto optimum.

Looking at Figure 5 and imaging a connecting road, being D the demand curve, reflecting the private marginal benefits (BMP) – decreasing with increasing number of vehicles – and CMP the private marginal cost curve,

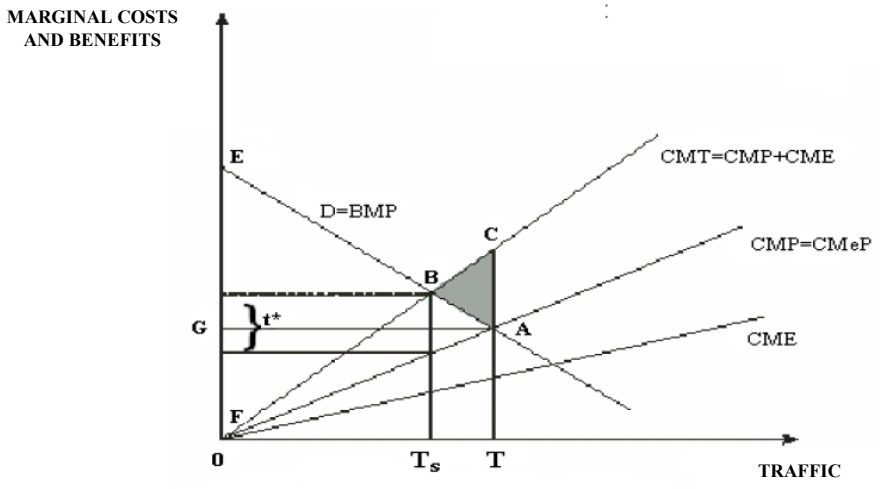

Table 8, The externality of air pollution

mainly consisting of the time needed for the travel and the fuel – increasing with increasing number of vehicles.

Assuming that all the individuals are equal, the private marginal cost curve is equivalent to the private average cost one (CMeP). The generated level of traffic is T – point in which the marginal costs match the marginal benefits. Up to T, each individual experiences a gain, being the marginal benefit of the travel superior to its marginal cost; for greater amount a loss, having the opposite situation.

The total surplus is given by the sum of the consumer surplus (EAG area) and the producer one (FAG area). However, the level of traffic, optimum for the social welfare, is not T in the presence of negative externalities for the air pollution. The emissions increase with the traffic, as well as the externality cost. Being CME the externality average cost curve, the total marginal cost curve (CMT) is given by the sum of CME and CMP. We can observe that in T, the private optimal point, there is a welfare loss equal to the area CBA, because the marginal costs prevail over the marginal benefits between Ts – intersection between EMP and CMT.

The maximum social welfare can be reached reducing the level of traffic from T to Ts.

Regarding the congestion, it is generated by the fact that drivers have property right on their cars, but not on the motorway they drive on. Indeed, they can not exclude each other to travel on the specific road, but they must share the

resource. However, any car occupies a portion of the lane that can not be used by others, so they claim a temporary proprietary right on it. This lead to a negative externality, the congestion, which slows down each driver.

Compared to the air pollution, the externality of congestion presents two main differences: it is an external cost for the driver but internal to the transport sector, and it impacts on the production and consumption functions increasing the time for completing the travel.

Looking at Figure 6, incrementing the flow of vehicles - number of vehicles passing through a road in the unit time – from a basic value T0 onwards, each additional vehicle operates at an increasingly private cost, and meanwhile it increases the cost borne by the other circulating vehicles, since their travel time growths.

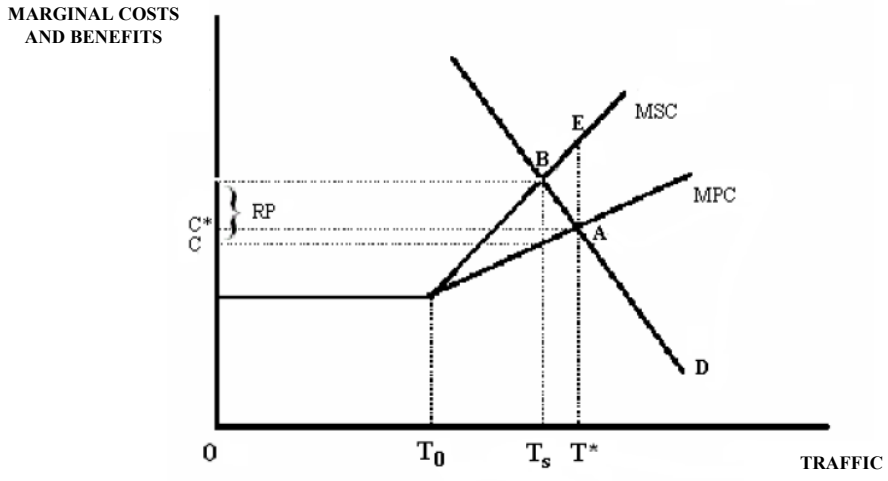

Table 9, The externality of congestion

Therefore, starting from T0, the marginal cost curve splits into private marginal costs and social marginal costs. Since, drivers consider just their private

costs and not the ones they cause to others, there is an efficiency and welfare loss equal to the area ABE. Indeed, the generated level of traffic is T, whereas the social optimum one is Ts.

3.3.4 The arguable incentive system created

The resolution issued by the CIPE in 1996 established the determination of quality-related standards and a direct connection – in the price cap formula - between the allowed toll-levels and the quality of the services offered by the concessionaires.

Adding a correction factor into the price-cap formula is, in principle, more efficient than the adoption of quality standards for reaching social-optimum quality levels. However, although in the regulatory framework being examined, the modalities of determination and application of the above-mentioned factor are not complete inefficient, they created an arguable incentive system for pursuing the production efficiency.

First, the used quality index Q is not able to represent the multi-dimensional nature of the service quality. Second, the accident rate, albeit partially, is unrelated to the choices of the concessionaires, which are awarded or penalized for something they do not control. The reduction of the Global Accident Rate shown in Figure 4 led to toll levels well above those suggested by economic logics for incentivising fair behaviour.

The incompleteness of the indicator Q was known from the moment of definition of the conventions, based on the CIPE Resolution. In fact, the conventions contained a commitment to determine a more efficient structure for Q. In this regard, Law 47/04 intervened stating that the Ministry of Infrastructure and Transport (MIT) should have submitted to the CIPE a proposal to integrate the quality standards with measurement and verification of the relative levels.

The introduction of a quality-related adjustment term in the price-cap formula aims at fostering the adoption of social-optimum quality levels by the concessionaires. This level is reached when the marginal benefit of the consumers equals the marginal cost borne by the concessionaire for offering the increased service quality. However, this optimum level is unknown to the regulator because of the knowledge asymmetry on the *efficient* structure of the costs of the concessionaires.

Furthermore, the index Q is higher the higher the starting quality level. Following the economics, the factor should decrease with the increase of the basic value, at least from a certain point onwards. In fact, the consumer benefit, although always growing with the quality, increases at decreasing rate for additional increment of the service quality level.

Another limit of the structure of the quality adjustment term in the formula, maybe the most serious one, relates to the unsuitable incentive given to the concessionaires, since it is always increasing, with quality increments, without limits.

Looking at Figure 2, it is possible to observe a significant growth of the maintenance expenditures following the coming into force of the price-cap regulation. This is the result of the discussed arguable incentive system created. As proof, approximately the 40% in 2002 [Pozzi, 2003] consisting of expenses for the motorway surface, and the average cycle for the re-asphalting reduced from eleven to six years [Gros Pietro, 2005].

In other words, the quality component of the price-cap formula, instead of representing an instrument for reaching social-optimum quality levels, revealed to be a mean to directly and indefinitely transfer to the toll-levels a significant share of the maintenance cost of the concessionaires.

4. THE ITALIAN MOTORWAY INDUSTRY IN THE MOST RECENT YEARS

4.1 Decree Law No 262/2006 and the Single Convention

Decree Law No 262/2006 defined a new discipline for the concession relationship. Indeed, the Ministry of Transport and Infrastructure, together with the Ministry of Economy and Finance, should guarantee that all the in-place convention provisions - at the time of the first revision of the Financial Plan – and those following the revision were included in a Single Convention.

The Single Convention substituted the original agreement and every additional act. This does not mean that the same convention was applied to all the concessionaires, but that a single convention was drafted for each operator,

considering the peculiarity of any relationship. Nowadays, the Single Convention format has been adopted by all the undertakings, except for the Autostrade Siciliane, the Società Autostrade del Brennero, the SITRASB and the SITMB, whose concessions are regulated by International Treaties.

The new protocol aimed at overcoming the past limits and the drawbacks, assuring more certainty and transparency in the concession relationship. Indeed, strictest rules have been introduced concerning the risk allocation, the remuneration of the invested capital, and the toll-adjustments. Specifically, it was established:

- A toll-determination based on the traffic evolution, the cost dynamics, the efficiency and quality rates reachable by the concessionaire;
- The definition of the destination of the extra-profits generated by the concessionaire;
- The recovery of the share of the toll-income due for the planned investments, and not-collected in the previous exercise;
- The recognition of the toll-adjustment for the planned investments only in case of their actual realization, checked by the granting body;
- The extension of supervision, control, and inspection competences of the granting body, through the obligation for the concessionaire to transmit annually an informative framework including economic, technical, financial, and managerial data;
- The identification of the business risk for the concessionaire;

- The specification of the use and the valorization of the sediments, intended for activities collateral to the motorway ones, for income purposes;
- The identification of procedures aiming at the effective decline of the concession, because of the efficacy, the efficiency, and the economy of the process of assessment of the concession requirements;
- Additional obligations for the concessionaire, as the maintenance of capital requirements, the implementation of adjudication procedure for job contracts, services respective the relative legislation, the submission to the granting body of the tender schemes for the job allocation, the prohibition to take part in the tender for companies connected to the concessionaire, the insertion in the concessionaire statute of measures to prevent conflicts of interests;
- The application of sanctions for the non-fulfilment, for the concessionaire fault, of the Single Convention provisions, and the gradation of them with respect to the severity of the failure. The granting body can impose administrative monetary sanctions non-inferior to 25.000 € and non-superior to 150.000.000 €.

4.2 Resolution No 39/2007 taken by the CIPE

Resolution No 39/2007 of the CIPE stated that the Economic-Financial Plans should be subject to a revision, at the end of each five-year regulation

period, and detailed the modalities for proceeding with the updates of the plans, as well as the acts to be prepared.

The procedure consists in reformulating the macro-economic and operating hypothesis, under which the concessionaire is bound to operate over the following five-year period, for both the management of the motorway service and the investment-plan implementation.

Resolution No 27/2013 taken by the CIPE, additional criteria for the economic-financial plan revision were introduced, mainly addressing the definition of the timing and the means of determination of the fair remuneration rate of the invested capital. This topic was also the subject matter of Decree Law No 201/2011, which stated that the updates or revisions of existing motorway conventions should be evaluated preemptively by the CIPE if involving modifications to the financial plan or regulatory aspects.

Nowadays, the revisions of the financial plans present different scenarios, given the heterogeneity in the subscription dates and emerged problems in the transmitted proposals.

On the expiry of the first regulatory period, Autostrade per l'Italia and SATAP accomplished the update of the financial plan with the Additional Act, signed on December 27th, 2013. For the other companies, the procedures are still in course of refinement. The forwarded proposals align with containment of the toll-increase. The recovery of the lower revenues is guaranteed by the re-

planning of the investments, postponing the non-priority ones, and the re-determination of the takeover value.

4.3 Decree Law No 355/2003, the CIPE Resolution No 39/2009 and the investments-related components in the price-cap formula

In terms of regulation, the price-cap formula, introduced by the CIPE Resolution of December 20th, 1996, was applied to all the concessionaires, until the toll-adjustment approved for the year 2008 - and it is still applicable in case of Single Conventions that are not approved or efficient.

Decree Law No 355/2005 intervened in the regulatory regime, adding an investment related component, $X_{Investments}$, concerning any additional intervention. The parameter was applied univocally to Società Autostrade per l'Italia. Specifically, the formula was as follows:

$$\Delta Toll = 70\%\Delta RPI_{Real} + X_{Investments} + K_{Investments} \qquad (V)$$

Where:

- ΔRPI_{Real} represents the variation in the real retail-price index, meaning the average annual variation for the entire national community published by the ISTAT, and referring to the period between July 1st and June 30th prior the date of filing for the toll-adjustment;

- $X_{Investments}$ refers to the investments added through the IV Additional Convention;
- $K_{Investments}$ relates to the remuneration of the investments included in the Single Convention, as stated by CIPE Resolution No 39/2007;
- The quality component does not affect the toll-level, but, if lower than the previous year, there may be penalties.

The CIPE Resolution of June 15th, 2007 further modified the price-cap formula, which became:

$$\Delta Toll = \Delta RPI - X_{Rebalancing} + K_{Investments} + \beta \Delta Q \qquad \text{(VI)}$$

With:

- ΔRPI being the planned variation in the retail price index;
- $X_{Rebalancing}$ being the percentage-annual-adjustment factor for the toll-level, determined at the beginning of the concession period and constant over it, so that, in the absence of additional investments, the present value of the expected revenues is equal to the cost one, considering the efficiency improvement of the concessionaire and discounting the amounts at the fair remuneration rate;
- $K_{Investments}$ being the percentage annual variation to allow the remuneration of the investment realized in the year preceding the adjustment.

The Resolution applies in the following cases:

- New concessions;
- Existing concession, if the concessionaire asks for the re-balancing of the economic-financial plan;
- Concerning investments not-yet inserted in the financial plans.

Thus, the involved concessionaires are:

- Autostrada Brescia – Verona – Vicenza – Padova S.p.A.
- Tangenziale di Napoli S.p.A.
- Raccordo Autostradale Valle d'Aosta (RAV) S.p.A.
- Autostrada Tirrenica (SAT) S.p.A.
- SATAP S.p.A. tronco A4
- SATAP S.p.A. tronco A21
- Strada dei Parchi S.p.A.

Furthermore, the Resolution covers the concessionaires with Single Convention, which do not ask for the re-balancing. In this case, the regulation affects just the new investments, object of the Single Convention, and the productivity indicator X – provided for in the CIPE Resolution of 1996 - is kept in the formula, as shown below.

$$\Delta Toll = \Delta RPI - X_{Productivity} + \beta \Delta Q + K_{Investments} \qquad \text{(VII)}$$

The interested concessionaires are:

- Autostrada Torino-Ivrea-Valle d'Aosta (ATIVA) S.p.A.

- Milano Serravalle - Milano Tangenziali S.p.A.

4.4 Law No 2/2009 and the rebalancing-relating component in the price-cap formula

Law No 2/2009 introduced a further regulatory regime, established by:

$$\Delta Toll = \alpha \Delta RPI_{Real} - X_{Rebalancing} + K_{Investments} \qquad \text{(VIII)}$$

Where α corresponds to a percentage, fixed for the entire convention period, of the real variation in the retail price index.

This regime applies to:

- Concessioni Autostradali Venete (CAV) S.p.A.
- Autocamionale della CISA (CISA) S.p.A.
- Autostrade Valdostane (SAV) S.p.A.

4.5 The six regulatory regimes and the concessionaires they apply to

Therefore, six different regulatory regimes exist, each one applying to one or more concessionaires.

Table 4 illustrates this scenario in detail. The number in the first column represents the regime number, in chronological order of introduction.

N.	FORMULA	CONCESSIONAIRE
1	$\Delta Toll = \Delta RPI - X + \beta\Delta Q$	Autostrada del Brennero S.p.A.; Consorzio per le Autostrade Siciliane
2	$\Delta Toll = 70\%\Delta RPI_{Real} + X_{Inv} + K_{Inv}$	Società Autostrade per l'Italia S.p.A.
3	$\Delta Toll = \Delta RPI - X_{Rebal} + K_{Inv} + \beta\Delta Q$	Autostrada Brescia-Verona-Vicenza-Padova S.p.A.; Tangenziale di Napoli S.p.A.; Raccordo Autostradale Valle d'Aosta (RAV) S.p.A.; Società autostrada Ragusa-Catania S.r.l.; Autovia Padana S.p.A.; Autostrada Tirrenica (SAT) S.p.A; SATAP S.p.A. tronco A4 Autostrada Asti-Cuneo S.p.A.; Società Autovie Venete S.p.a.; Autostrade Meridionali S.p.A.; SATAP S.p.A. tronco A21 Strada dei Parchi S.p.A.;
4	$\Delta Toll = \Delta RPI - X_{Prod} + \beta\Delta Q + K_{Inv}$	Autostrada Torino-Ivrea-Valle d'Aosta (ATIVA) S.p.A.; Milano Serravalle-Milano Tangenziali S.p.A.
5	$\Delta Toll = \alpha\Delta RPI_{Real} - X_{Rebal} + K_{Inv}$	Concessioni Autostradali Venete (CAV) S.p.A.; SALT S.p.A. - tronco Autocisa; Autostrada Campogalliano-Sassuolo S.p.A.; Autostrade Valdostane (SAV) S.p.A.
6	$\Delta Toll = \alpha\Delta RPI_{Real} + K_{Inv}$	Autostrada dei Fiori S.p.A. – tronco A10; SALT S.p.A. - tronco Ligure Toscano; Autostrada dei Fiori S.p.A. – tronco A6 Torino Savona; Società Italiana per il Traforo Autostradale del Frejus (SITAF) S.p.A.

Table 10, The six regulatory regimes and the concessionaires they apply to

4.6 Decree Law No 241/2012

Decree No 72 of February 11th ,2014, issued by the President of the Council of Ministers, the General Direction for the Supervision of the Motorway Concessionaires, within the Ministry of Transport and Infrastructure, having the following competences:

- Supervision and control over the concessionaires, including the supervision on the execution of the construction work under concession and the control on the management of the motorways under concession;
- Managing the existing relationship with the concessionaires, as well as the preparation of the additional acts;

- Approval of the projects of national interest relating to the motorway network;
- Planning proposal for the progressive improvement and adjustment of the motorways under concession, to be submitted to the General Direction for the roads and the motorways and for the supervision and the safety of the road infrastructure;
- Proposal in relation to the regulation and the toll-variations for the motorway concession, according to the criteria established by the Regulatory Authority for the new concessions;
- Supervision on the implementation by the concessionaires of the norms for the motorway heritage protection, as well as the preservation of the traffic and the signage;
- Supervision on the adoption by the concessionaires of the provisions necessary for the safety of the traffic.

Therefore, the Direction is empowered with the duties of the granting body, transferred to the Ministry of the Transport and Infrastructure, relating the managing, supervising, and controlling over the motorway concessionaires and the formalization of the Additional Acts. It is structured as stated by Decree No 346/2014 in eight divisions and four territorial inspection offices.

4.7 The Regulatory Authority of Transport

The Regulatory Authority of Transport (hereinafter “Authority”) was instituted through Decree Law No 201 of December 6th, 2011 and granted with several competences in the transport sector.

Concerning the motorway industry, the scope of intervention of the Authority was defined as “ensuring 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” and “inter alia, the task of (...) defining optimal management areas of toll motorway sections, to promote plural management thereof and foster competition by comparison”.

To implement these provisions, in early 2014, the Authority began studies for the identification of the factors that could best represent the trend in the production costs of motorway concessionaires, so to determine "efficient cost frontier" - the set of points representing the minimum cost of production for each output level, given the prices of inputs and the quality/quantity features of existing technology. Indeed, this curve allows the determination of the minim optimal production size (i.e. the size below which diseconomies of scale clearly appear). The econometric estimates have been performed by using a Cobb-Douglas type cost function, together with a translog cost function. For a better understanding, their general form is reported below, respectively Formula IX and Formula X.

$$lnC = \propto + \sum_i \beta_i \ln x_i + \varepsilon_i \qquad \text{(IX)}$$

Where:

- C is the costs of production;
- x_i are explanatory variables, as prices of inputs, outputs and other control variables);
- β_i is value of cost elasticity with respect to the x_i factor; and
- ε_i is the error term of the estimation.

$$\ln C = \propto + \sum_i \beta_i \ln x_i + \sum_i \sum_j y_{ij} \ln x_i \ln x_j + \varepsilon_i \qquad \text{(X)}$$

Where, y_{ij} represents the variation in cost elasticity with respect to x_i factors upon their variation.

Moreover, 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 the inefficiency levels and technical progress are changing over time). Finally, the estimates, through both functions, were carried out, with the entire sample of concessionaire, the sample of concessionaires without Società Autostrade per l'Italia, the variables related to the quality and the type of the charging methods applicable to each concessionaire, the normalization with respect to product prices and median values.

The results obtained by the Authority have led to the identification of an optimal area, expressed in terms of length in kilometers 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.

Therefore, to take advantage of economies of scale and remove production inefficiencies, the length of the motorway infrastructures included in a single concession should not be less than 180 km. Significant structural inefficiencies are observed for lengths less than 180 km, greatly increasing with length reduction. As for lengths exceeding 315 km, no additional structural benefits are reported. In the range between 180 km and 315 km, benefits linked to the increased size increase at decreasing rate, as the length approaches values near to the upper limit (i.e. 315 km).

Within the competence assigned to the Authority in the field of the motorway industry, Decree Law No 201 of December 6th, 2001 included the definition of the concession schemes to be inserted in the tenders for the management and the construction of motorways, as well as to establish for new conventions, toll-determination mechanism based on the price-cap model.

In this regard, the Authority defined a toll-determination system for the motorwaysA5 Torino-Ivrea-Quincinetto, A4/5 Ivrea-Santhià, Sistema Tangenziale di Torino, Diramazione Torino-Pinerolo e A21 Torino-Alessandria-Piacenza, through Resolution No 119/2017; for A22 Brennero-Modena through Resoution 73/2018; A4 Venezia-Trieste, A23 Palmanova-Udine, A28

Portogruaro-Conegliano, A57 Tangenziale di Mestre per la quota parte e A34 raccordo Villesse-Gorizia, through Resolution 133/2018. Finally, Resolution No 1/2019 started the procedure for the toll-determination for the motorways A12 Sestri Levante-Livorno, A11/A12 Viareggio-Lucca, A15 diramazione per La Spezia e A10 Ventimiglia-Savona.

A detailed explanation of the toll-regulatory mechanism introduced by the Authority is reported in Chapter 5.

4.8 The Italian motorway network in the 21st century

4.8.1 Extension of the network

On December 31st, the Italian motorway network extended for 5.978 kilometers of motorways in-operation, 40 kilometers of motorways under-construction, and 467 kilometers of planned motorways, for a total of 6.485 kilometers. Specifically, three-lane motorways accounted for 1.870 kilometers and four-lane ones for 129 kilometers. Figure 7 illustrates the network distribution across the peninsula, being the green line the representation of the in-operation section, the dotted line of the under-construction one, and the blank line of the planned one.

Moreover, Figure 9 shows the development of the network in the 1970-2017 period, highlighting how, after a rapid growth in the nascent years, the extension, although always upwards, has been increasing at a slower rate.

Table 12, The Italian motorway network in 2017

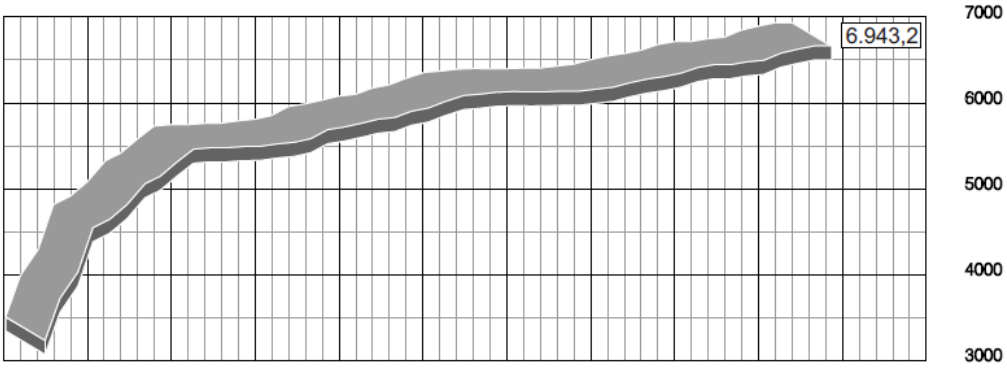

Table 11, The Italian motorway extension in the 1970-2017 period

4.8.2 The traffic volumes and the accident rate

As shown in Figure 9, the traffic volumes have been steadily increasing for the light-vehicles, over the entire investigated period, excepting for the years between 2010 and 2015. The same pattern is observed for the heavy vehicles, but at a much slower rate. Moreover, for the latter category, the traffic, after a slight decrease, remained approximately stable from 2010. In 2017, the overall traffic value was of 83.8 billion of vehicle/km.

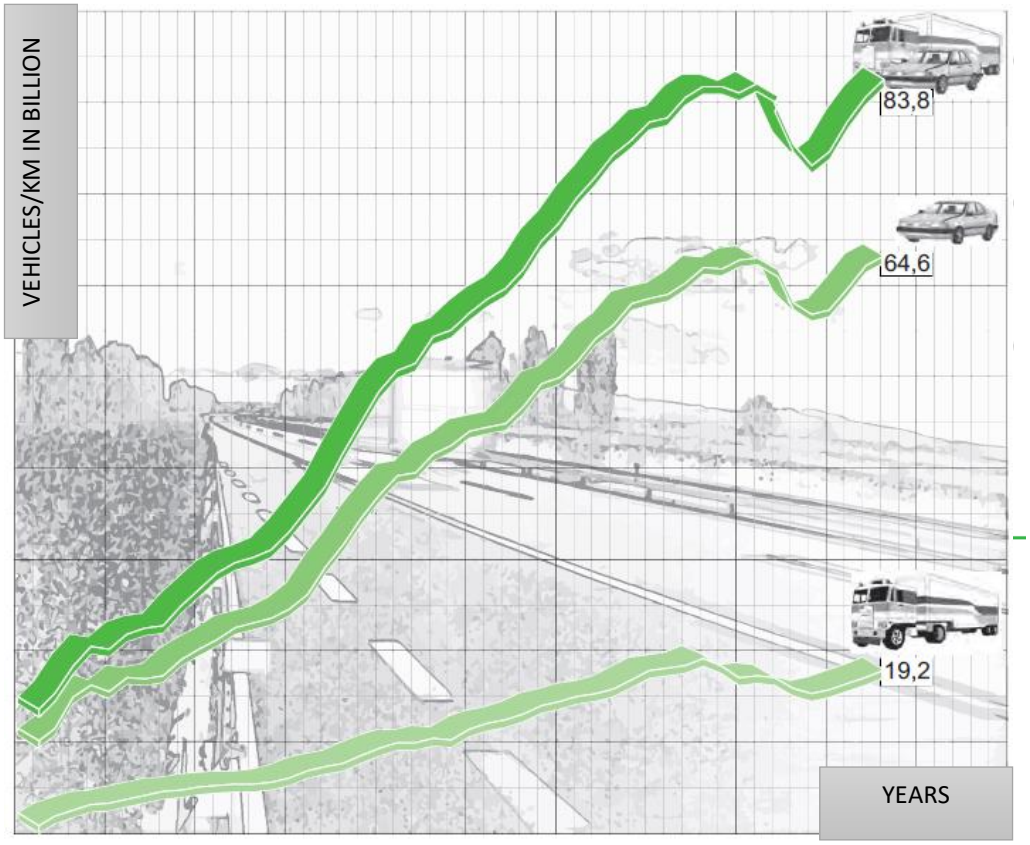

Table 13, The traffic volumes in the 1970-2017 period

Furthermore, the accident rate, weighted at 100 million km travelled, has been decreasing, steeply across the 1970-1975 and the 2000-2017 periods, and

more slowly between 1975 and 2000. In 2017, the overall accident rate was equal to 7,58.

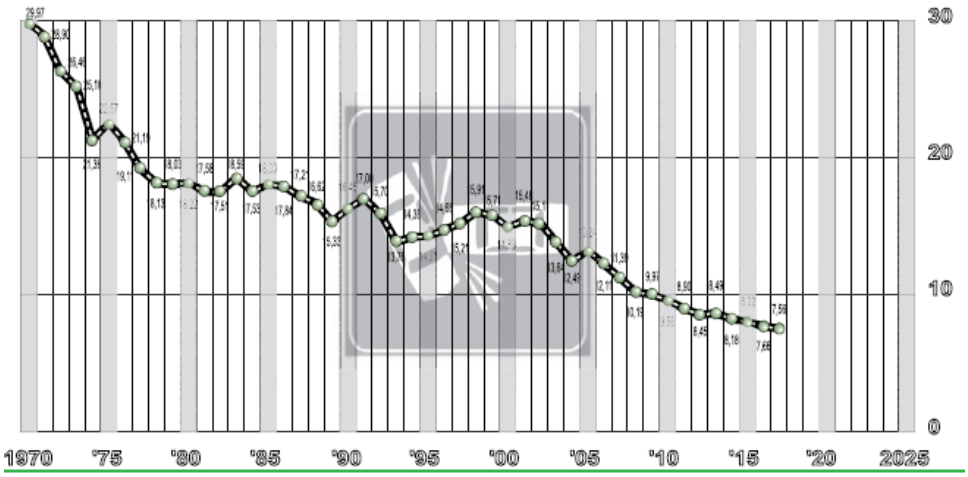

Table 14, The accident rate in the 1970-2017 period

4.8.3 The investment expenditure

The investments borne by the concessionaires over the 2000-2017 period accounted for € 22.127 billion, equal to an average annual expenditure of € 1.301 billion. Specifically, the expenditure was:

- For the third-forth lane construction of € 8.345 billion;
- For new works of € 8.704 billion;
- For adductions of € 1.113 billion;
- For new junctions of € 1.003 billion;
- For the safety and the environment of € 2.961 billion.

4.8.4 The maintenance costs

The overall expenditure of the concessionaires for intervention of ordinary maintenance was of € 11.639 billion across 2000-2017, being equivalent to an average annual amount of € 0,646 billion.

Figure 11 shows the allocation of the expenditure.

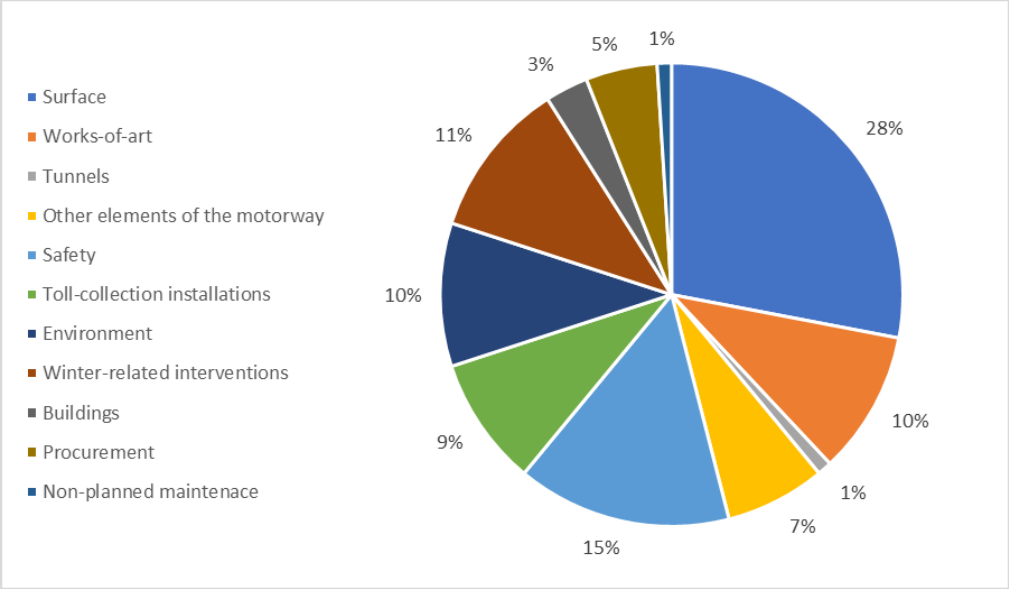

Table 15, The maintenance expenditure composition over the 2000-2017 period

4.8.5 The quality-related indicators

As shown in Figure 12, concerning the quality-related indicators of the price-cap formula, provided for in the CIPE Resolution in 1996, it is possible to deduce that:

- $I_{Surface}$ increased over the 2001-2011 period and then remained approximately stable, with values above 70;

- $I_{Accidents}$ presents a deep growth between 2001 and 2011, reaching a level equal to 99, kept for the following years;
- Consequently, Q grew across the same years, and stabilized after 2011 with values above 80.

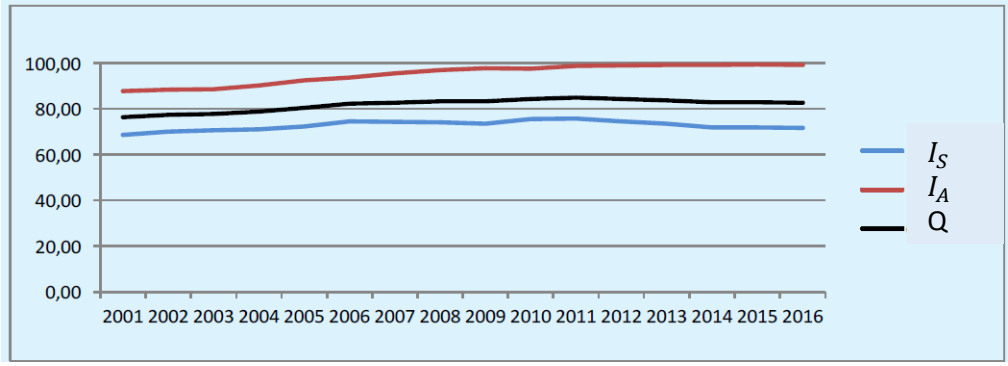

Table 16, The quality-related indicators in the 2000-2016 period

4.9 The concession-granting bodies and the institutional stakeholders

The Italian motorway network is assigned under concession by different granting bodies. The first of them is the Ministry of Transport and Infrastructure, replacing the A.N.A.S in this role, in October 2012. Indeed, most of the existing network reports to the Ministry, then there is the A.N.A.S., which is simultaneously a motorway operator and the granting bodies for several concessions, participating in 50% of the capital of regional companies.

Finally, there are regional companies having granting competences only for infrastructures in their territory.

The tables below illustrate the concessions relating to each granting body.

MINISTRY OF INFRASTRUCTURE AND TRANSPORT	
CONCESSIONAIRE	**KM**
ATIVA SpA	155,8
Autostrade per l'Italia SpA	2.857,5
Autostrada del Brennero	314,0
Autostrada Brescia – Verona – Vicenza – Padova SpA	235,6
Autostrade Centro Padane SpA	105,5
Autocamionale della Cisa SpA	101,0
Autostrada dei Fiori SpA	113,3
CAS – Consorzio per le Autostrade Siciliane	298,4
Autovie Venete SpA	210,2
Milano Serravalle – Milano Tangenziali SpA	179,1
Tangenziale di Napoli SpA	20,2
RAV – Raccordo Autostradale Valle d'Aosta SpA	32,4
SALT– Società Autostrada Ligure Toscana SpA	154,9
SAT – Società Autostrada Tirrenica SpA	54,6
SAM – Società Autostrade Meridionali SpA	51,6
SATAP A4 Torino – Milano	127,0
SATAP A21 Torino – Piacenza	164,9
SAV –Società Autostrade Valdostane SpA	67,4
SITAF – Società Traforo Autostradale del Frejus SpA	82,5
Autostrada Torino – Savona SpA	130,9
SITMB – Società Italiana Traforo del Monte Bianco SpA	5,8
SITRASB – Società Italiana Traforo Gran San Bernardo SpA	12,8
Strada dei Parchi SpA	281,4
Società Autostrada Asti – Cuneo SpA	55,7
CAV – Concessioni Autostradali Venete SpA	74,1
TOTAL	**5.886,6**

Table 17, Motorway network with the Ministry of Transport and Infrastructure as granting body

NON-TOLL MOTORWAYS DIRECTLY OPERATED BY THE A.N.A.S.	KM
A90 Grande Raccordo Anulare di Roma (GRA)	68,2
A91 Roma – Fiumicino	17,4
A3 Salerno – Reggio Calabria	442,9
A29 Palermo – Mazzara del Vallo e diramazione Punta Raisi	118,8
A29 Dir – Alcamo – Trapani e diramazione per Birgi	50,0
A19 Palermo - Catania	192,8
A19 Diramazione per Via Giafar	5,2
A29 Racc. Bis – Raccordo per Via Belgio	5,6
A18 Dir – Catania Nord – Catania Centro	3,7
Catania - Siracusa	49,2
TOTAL	**953,8**

Table 18, Non-toll motorways directly operated by the A.N.A.S.

COMPANIES OWNED 50% BY THE A.N.A.S. AND 50% BY REGIONAL UNDERTAKINGS	KM
AUTOSTRADA DEL LAZIO S.p.A. (ANAS S.p.A. – Region Lazio)	112
Roma – Latina Cisterna – Valmontone	
AUTOSTRADA DEL MOLISE S.p.A. (ANAS S.p.A. – Regione Molise)	82
Termoli – San Vittore del Lazio	
CAL S.p.A. - CONCESSIONI AUTOSTRADE LOMBARDE (ANAS S.p.A. – Region Lombardia)	200,8
Pedemontana Lombarda BRE.BE.MI. Brescia – Bergamo – Milano TEM Tangenziale Est Esterna of Milan	
CAP S.p.A. – CONCESSIONI AUTOSTRADALI PIEMONTESI (ANAS S.p.A. – Region Piemonte)	88
Pedemontana Piemontese Tangenziale Est di Torino Connection of Corso Marche, Connection Autostradale Strevi Pedrosa	
TOTAL	482,8

Table 19, The Companies owned 50% by A.N.A.S. and 50 % by Regional Undertakings

5. THE CURRENTLY IN-PLACE REGULATORY REGIME

5.1 The regulatory framework

Within the competences granted to the Regulatory Authority of Transport (hereinafter "Authority"), the toll-related ones resulted to be relevant. In fact, article 16 of Decree Law No 109 of September 28th, 2018, referring to articles 37 and 43 of Decree Law No 201/2001, extends the intervention scope of the Authority in the Italian motorway industry. Specifically, these provisions require the Authority to determine a price-cap based toll-determination mechanism – including the computation of the five-year-lasting index X, for:

- New concession contracts, and

- Approval of revisions of the conventions already-in-place when Decree Law No 201/2011 came into force – regardless those revisions involve changes in the investment plan.

Consequently, the Authority should identify the toll-determination mechanism for all the existing conventions, under revision process, regardless the involvement of modifications in the investment plan, and including the computation of the indicator X.

In this perspective, considering that the financial plan – integral part of the motorway convention – is subject to revisions, at the end of each concession period, it is necessary to set the toll-related system for those agreements whose regulatory period expired:

- After the coming into force of Decree Law No 109/2018;
- Before the coming into force of Decree law No 109/2018, if, by that date, the economic-final plan has not finished the upgrade process.

Once the toll-mechanism is established for the identified concessionaires, the Authority communicates the result to the Granting Body, which determines the consequent aspects affecting the in-place relationships.

In the implementation of the provisions of article 37 of Decree Law No 201/2011, the Authority already provided for the definition of the optimal size of the concessionaire through Resolution No 70/2016, and for the identification of the toll-structure for several new conventions – as explained in the previous

chapter. In this regard, the Authority used a technical and economic dataset, constructed with information directly provided by the concessionaires since 2005. Studied conducted on this database allowed the Authority to estimate the efficiency gap of each concessionaire and to focus on the potential recovery targets.

As part of these procedures, the Authority perfectioned an homogeneous toll-determination mechanism based on the price-cap regime. Specifically, the methodology was drafted starting from an econometric model, built upon the efficient frontiers of the sector operators and aiming at encouraging the competition. In this regard, the analysis conducted on the previously-mentioned historical data led to the construction of the links between the efficient operating costs and technical-economic variables, specific to each concessionaire.

Therefore, the toll-regulation system developed around these considerations, as stated by the Authority itself, “addresses the objectives of promoting the competition, fostering the productive efficiency and the cost reduction for companies and consumers, while enhancing the peculiarity of each concession relationship”.

For these reasons, the Authority proposed the same methodology for the existing conventions, the toll-adjustment process of which falls under its competences, for the provisions mentioned above.

5.2 The targeted conventions

For a better understanding, this paragraph shows the conventions falling within the scope of articles 37 and 43 of Decree Law 201/2011:

- Table 5, for concessions whose five-year regulatory period expired after the coming into force of Decree Law No 109/2018;

Conventions	Motorway	Concessionaire	Signature Date	Expiration Date
Convenzione Unica ANAS S.p.A.- Autocamionale della CISA S.p.A.	A15 Parma - La Spezia	Società Autostrada Ligure Toscana S.p.A. (SALT) - Tronco Autocisa	03/03/2010	31/12/201
Convenzione Unica ANAS S.p.A.-Autostrada dei Fiori S.p.a.	A10 Savona – Ventimiglia	Autostrada dei Fiori S.p.A. (Tronco A10)	02/09/2009	31/12/2018
Convenzione Unica ANAS S.p.A.-Autostrada Torino Savona S.p.A.	A6 Torino – Savona; A6 Diramazione per Fossano	Autostrada dei Fiori S.p.A. (Tronco A6)	18/11/2009	31/12/2018
Convenzione Unica ANAS S.p.A.-SALT S.p.A.	A11/A12 Viareggio – Lucca; A12 Sestri Levante – Livorno; A15 diramanzione per La Spezia	Società Autostrada Ligure Toscana S.p.A. (SALT) - Tronco LigureToscano	02/09/2009	31/12/2018
Convenzione Unica ANAS S.p.A.-SAV Società Autostrade Valdostane S.p.A.	A5 Quincinetto – Aosta; A5 Raccordo Aosta - Gran San Bernardo	Società Autostrade Valdostane S.p.A. (SAV)	02/09/2009	31/12/2018
Convenzione Unica ANAS S.p.A.-SITAF S.p.A. Autostrada A32 Torino-Bardonecchia	A32 Torino – Bardonecchia; A32 Circonvallazione di Oulx; T4 Traforo del Frejus	Società Italiana Traforo Autostradale del Frejus S.p.A. (SITAF)	22/12/2009	31/12/2018
Convenzione Unica ANAS S.p.A.-Tangenziale di Napoli S.p.A.	A56 Tangenziale di Napoli	Tangenziale di Napoli S.p.A.	28/07/2009	31/12/2018

Table 20, Concession expiring after Decree Law No 109/2018 came into force

- Table 6, for concessions whose five-year regulatory period expired before the coming into force of Decree Law 109/2018 without concluding the adjustment of the economic-financial plan.

Conventions	Motorway	Concessionaire	Signature Date	Expiration Date
Convenzione ANAS S.p.A.-Concessioni Autostradali Venete- CAV S.p.A.	A4 Padova Est - bivio A4/A57; A4 bivio A4/A57-Quarto d'Altino; A57 bivio A4/A57–Mestre-Terraglio; A57 Diramazione per l'aeroporto Marco Polo	Concessioni Autostradali Venete S.p.A. (CAV)	23/03/2010	31/12/2014
Convenzione Unica ANAS S.p.A. - Società SATAP Tronco A4	A4 Torino-Milano;	Società Autostrada TorinoAlessandria-Piacenza S.p.A. (SATAP) Tronco A4	10/10/2007	31/12/2017
Convenzione Unica ANAS S.p.A.-Società Milano Serravalle-Milano Tangenziali p.A.	A7 Milano-Serravalle; A7 Raccordo A7-Piazza Maggi; A7 Raccordo A7 - Piazza Maggi (da B al km 0 dell'autostrada A7); A50 Tangenziale Ovest di Milano; A50 Tratta A; A51 Tangenziale Est di Milano; A52 Tangenziale Nord di Milano; A53 Raccordo Bereguardo – Pavia; A54 Tangenziale di Pavia.	Milano Serravalle S.p.A.	07/11/2007	31/12/2017
Convenzione Unica ANAS S.p.A. - Società Autostrada Brescia–Verona – Vicenza – Padova S.p.a.	A4 Brescia – Padova; A31 Rovigo - Vicenza – Piovene Rocchette (Valdastico)	Brescia - Verona - Vicenza - Padova S.p.A.	09/07/2007	31/12/2017
Convenzione Unica ANAS S.p.A.- Autostrade per l'Italia S.p.A.	A1 Milano – Napoli; A1 Diramazione Roma Nord; A1 Diramazione Roma Sud; A1 Raccordo A1 – Tang. di Milano; A4 Milano – Brescia; A7 Serravalle – Genova; A8 Milano – Varese; A8 Diramazione Gallarate – Gattico; A9 Lainate - Como – Chiasso; A10 Genova – Savona; A11 Firenze - Pisa Nord; A12 Genova - Sestri Levante; A12 Roma – Civitavecchia; A13 Bologna – Padova; A13 Diramazione per Padova Sud; A13 Diramazione per Ferrara; A14 Bologna – Taranto; A14 Diramazione per Ravenna; A14 Diramazione per la Tang. di Bari; A14 Raccordo A1 - A14; A16 Napoli – Canosa; A23 Udine – Tarvisio; A26 Genova Voltri – Gravellona Toce; A26 Diramazione Predosa – Bettole; A26 Diramazione Stroppiana - Santhià; A27 Mestre – Belluno; A30 Caserta - Nola – Salerno; A52 Rho - Monza	Autostrade per l'Italia S.p.A	12/10/2007	31/12/2017
Convenzione Unica ANAS S.p.A. - Società di Progetto Autostrada Asti-Cuneo p.A.	A33 Cuneo centro – Massimini; A33 Marene – Cherasco; A33 Guarene - Alba - Roccaschiavino; A33 Diramazione per Cuneo est; A33 Viabilità di collegamento con la Tangenziale Ovest di Bra; A33 Diramazione per Cherasco	Società di progetto Autostrada Asti Cuneo S.p.A.	01/08/2007	31/12/2017

Convenzione Unica ANAS S.p.A. - Raccordo Autostradale Valle d'Aosta S.p.A.	A5 Aosta - Traforo del Monte Bianco	Raccordo Autostradale della Valle d'Aosta S.p.A. (RAV)	29/12/2009	31/12/2013
Convenzione Unica ANAS S.p.A. - Società Autostrada Tirrenica p.A.	A12 Livorno - San Pietro in Palazzi; A12 Civitavecchia - Tarquinia (lotto 6A); T4 Traforo del Frejus	Società Autostrada Tirrenica S.p.A. (SAT)	11/03/2009	31/12/2013
Convenzione Unica ANAS S.p.A. - Strada dei Parchi S.p.A.	A24 Roma – Teramo; A24 Diramazione GRA - Tangenziale Est di Roma;	Strada dei Parchi S.p.A.	18/11/2009	31/12/2013

Table 21, Concessions expired before Decree Law 109/2019 came into force and without concluding the Financial Plan adjustment-program

5.3 The regulatory model

In accordance with the provisions of article 37 of Decree Law 201/2011, the toll-regulating system proposed by the Authority is a price-cap based one, having the main following features:

a) A five-year duration period;

b) The distinction between activities

- ✓ directly under regulation;
- ✓ Not-directly subject to regulation, but relevant for addressing the extra profitability, generated by the "ancillary activities";
- ✓ Non-relevant.

c) Definition of the methodologies for the toll-determination, through

- ✓ Ex ante identification of the toll maximum initial level, considering the criteria provided by the Authority regarding the formula components, the volume forecasts, and the analysis of the efficient frontier of the concessionaire;

- ✓ Application of the price-cap method, including the computation of the five-year lasting indicator X;

d) Definition of an efficient mechanism aiming at directly transferring the extra-profits, deriving mainly from incorrect traffic forecasts.

e) Introduction of a detailed and complete penalties/rewards system for the quality of the services offered, allowing the identification of the key quality objectives and the respective indicators, and to evaluate the concessionaire performance, directly affecting the toll-level.

f) Obligations for the concessionaire of maintaining separate accountings and implementing a compulsory accounting model for the activities under regulation.

Therefore, in response to the existing six different regulatory regimes, described in the previous chapter, the Authority proposes a uniform approach, aiming at creating homogeneity in the regulation of the concessionaires, at simulating the competitive pressure in the motorway monopoly industry, and at incentivizing the management efficiency.

5.3.1 Identification of the relevant activities

The toll-determination mechanism applies exclusively to motorway activities, meaning those connected to the planning, construction, management, and maintenance of motorways, including the absorption of the extra-profits from the ancillary activities. The ancillary activities relate to commercial exploitation of the motorway areas, but they are not related to the motor-vehicle

circulation – for instance the signage, refueling stations, rest stops, and the technological and information systems.

5.3.2 Implementation of the Price-Cap model

The choice of a price-cap model assures:

- An annual dynamic for the management-related component of the formula, coherent with the achievement of the productivity-recovery objective;
- A ROI equal to the pre-tax remuneration index for the concessionaire over the concession period, referring to
  - Investments on assets subject to the concession, including the value of a potential takeover – amount paid to the retiring concessionaire for works already computed but not amortized prior the expiration of the concession;
  - Investments on relevant and efficient assets for the functioning of the concessionaire.

5.3.3 The toll-determination process

The toll-determination follows a complex process, affected by multiple components, as shown in Figure 7. The following paragraphs offer a deeper analysis of them.

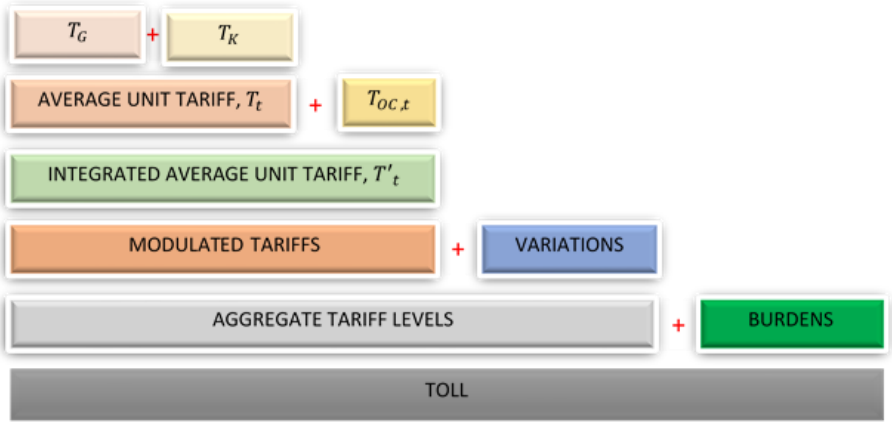

Table 22, The toll-determination process

*5.3.3.1 T*oll average-unit-charge

The tariff system developed by the Authority relies on the concept of toll average-unit-charge, meaning the average unit price (€/vehicles * km) applied to the different vehicle classes and motorway sections by the concessionaire, weighted with the traffic volumes of the reference year, deducting:

- The concession fee, equal to the 2,40 % of the toll-income net value, as stated by Law No 296 of December 27th, 2006;
- The integration to the concession fee, fixed by Decree Law 78/2009;
- Taxes and other burdens;
- The supplements for the adjustment of the motorway infrastructure, provided for by Decree Law No 285/1992.

The toll average-unit charge consists of two components:

- The management-related component (T_G), aiming at, respecting all the provisions and limitations, assuring the recovery of the operative costs

estimated with respect to the reference year, and the amortization and remuneration of the invested capital for the assets functional to the concession management and non-reversible at the time of conclusion of the concession relationship; and

- The construction-related component (T_K), aiming at allowing the amortization and the remuneration of the invested capital concerning the assets reversible at the time of conclusion of the concession relationship, including a potential takeover to be given to the retiring concessionaire, and the investments realized for works provided for in the investment plans subject to the convention.

$$T_t = T_{G,t} + T_{K,t} \qquad \text{(XI)}$$

Potentially, an integrative component accounting for the recovery of the concession burdens, introduced by the granting body, may be added to the toll average-unit charge, through the identification of an annual amount, constant for the entire concession period. Obtaining,

$$T'_t = T_t + T_{OC,t} \qquad \text{(XII)}$$

The integrated average unit tariff must verify:

$$T'_t = \frac{\sum p_i^t q_i^t}{\sum q_i^t} \qquad \text{(XIII)}$$

Where p and q refer respectively to the toll and kilometers for the vehicle class i, at time t.

Moreover, the traffic estimations, the building block for the computation of these tariff components, should be revised every five years – at the time of conclusion of the regulatory period, and performed with transparency, replicability, and analytic strength, to ensure simulation, sensitivity, and risk analysis by the Institutional bodies.

The management-related component dynamics is ruled by the formula:

$$T_{G,t+1} \leq T_{G,t}(1 + P_{t+1} - X_{t+1}) \qquad \text{(XIV)}$$

Being:

- $T_{G,t+1}$ the toll management-related component applicable by the concessionaire at the time t+1;
- $T_{G,t}$ the initial toll management-related component, subject to the price-cap mechanism for the regulatory period, computed as operating costs, allowed in the bridge-year, times the arithmetic average of the traffic volumes estimated ex-ante for each regulatory year. Specifically,

$$T_{G,t} = \frac{C_{G,ap}}{V_{m,1-5}} \qquad \text{(XV)}$$

  - ✓ $C_{G,ap}$ representing the management-related cost level for the bridge-year, defined as

$$C_{G,ap} = C_{G,ab}(1 + P_{ap}) \qquad \text{(XVI)}$$

    - $C_{G,ab}$ is the management-related cost level for the reference year;
    - P_{ap} is the retail price index planned for the bridge-year;

- The bridge-year is the one between the reference year and the first regulatory year, period over which the concessionaire complies with all the requirements for the reduction and the submission of the proposal of the Financial Plan revision to the granting body and the Authority.

✓ $V_{m,1-5}$ is the annual average traffic-level, computable as the arithmetic average of the traffic volumes estimated ex-ante for each regulatory year.

- P_{t+1} the planned retail price index reported in the last-available Economy and Finance Document at the beginning of the regulatory period;
- X_{t+1} the productivity-increase coefficient, adjusting the in-place average toll per kilometer - time t - depending on the productivity-increment, deriving from efficiency improvements, for time t+1, determined by the Authority every five years for each concessionaire.

The dynamics of the component is modulated by the following formula:

$$T_{K,t+1} = \frac{C_{a,r,t+1} + C_{r,c,r,t+1} + PF_{K,t+1}}{V_{t+1}} \qquad \text{(XVII)}$$

Where:

- $C_{a,r,t+1}$ represents the amortization cost, referring to year t+1, for the assets reversible at the time of conclusion of the concession period;

- $C_{r,c,r,t+1}$ represents the capital remuneration cost, referring to year t+1, for the assets reversible at the time of conclusion of the concession period;
- $PF_{K,t+1}$ represents the, positive or negative, value of the tariff figurative components, computed every year in accordance with the principles of economic and financial transparency, aiming at assuring the graduation of the variation of the toll-levels across the concession period;
- V_{t+1} represents the traffic volumes, estimated ex-ante and referred to year t+1.

Moreover, $C_{a,r,t+1}$ and $C_{r,c,r,t+1}$ derived from:

$$C_{a,r,t+1} = C_{a,r,f,t+1} + C_{a,r,t,t+1} \qquad \text{(XVIII)}$$

$$C_{rc,r,t+1} = CIN_{r,t+1} R_r \qquad \text{(XIX)}$$

With:

- $C_{a,r,f,t+1}$ is the amortization cost, referring to year t+1, of the reversible assets subject to financial amortization;
- $C_{a,r,t,t+1}$ is the amortization cost, referring to year t+1, of the reversible assets subject to economic-technical amortization;
- $CIN_{r,t+1}$ refers to the regulatory net invested capital, for the reversible assets, concerning year t+1, computed on January 1st;
- R_r is the real index of remuneration of the invested capital (WACC).

The dynamics for the net investment capital, over the regulatory period, is as follows:

$$CIN_{r,t+1} = (CIN_{r,t} - C_{a,r,t} + I_t)(1 + \widehat{P_t}) \qquad \text{(XX)}$$

Being:

- $CIN_{r,t}$ the regulatory net invested capital, for the reversible assets, referring to year t+1, computed on January 1st;
- $C_{a,r,t}$ the amortization cost, referring to year t, for the reversible assets, as recorded on January 1st of the same year and reported in the Financial Plan;
- I_t the annual quota of the investments expected for year t, referring to the works object of the investment plans;
- $\widehat{P_t}$ the planned retail index for year t.

5.3.3.2 The productivity coefficient X

As matter of determination of the factor X, the Authority uses the dataset of information, starting from 2005 and annually updating, for the econometric analysis addressing the determination of the efficient frontier of each concessionaire.

The model elaborated by Authority contemplates the estimation of a cost function by the formula:

$$C_{i,t} = f(V_{i,t}, L_{km_{i,t}}, P_{j,i,t}, H_{i,t}) \qquad \text{(XXI)}$$

Where:

- i represents the i-th concessionaire;
- t represents the year;
- j represents each production factor considered (being labour, capital, maintenance, and other costs);
- $C_{i,t}$ represents the overall cost borne by the i-th concessionaire at time t;
- $V_{i,t}$ represents the traffic volume on the motorway of the i-th concessionaire at time t;
- $L_{km_{i,t}}$ represents the motorway extension in kilometers of the i-th concessionaire at time t;
- $P_{j,i,t}$ represents the price of the j-th input;
- $H_{i,t}$ represents a vector of control variables (as percentage of network with three or four lanes, the percentage of remaining concession years, debt to equity ratio, the surface-related indicator, ext.).

The estimations are performed through time-invariant or time-varying decay models, using Cobb-Douglas and Translog cost functions.

Then, a benchmarking analysis is implemented between the motorway operators to adjust the indicator X, so to repositioning the costs on the efficient frontier.

Therefore, the parameter X is specified with respect to single annual productivity objectives. Indeed, the formula is as follows:

$$\prod_1^5(1 - X_t) = 1 - X^*, X_t > 0 \; \forall t \qquad \text{(XXII)}$$

Being X^* the overall recovery percentage for the first five-year regulatory period, annually declined in single efficiency targets X_t.

Therefore, the Authority determined the value of the productivity indicator X_t for the first regulatory period of application of the proposed toll-determination mechanism.

On the other side, the toll construction-related component – for the year t+1 - guarantees the link between the toll-levels and the planned investments, so that the present value of the earnings from the investments, to be realized until the precedent year – year t – equals the present value of the allowed cost, net of the fair remuneration rate. The investments are no longer subject to an ex-post adjustment through the X-factor, because their realization should align coherently with the Guidelines for the evaluation of the investments in public works within the sectors of competence of the Ministry of Transport, and they should be selected based on transparency, efficacy, and efficiency criteria.

5.3.3.3 The concession-burden related component

The concession-burden related component is designed to the recovery of specific concession rates deriving eventual convention obligations. Specifically, it is considered the amount that the granting body intended to introduce for the concessionaire and it is decided to distribute in annual quotas over the entire concession period, regardless the payment methods.

The dynamics of the component is regulated by:

$$T_{OC,t+1} = \frac{C_{vc}}{V_{t+1}} \qquad \text{(XXIII)}$$

Where:

- C_{vc} represents the potential annual quota of the concession value;
- V_{t+1} represents the traffic level estimated ex-ante for the year t+1.

The toll-adjustment for the investment realization

The average unit tariff is annually monitored and adjusted based on the quality of the services and the realization of the investments, as follows:

$$T''_{t+1} = T''_{G,t+1} + T''_{K,t+1} \qquad \text{(XIV)}$$

Being:

$$T''_{G,t+1} = T_{G,t+1}(1 - \Delta T_{G,t+1})(1 + Q_t) \qquad \text{(XV)}$$

$$T''_{K,t+1} = T_{K,t+1} + \Delta T_{K,t+1} \qquad \text{(XVI)}$$

Where:

- $T''_{G,t+1}$ is the level of the management-related component computed at year t and applicable by the concessionaire in year t+1;
- $T_{G,t+1}$ is the level of the management-related component computed at the time of signing of the convention;

- $\Delta T_{G,t+1}$ is the variation in the management-related component for the failure in incurring the operating costs planned ex-ante and referring to the planned investments and normative contingences;
- Q_t is the quality-related component, having positive or negative value, and computed as explained in the following paragraph;
- $T''_{K,t+1}$ is the construction-related component, computed at year t and applicable by the concessionaire at year t+1;
- $T_{K,t+1}$ is the construction-related component determined at the time of signing of the convention;
- $\Delta T_{K,t+1}$ is the variation in the in the construction-related component, having positive or negative value, computed at time t, and composed as follows:

$$\Delta T_{K,t+1} = \Delta T_{I,K,t+1} + H_{k,t+1} \qquad \text{(XXVII)}$$

Being:

- $\Delta T_{K,t+1}$ the sub-component related to the amount of non-realized investments, computed as:

$$\Delta T_{K,t+1} = -(1 - \propto_t) T_{k,t+1} \qquad \text{(XXVIII)}$$

$$\propto_t = {\sum_{a=1}^{t}(I_{R,a})} \Big/ {\sum_{a=1}^{t}(I_{p,a})} \qquad \text{(XXIX)}$$

With $I_{R,a}$ the amount of the costs admissible for tariff purposes for the year t+1, referring to the investments realized, including the potential takeover quota and $I_{p,a}$ the amount of the costs

admissible for tariff purposes for the year t+1, referring to the planned investments, including the potential takeover quota.

- $H_{k,t+1}$ the penalty applicable in case of a delay in the investment realization imputable to the concessionaire, determined as follows:

$$H_{k,t+1} = -(y_t R_c)\left|\Delta T_{I,K,t+1}\right| \qquad \text{(XXX)}$$

Where y_t represents the non-realized investment share imputable to the concessionaire, up to year t, and R_c the remuneration rate of the invested capital (WACC).

Therefore, the integrated average unit tariff is:

$$T'''_{t+1} = T''_{t+1} + T_{OC,t+1} \qquad \text{(XXXI)}$$

5.3.3.3 The penalty-reward system

A penalty-reward system was introduced, in relation to the quality of the services offered by the concessionaire. The mechanism is linked to the management-related component, having the effect of producing, for the following year, a variation in its value, between +2% and -2%. The exclusion of a correlation with the construction-related component ensures the disincentives of opportunist behavior and the risk of double counting of the investments. The model is designated to pursue a balance of the performances of the concessionaires with respect to all the identified areas of intervention, and it is

not completely symmetric, meaning that it may be more challenging for some concessionaires.

The distinct quality thresholds are defined for each quality indicator:

- Minim threshold, lq_{min}, at which the mechanism assumes the lowest value (i.e. $Q_i = -0{,}02$), aiming at incentivizing the concessionaires to reach performance levels upon the minim standard required;
- Objective threshold, lq_{min}, value at which the mechanism does not affect the toll-determination (i.e. $Q_i = 0$);
- Best-practice thresholds, $lq_{bestprac}$, value at which the quality-related variation in the toll level is maximized (i.e. $Q_i = 0{,}02$).

The quality thresholds must be identified by the granting body at the beginning of each regulatory period, ex-ante and on an annual basis, and they must be annually monitored. Indeed, a weight is associated to each performance by the granting body ($P_{q,j}$). If at least one of the dimensions lq_j is below the minimum threshold, then a penalty 0f -2% is applied to the concessionaire. If all the dimensions are above the minim thresholds, but at least one is below the objective thresholds, then $-0.02 \leq Q_{t,j} \leq 0$, with $Q_{t,j}$ obtained by linear interpolation of the indictor values. If all the dimensions are above the objective thresholds, but at least one is below the best practice thresholds, then $0 \leq Q_{t,j} \leq 0{,}02$, with $Q_{t,j}$ obtained by linear interpolation of the indictor values.

Finally, the overall toll quality-related variation is given by

$$Q_t = \sum_{j=1}^{N} P_{q,t}\, Q_{t,j} \qquad \text{(XXXII)}$$

The granting body must provide for at least one indicator for each of the following areas:

- Average flow speed of travel;
- Availability of the infrastructure;
- Fluency at the toll booths;
- Surface;
- Dynamic updating of the information through variable message signs;
- Resting areas;
- The adoption of Intelligent Transportation Systems;
- The availability of connectivity systems, as radio signal coverage;
- The implementation of automated systems for monitoring the surface-status;
- The adoption of free-flow technology for the toll-collection;
- Customer satisfaction;
- The presence of guardrails;
- The presence of noise barriers.

5.3.4 The revenue sharing mechanism

Starting from the second regulatory period of the proposed toll-determination model, in case the effective variation in the traffic volumes is positive and above the predetermined threshold of 2%, an amount between 50%

and 100% - depending on the value of deviation, from 2% to 10% - of the annual extra-income, attributable to incorrect traffic estimation, will be recorded as figurative tariff, deducting the admissible costs for the following concession period. It is computed as the difference between the actual annual income and the one deriving from the ex-ante traffic volume estimation.

5.3.5 Other burdens

The concessionaire is obliged to pay to the legitimate authorities the following additional amounts:

- The annual concession rate;
- The integration to the rate, stated by Decree Law No 78/2009;
- The taxes fixed by Law;
- The supplementary burdens for the infrastructure adjustments, as established by Decree Law No 285/1992.

5.3.6 Additional toll-variations

The granting body is entitled to introduce variations, increasing or decreasing the integrated average unit charge, because of specific normative provisions.

In this case, the resulting toll-levels must conform with the following principles, contained in Decree Law No 201/2011:

- Productive efficiency in the management;

- Cost containment for users, companies, and customers;
- Transparency, equity, non-discrimination.

Prior their inclusion, the Authority evaluates the conformity of the proposed variations.

5.4 Monitoring

The Authority annually monitors the application of the toll-determination mechanism. Specifically, after the submission of Regulatory Financial Plan (the unified model the concessionaire drafts according with what defined by the Authority), the Authority checks the following requirements:

- The correct implementation of the price-cap mechanism;
- The equivalence between the net present value of the expected toll-revenues and the net present value of the expected admissible costs;
- The conformity of the potential figurative burdens;
- The respect of the admissibility principles.

5.5 The tariff modulations

Based on integrated average unit tariff, the concessionaire determines the toll-levels for each vehicle-class and motorway-typology. The tariff modulation depending on the vehicle class is applied according to the environmental impact. Moreover, additional modulations can be adopted, considering for instance a

more detailed vehicle and motorway classification, a daily differentiation, a time-frame articulation, or benefits for frequent users.

Moreover, the granting body and the concessionaire may agree on a toll-modulation that, keeping revenues constant, allows a greater harmony between the toll and the cost structure, incentivizes the intermodal traffic, and supports the users.

In any case, modulations must comply with the equity and non-discrimination principles.

6. AN EMPIRICAL ANALYSIS OF THE TECHNICAL PROGRESS, THE SCALE AND DENSITY ECONOMIES, AND THE PRODUCTIVITY LEVELS REACHED BY THE ITALIAN MOTORWAYS INDUSTRY

6.1 The information dataset

A unique dataset, virtually representing the entire industry, was constructed based on collected information covering the 1992-2017 period and concerning an overall number of 25 Italian motorway concessionaires.

The data have been retrieved inspecting several sources, including official reports, publications by AISCAT (the concessionaires' association), press articles, and others.

Relating to each concessionaire, the dataset contains:

- Balance sheet data, as cost categories, revenues, and profits;
- Characteristics of the activity, as length of the network, percentage of network with three lanes in each direction, and total number of km travelled; and
- Institutional characteristics, the private or public ownership.

Information on ownership mainly derive from the official reports of the concessionaires, integrated, in case of necessity, with the R&S directory, yearly published by the Mediobanca investment bank, and with the information provided by the web sites of the concessionaires.

Six concessionaires are excluded from the sample:

- Two of them run only tunnel sections (Gran San Bernardo and Monte Bianco);
- Strada dei Parchi (for the 2008-2017 period), Consorzio delle Autostrade Siciliane, and Autostrada Torino-Savona (for the 2008-2016 period, in

2017 the undertaking was acquired by Autostrada dei Fiori S.p.A.) for the failure in finding the official balance sheets of the companies;

- Autostrada Pedemontana S.p.A. because it started operating in 2015.

In addition, concessionaires included in the sample but entailing less observations because entered in the industry in following years are:

- Asti-Cuneo in 2010;
- Concessioni Autosradali Venete in 2010;
- Tangenziale Esterna in 2015;
- Società di progetto Brebemi in 2015.

Our sample is unbalanced as fourteen observations are missing (see Table A4), because three concessionaires started operations in 1993 or 1994, two of them merged in 2004 and two in 2017, and an overall number of seven years is uncovered by the collected data.

Regarding the estimation variables, the maintenance and the labour costs derive from the corresponding heading of official statements of the concessionaires (or from the auditors' notes), whereas other costs is the sum of the costs for materials (including energy, excluding the maintenance-related ones), services (different from maintenance), and depreciations of immaterial goods and soft capital (i.e. capital goods used in the operation of the motorways).

The variable-relative prices have been constructed by dividing each cost category (maintenance, other inputs and labour costs) by the main determinant

of these expenditures. Therefore, the maintenance price has been constructed dividing the maintenance costs by the number of km travelled, the other inputs price dividing the other input costs by the network length, and the labour price dividing by the average number of employees.

Moreover, the variable accounting for the three lane motorways, it represents the percentage of the network with three lanes in each direction. Costs and profits are deflated with the consumer price index to allow comparability over time.

Finally, two time-variant firm specific dummies were introduced, accounting for the ownership. The first dummy takes a value of 1 (0 otherwise) if the largest shareholder is a private firm or an individual for at least 6 months in the relevant year; the second one takes a value of 1 (0 otherwise) if most of the shares belongs to private firms or individuals for at least 6 months in the relevant year.

As suggested by the difference between the mean and the median value of the network, shown in Figure 14, the network is characterized by a main operator, Autostrade per l'Italia, controlling almost half of the network, and a host of relatively small concessionaires. The number of kilometres travelled reported in the table are in million km and the network in km. All figures refer to the entire sample of 508 observations.

Variables	Sum	Mean	Sd	Min	Median	Max
Totak km travelled	7.29e+11	1.47e+09	6.25e+09	32.00	2339.40	4.80e+10
Network	132745.40	261.31	606.71	20.00	113.30	2855.00
Three-lane network	39481.80	77.72	218.17	0	3.10	1224.80

Table 23, Statistics for the variables: total km travelled, network, three-lane network

The privatization process undertaken by the industry in the early 2000s is summarized in Table 24, together with the value of the dummy connected to the ownership of the majority of the shares of the concessionaires, over the entire period considered.

It is important to highlight in this section how the technical progress experienced by the industry, and shown in the following paragraphs, is strictly

Percentage of e-zpass equipped toll-booth

Year	Mean	Sd	N
1995	22.35	35.66	20
2003	98.33	7.45	20

Table 25, The adoption of the e-zpass

	THE DUMMY VARIABLE FOR THE MAJORITY OF THE SHARES		
Year	0	1	N
1992	16	1	17
1993	17	1	18
1994	17	3	20
1995	15	5	20
1996	15	5	20
1997	15	5	20
1998	14	6	20
1999	14	6	20
2000	8	12	20
2001	8	12	20
2002	8	12	20
2003	7	14	21
2004	7	13	20
2005	7	13	20
2006	7	13	20
2007	7	13	20
2008	5	12	17
2009	5	13	18
2010	6	13	19
2011	6	13	19
2012	6	13	19
2013	6	13	19
2014	6	13	19
2015	6	15	21
2016	6	15	21
2017	6	14	20
Total	240	268	508

Table 24, The private and public ownership, by year

related with the introduction of the e-zpass, allowing in the long run to a

reduction of the cost for the personnel cost. Figure 25 illustrates the massive adoption of the e-zpass by the concessionaires starting from 1995.

The statistics of other relevant variables are reported in the Table 26.

Variables	Sum	Mean	Sd	Min	Median	Max
Maintenance	7.54e+09	1.53e+07	7.51e+07	164.75	22147.19	9.14e+08
Personnel	8.22e+07	1.66e+07	5.60e+07	3328.57	27640.15	4.11e+08
Other costs	1.85e+10	3.74+e07	1.85e+08	2210.95	4.11e+08	1.65e+09
EBIT	1.65e+10	3.33e+07	1.49e+08	-265377	39319	1.35e+09

Table 26, Statistics of the cost variables for the maintenance, the personnel, and the other costs related to the motorway management, and for the EBIT

6.2 The selected estimation model

A long run total cost function was estimated for the operation of the motorway, consisting of three inputs (labour, maintenance and other inputs), one output (the number of km travelled), and one output characteristic (the network length). Moreover, a neutral technical progress, some hedonic (control) variables, reflecting the characteristics of the network, and a dummy representing the ownership were included in the computation.

The most general model estimated is the following translog specification:

$$\ln TC = \beta_0 + \sum_{j=o,l,m} \beta_j \ln p_j + \beta_y \ln y + \beta_n \ln n + \beta_t t + \beta_{own} own +$$

$$\beta_{kmtreco} kmtreco + \frac{1}{2}\sum_{j=o,l,m}\sum_{i=o,l,m} \beta_{j\_i} \ln p_j \ln p_i + \frac{1}{2}\sum_{h=y,n} \beta_{h_h} (\ln h)^2 +$$

$$\sum_{j=o,l,m}\sum_{h=y,n} \beta_{j\_h} \ln p_j \ln h + \frac{1}{2}\sum_{k=kmtreco} \beta_{k\_k} k^2 +$$

$$\sum_{j=o,l,m}\sum_{k=kmtreco} \beta_{k\_j} (\ln p_j)\, k + \sum_{h=y,n}\sum_{k=kmtreco} \beta_{k\_h} (\ln h) k +$$

$$\beta_{y\_n} \ln y \ln n + \varepsilon \qquad \text{(XXXII)}$$

Being:

- TC the total cost, i.e. sum of maintenance, labour and other costs.
- pm, pl, and po thr prices for maintenance, labour and other inputs, respectively, obtained dividing each cost category (maintenance, labour and other costs) by their main determinant (i.e. km travelled, average number of employees and network length);
- y is the total number of km travelled,
- n is the network length;
- t is a time trend (i.e. t = 1 when the observation year is 1992 and t = 26 when the observation year is 2017);
- Own is a dummy indicating whether the concessionaire is under private or public ownership; and
- Kmtreco is the percentage of the network with three lanes in each direction.

All variables are indexed i, t with i = 1, ..., 25 and t = 1992, . . . , 2017.

We estimate a system of equations composed by (XXXII) and the corresponding cost shares (derived via the Shephard's lemma) by using the SUR technique. To avoid singularity of the variance matrix of the errors, we dropped one cost share (the one for other inputs). We impose the usual restrictions stemming from symmetry of the Hessian matrix of price elasticities, from homogeneity of degree 1 in prices of the cost function and from cross equations symmetry. Furthermore, to ease the computation of elasticities, we standardize

all prices, the network variable, km travelled, hedonic variables, and total cost by some relevant percentile of their distribution (such as the median) so that first order coefficients are the elasticities evaluated at that percentile. To control for individual heterogeneity, we add to the total cost function equation (XXXII) individual (concessionaires) dummies, capturing time invariant unobserved heterogeneity which, if correlated with included regressors, would cause estimates to be inconsistent. Finally, we label the models with individual dummies amongst the regressors as fixed effects (FE, henceforth) models.

However, the inclusion of individual dummies may prevent the estimation of time invariant regressors and hampers precise estimation of regressors almost invariant, which is the case for most network characteristics.

To improve the accuracy of the results, as the measurement of scale economies, which heavily relies on network characteristics, in some models, individual dummies have been dropped from the total cost function equation.

6.3 The regression results

In studying the underlying industry technology, focus is addressed to the measurement of economies of scale and density, as well as on the rate of technical progress.

The scale elasticity is given by:

$$\varepsilon_S = \frac{1}{\varepsilon_y + \varepsilon_n} \qquad \text{(XXXIII)}$$

Where ε_y and ε_n represent the elasticity of total cost to output (kilometres travelled) and to network length, respectively. Thus, ε_s measures the inverse of the percentage increase in total cost due to a percentage increase in output *and* in the network length. A value above (below, respectively) 1 indicates increasing (decreasing) return to scale.

A second measure is *density elasticity*, defined as:

$$\varepsilon_d = \frac{1}{\varepsilon_y} \qquad \text{(XXXIV)}$$

being the inverse of the percentage increase in total cost due to a percentage increase in output, holding the network length fixed. A value above (below) 1, showing increasing (decreasing) returns to density, indicates that an increase in output induces a less-than-proportional increase in total costs.

The last important measure, for illustrating the characteristics of the underlying technology, is the yearly rate of technical progress, measured by:

$$\varepsilon_t = \frac{\partial \ln TC}{\partial t} \qquad \text{(XXXV)}$$

a negative (positive) value indicates technical progress (regress).

Table 27 reports our main results, columns (1), (2), (3) show those of the fixed effects (FE) models, the others the estimates of models without individual dummies.

Specifically, the first column reports the estimates of our basic model, non-including the ownership dummy, but providing for the concessionaire individual dummies. Coefficients of prices are positive, and highly significant. Since all the regressors have been standardized with their medians, the first order coefficients represent the elasticities evaluated at the sample medians. Economies of scale account for 1.13, the sizeable economies of density for 3.49, and the technological progress is in the order of 0.2% *per annum*.

This can be explained, as already mentioned in the previous paragraph, to the introduction of automated toll-collection systems. The coefficients for network length and total number of km travelled have the expected sign and are highly significant. The measure of density elasticity suggests that a 1% increase in traffic leads only to a 0.29% increase in total cost. The measure of scale elasticity illustrates instead that, a simultaneous increase in traffic *and* network accounting for 1%, there is a less than increase in total cost, in the order of 0.9%.

The ownership dummy is introduced in the estimation (2), for the FE model. The inclusion of the new variable leaves the price coefficients almost unchanged; the networks and the output coefficient are very similar relative to the previous models, with the exceptions that the technological progress is slightly less pronounced than before. Moreover, private-owned firms prove to be more productive than the public ones. Indeed, the ownership dummy is negative and very significant, showing that private concessionaires enjoy a cost advantage of approximately 4,5%.

Columns (3) and (5) report the estimation for the FE model, including the ownership dummy and differentiating between the public and the private technical progress, for years preceding 2004, when the privatization process almost arrested, and for years from 2004 to 2017, respectively. Columns (4) and (6) present the same structure but exclude the concessionaire individual dummies.

The main difference with the previous results for the FE model regards the sign and the value of the ownership dummy. In fact, in the FE model concerning the period preceding 2004, the dummy is positive and highly significant. On the other side, after 2004, the sign changes, becoming positive, showing an apparent cost disadvantage for the private owned-firms.

Regarding the private and the public trends, in the FE model, the public one resulted to be inferior, with the private one being significant (around 3%-5%) and negative for all the estimations reported.

The public trend results to be positive, showing a technical regression, in the FE model, whereas it is negative and significant for the estimations without the concessionaire individual dummies. Specifically, it is higher, in negative value, than the private one, before 2004, and lower after, even if still negative and close to the value of the private-owned concessionaires.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Ln network	0.590	0.581	0.558	0.252	0.545	0.602
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log km travelled	0.290	0.286	0.271	0.618	0.268	0.299
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log price labour	0.328	0.330	0.365	0.437 (0.000)	0.321	0.146
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)
Log price other	0.406	0.405	0.383	0.318 (0.000)	0.408	0.544
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)
Log price maintenance	0.267	0.266	0.252	0.246 (0.000)	0.270	0.310
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)
Ln network 2	0.0953	0.0821	0.110	0.181 (0.000)	0.0520	0.0358
	(0.000)	(0.000)	(0.000)		(0.033)	(0.0158)
Log km travelled 2	0.0638	0.0637	0.0636	0.163 (0.000)	0.0610	0.0158
	(0.000)	(0.000)	(0.000)		(0.000)	(0.183)
Log pl-network	0.0135	0.0149	0.0162	-0.0138	0.0231	0.0587
	(0.000)	(0.000)	(0.001)	(0.664)	(0.000)	(0.025
Log pother-network	0.111	0.110	0.109	0.0138	0.101	-0.00592
	(0.000)	(0.000)	(0.000)	(0.645)	(0.000)	(0.000)
Log pm-network	-0.124	-0.124	-0.125	-0.0000746	-0.124	-0.0528
	(0.000)	(0.000)	(0.000)	(0.998)	(0.000)	(0.109)
Log pl-km travelled	-0.0456	-0.0441	-0.0390	-0.00470	-0.0363	0.0714
	(0.000)	(0.000)	(0.000)	(0.824)	(0.000)	(0.000)
Log pother-km travelled	-0.0865	-0.0872	-0.0907	-0.0636	-0-0863	-0.109
	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)
Log pm-km travelled	0.132	0.131	0.130	0.0683	0.123	-0.0376
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.097)
Log network-km travelled	-0.119	-0.119	-0.121	-0.334	-0.122	-0.0395
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.248)
Log pother-pl	-0.0886	-0.0867	-0.0672	-0.0527	-0.0813	-0.0525
	(0.000)	(0.000)	(0.000)	(0.069)	(0.000)	(0.055)
Log pl-pm	-0.0455	-0.0437	-0.0362	-0.144	-0.0363	0.0637
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log pm-pother	-0.0874	-0.0883	-0.0930	0.0212	-0.0874	-0.109
	(0.000)	(0.000)	(0.000)	(0.292)	(0.000)	(0.000)
Log pl 2	0.0671	0.0652	0.0517	0.0984	0.0588	-0.00559
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.637)
Log pother 2	0.0880	0.0875	-0.0801	0.0518	0.0844	0.0806
	(0.000)	(0.000)	(0.000)	(0.271)	(0.000)	(0.000)
Log pm 2	0.0665	0.0660	0.0646	0.0614	0.0619	0.00224
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.037)
Trend	-0.00195	-0.000434	0.000527	-0.00865	0.00182	-0.00221
	(0.000)	(0.404)	(0.463)	(0.000)		(0.520)
Private trend			-0.00749	-0.00491	-0.00543	-0.00370
			(0.000)	(0.83)		(0.282)
Ownership dummy		-0.0446	-000346	0.0334	0.0496	0.00288
		(0.000)	(0.000)	(0.160)	(0.147)	(0.282)
_cons	-0.108	-0.0655	-0.0339	0.0674	-0.0818	-0.0956
	(0.001)	(0.000)	(0.425)	(0.000)		(0.110)

Table 27, The regression results

CONCLUDING REMARKS

The Italian motorway industry plays a vital role in the national economy and, presenting intrinsic monopoly features, needs an appropriate regulatory regime and a stable and certain legislative framework.

Recently, the sector has attracted higher attention, and the institution of the Regulatory Authority of Transport represents, in this regard, an important breakthrough.

As we have seen, concessionaires benefit from economies of scale and density, as well as an upward technical progress, different between private and public ones.

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