

Motorway provision and management in France: some lessons and perspectives

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Abstract:

Public authorities or infrastructure agencies in charge of motorway networks have to answer to questions such as: “should we build and run the motorways on our own or should we franchise them? If we franchise them, how should the concessions be designed?” This paper addresses these questions, mainly the second one; the first question will just be evoked in the conclusive part. The objective of the public authority is assumed to be the optimisation of global welfare in a framework of asymmetric information and uncertainty.

After having reviewed, through the history of French motorways, the main pertinent peculiarities of motorway projects, which are related to externalities, uncertainty and information asymmetry, we discuss some options for the provision and management of motorways in the framework of concession.

Issues of quality of services and of tariffs are considered both from a short-term and from a long-term perspective: quality of daily operations, maintenance and investment may interfere on different time scales. Contract design includes, explicitly or not, some rules on these time scales. These rules may directly apply to the quality of services (minimum standard requirements, long-term infrastructure development). Usually, rules governing tariffs include precise elements for the first year of operation, more or less rigid rules for periodic review of tariffs and, possibly, « bargaining » rules for exceptional events or long-term adaptation of the infrastructure. Both issues may interfere when incentive rules are introduced concerning, for instance, relaxation of tariff regulation or specific subsidy. Some impacts of allowing tariff modulation are discussed.

We then come back to uncertainties, checking how concession design may offer flexibility in order to deal with these uncertainties: who has more information on such uncertainty, ex-ante and ex-post, who may better control the uncertainty, and how does concession design allocate the burden of risks? Specificities of the concessionaire may play a role in this regard.

In the conclusive part, some qualitative hints are given on how the ideas of the paper may be used in practice and on the decision whether to franchise or not.

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Introduction

Motorways are one of the largest capital stocks of transportation infrastructure, and the extension of their networks is, in most countries, a salient feature of the past decades, and probably of the future ones. It is therefore important to try to optimize their provision and management, and this paper is an attempt to participate to this objective. The ambition of this contribution is to use historical long term experience, analyzed in the light of economic theory, and to draw suggestions and open some perspectives for the future. Instead of covering loosely a large geographical area, the choice has been to cover more in depth a limited area, France, with some incursions on other Western European continental countries. Of course, the lessons are limited to this experience, where and may possibly apply only in similar situations.

The first section of this paper presents a short history of French motorways provision, showing how the general framework has evolved from a situation where piecewise isolated links have been progressively integrated into a network, and how the concerns have changed with the growing importance of external factors. It analyzes these changes in terms of economic characteristics, namely the relative importance of uncertainty, externalities and network effects, and assesses how the political decisions have worked.

The second section uses these characteristics to make suggestions and recommendations on how to provide motorways. The main issues considered are the choice between a free motorway and a toll motorway, the geographical scope of a concession, and the architecture of the contract regarding toll regulation and incentives.

The third section suggests some possible directions for the future of toll provision, taking stock of the on-going technical changes in ICT (information and communication technologies) for broadening the scope of pertinence of a separation between infrastructure provision and operations, and asks for further historical analyses of other countries' experience.

History of French motorways

France has a long lasting experience both in motorway building and in motorway management, with special reference to concessions. As a matter of fact it has developed many specific organizational procedures, and lessons can be drawn for the future from this experience. The aim of this section, which draws on Fayard, Gaeta and Quinet (2005), is to provide some of these lessons looking into the evolution of the French motorway system in connection with economical and institutional changes.

Overall evolution

The motorways network in France amounts to 10 800 km of which 8 150 are toll motorways and the rest, 2 650 km, are toll free. The main free motorways are located in urban areas, while almost all intercity motorways are toll motorways. Related to the population or to the area, the density of this network is a bit above the European average. For the former 15 European countries, the figures were as follows in 2000:

Table 1- Motorway density in Europe (after Fayard 2005)

In km	France	Average EU15
Motorways per 1 000 km ²	18	16
Motorways per 1 000 000 inhabitants	161	138

This network has been built from 1960 according to the pace recorded in the following table:

Table 2 - Motorway network evolution (Fayard, Gaeta and Quinet 2005)

Year	Network motorway Length (km)	Of which toll motorways (km)
1960	170	10
1970	1 560	1 060
1980	5 010	3 730
1990	6 910	5 515
2005	10 800	8 150

These figures show a steady rate of implementation, such that the reader could think that a stable institutional framework must have been maintained throughout the whole period. In fact several changes have occurred, which are now described.

Institutional changes

1950-1970: public concession with isolated links

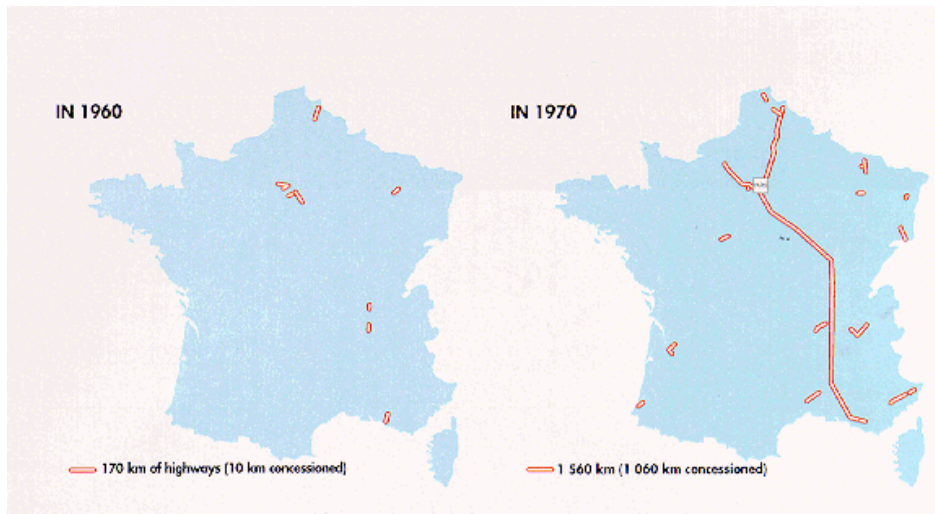
In the 1950s car-ownership began to increase rapidly. In order to cope with this growth, the Government sought to increase funds for roads. By 1951 it established a special dedicated road fund (FSIR), which was to receive a percentage of motor fuel tax receipts but competing budgetary pressures prevented the Government from funding the FSIR in full. Thus, in 1955 a law was passed to allow toll financing of motorways. Public control would be maintained by granting concessions without competition, and granting them only to a public company in which public interests should have a majority of shares: in fact, they had the totality of them. In this framework, five public companies were set up. Nevertheless, the initial concessions were for only short portions of motorways, of 50 to 100 kilometers. The Government provided initial financial assistance by guaranteeing the loans of the public firms and providing cash and advances which were fairly significant (averaging 30 to 40% of construction costs). Throughout the 1960s these public firms were little more than paper organizations, nothing more than the "false nose of the State" as a Minister said. They were in fact public services, and the relation with the Minister was quite a hierarchical one.

Besides, during the period of the 1960s, the links were isolated, without connection, as is shown by the following graph.

As a whole, the system designed for motorway development in this period coped with a sharp increase of traffic without too much budget funds. Indeed, traffic growth was a precious advantage when the public budget constraint was especially tight. Tolls received a good acceptance from the public opinion. Full privatization of motorways firms would not have got support from the political decision-makers. The tolls were explicitly fixed by the

administration at a level balancing the aim not to divert too much traffic towards the free highways and the objective to fund a sufficient part of the investment.

Graph 1- The network in 1960 and 1970



1970-1990: Private concession, new problems

At the end of the 1960s only 1,125 km of intercity motorways were in service, while the traffic was steadily increasing and congestion was growing. A reform was set up to boost the rhythm of motorway provision. Two means were used: (i) to allow private companies to compete for new concessions; and (ii) to strengthen the existing public firms in order to give them more autonomy and responsibility.

Between 1970 and 1973, four private toll road companies were awarded contracts for 300 to 500 km motorways each, after a competitive tendering. All four new concessionaires were consortia of major French public works companies. No investors were interested in investments with such a long payback period, and banks became involved more because they wanted to support contractors that they were linked with than because they wanted to invest. The Government was less generous with assistance for concessions granted in the 1970s than it had been in the 1960s. Nevertheless, significant financial aid, amounting to roughly about 50% of the total cost of the investment, stayed available to both private and public concessions. For example for the first private company, COFIROUTE, 10 % of the funds was covered by equity, 10 % by in kind advances from State, 65 % by State-guaranteed loans and 15 % by loans without guarantee, that is to say that 75 % of the funds was brought or backed by the Government.

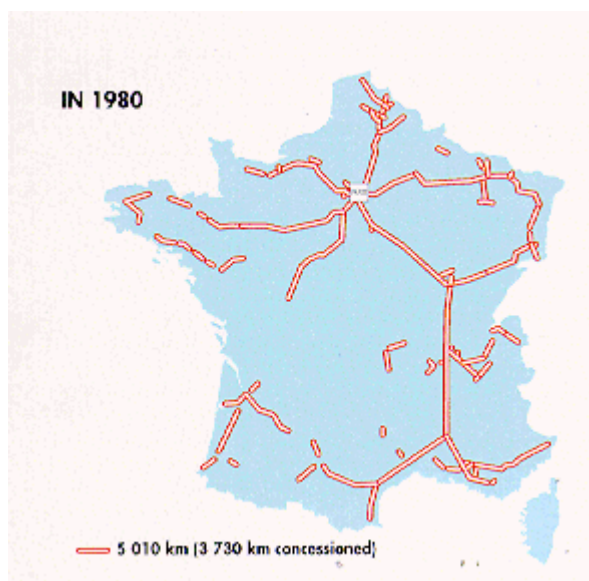
In the same time the historical public firms gained more independence. They created their own consultancy firm (previously, they used the consultancy services of the State) and their own maintenance services.

Comparisons of investment costs between private companies (in this special case, public work consortia) and public firms led to the conclusion that roughly the private costs were about 5 to 10% lower than cost of public firms. These figures may have been underestimated, as they did not take into consideration the changes in maintenance costs and the possible synergies

between investment and maintenance operations. Control of quality of services, which is often considered as a major point of franchises, did not prove to be a problem, by comparison with, for instance, railways. This point is due partly to the technical characteristics of the road transport, and perhaps also partly to the fact that the motorways firms, anticipating a huge development of future concessions, had to build their reputation.

Extensions of concessions were granted to the existing firms, without tendering, through cross-subsidization of new links by older segments which had become profitable over time. Moreover, the dates at which the older and more lucrative sections of the concessions expired would often be extended. During this period, tolls were regulated by the State (in fact the Ministry of Finance) and fixed yearly.

Graph 2- The network in 1980



At the beginning of the 1980s the motorway system faced serious problems, due to several reasons: the first one was the oil crisis, which induced in the same time the slackening of traffic growth, and an increase of investment costs. This increase was due, not to technical underestimations, but mainly to increases in economic factors such as the petrol price and the interest rates. Another and more important problem arose from large errors in traffic forecasts for the new concessions: some of them had been overestimated by 200%! An explanation of these errors, besides the changes in traffic growth, was that the new concessions were networks, with large network effects that were more difficult to analyze. The previous concessions dealt with isolated and rather short links, the traffic of which was easier to forecast, and the experience was more transferable from one case to another. It happened also that, faced to such events, the firms had no possibility to adapt their behaviour other than to change the tolls, a remedy which proved to be quite insufficient: there seemed to be not much room for commercial management initiative in the motorways business.

The State took over three out of the four private companies through mergers with the old public firms, which, having the revenues of an old and already extended network, suffered less from the new situation. It indemnified shareholders, which was a soft enforcement of the forfeiture clause. As a whole, the system proved to be subject to a soft budget constraint.

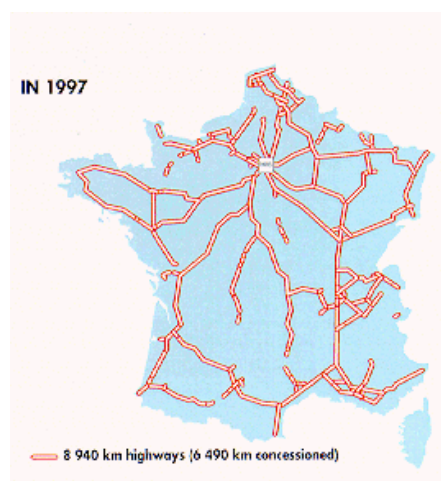
1990: more externality problems and more separation between the operator and the State

From the mid-1990s, new private concessions appeared, that were granted after tendering competition, on a non-recourse basis, especially in urban areas. The first intra-urban motorway was the Prado-Carénage tunnel inside Marseille (1993), connecting the center of the city to the eastern part of the agglomeration through a tunnel that already existed and had just to be reshaped. The tunnel was franchised to a private company, which runs it successfully. In Lyon, the TEO scheme (1997, about 10 km long) was not so successful. The toll motorway was auctioned and franchised to a private consortium, but in order to obtain its financial return, it levied a relatively high toll and needed also restrictive actions on the parallel and adjacent network so as to capture more traffic. After demonstrations and protestations of the users, the municipality cancelled the franchise at a great expense and operated the link by itself, with a much lower toll. Another urban toll link was built in 1998 in the Ile de France agglomeration (A14, between La Défense and Orgeval, about 20 km long), and it worked successfully. A toll motorway link (A86, about 20 km long), which will achieve the second ring road around Paris, is presently under construction.

It must be noted that these concessions, located in urban areas, raise new problems. Environmental concerns, which appeared progressively since the mid-1970s, are especially acute in these areas. The congestion in suburban motorways due to the incoming traffic spread in the urban area gives an example of the conflicts between profit maximization and collective surplus maximization. These concessions also gave rise to some traffic forecasting errors, for instance in the case of Prado-Carénage and, furthermore, TEO. But these symptoms are also growing in the interurban network, where the network effects are more sensitive, due to possible competition between motorways for route choice, and to complementarities between links.

Apart from this change in the exogenous environment, the concession became less and less close to the State. Since 1995, multi-year contracts for investment have been implemented. These contracts make a balance between investments in renewal and lane extension, on one hand, and toll increases, on the other hand. They offer a very good foresight to concessionaires for a five-year period. These five years contracts replaced the previous yearly command both of toll level and investments.

Graph 3- The network at the end of the nineties

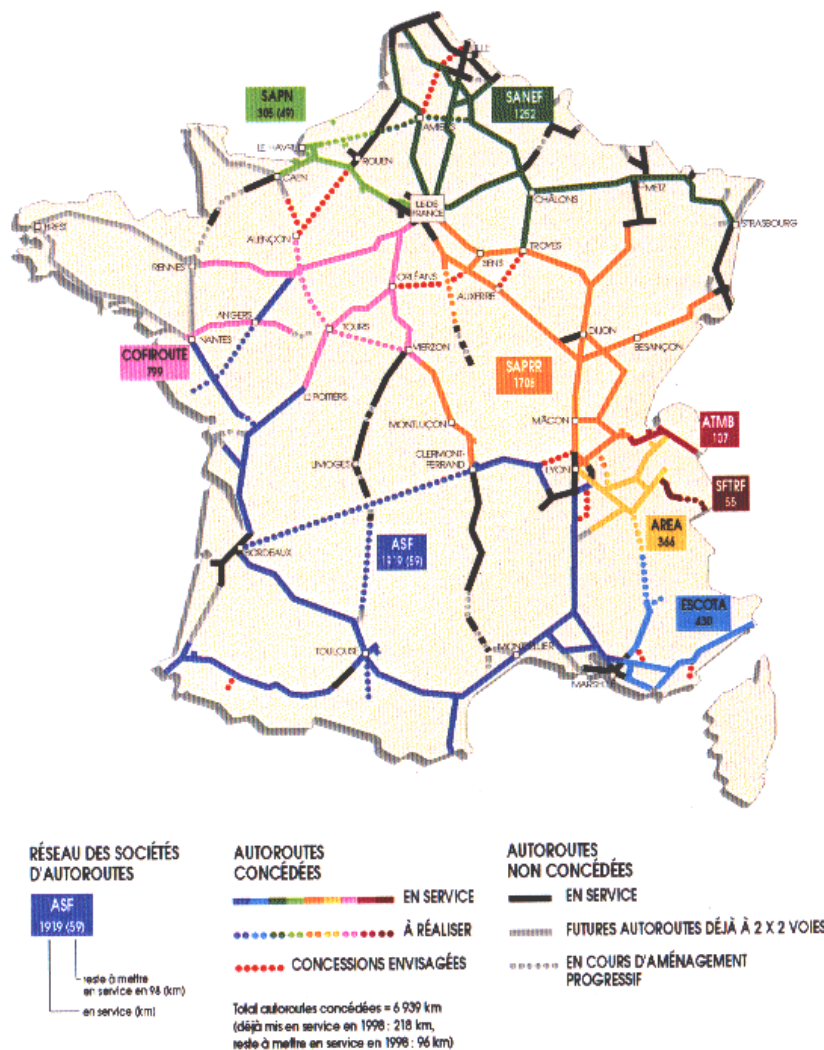


An interesting point is the respective physical connections between the different motorway concessions. They are indicated in the Graph 4 below. Each concessionaire has been attributed by the public authority a distinct area of the country. This feature generates some moderate economies of scale in maintenance and operations. But on the ground of demand management, it appears too that there is not much competition between different firms, more often complementarities (case of Paris-Bordeaux for instance), and that competitive links are predominantly located inside the same firm (case of Paris-Lyon).

Graph 4 the geographical areas of the concessionaires

Le réseau des sociétés concessionnaires

Juin 1998



Without appropriate regulation, the outcome of such a situation would be a strong monopoly power, with double marginalization on adjacent complement links. The regulation should be especially cautious about this point, all the more when concessionaires get privatized.

More recently, the toll motorway policy has experienced important changes in order to keep in line with the European Directives and their general orientation towards competition and efficiency. First, from now on, concessions are granted after a public competition process and are no more directly backed by collateral existing motorways. Secondly the accounting regime of the present concessions has been modified so as to be more in line with the common rule (the core question was the depreciation process), and the State gave up the guarantee for liabilities to existing concessions. As a compensation, the duration of the concessions was increased. As a consequence (linear depreciation on a longer period of time), the companies, without any change in their cash flows, have produced positive results, paid income tax and distributed dividends.

The main public motorway companies were consolidated into three main groups in order to gain in terms of geographical coherence and financial viability. In 2002, they were introduced on Euronext for two of them, and ended up to be privatized through an auction process. In the same time, the motorway firms adopted a more aggressive commercial policy, based on tariff differentiation (discount fares, season tickets, subsidies from local authorities for discount rates to the local users ...). In a word, the motorway system is more and more transforming into the textbook system of concessions regulated by the State and aiming at maximizing their profit through the usual devices of private firms. This last evolution is too recent to be assessed. A hint: the auction process, which was deemed to bring about 12 billion Euros to the State, brought in fact 15 billion. The difference may represent the gain in cost efficiency and demand management that the auctioneers hope to achieve compared to the previous standards. It may also represent the hope that public regulation will not be so efficient for controlling profit growths.

As a whole, French motorways policy has experienced important changes during the past fifty years. The network has evolved from a juxtaposition of isolated links to a fully connected and integrated network. At the beginning, the management was fully public, with a hierarchical organization the executive of which was the head of the Ministry of Transport. Gradually this type of management evolved towards an organization where independent and private concessionaires are chosen through a bidding process and operate through a long-term contract with the Ministry of Transport. Nevertheless, it appears that these contracts show a high degree of incompleteness, with, for instance, a toll regulation renegotiated every 5 years.

Some interpretations through economic analysis

Conclusions can be drawn from this short historical review on the grounds of economic analysis.

Clearly, the system of toll motorway had, and still has, a financial purpose. The question was to raise funds above the ordinary public budget. Tolls were disconnected from the marginal cost that would induce efficiency. In fact calculation show that, for intercity motorways, tolls were, and still are, much above the marginal cost of infrastructure, which in fact was paid already once through the mere petrol taxes. The situation is reversed in urban areas, where congestion marginal costs are very high (Roy 2001).

Tolls have also effects on investment costs: several comparisons show that a toll motorway is about 10 to 20% more expensive than a free motorway, the difference being due to toll booths construction and operation, and to interchanges which are more costly. There is also a difference between public and private investment and maintenance costs, about 5 to 10% in favour of private costs.

A fact appears clearly from the French experience, which is confirmed by many other records: motorway planning exhibits many uncertainties, the most important of which are related to traffic forecasts (see for instance Flyvberg et al (2006)). Uncertainty on costs exists too, but the collective and individual experience of firms, in general, allows limiting this risk more effectively than for traffic forecasts.

Information asymmetry between the operator and the regulator exists, but to a moderate extent, at least ex-ante. It even sometimes happens that the asymmetry goes the reverse direction. In France for instance, at the period of the first private concessions, in the 1970s, the public administration had a much better appraisal of traffic forecasts than the competitors (things have turned to the usual direction afterwards).

Ex post, once the concession has been granted, the asymmetry information is much in favor of the concessionaire, who has a better knowledge of maintenance and investment costs, and has also a better knowledge of operational traffic management conditions. Incentives for the concessionaire to get precise information on traffics appear naturally, for instance, in order to optimize the toll booths operations and the organization of maintenance operations.

Technical quality of the infrastructure seems rather easy to assess by the regulator; visual inspection and technical measures are easy and reliable in the highway sector.

Investment in motorways is highly specific. Once achieved, it is not possible to change the products; the single possibility is to act on tolls, and the effectiveness of this tool is limited. No business plan can reverse the course of a structurally unprofitable concession, as shown by the examples of bankruptcy experienced in the late 1970s.

Another characteristic of motorways is that motorways generate congestion externalities, both internal (congestion on the motorway) and external (congestion on other links of the network). These effects induce substitution or complementarities between each link and the adjacent links, whether in complicated networks such as urban systems or in intercity motorways as soon as the links become connected into a network, as happened in France after 1980. Regulation should take account of this fact.

A few lessons on how to franchise motorways, and some perspectives

Let us try, in the light of the previous considerations, to draw conclusions on how to improve motorways provision, being well aware that these suggestions are partial as the experience upon which they are based is limited to just one country. Let us consider the following situation, where a public authority or an infrastructure agency has to build a motorway. Should it build and run the motorway on its own or should it franchise it? If it franchises it, how should the concession be designed? Let us leave the answer to the first one – to franchise or not - to the conclusive section, and deal now with the second one: how to franchise? For the purpose of presentation, we distinguish first the problems of general design of the concession and bidding, then the questions of regulation once the concession has been granted.

General Design of the concession

Geographical scope

Road congestion creates externalities between the traffic of the motorway and the traffic of the neighbouring links, whether they are complements (for instance the motorway links at the end of the motorway) or substitutes (a parallel road).

These externalities induce consequences on the collective efficiency level achieved by a profit-maximising operator. The complement situations, for instance, the case of adjacent links, may lead to double marginalisation if the two links are operated by two different operators, each one of them adopting monopoly-like pricing strategies.

The situation of substitute links, the case of parallel competing links between the same origin and the same destination, is different³. Competition between parallel motorways decreases the difference between the optimal charge and the monopoly charge.

The use of this result in real network situations must be qualified. Except in some urban situations, it rarely happens in Europe that two - or more than two - parallel roads bear traffic joining one origin and one destination: the traffic on one road comes from many origins and goes to many destinations. Generally speaking, the major part of the traffic borne by each motorway is short distance traffic (less than two hundred kilometres). The French legal principle stating that “any toll motorway should have a free alternative” can be seen as a market power regulation principle, but it was moreover a principle aiming at facilitating public acceptance of tolls. This principle has led to many discussions and it does not seem convincing to some authors, on grounds of over-investment particularly.

These considerations show, first, that the control of market power of the concession is necessary; secondly, that in order to decrease the gap between the objectives of the concession and the social objective, it is preferable to have complementary (adjacent) links provided by the same concession; and, thirdly, that the existence of competing links operated by different concessions is favourable to the implementation of social objectives.

Therefore, it might be worth considering that the franchise’s network covers an area such that, in relation to this sub-network, the rest of the network has a minimum of complementary links and a maximum of substitute links. Of course, this kind of design also has to take into account the financial viability of the sub-network. The least these conditions are fulfilled, the more cautious should be the regulation.

Let us note that this vision supposes a long term foresight of network development, and that it contradicts the usual financial purpose of concession design, which focuses on minimizing the financial support from public authorities at the scale of successive functional links.

Bidding conditions

Besides the cost uncertainty encountered in some specific local conditions, the main question in this field is the uncertainty on traffic forecasts. Some authors argue that, since the traditional auction mechanisms used for awarding concession contracts imply that traffic uncertainty translates into revenue uncertainty, endogenous duration contracts should be used,

³ Engel, Fischer and Galetovicz, 2004. See also De Palma and Lindsey (2000) and de Palma and Lindsey (2002)

where firms would be invited to submit offers with claims for total revenue. The mechanism reassures the firm that its declared costs will be covered, and that it will obtain the desired revenue, therefore the risk premium of the concessionaire is reduced. However, possible side effects, on cost reduction efforts, bidding strategies or other, have to be controlled by the public authority, and we lack long-term experience of such contracts.

Another uncertainty arises during the concession. Motorways concessions are long-lasting, generally 20 to 40 years. Toll regulation can therefore take several forms: either the contractual rules are fixed rigidly for the whole length of the contract, and they will almost surely not be adapted in some future⁴; or the contract sets up rules for a shorter period, entailing successive renegotiations. Concession contracts are therefore by nature incomplete contracts, which mean that they cannot include highly powered incentive mechanisms. Empirical studies (Athias, Saussier 2006) indicate that contracts for concessions with high traffic uncertainty are more likely to be flexible.

Regulation during the concession

We will assume that the objective of the concession regulator is global welfare maximisation. In practice, this is not always the case; for instance, the financial public goal may become predominant. This may be the case when public companies return good dividends to the State in a situation of high public deficit, or when short-term reduction of public debt puts a high pressure on the conditions surrounding the concession redefinition preceding the privatisation of a motorway company (see Greco and Ragazzi, 2005).

Tariff regulation

Toll regulation is needed in order to avoid market power from the concession, even if this market power is reduced by the network structure through the presence of competing substitute links. This toll regulation could be implemented through a price-cap⁵ which could leave the risk to the concession, once the traffic risk is covered by the endogenous duration device and the risk on costs is estimated to be rather low. This price-cap should be understood as an average price-cap, leaving open the possibility of varying tolls over time in order to cope with peak traffic loads.

Unfortunately, there is information asymmetry on the real time operations and the regulator is in a bad position to impose optimal peak period tariffs. For this goal, it is not sufficient to regulate average prices, leaving to the concessionaire the possibility of modulating the tariffs according to the time. It may be shown that under this constraint, a concessionaire aiming at maximising its profit would not set up tolls according to the congestion charging system⁶. Information on traffic congestion is more easily available (for example, through drivers'

⁴ the experience shows that contracts of this type usually never go to their end without breach

⁵ Incentives theory indicates that, through price-cap regulation, even if the incentive scheme is highly powered, it is not the optimal one, and that letting a concessionaire choose from a menu of contracts should help to reveal part of its information and to determine a more optimal scheme. Nevertheless, we will proceed from now on using the term « price-cap » in order to simplify, since we will try to go more deeply into more specific issues, and because this simple scheme is used very often.

⁶ Depending on the values of the price elasticities, it may even happen that the concessionaire lowers the tolls at peak hours.

complaints or data from inductance loops under the road) and less costly to gather for the regulator than the information needed for direct implementation of a peak pricing regulation.

Therefore, the solution should rather be to impose a minimum quality of service level (for instance a minimum speed), to be achieved through toll modulation. This is done using scheduled tolls on State Route 91 in Riverside County, California, and Highway 407 in Toronto. And it is done using responsive (real-time) tolling on Interstate 15 in San Diego County, California. The multidimensional nature of such service levels (time, network, segments of demand), and the difficulty of defining and measuring them, imply that the public authority should take great care in such a regulation: the flexibility left to the concessionaire should not become a blank cheque and should not induce super-profits for the concessionaire. From this point of view the experience of SR 91 leads to some doubts on the possibility of a proper regulation.

Some mistrust appears sometimes explicitly about risks of abuse of tariff modulation freedom, on competition rule grounds. For instance, in the new Eurovignette directive, the tariff rebates for heavy goods vehicles are rigidly limited to 13%. The public objectives of balanced competition conditions, on one hand, and of finely tuned tariff modulation, on the other hand, may indeed become conflicting.

Other concerns about the possibility of unacceptable profit levels appear in some recent concessions. Such is the case in France, where the State has the (theoretical) possibility of ending the concession contract prematurely, with payment of a premature ending penalty, in case the cumulated revenues of the concessionaire exceed some threshold. The precise rules defining the penalty level could deserve more attention: in France, the penalty is supposed to fully compensate the concessionaire for expected actualized profits, up to the end of the original concession, under current conditions at the time of the decision. But, if high profits result from an abuse of market power that the regulator wants to stop, why should the penalty compensate the concessionaire on the basis of the future consequences of this abuse ? Such a rule does not seem to be an efficient incentive for limiting such risks of abuse.

Toll regulation concerns about toll discrimination will get more and more importance in the future, under the pressure of the development of new technologies. Right now, most tariffs structures consider a price per section of the motorway. But progressively the concessionaire is able to get more and more precise information on its customers, on individual bases: this raises the question of the limits of price discrimination. Discrimination may be used for congestion regulation, for re-distributive and other public goals, but it does not coincide with the discrimination aiming at profit maximisation. This problem is accentuated by the problem of information asymmetry, which makes public regulation more difficult.

Regulation of the quality of service

Besides the time modulation intended to master congestion, how is it possible to induce the concessionaire to provide a good technical quality of service (smoothness of the road surface, speed of reaction to accidents)? Let us note that the interest of the concessionaire looking after profit maximisation is to provide the right quality of service from the welfare point of view, provided that some realistic assumptions are satisfied⁷.

⁷ see Tirole (1988) or Quinet and Vickerman (2004)

In practice, some elements may not be observable by the user or may even be resented by him, for instance, preventive maintenance. In these cases, the price regulation should include a bonus related to the quality of service in order to allow the concessionaire the amount of money compensating its expenses for this purpose. This mechanism is used in Italy and Spain. It raises concerns about the measurement of quality level and/or of quality investment (see Muren 2000)).

Efficient investment incentives

Generally speaking, the infrastructure manager has no decision to take regarding heavy investments, which are decided by the public authority. It is nevertheless useful to have a look at the inducements to invest for the infrastructure manager as, first, he may have many small investments to decide on (widening a section, creating a new interchange), and, secondly, he may influence the decision of the public authority through lobbying.

Let us first note that, since the public authority and the concessionaire do not have the same goals, the final effect is not clear. The time of implementation in terms of financial optimisation is often later than the time of implementation in terms of welfare considerations. But if there were some form of competition between possible concessionaires, the time of implementation would be advanced up to the time when the benefit of the motorway is zero. It follows that the regulator, who controls the implementation date, may be subject to pressures from potential concessionaires to advance this date, and may advance this date if he is captured. The outcome of these two opposite effects is not clear. Furthermore, in the case of a simple rate of return regulation⁸, the Averch-Johnson effect leads to over-investment.

Additionally, in the framework of the short-run marginal social cost pricing, the concessionaire has a strong incentive to under-invest, especially in the framework of the short term congestion management mentioned above, where a minimal quality of service is fixed and is reached through tariff modulation. To avoid this mismatch, a suggestion could be, in the framework of time modulation induced by this management of demand, to fix a threshold for tariff. The revenue collected above this threshold would be sent to a fund managed by a public authority, in order to remove the manager's incentives to develop congestion and to reduce his incentives for unduly postponing investment.

This design might be very sensitive, for instance, to the level chosen for the price-cap on average tariff or to the conditions set for the end of the contract. The dynamic effects of such a design would need to be analysed in more depth.

Sustainable development concerns

Whenever motorway companies have high interaction issues with their environment (motorway enlargement or network development projects, for instance), they are likely to be careful about external concerns beyond their traffic revenue concerns⁹. Indeed, they wish to be in a favourable negotiation position in the future. Some considerations of sustainability

⁸ A regulation where the regulator imposes an upper bound on the firm's realized rate of return on its physical capital. This type of regulation may not capture the whole flavor of rate of return regulation. See Guthrie (2005) for a more elaborate concept where the regulation sets the prices for all of the goods and services provided by the regulated firm.

⁹ at least about the concerns that are important for the main lobbies

may also appear important directly for traffic revenue concerns: a bad safety record, for instance, could be a bad signal for motorway users, and bad news for traffic revenues.

On the opposite, a purely financially oriented motorway company experiencing low elasticity demand and limited interactions, would be likely to pay much less attention to external and long-term concerns. Of course, public companies are more likely to internalise such concerns. But they may become privatised. Similarly, a private company pursuing a sustainable development policy may change rapidly, through a take-over or a change in the orientations given by its shareholders¹⁰.

Therefore, a public authority motivated by sustainable development issues should include not only regulatory instruments such as noise level norms, but also specific contractual rules for sustainable development enforcement. Among these rules, obligations of reporting on environmental topics, with precise indicators, would converge with the recurrent regulation concern of reducing the asymmetry of information between the regulator and the concessionaire.

Risk and uncertainty

We will focus here on the uncertainty on traffic levels. We have already seen that some concession designs may reduce this uncertainty or, more correctly, its consequences: the endogenous duration of the contract, for instance. But even with more usual concession designs, the conditions surrounding the procurement process may have predominant importance.

Let us take the example of the French network: up to the 1990s, the traffic uncertainty was, schematically, secured by the stable revenues of existing links operated by the concessionaire. In practice, the main motorway companies still have this strategic advantage, compared to brand-new companies. The difference is now that the (financial) management of risks may be offered through other means than existing toll network.

For instance, a major company totally external to the motorway sector may find interesting to diversify its risks in the motorway sector. The trends in motorway traffic increases, that are considered to be relatively robust, at least until the recent boost in oil prices, may be quite attractive.

Some other types of risk management may be theoretically imagined. For instance, one may think of a kind of national or supranational insurance fund that could balance the individual project risks on a more global level. Each concessionaire would pay for externalising part or its risk. Such a mechanism would suppose that the traffic forecasts for motorways are not too biased as an average. This seems to be the case, contrarily to some other transport modes, according to some studies (Flyvbjerg et al, 2006). Such a mechanism may help reducing the strategic disadvantage of small companies compared to big companies, as regards activity risk.

¹⁰ It will be interesting to observe how the actions related to sustainable development evolve in the privatised motorway companies, or after some take-overs.

This disadvantage may also be reduced, at the procurement stage, by their respective attitudes towards risk: a small company may be more risk-taking, especially if getting the concession is vital for her. Such a situation may accentuate the usual “winner’s curse”, which states that the winner of an auction may be likely to have made too low an estimation of its risks, compared to the price it has accepted to pay. This observation raises the concern of “reasonable bidding” for concession procurement: a public regulator will always bear a residual risk that the concessionaire selected is not able to comply with its obligations.

Let us note also that integration of activities within companies may offer new opportunities of risk management. For instance, the concessionaire of the Millau viaduct has financed its project in two steps: the construction phase was covered by equity, allowing to negotiate under much better conditions a long-term re-financing on the financial market, once the viaduct is constructed. This was possible because the concessionaire felt confident in mastering the construction risks, leaving only residual risk to the financial market, with a much lower risk premium.

Conclusive remarks

This historical perspective of French motorways network evolution and concession devices has allowed stress the importance of several features of motorways provision, particularly:

- uncertainty on traffic forecasts
- externalities both out of the system (environment) and inside the system (congestion externalities with substitute or complement links), creating a gap between the concessionaire objective (profit maximization) and the regulator objective (welfare maximization)
- difficulty of co-ordinating the operations of the motorway in order to optimise the real time operation of the whole network
- long duration of contracts, making complete contractualisation almost impossible, and implying low powered incentives.

In order to cope with these problems, suggestions are made to consider the possibility of endogenous duration, tariff regulation being reviewed after periods of about 5 years, allowing for time modulation but imposing a minimal quality of service, for instance a minimum speed level. The extra tariff, needed for achieving a pre-determined level of congestion whenever pricing constraints are binding, would go to a fund managed by the public authority and not by the concessionaire. A bonus on the price-cap should be possible, depending on the technical quality of the service provided. The geographical area of each concession should encompass most of the complement links, and the least of substitute links.

These considerations lead to conclusions about the upstream choice of the public authorities between public and private management, both in a general way and in relation to French policy.

The choice between concession and direct implementation depends on several considerations. In REVENUE D2 (2004), they are synthesized in four categories:

1. the shortage of public funds, summarized by the *cost of public funds* in the case of public funding
2. the difference in risk appraisal and management between public and private systems, summarized by the *risk premium* in the case of private finance
3. *the gain in cost efficiency* (both for infrastructure construction and maintenance) in the case of concession
4. the *quality of regulation*, i.e. the intensity of convergence that can be achieved between the private objectives of the concessionaire and the public objectives of the regulator.

The issues presented at the beginning of this section are related to the fourth item, the quality of regulation of the concession. Whenever the first three factors are equal, the choice between doing directly and franchising depends on the magnitude of the above mentioned issues.

It appears that the momentum of history tends to increase their magnitude:

- due to the slackening and growing uncertainty of traffic growth (resulting both from autonomous factors such as the slackening of economic growth and generalization of car use, and from policy factors such as the actions against global warming), the uncertainty of traffic forecasts is increasing
- due to the growing concerns about environment and to the increasing network effects, the gap between the concessionaire objectives and the regulator objectives are increasing
- the traffic growth will increase congestion and make short term regulation more stringent. This point is especially relevant for urban and sub-urban areas.

In such cases, the solution of motorways links built and operated through a classical concession process should be questioned and balanced with other possibilities giving more weight to the public management. An extreme opposite solution would be that the public service builds and operates the network.

This solution may be considered too extreme, as it cancels the advantages of private management in terms of cost and risk management. In that case, an intermediate solution would be to build and operate through a concession process, the concessionaire being rewarded, not by the revenues of the charging system, but by a mix of shadow tolls and fees linked to the achievement of some pre-determined travel time goal. Monitoring would be made possible through the use of New Information and Communication Technologies (NICT). Another possibility would be that the infrastructure be built and maintained by the public authority, while the toll management would be sub-contracted to a private operator, who should not be rewarded by the revenues of the charging system, but by a fee linked to the achievement of some pre-determined travel time goal. It may be deemed that this kind of arrangement should gain increasing interest with the development of congestion charges and the increasing use of the NICT.

If we now go back to the case of France, the paradox in this case is that while the motorways policy has steadily shifted from public to private management, the analysis of factual evolution would tend to favour the opposite evolution, unless top-quality regulation can be achieved. This observation should lead this country to put more pressure on the quality of regulation and adaptation of the concessions.

It is clear that these considerations would need to be extended and supported by other historical experiences, in order to check if they could be applied to more general situations. The authors hope that they will generate interest in confrontations of international and historical contexts and varied points of view.

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