

## Motorway Provision and Management in France: Analyses and Policy Issues

Alain Fayard · David Meunier · Emile Quinet

Published online: 15 December 2009  
© Springer Science+Business Media, LLC 2009

**Abstract** Motorways are one of the largest capital stocks of transportation infrastructure. It is therefore important to try to optimize their provision and management. This paper contributes to this goal by analysing France's historical long term experience through the prism of economic theory, and by offering suggestions and perspectives for the future. The first section presents a short history of motorway provision in France. It shows how the general framework evolved from isolated links to an integrated network. It discusses how concerns have changed with the growing importance of external factors; these changes are analysed in terms of economic characteristics, namely the relative importance of uncertainty, externalities and network effects. Finally, it assesses how the political decisions have had a major influence, mainly through the privatisation process and through changes in regulations. The second section uses these characteristics to make suggestions and recommendations on how to provide motorways. The main issues considered are the scope of a concession, and the architecture of the contract regarding toll regulation

---

A. Fayard  
General Directorate for Roads, Paris, France  
e-mail: alain.fayard@laposte.net

D. Meunier  
Université Paris-Est, Laboratoire Ville Mobilité Transport, UMR T9403,  
Ecole des Ponts ParisTech-INRETS-UPÉMLV, Champs/Marne, France  
e-mail: david.meunier@enpc.fr

E. Quinet  
Ecole Nationale des Ponts et Chaussées, Paris, France

E. Quinet (✉)  
PSE-Ecole des Ponts ParisTech, 48 boulevard Jourdan, 75014 Paris, France  
e-mail: quinet@enpc.fr

and incentives. Hints about possible future evolutions are presented too, concerning the choice between concession and public provision of motorways, and concerning the separation between infrastructure provision and management. The third section concludes by suggesting some research tracks that may help improving international knowledge through comparison between countries.

**Keywords** Motorways · Infrastructure · Public private financing · Regulation · Infrastructure charges · Quality of service

Motorways<sup>1</sup> are one of the largest capital stocks of transportation infrastructure. In past decades the extension of these networks has been a salient feature in most countries, and it will probably continue to be so. It is therefore important to try to optimize their provision and management. This paper contributes to this goal by analysing France's historical long term experience through the prism of economic theory, and by offering suggestions and perspectives for the future. While it covers a limited area (France with some incursions into Western European and North American countries), the treatment is more in-depth than can be achieved by covering a large geographical area. Of course, the lessons are limited to this experience and they may, possibly, apply only in similar situations.

The first section of this paper presents a short history of motorway provision in France. It shows how the general framework evolved from initially isolated links to a progressive integration into a network. It discusses how concerns have changed with the growing importance of external factors; these changes are analysed in terms of economic characteristics, namely the relative importance of uncertainty, externalities and network effects. Finally, it assesses how the political decisions have had a major influence, mainly through the privatisation process and through changes in regulations.

The second section uses these characteristics to make suggestions and recommendations on how to provide motorways. The main issues considered are the scope of a concession, and the architecture of the contract regarding toll regulation and incentives. Hints about possible future evolutions are presented too; these include the modalities of choice between concession and public provision of motorways, and they include the effect of the on-going technical changes in ICT (Information and Communication Technologies) on separating infrastructure provision from operations. The third section concludes.

## 1 History of French motorways

France has a long experience both in motorway building and in motorway management, especially as regards concessions. As a matter of fact, it has developed many organisational procedures, and its use of concessions has evolved. From this

---

<sup>1</sup> In this paper the word "motorway" has the European English meaning, i.e. "A road specially designed and built for motor traffic, which does not serve properties bordering on it, with separated carriageways for the two directions of traffic, which does not cross at level with any road or motorway and is reserved for specific categories of road motor vehicles" (World road association-PIARC dictionary).

extensive experience, lessons for the future can be drawn. The aim of this section, which draws on Fayard et al. (2005), is to provide some of these analyses by looking at the evolution of the French motorway system in connection with economic and institutional changes.

### 1.1 Overall evolution

The motorway network in France amounts to 10,800 km of which 8,150 are tolled. The main free motorways are located in urban, semi-urban or landlocked areas, while almost all intercity motorways charge toll. Based on either population or area, the density of France's network is a bit above the European average. For the former 15 European countries, the figures for 2000 are given in Table 1.

This network has been built since 1960 according to the pace recorded in Table 2.

While these figures show a steady rate of implementation, the reader should not think that a stable institutional framework has been maintained throughout the whole period. In fact several changes have occurred, which are now described.

### 1.2 Institutional changes

#### 1.2.1 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 had established a special dedicated road fund (FSIR) that was to receive a percentage of the motor fuel tax receipts, but competing budgetary pressures prevented the Government from funding the FSIR in full. Thus, in 1955 a law was passed allowing the toll financing of motorways. Public control was maintained by granting concessions, without any competitive process, to public companies in which public interests had all the shares. In this framework, five public companies were set up. Nevertheless, the initial concessions were for only short portions of motorways, of 50 to 100 km. The Government provided initial financial assistance by guaranteeing the loans of the public firms and providing cash and advances that were fairly significant (averaging 30% to 40% of construction costs). Throughout the 1960s these public firms were little more than paper organisations. At this stage their main goals were to make tolls acceptable to users, to earmark these new resources and to provide a better flexibility in project management than in the government's financial and administrative framework. In fact the equity was virtually nonexistent (e.g. 1 million French francs, i.e. roughly 150,000€), so loans had to be guaranteed. The staff was limited to the chairperson and toll receivers. Construction engineering and

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

In km	France	Average EU15
Motorways per 1,000 km <sup>2</sup>	18	16
Motorways per 1,000,000 inhabitants	161	138

**Table 2** Motorway network evolution (Fayard et al. 2005)

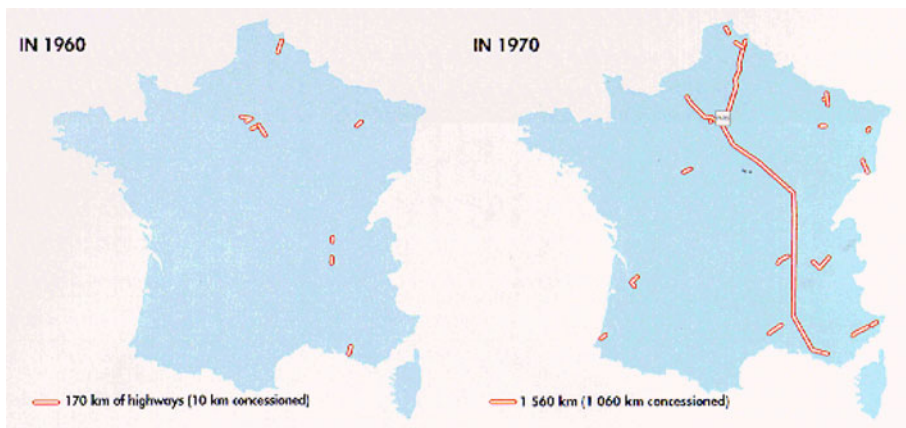
Year	Network motorway length (km)	Of which toll motorways (km)
1960	170	10
1970	1,560	1,060
1980	5,010	3,730
1990	6,910	5,515
2005	10,800	8,150

operation were provided by government staff and paid back to the government by the motorway companies. Concession companies were commercial registered firms but fully owned by public authorities; they were a tool of the general infrastructure policy as also was the government owned national railway company. They were in fact public services, and the relation to the Minister was hierarchical.

The tolls were explicitly fixed by the administration at a level that would fund a significant part of the investment while not diverting too much traffic towards the free highways (Quinet 1998). As a whole, the system coped with a sharp increase in traffic without taking too much public money. Indeed, it had a major advantage in that it could deal with traffic growth and even benefit from it, when the public budget constraint was especially tight. During the 1960s, the links were isolated, without connection, as is shown by Fig. 1. Although tolls were accepted by the public, full privatisation of the motorway firms would not have got support from the political decision-makers.

Two features of the French system have endured:

- The concessions were, and still are, designed on the Build Operate Transfer (BOT) scheme: the concessionaire has to build and operate the motorway and, at the end of the concession, transfer management of the motorway to the State, which is the owner of the investment from the start.

**Fig. 1** The network in 1960 and 1970

- The decision to build a link is, and has always been, made by the State. As in every country, it is motivated by classical welfare concerns. These are estimated through economic return, public finance concerns and constraints, regional balanced development and equity issues, and politics.

In the framework of these permanent features, several changes happened through the years.

### 1.2.2 1970–1990: Private concession, new problems

At the end of the 1960s, only 1,125 km of intercity motorways and 435 km of urban motorways were in service, traffic was steadily increasing and congestion was growing. A reform was set up to accelerate motorway provision. Two means were used: (a) to allow private companies to compete for new concessions; and (b) to strengthen the existing public firms in order to give them more autonomy and responsibility.

Between 1970 and 1973, after a competitive tendering, four private toll road companies were awarded contracts for stretches of 300 to 500 km of motorways each. 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 rather 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 about 50% of the total cost of the investment, remained available to both private and public concessions. For example, for the first private company COFIROUTE, 10% of the funds were 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 were brought or backed by the Government.

In the same period, the 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. This *de facto* shift was followed by slight changes in the concession contracts so that they became *de jure* suited to the situation.

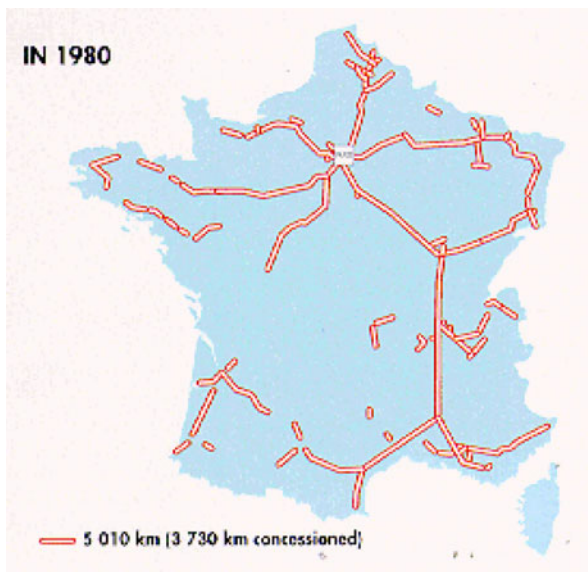
Comparisons of investment costs between private companies (in this case public work consortia) and public firms<sup>2</sup> led to the conclusion that private costs were roughly 5% to 10% lower. These figures should be interpreted with caution, as they did not take into consideration the changes in maintenance costs and the possible synergies between investment and maintenance operations. Control over service quality is often considered a major point of franchises; in this case it did not prove to be a problem, in comparison with railways for instance. This is due partly to the technical characteristics of road transport, and perhaps also partly to the fact that the motorway firms, anticipating a huge development of future concessions, had to build their reputation.

<sup>2</sup> See for instance Cour des Comptes 1974

Extensions to the concessions (see Fig. 2) were granted to existing firms, without tendering. This was done through the cross-subsidisation of new links, for which the collective surplus was positive but the financial profitability was negative, by older segments which had become profitable over time, and by extending the dates at which the older and more lucrative sections of the concessions expired. The public status of most motorway companies made this process easier, since no shareholder claimed additional profit: under public management all the money is devoted to network development.

During this period, tolls were regulated by the Ministry of Finance and fixed yearly. These procedures can be explained either as a ploy that allowed the Ministry of Transport to avoid the pressure faced by the Ministry of Finance, or as a way to lower the burden of taxes and to avoid the cost of public funds; it is not easy to disentangle these two reasons.

For several reasons the motorway system faced serious problems at the beginning of the 1980s. The first one was the oil crisis, which induced both a slackening of traffic growth and an increase in investment costs. This increase was due, not to technical underestimations, but mainly to economic factors such as higher petrol prices and interest rates. The second, and more important, problem arose from large errors in traffic forecasts for some of the new concessions—two of them had been overestimated by 200%! The previous concessions dealt with isolated and rather short links that were parallel to untolled highways, meaning that the route choices were much more simple and casual. Consequently, the traffic was easier to forecast, and the experience was more transferable from one case to another. Faced with such events, the firms had no way to adapt their behaviour, other than to change the tolls. This remedy proved to be quite insufficient, so there seemed to be little room for a commercial management initiative in the motorway business.



**Fig. 2** The network in 1980

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 the shareholders through a soft enforcement of the forfeiture clause. As a whole, the system proved to be subject to a soft budget constraint, especially through the *Autoroutes de France* cash pooling system.

### 1.2.3 1990: More externality problems and more separation between the operator and the State

From the mid-1990s, new private concessions began to appear, especially in urban areas, and the network became more and more meshed (see Fig. 3). The first intra-urban motorway was, in 1993, the *Prado-Carénage* tunnel inside the city of Marseille, Marseille, connecting the centre of the city to the eastern part of the agglomeration through a tunnel that already existed and just had to be reshaped. The tunnel was franchised to a private company, which runs it successfully. In Lyon, the “*Tangentielle Est Ouest*” (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 it also needed restrictive actions on the parallel and adjacent network so as to capture more traffic. After demonstrations and protests by the users, the municipality cancelled the franchise at a great expense and operated the link 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. Currently, a toll motorway link (A86, about 20 km long), which will complete a second ring road around Paris, is under construction (its first section was opened mid-2009).

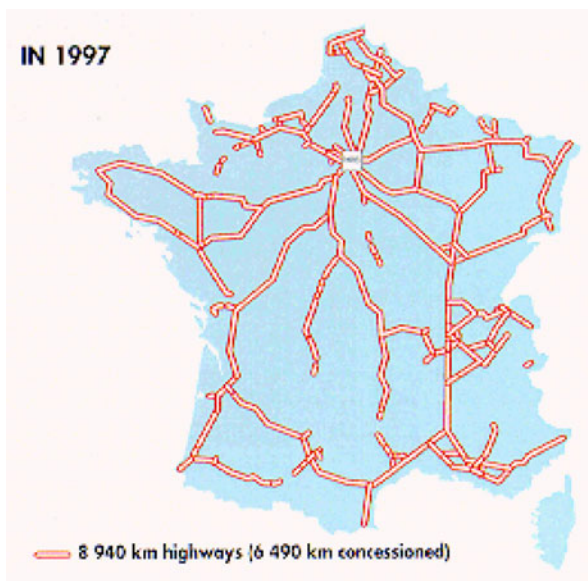


Fig. 3 The network at the end of the nineties

It must be noted that these concessions, located in urban areas, raise new problems. Environmental concerns, which increased progressively since the mid-1970s, grew enough to increase the construction costs. Further, the increased congestion on untolled roads compared to the fluid traffic on tolled motorways leads to suboptimal situations and gives an example of the conflict between profit maximisation and collective surplus maximisation (see for instance Brossier and Leuxe (2000) for figures and evidence that, in France, tolled motorways are overpriced and non tolled motorways are underpriced for most categories of vehicles, due to the high petrol taxes).

Besides this change in the exogenous environment, the concessions became less and less tied to the State. As from 1995, multi-year contracts that balance investments in renewal and lane extension on one hand, and toll increases on the other, were implemented. These 5 year contracts replaced the previous annual announcement in both toll level and investment. As such, this change has given concessionaires much better foresight over a 5-year horizon.

As evident in Fig. 4, an interesting observation is the relationship between the physical connections of different motorway concessions. Each concessionaire has been given a distinct area of the country by the public authority.

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

More recently, the toll motorway policy has experienced important changes in order to keep in line with European Directives,<sup>3</sup> whose general orientation is towards competition and efficiency (through transparent and competitive auctions and the elimination of discriminatory procedures). Concessions are now granted after a public competition process and they are no longer directly backed by collateral existing motorways. As well, 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 has given up the guarantee for liabilities to existing concessions. In compensation, the duration of the concessions was increased. While cash flows have not changed, assets are now linearly depreciated over a longer period, the consequence being that the companies have been profitable, paid income tax, and distributed dividends.

The main public motorway companies were consolidated into three main groups in order to benefit from geographical consistency and financial viability. In 2002, two of them were introduced on Euronext, the European stock exchange, and they ended up being privatized through an auction process. In the same period, 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 other words, the motorway system, while progressively adapting its regulatory regime, is more and more transforming into the textbook case of a concession regulated by the State and aiming at maximising its

<sup>3</sup> Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts; see also the [EU Commission](#) Communication on public-private partnerships and Community law on public procurement and concessions COM/2005/569 of 15 November 2005





Fig. 4 The geographical areas of the concessionaires

profit through the usual devices of private firms. Concessions are granted under an auction process, where the choice is based on a multi-criterion assessment that puts the most important weights on the level of subsidies and tolls requested, and on technical and financial ability. While this last evolution is too recent to be assessed, it is interesting to note that the auction process brought in an extra 3 billion Euros [15 billion (actual)–12 billion (expected)]. The difference may represent the gain in cost efficiency and demand management that the auctioneers hope to achieve compared to the previous standards, or it may represent the hope that public regulation will not be efficient at controlling profit growth.

As a whole, French motorway policy has experienced important management changes during the past 50 years. These changes resulted from pragmatic rather than dogmatic considerations, in line with the evolution of the issues to be addressed. In the first stage, tolls were introduced in order to develop the motorway network. In the second stage, delegated management (going well beyond just tolling) and autonomy for government-owned companies and private sector-owned companies

were introduced along with competition for concession awarding. The third stage was the implementation of general cash pooling as a way to ease a financial crisis for any single company, and to a lesser extent, a general crisis of the whole system. The fourth stage corresponded to a quieter period, with the implementation of the EU rules for awarding concessions. The last stages were the partial and—after some hesitation—complete privatisation of the companies.

The geographical network has evolved from a juxtaposition of isolated links to a fully connected and integrated network. In the beginning, the management was fully public with a hierarchical organisation, the executive of which was the head of the Ministry of Transport. Concession contracts were at first relatively simple and essentially concerned with financial elements and the definition of the infrastructure. The very close relationship between companies and the State allowed unplanned actions to be decided, or to be oriented according to public objectives. Additional expenses incurred were mainly covered through an increase of the concession's duration.

Gradually, the management evolved towards an organisation where independent and private concessionaires were chosen through a bidding process and who operated 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. Having experienced different types of concessions, the French system is now open to new solutions, for instance, with broader long term public–private partnerships (PPP). The role of concessionaires is now more complex; it includes many dimensions of services, the possibility of toll differentiation, and so on. Both the nature of the concession and the relationship with the State have changed completely. The importance of contractual rules is paramount given that the government has to clearly specify its objectives, and to design and negotiate contractual rules ensuring that the concessionaire's actions keep in line with public objectives.

### 1.3 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 point was to raise funds outside of the ordinary public budget. In fact, calculations show that for intercity motorways, tolls were, and still are, higher than the short run marginal cost of infrastructure, which on average is roughly equal to the petrol taxes (see for instance CGPC (1991), Brossier and Leuxe (2000), and Meunier (2009)). The situation is different in urban areas, where short run marginal costs are very high due to congestion costs (Roy 2001). This disconnection of tolls from the marginal cost induces inefficiency.

Tolls also have effects on investment costs. Several comparisons show that a toll motorway is about 10% to 20% more expensive than a free motorway, both for construction and for operations. The difference of costs is obviously linked to the implementation of a fee collection system (toll booth construction, system of vehicle identification, data bases and transmission, toll calculation and cashing, enforcement). Besides, as previously seen, private investment and maintenance costs are 5% to 10% lower than their public counterpart.

The French experience, confirmed by many other records, shows clearly that the main risk in motorway planning is related to traffic forecasts (see for instance Flyvbjerg et al. (2006) and more specifically SETRA (2008)). This risk is composed of a possible over-estimation bias in some cases, and a rather large standard deviation. Uncertainty on costs exists too, but the collective and individual experience of firms, in general, can limit this risk more effectively than for traffic forecasts. The financial and economic crisis has indeed introduced increased uncertainty for financing, but this is also true for traffic forecasts: is it transitory or will long-lasting trends be modified? nobody knows yet. Political risks, relative to the control of tariff levels, have decreased progressively during the French experience.

No business plan can reverse the course of a structurally unprofitable concession, as shown by the bankruptcies experienced in the late 70's. The reason is that investment in motorways is highly specific. Once completed, it is not possible to change it; you can only work with the tolls, and the effectiveness of this tool is limited.

A characteristic of motorways is that they 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. This increased complexity makes the situation more difficult both for the concessionaires, and for the public entities in charge of the regulation.

Information asymmetry between the operator and the regulator exists, but to a moderate extent, at least ex-ante. Ex post, once the concession has been granted, the asymmetric information is much in favour 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 traffic appear naturally, for instance, in order to optimise the toll booth operations and the organisation of maintenance operations.

The 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. Also, whenever the concessionaire has a global long term contract and financial accountability, he can implement an efficient optimisation of the long term global cost.

## **2 A few analyses on how to franchise motorways, and some perspectives**

Let us draw conclusions on how to improve motorways provision, even though the suggestions would be partial, as the experience upon which they are based is limited to just one country. 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, and how should the franchisee be compensated? If it franchises, how should the concession be designed? The answer to the first question—to franchise or not—is left for the paper's conclusion, the second one is dealt with now: how to franchise? For the purpose of presentation, we first deal with the problems facing concession and general design of bidding, and then the questions relating to regulation after the concession has been granted.

We will mainly talk here about concession of toll motorways. But a good part of the analysis may apply to other types of concessions, and we will see that some kind of unbundling between toll revenues and facility operations of the concessionaire may be advisable.

## 2.1 General design of the concession

### 2.1.1 *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. For instance, in complement situations, the case of adjacent links may lead to a double marginalisation if the two links are operated by two different operators adopting monopoly-like pricing strategies. Consequently, prices would be much higher and traffic much lower than socially optimal.

The case of parallel competing links between the same origin and the same destination, is different.<sup>4</sup> Competition between parallel motorways decreases the difference between the optimal charge and the monopoly charge. But 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.

These considerations show three conclusions (see REVENUE 2004). First, control over the market power of the concession is necessary. Second, 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 third, 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.

### 2.1.2 *Bidding conditions*

Bidding conditions are highly dependent on risks and uncertainty.<sup>5</sup> Besides the cost uncertainty encountered in some specific local conditions, as long as concession

<sup>4</sup> Engel et al. (2004). See also de Palma and Lindsey (2000) and de Palma and Lindsey (2002)

<sup>5</sup> Risks and uncertainty considerations are developed in a broader context just before the concluding section. In the economic literature, the term "risk" usually covers situations where all possible future outcomes ("states of nature") are known and can be given a precise value as to their probability of occurrence. "Uncertainty" covers situations where probabilities cannot be computed or defined, or where all possible outcomes are not known. In practice, unlike in situations where there are a large number of draws from the same distribution, motorways are unique objects for which detailed updated probabilities may not be estimated precisely: they are subject to "uncertainty" in the economic meaning of the word. Here, we will use the term "risk" in its common meaning of "risk factor".

revenues depend notably on traffic level the main risk is the uncertainty of traffic forecasts. We will simplify the question by talking mainly about traffic risks, even though other factors may have major influence on the level of revenue attainable through tolling, for instance, uncertainty about the shape of the demand curve.

Some authors (see for instance Engel et al. 2001) argue that, since the traditional auction mechanisms used for awarding concession contracts imply that traffic uncertainty translates into revenue uncertainty (reduced traffic levels implying reduced final revenues), endogenous duration contracts should be used, 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 through an adequate adjustment of the contract duration (the less the traffic level observed, the longer the contract duration). Therefore, the risk premium of the concessionaire is reduced.<sup>6</sup>

Another uncertainty arises during the concession. Motorway concessions are long-lasting, generally 20 to 40 years, therefore toll regulation can take several forms: the contractual rules are fixed rigidly for the whole length of the contract, thus they will almost surely become obsolete sooner or later,<sup>7</sup> or the contract sets up rules for a shorter period, which entails successive renegotiations. Concession contracts are therefore by nature incomplete contracts, and this means that they cannot include highly powered incentive mechanisms. Empirical studies (Athias and Saussier 2006) indicate that contracts for concessions with high traffic uncertainty are more likely to be flexible.

## 2.2 Regulation during the concession

We will assume that the objective of the concession regulator is 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 a short-term reduction of public debt puts high pressure on the conditions surrounding the concession redefinition preceding the privatisation of a motorway company (see Greco and Ragazzi 2005). Besides, the regulator may have its own failures: conflicts between its main functions (control, award of contracts, financing, etc.), organisational problems and so on. And these failures are all the more obvious when the regulator's functions are not sufficiently identified (see Talvitie 1998), which was the case in France.

### 2.2.1 *Tariff regulation*

Toll regulation is needed in order to limit market power from the concession, even if this market power is already reduced by the network structure through the presence of competing substitute links. This toll regulation could be implemented through a

<sup>6</sup> However, possible side effects may occur, for example on cost reduction efforts or on bidding strategies, and we lack long-term experience of such contracts.

<sup>7</sup> Experience shows that contracts of this type usually never go to their end without breach.

price-cap;<sup>8</sup> after the traffic risk is covered by the endogenous duration device and the risk on costs is estimated to be rather low, it could leave the remaining risk to the concession. 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. In this case, it is not sufficient to regulate average prices, while leaving 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 system. Information on traffic congestion is more easily available (for example, through drivers' 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. As the effects of price regulation are more uncertain and less observable than the effects of quantity (here quality) regulation, it may be better, in the concession contract, to fix the level of quality instead of fixing the price.

Therefore, a possible approach could be to impose a minimum quality of service level (for instance a minimum speed), to be achieved through toll modulation. This was 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 one to be quite cautious about the conflict between public and private objectives, whenever congestion increases substantially.

Other concerns about the possibility of unacceptable profit levels appear in some recent concessions, which raise two questions. First, a distributional one that is mainly based on equity, and second, one that is based on efficiency, taking into account the cost of public funds, which leads one to reap these profits in order to benefit the State. Such is the case in France, where the State has, with payment of a premature ending penalty, the (theoretical) possibility of ending the concession contract prematurely if the cumulated revenues of the concessionaire exceed some threshold.

A second point is to get an efficient mechanism that ensures that contractual rules do not lead to X-inefficiency<sup>9</sup> and Tullock rent-seeking.<sup>10</sup> This difficulty can be

<sup>9</sup> X-inefficiency is the difference between efficient behavior of firms assumed or implied by economic theory and their observed behavior in practice (Leibenstein 1966).

<sup>10</sup> Rent seeking occurs when an individual, organization or firm seeks to earn income by capturing economic rent through manipulation or exploitation of the economic environment, rather than by earning profit through economic transactions and the production of added wealth (Tullock 1987).

<sup>8</sup> A price-cap is the limited flexibility left to the concessionaire to decide on toll levels, up to a maximum level. Incentive theory indicates that, through price-cap regulation, even if the incentive scheme is highly powered it is not necessarily the optimal one. Letting a concessionaire choose from a menu of contracts should help reveal part of its information and help determine a more optimal scheme, which is somewhere between the polar cases of "cost-plus" (reimbursement of costs, plus a fee) and "price-cap". 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.

reduced through clear and non-discretionary rules of concession granting and regulation.

Under pressure from the development of new technologies, toll regulation concerning toll discrimination will gain more and more importance in the future. Right now, most tariff structures consider a price per section of the motorway, but eventually as the concessionaire gets more and more precise information on its customers, it becomes able to charge on an individual basis. This raises the question of the limits of price discrimination, since it may be used for congestion regulation, or for re-distributive and other public goals; but it is then not likely to coincide with the discrimination aimed at profit maximisation. This problem is accentuated by the problem of information asymmetry, which makes public regulation more difficult.

### *2.2.2 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)?<sup>11</sup> Apart from technical standards and practices, there is a need for a proper balance between incentives and obligations. 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 satisfied.<sup>12</sup>

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 compensate the concessionaire for the expenses incurred. This mechanism is used in Italy and Spain, and it raises concerns about the measurement of quality level and/or of quality investment (see Muren 2000).

### *2.2.3 Efficient investment incentives*

Generally speaking, the infrastructure manager has no decision to take regarding major investments, which are decided by the public authority using, sometimes, a pre-set schedule of additional investments to be made after the main initial investment. Nevertheless, it is useful to look at the infrastructure manager's investment inducements; first, he may have many small investments to decide on (widening a section, creating a new interchange), and second, 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 outcome is not clear. The time of implementation in terms of financial optimisation is often later than the time of implementation in terms of

<sup>11</sup> While the trend towards a "commercial" management leads the company to offer a "service" to the users, and not only an infrastructure to the community (*a service more than an asset*), in France these services are yet more devoted to road safety.

<sup>12</sup> See Tirole (1988) or Quinet and Vickerman (2004).

welfare considerations.<sup>13</sup> It follows that the regulator, who controls the implementation date, may be subject to pressures from the concessionaire to delay this date. The regulator may postpone this date if he is captured, or keep it and grant subsidies to the concessionaire. In the latter case, information asymmetry will still be present and costly, whatever the decision process, bilateral bargaining or auction (for which there is very often risks of collusion and very few competitors). The outcome of these two opposing forces is not clear. Furthermore, in the case of a simple rate of return regulation,<sup>14</sup> the Averch-Johnson effect<sup>15</sup> leads to over-investment.

Additionally, in the framework of 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. Obviously, whenever external costs would translate purely into net revenue for the concessionaire, he would have no reason for helping in reducing these costs. In order to avoid this mismatch, in a framework of time modulation induced by management of demand, a suggestion could be to fix a threshold for the 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 the 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.

#### *2.2.4 Some considerations regarding internalisation of sustainable development concerns by motorway concessionaires*

Whenever motorway companies impinge on their environment (via motorway enlargement or network development projects, for instance), they are likely to be careful about external concerns beyond their traffic revenue concerns, as they want to be in a favourable negotiation position in the future. Some considerations of sustainability may also appear important directly for traffic revenue concerns. For instance, a bad safety record could be a bad signal to motorway users, and bad news for traffic revenues.

On the opposite end of the spectrum, a purely financially oriented motorway company experiencing low demand elasticity and limited interactions, would be likely to pay much less attention to external and long-term concerns. Surely enough, public companies are more likely to internalize such concerns; but they may become privatized. Similarly, a private company pursuing a sustainable development policy

<sup>13</sup> The majority of projects, which are profitable from a socio-economic point of view, are not profitable in financial terms due to external effects: there is a fundamental distinction between financial rate of return and the socio-economic rate of return. In case of toll concession projects for instance, in a country without tolling experience, initial public support is often necessary to have the toll motorway system take off.

<sup>14</sup> 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 flavour of rate of return regulation. See Evans and Guthrie (2005) for a more elaborate concept where the regulator sets the prices for all of the goods and services provided by the regulated firm.

<sup>15</sup> The Averch-Johnson effect is the excessive capital accumulation that firms engage in so as to expand their profits, when they are submitted to rate of return regulation. Averch and Johnson (1962).



may change rapidly, through a take-over or a change in the goals of its shareholders.<sup>16</sup>

Therefore, a public authority motivated by sustainable development issues should include not only regulatory instruments such as noise level norms, but it should also have specific contractual rules for sustainable development enforcement. In order to reduce the asymmetry of information between the regulator and the concessionaire, these rules should contain obligations for reporting (with precise indicators) on environmental and social topics.

### 2.3 Risk and uncertainty

We will focus here on the uncertainty of traffic levels, as we have previously seen that this is the most important source of uncertainty, and we will assume that the concessionaire's revenues are positively dependent on future 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).<sup>17</sup> 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 an existing toll network. For instance, a major company totally external to the motorway sector may find it interesting to diversify its risks in the motorway sector. The trends in motorway traffic increases may be quite attractive, and they are usually considered to be relatively robust—at least they were considered quite robust before the recent boost in oil prices and the economic crisis—.

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 of its risk. Such a mechanism would suppose that the traffic forecasts for motorways are not too biased as an average, which seems to be the case according to some studies (Flyvbjerg et al. 2006), unlike other transport modes. This kind of risk-sharing mechanism may also help to reduce the strategic disadvantage of small companies compared to big companies, with regard to activity risk.

This disadvantage may also be reduced, at the procurement stage, by their respective attitudes towards risk, since a small company may be more risk-taking; especially if getting the concession is vital for it. Such a situation may accentuate the usual “winner's curse”, which states that the winner of an auction may often have

---

<sup>16</sup> It will be interesting to observe how the actions related to sustainable development evolve in the privatized motorway companies, or after some take-overs.

<sup>17</sup> Other means of disconnecting concessionaire's revenues from traffic levels exist. An example is given by the A Betreiber Modell concessions that will be paid with LKW Maut (Heavy Goods Vehicle toll) revenues.

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 for risk management. For instance, the concessionaire of the *Millau* viaduct has financed its project in two steps. The construction phase was covered by equity; once the viaduct is constructed and the traffic level is known, it allows the company to negotiate a long-term re-financing deal in the financial markets under much better conditions. This was possible because the concessionaire felt confident in mastering the construction risks, leaving only the residual risk to the financial market, yielding a much lower risk premium.

Risk sharing between the regulator and the operator is in fact the core point. But the practice reveals some confusion. Indeed, a distinction needs to be drawn between commercial risks (i.e. risks relating to the number of future users and income levels) and risk-sharing in that all random elements, whenever they become apparent (design, construction, operation...), may have an adverse impact on the profits and losses account. The final profit and losses account depends only partly on the commercial risks. The level of uncertainty concerning traffic predictions for new toll infrastructures is generally high with respect to the duration needed to achieve expected significant dividends. This is all the more so as the estimates cover a very long period (concession periods are usually around 30 years long and more). It is therefore advisable to alleviate the commercial risk and take a counterpart. This counterpart could for instance consist in mechanisms, incorporated in the contract between the regulator and the operator, that cap the amount of toll revenue collected by the concession company, control the concession company's rate of return, or that apply a variable concession period. Alleviation of commercial risk does not however lead to elimination of any other risk.

#### 2.4 The historical momentum

It appears that the momentum of history tends to reinforce the importance of the features which have been presented above:

- Due to the slackening and growing uncertainty of traffic growth (resulting both from autonomous factors such as the slackening of economic growth and the increase of oil price, 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's objectives and the regulator's objectives is increasing.
- 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 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 in some aspects of risk management. In that case, an intermediate solution could 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.<sup>18</sup> Monitoring would be made possible through the use of New Information and Communication Technologies (NICT). Another possibility would be to have the infrastructure built and maintained by the public authority, while toll management would be sub-contracted to a private operator; in this case the operator 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. One can reasonably assume 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 is that while the motorways policy has steadily shifted from public to private management, experience 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.

### 3 Concluding remarks

This historical perspective of the French motorway network's evolution and its concession devices is characterised by a steep growth of the network length, an evolution from isolated links to an integrated network, and by changing concerns with the growing importance of external factors; along with a regular tendency towards more liberalization of motorway procurement ending in the present situation where all motorway firms are private. Finally, it assesses how the political decisions have had a major influence, mainly through the privatization process and through changes in regulations.

These changes are analysed in terms of economic characteristics of motorways, namely, first, the relative importance of uncertainty; second, the externalities both outside the system (environment) and inside the system (congestion externalities with substitute or complement links) that create a gap between the concessionaire's objective and the regulator's objective; third, the difficulty of co-ordinating the operations of the motorway in order to optimize the real time operation of the whole network; and, fourth, the long duration of contracts, that make complete contracts almost impossible and imply relatively low powered incentives.<sup>19</sup>

---

<sup>18</sup> And a distinction must be made between two different types of activities, the collection of toll fees and the infrastructure operation. In Germany for instance under the A Betreiber Model, the multilane extension of existing motorway sections as well as their maintenance, operation and financing may be assigned to private investors whose remuneration may be backed by LKW Maut, the "toll collector".

<sup>19</sup> High powered incentives need very credible commitment of the public authority ensuring that the rules will not be modified ex-post. The unavoidable renegotiations of some elements of the contract, during its long life, make this commitment quite difficult to believe.

This analysis allows us to draw recommendations on several issues, mainly on the scope of a concession, and on the architecture of the contract regarding toll regulation and incentives. Hints about possible future evolutions are presented too, concerning the choice between concession and public provision of motorways, and the separation between infrastructure provision and management.

The main suggestions made are:

- Tariff regulation could be reviewed after periods of about 5 years, allowing for time modulation of tolls but imposing a minimal quality of service requirement, 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.
- Consider the possibility of endogenous duration contracts.
- 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.

It also appears that the more the changes mentioned above become important, the more difficult it is to regulate the concessionaire, and the use of concession appears less interesting vis-à-vis direct public management.

Combined with the possibilities offered by the new electronic toll collection and toll differentiation technologies, this raises the possibility for a dramatic change in motorway management: for instance, going back to building under a public authority, and having the operations management run by service firms that are given quality objectives by the public authorities.

These considerations lead also to suggestions for future research. Comparisons between historical experiences of different countries and of different modes would allow to enforce or qualify these conclusions. They would allow undertaking statistical tests and quantification of what is up to now only qualitative assessments. They would then allow assessing the relative magnitudes of the various parameters which have been identified.

## References

- Athias L, Saussier S (2006) Contractual design of toll adjustment provisions in infrastructure concession contracts, *Working Paper ATOM & SSRN*
- Averch H, Johnson L (1962) Behavior of the firm under regulatory constraint. *Am Econ Rev* 52(5):1052–1069
- Brossier C, Leuxe A (2000) L'imputation des charges d'infrastructures routières pour l'année 1997: des coûts complets intégrant les effets environnementaux. Notes de synthèse du SESP, March–April 2000. SESP, Paris
- CGPC (1991) Rapport n° 1991–105 sur l'imputation des coûts d'infrastructure de transport. CGPC, Paris
- Cour des comptes (1974) Rapport public pour 1973. La documentation Française, Paris
- de Palma A, Lindsey R (2000) Private toll roads: competition under various ownership regimes. *Ann Reg Sci* 34:13–35
- de Palma A, Lindsey R (2002) Private roads, competition and incentives to adopt time-based congestion tolling. *J Urban Econ* 52:217–241

- Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts
- Engel EMRA, Fischer RD, Galetovic A (2001) Least-present-value-of-revenue auctions and highway franchising. *J Polit Econ* 109:993–1020
- Engel EMRA, Fischer RD, Galetovic A (2004) Toll Competition among congested roads. *Topics in Economic Analysis & Policy* 4(1) 2004 Article 4, Berkeley Electronic Press. <http://www.bepress.com/bejeap/>
- EU Commission (2005) Communication on public–private partnerships and Community law on public procurement and concessions. COM/2005/569 of 15 November 2005
- Evans LT, Guthrie G (2005) Risk, price regulation and irreversible investment. *Int J Ind Organ* 23:109–128
- Fayard A (2005) Analysis of highway concession in Europe. In: Ragazzi G, Rothengatter W (eds) *Procurement and financing of motorways in Europe (Research in Transportation Economics, Vol. 15)*. Elsevier, Amsterdam
- Fayard A, Gaeta F, Quinet E (2005) French motorways: experience and assessment. In: Ragazzi G, Rothengatter W (eds) *Procurement and financing of motorways in Europe (Research in Transportation Economics, Vol. 15)*. Elsevier, Amsterdam
- Flyvbjerg B, Skamris-Holm MK, Buhl SL (2006) Inaccuracy in traffic forecasts. *Transp Rev* 26(1):1–24
- Greco A, Ragazzi G (2005) History and regulation of Italian highways concessionaires. In: Ragazzi G, Rothengatter W (eds) *Procurement and financing of motorways in Europe (Research in Transportation Economics, Vol. 15)*. Elsevier, Amsterdam
- Leibenstein H (1966) Allocative efficiency and X-efficiency. *Am Econ Rev* 56:392–415
- Meunier L (2009) « La circulation routière est-elle bien tarifée? ». In “La tarification, un instrument économique pour des transports durables. La revue du CGDD, Paris
- Muren A (2000) Quality assurance in competitively tendered contracts. *J Transp Econ Policy* 34(1):99–112
- Quinet E (1998) *Principes d'économie des transports*. Economica, Paris
- Quinet E, Vickerman R (2004) *Principles of transport economics*. Edward Elgar, Cheltenham and Northampton
- REVENUE (2004) Revenue use for transport pricing, deliverable D2 theoretical framework, Proost S. (KULeuven), de Palma A., Lindsey R. (ADPC), Balasko Y., Meunier D., Quinet E. (CERAS), Doll C. (IWW), van der Hoofd M., Pires E., project coordinator: ISIS
- Roy R (ed) (2001) Revenues from efficient pricing: evidence from the member states, UIC/CER/European Commission DG-TREN study: Final study report, edited by Rana Roy, London, November 2000. Paris: UIC, Paris
- SETRA (2008) *Analyse transversale de bilans LOTI de projets routiers*. SETRA, Paris
- Talvitie A (1998) International experiences in restructuring the road sector. *Transp Res Rec* 1556:99–108
- Tirole J (1988) *Theory of industrial organisation*. MIT Press, Cambridge
- Tullock G (1987) Rent seeking. *The new palgrave: a dictionary of economics*. Palgrave Macmillan. vol 4, pp 147–149. ISBN 0333372352