The cost of capital of motorway concessions in France

A modern approach to toll regulation

September 2020

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1. Introduction

In France, when setting or renegotiating the tolls applicable in motorway concession contracts, the concession company's cost of capital is one of the major determinants of the decision taken by authorities.

Fors instance, when new investments are required by the State, the new expense typically falls on the concession holder. The latter is then "compensated" for its investment either by a direct increase in its revenues through higher tolls or by extending the duration of its concession, which proportionally increases the sum of tolls to be received during the period of operation granted.

To determine these new conditions, a discount rate giving the present value of the concession holder's future cash flows is needed. A toll increase and/or concession extension can then be chosen that keeps the contract "in equilibrium" - i.e. will not change its overall value - in view of the new investments to be made. To be consistent with the established results of financial research, this so-called "internal rate of return" or IRR should correspond to the concession holder's cost of capital, i.e. the time value of money and the market price of the risks involved.

In principle, financial markets should allow a direct or indirect estimate of the cost of capital that should apply at a given point in time. In practice, most motorway concession projects are not listed on the stock exchange. Even if the concession companies happened to be listed, it would still be difficult to directly deduct this IRR, and the risk premium applying to a particular concession project, from the stock prices of these companies.

Financial theory also reminds us that it is the cost of capital of the project that should apply and not that of its sponsor. The lack of information and comparable cases therefore makes this valuation difficult. Few motorway concession projects exist, and they are not always re-valued at the same time.

Finally, the compounding effect of this rate has a significant impact on the result obtained and therefore has strong redistributive implications between concession holders and users. Determining the fair discount rate for the future cash flows of a particular concession holder is therefore a delicate and controversial exercise in the French context. It is therefore important for the parties to be able to refer to the most transparent and scientifically justified rates for measuring the risk premium of such investment projects.

This note begins with a brief summary of the role of discount rates in French motorway concessions and the ensuing debate (section 2).

We then look at the issue of measuring these rates for private motorway concession companies. We propose a so-called "modern" approach that corresponds to the state of the art in financial research and is based on a multifactorial risk model.

This type of model makes it possible to determine these premiums for the market for private investment in infrastructure (section 3).

We then present empirical results based on a large database for this type of investment in 25 countries spanning more than 15 years, showing the evolution of the average cost of capital in motorway projects in several European countries, including France (section 4).

We find that French Authorities have failed to estimate and use discount rates that are commensurate with the risks taken by the road concessionaires and instead have agreed to use discount rates that are significantly above observable market rate, thus agreeing to increases in tolls that are not justifiable. We also show that tolls could be significantly lower in French concessions without jeopardising the eocoomics of the contracts if the authorities used an adequate approach and data.

2. The central role of the cost of capital to set fair tolls

Changing needs of infrastructure and renegotiation of concession contracts

The awarding of an infrastructure concession to a private operator comes with many conditions. It will be also subject to public policies in terms of the quality and quantity of services made available to users, as well as their environmental and social impact. As these evolve, the concession holders' specifications will be subject to frequent changes to during the term of the contract. This proven need for flexibility and adaptation over the lifetime of an infrastructure project is an integral part of the relationship between the granting authority and the private operator.

French motorway concession contracts provide for the possibility of "plan contracts" (Contrats de Plan) to finance additional investments not initially provided for in the concession contract. Consequently, the State has been able to repeatedly ask the companies concerned to amend the specifications agreed when their contracts were signed. Recent examples include:

- The "Green Package" designed in 2008, following the *Grenelle de l'environnement* and signed in 2010, contained a set of environmentally orientated motorway construction works representing €1 billion of new investment;
- In 2011, a Motorway Recovery Plan (MRP) led to the modification of the specifications of the concessionary companies in August 2015 and required €3.2 billion of new investments;
- In 2016, a new Motorway Investment Plan (MIP) includes €700m of new construction works, including environmental improvements and the creation of new interchanges.

It should also be noted that such renegotiations are extremely frequent in public-private contracts related to infrastructure. This is the case not only in France but also elsewhere, whatever the sector of activity (see for example Guasch 2004, de Brux *et al.* 2011, Cruz & Marquez 2013 and Beuve *et al.* 2014).

As the costs of these new investments is borne by the concession holders, the State must compensate them in order to bring their concession contracts back to financial equilibrium.

There are two main ways to achieve this:

- **An extension of concession contracts:** Extending the length of the concession period increases the sum of the concession holder's future revenues and may therefore allow them to obtain the same return over time despite increased capital investment. The European Court of Auditors (CdC, 2018) notes that this solution poses the problem of re-opening contracts to competition and of passing on a significant part of the cost of these investment decisions to future users;
- **An increase in toll charges:** This approach allows a more immediate increase in the revenues of the concessionary companies but weighs more directly, and earlier, on the users. Following this route, tariff evolutions can be adjusted by following a formula such as 85% × inflation rate + y%, depending on the construction cost and traffic assumptions made.

The European Court of Auditors also notes that, whatever the method of financing these investment plans, they are typically the subject of "difficult negotiations in which the public authorities often appeared to be in a weak position". The court considers that two questions are at the heart of these negotiations: firstly, the "compensable" nature or otherwise of the construction works, and secondly, the determination of the level of compensation, i.e. the length extension of the contract or the size of any increase in tolls.

The remainder of this note focuses on this second question, namely of the level of compensation and the determination of the discount rate used to assess the level of compensation required to maintain the financial equilibrium of the contracts.

IRR, WACC and financial equilibrium

Calculating how to compensate of concession holders by increasing tolls depends on assumptions made on four parameters: the future level of inflation, the cost of the construction works, expected traffic and finally the discount rate for future flows. The assumptions made on the first three parameters are the subject of expert appraisals that benefit from historical data and are less controversial. Above all, they are the subject of direct *ex-post* observations which make it possible to validate or even modify the assumptions made *ex ante*.

Conversely, the discount rate that applies to each concession holder is not directly observable and must be estimated. In theory, it should be estimated based on market data. In practice, its determination is the subject of expert opinions and direct negotiations between the concession holders and the State, as indicated in several documents of the European Court of Auditors (CdC 2013, 2019) and in the answers given by the Minister of Transport (MdT, 2019).

This rate plays a central role. *In fine*, the valuation of two adjustment mechanisms, i.e. extending the duration of contracts or increasing tolls, is based entirely on the time value of money and the risks incurred by the concession holders.

These adjustment decisions are based on the discounted cash flow method, which consists of valuating all the positive and negative financial flows induced by the planned investment and reducing them to their present value at the date of renegotiation.

Positive financial flows correspond mainly to toll revenues. Negative cash flows correspond to expenses related to the implementation of construction programmes and all operating expenses.

The difference between discounted revenue and discounted expenditure is the net present value or NPV of the investment programme. Without adjustment, the initial NPV of new investments made by concession holders would be negative, as the expected revenues would not offset the cost of those new expenditures. The increase in tariffs or the extension of the concession therefore helps to offset this effect. For the concession to remain in balance, toll increases must strictly offset the NPV of new investments. The discount rate to be used is therefore the equivalent of the internal rate of return, or IRR.

It is the choice of this rate that determines the level of toll increase or contract extension.[1]

One of the key findings of modern financial theory since Modigliani and Miller (1958) is that the future flows of an investment project should be discounted using the rate that reflects the level of risk of the project. In this framework, the choice of rate used as IRR should therefore be the weighted average cost of capital (WACC) of the project in question.

It should be noted that many companies use a discount rate corresponding to the WACC of

1 - The internal rate of return is a purely technical concept: it is the rate at which the present value of a series of positive and negative future cash flows is equal to zero. It is therefore the rate that keeps the concession contracts in equilibrium. It should be noted that since this valuation applies only to a specific plan contract, it covers only the incremental costs and revenues generated by the new construction works and not the overall costs and revenues.

the parent company rather than a rate representative of the risk of each project when evaluating their projects. As shown by Krüger *et al.* (2015), this poor choice of WACC creates a distortion in investment decisions and tends to favour the riskiest projects.

In the case of motorway concessions, each plan contract corresponds to a specific project. Therefore, the rate used should therefore be the one corresponding to the risks incurred by the concession holder for the new investment project provided for in the contract.

However, these investment projects are merely additions to the cost of the concession, so that, ultimately, their risk corresponds to a fungible revenue stream and/or that it is not necessarily possible to distinguish specific revenues associated with the additional investments. Hence the negotiations of the plan contracts might provide an opportunity to re-estimate an overall cost of capital that would apply to the entire economic equilibrium calculation of the concession. This situation was unfortunately not foreseen in the initial structuring of the concession contracts, but it retains its economic logic.

It is good practice to take account of the fact that the discount rate used in the investment decision at a given date may vary over time as a result of changes in the financial structure and changes in the cost of equity and debt. This has been the case for French motorway concessions, which have become much more indebted than initially planned. By refraining from this approach, the parties have committed themselves to a logic of crystallisation of discount rates which is not justified from an economic point of view.

A contested choice of discount rate

In its report of July 2013, the European Court of Auditors had this to say regarding the discount rate used in negotiations with concession holders (CdC, 2013):

"This rate was assessed differently by the departments and companies. (...) The fact that we've assumed a rate of 8.08% for APRR[2] instead of 6.7% represents a cash flow surplus of about €38m, all other things being equal and using the DTI (Department of Transportation and Infrastructure) model[3]. The fears expressed by the DTI proved to be well-founded: the rate of 8.08% was used as a reference for the negotiation of the other plan contracts."

However, several estimates, including those based on market data, concluded that the WACC for motorway concessions was around 6% in 2010 (see AdC, 2014, p. 38). The French Competition Authority' September 2014 report (AdC, 2014, p. 15) concluded that the choice of discount rate used to justify toll increases was at the root of the "high profitability of French motorways". It noted:

"If the sharp increase in the revenues of the 'historic' concession holders cannot be explained either by the increase in traffic or by the commissioning of new motorway sections, it is essentially due to the increase in toll rates."

In 2016, the French Transport Regulatory Authority (Arafer) reported that "the estimates of the discount rates that emerge from these calculations vary between approximately 9 and 11% depending on the company" (Arafer, 2016, p. 21). In 2017, Arafer published its own study of the WACC and concluded that the latter should be between 4- 5.6%, the upper limit corresponding to the WACC derived from calculations provided by the State. However, Arafer noted that:

"The level of the benchmark 'projected' IRR reflects a deviation of at least 0 to 200 basis points from the WACC calculation made by the licensing authority or even 100 to 300

2 - Autoroutes Paris-Rhin-Rhône
3 - Department of Transportation and Infrastructure

basis points if one considers the average of the Authority's estimate range." (See Arafer, 2017.)

Successive plan contracts have therefore continued to be the subject of negotiations on discount rates, which have been gradually revised downwards but continue to be subject to substantial tariff increases. In 2018, as part of the implementation of the MIP, seven amendments to concession holders' contracts were made. These were financed mainly by toll rate increases of between 0.1% and 0.4% per year over the years 2019, 2020 and 2021. In 2018, the average tariff increase for the entire French network was 1.5% (Arafer, 2019).

The issue of the discount rate was also raised in a January 2019 letter from the European Court of Auditors to France's Minister of Transport (CdC, 2019). The level of the WACC for motorway concessions was presented as high and lacking justification:

"It emerges from the Court's audit that the values adopted for these parameters are the result of valuation work, the traceability of which is not always perfect, in particular because they include part of the negotiations between licensor and concession holders. Overall, they appear to be too pessimistic as regards the real risks borne by the motorway concession companies."

The Minister of Transport, in a reply given on 4 April 2019, nevertheless considers stated the rates used are correct because they are in line with several expert opinions. These included that of The European Commission which considers that the "IRR levels make it possible to meet the requirements of the 2012 framework on the concept of 'reasonable profit' for this sector according to the type of construction works concerned, of the compensation mechanism and the level of risk". Arafer, meanwhile, "estimated the weighted average cost of capital (WACC) in relation to the level of risk taken by the concession holders and the economic situation. However, the Department of Transportation and Infrastructure, jointly with the Treasury Department, had precisely the same WACC estimate as the Arafer during the negotiations of the plan."

The Minister adds that in the context of the latest plan contracts, "(t)he State was able to renegotiate **a reduction in the internal rate of return to a level of 5.9%**, all other economic parameters remaining unchanged. The State Council (...) considered that this level of profitability was reasonable." (See MdT, 2019.)

The fact remains that the choice of this discount rate and the criticisms or defences of the rates used were not made based on transparent calculations justified by market data. It should be noted that neither the Ministry of Transport, the European Court of Auditors nor the State Council have been able to justify their position based on reference data, although such data does exist.4

It is based on this reference data that we propose, in the following section, an approach that is both scientific and parsimonious for estimating the cost of capital of French motorway concessions.

4 - However, the determination of the appropriate rate remains a controversial issue that has a significant impact on the rates charged by concession holders, which are known for their monopolistic characteristics (AdC, 2014). Since 2017, EDHEC*infra* has been publishing data on the performance, risks and risk premiums of infrastructure projects and studies based on this data. These are known to the financial administrations of the G20 countries since EDHEC*infra* has regularly presented its work in the meetings of the G20 working group on infrastructure investments. Presentations notably took place in March 2018 in Singapore and in December 2019 in Riyadh, and during conferences organised at the Ministry of Finance in Paris (infraweek) in October 2018 and 2019.

3. A better estimation of the cost of capital of motorway concessions

The WACC is defined according to the following formula:

$$wacc_t = \frac{\sum_{i=1}^{N} r_{i,t} \times MV_{i,t}}{\sum_{i=1}^{N} MV_{i,t}}$$

i.e. the weighted average of the N sources of capital whose rate of return is $r_{i,t}$ for each type of financial instrument i on the date t $MV_{i,t}$ represents the market value of instrument i at the same date.

Infrastructure projects are typically financed by a combination of equity provided by shareholders and debt raised from banking institutions or securities markets. Hence, this first formula can be reduced to the following:

$$wacc_t = \frac{E_t}{D_t + E_t} \times COE_t + \frac{D_t}{D_t + E_t} \times COD_t \times (1 - tax_t)$$

Here, the firm's debt ratio (expressed either as a percentage of equity E_t or debt D_t) weights, respectively, the cost of the equity COE_t and cost of debt COD_t at date t. This formulation also includes the effect of debt interest deductibility.

Most motorway concessions are private and unlisted companies. Some listed companies, such as ASF, were also de-listed in the periods following their acquisition by institutional investors and their managers.

Determining the WACC of these companies is therefore more difficult than if the expected return on their equity and debt could be observed directly in the equity and bond markets.

This rate must therefore be approximated. An indirect method based on market proxies can be used to determine the WACC but tends to smooth these rates over time. Above all, it is based on a financial asset pricing model (CAPM) whose lack of robustness has been repeatedly demonstrated by academic research, namely that a model based on a single risk premium does not provide an adequate representation of the returns required by investors.

We therefore propose an alternative "modern" method. It is based on the direct measurement of risk premiums in private investment in infrastructure projects, and on a decomposition of these premiums into several risk factors that correspond to the objective assessment of the risk to the net revenues of the project, i.e. here of the motorway concession. This approach corresponds to a state-of-the-art application of academic research to the valuation of financial assets and has been the subject of numerous scientific publications (see for example Blanc-Brude and Tran, 2019, Blanc-Brude and Yim, 2019).

Standard method

The determination of the WACC described above requires first and foremost a measurement of the cost of each source of capital, i.e. the expected returns to investors, expressed as follows:

$$r_{i,t} = Rf_t + \beta \times r_{m,t} + \alpha$$

Knowing that $r_{i,t}$ represents the expected return of financial instrument i at date t, β represents the correlation between this performance and that of the market $r_{m,t}$ for this type of instrument at the same date, and $r_{m,t}$ represents a set of additional premiums. That is the CAPM equation.

The most common approach to estimating the WACC for motorway concessions is based on the observation of listed companies around the world with large market capitalisations (€250m or more). These companies are classified according to the Global Industry Classification Standard (GICS). In this classification there is a category for companies in the Transport sector.

The cost of equity is determined using the CAPM model:

- A risk-free rate is estimated per three-month moving average of 20- or 30-year government bonds at the valuation date.
- A market beta estimating the relative volatility of the sector compared to the stock market is extracted from long series of data. This coefficient must then be adjusted for the level of indebtedness of the company to be valued.
- Finally, a risk premium corresponding to equity investments is estimated on a moving average basis. In France in 2020, it is typically in the range of 5.75-7.25% (source: PwC France, 2020).

The cost of debt is estimated using a similar approach:

- A risk-free rate is estimated per three-month moving average of 10-year government bonds at the valuation date.
- A credit risk premium is estimated in relation to the premiums observed on 10-year bonds whose rating corresponds to the average of the ratings of the companies in each sector sample.
- The standard tax rate in France applicable at the time of the valuation, i.e. 25.7% in France after considering the social contribution, is used to determine the cost of the debt after tax.

A number of additional premiums (α) may be added to this generic approach. They can be aimed at certain risks such as the absence of a liquid market for the firm's shares, or the country in which all or part of its operations take place.

Brotherson *et al.* (2013) report similar elements in their review of WACC determination practices in large firms and by industry practitioners.

This method poses several major problems that make its use irrelevant in practice when applied to private infrastructure projects, including motorway concessions in France:[1]

1. **Lack of representativeness of the sector of activity in the choice of beta:**
   The choice to represent the sector beta using global industrial classifications such as GICS implies that many companies that are by no means transport service providers are included in these estimates. In fact, there are very few motorway operators listed on the stock exchange and most of them are not in France. A robust estimate of the beta of transport infrastructure or even motorways is therefore impossible. The use of a non-representative beta makes the exercise unconvincing.
2. **Lack of representativeness of risk premiums:**
   For the same reason, the risk premiums used are not causally related to motorway concessions but are supposed to represent the cost of risk at a highly aggregated level. Not only are most listed companies in the transport sector not motorway concessions, but they are financed as much on the securities market as on the bank debt market. Yet, the determination of risk premiums for private debt (term loans) is not directly comparable with that of the securities market.
3. **Lack of representativeness of the financial structure:**
   - The previous point is problematic if the investments made by the concession

1 - Especially when direct assessments of project risks can be made, which is now the case with the EDHEC*infra* database.

holders do not take the form of equity capital *stricto sensu* but of loans made by the shareholders to the concession holder. This debt, although highly subordinated, is not the strict equivalent of equity. Yet, betas and risk premiums measured on the equity markets only reflect the risks of equity investments. From the shareholder's point of view, however, their loans count as part of their investment since they are part of the financing received and are regularly repaid to the shareholders. Above all, they can represent a significant portion of the contributed capital.

- The level of indebtedness used to calculate the WACC is not that of the concession holders but an average level observed in the transport sector. Hence it may be much too low and lead to an overestimation of the WACC, as the cost of debt is lower than the cost of equity. Infrastructure projects have high levels of "normal" external debt, often exceeding 70%, while the debt ratios typically used to calculate sectoral WACCs are lower.

4. The smoothing of the estimates does not reflect the evolution of the markets: by relying on moving average data (interest rates) and estimated over long periods (beta and risk premiums) the WACC estimates become exceptionally smooth. They therefore do not reflect the evolution of prices if the markets evolve a lot in a few years, which has been the case for infrastructure since 2010 (we return to this in the next section). The choice of 10- or 30-year (so-called "risk-free") interest rates is also not directly related to the concession holder's investment horizon or the maturity of debt instruments (IFRS 13 recommends using an interest rate that is representative of the duration of the investment).
5. Existence of *ad hoc* premiums: the use of fixed and often subjective risk premiums for various additional risk reasons further reveals the limitations of this approach:
   - The need for additional premiums confirms that the measure of the cost of capital extracted from public market data is not sufficient and does not represent the risks of the investment in question;
   - *In fine*, the global premiums used to calculate the WACC have no basis and become completely *ad hoc*.

In the end, this standard WACC estimation method has two important negative consequences:

1. The resulting WACC tends to be rooted in the past and does not reflect the changes in expected future returns that it is supposed to capture;
2. The use of risk premiums that are not very representative of motorway concession contracts, or even completely ad hoc, removes most of its scientific credibility from the exercise.

It is therefore easier to understand why these rates are ultimately determined by negotiation between the companies and the State, thus returning more of the "bargaining power" and informational asymmetry that characterise these talks, as the European Court of Auditors reminds us.

In this context, the State's non-compliance with the contracts it had signed as a result of a unilateral decision to freeze motorway tariffs in December 2014 did not put it in the best negotiating position.

Modern approach

The limitations of the standard approach are because it is based on a strong assumption of representativeness of segment data as defined and observable in equity and securities markets. In the case of infrastructure projects, including motorway concessions, this assumption is too strong and necessitates *ad hoc* adjustments that make the exercise essentially meaningless.

A more appropriate approach would be to measure the cost of risk for investors in infrastructure, including motorway concessions, directly each time they buy or sell shares or issue debt, including bank debt. This approach, however, comes up against an important limitation: the relatively small number of companies and therefore transactions that would allow relevant and regular comparisons to be made. For example, there are only a few dozen conceded motorways in Europe, and these are very rarely acquired.

However, it is possible to get around this difficulty: although very few unlisted motorway shares trade quarterly, there is a secondary market for infrastructure companies. This market has also grown significantly over the past two decades as many institutional investors have become interested in infrastructure as an alternative asset class.

It is therefore possible to observe transactions on this secondary market on a regular basis. Each of these transactions reveals the expected return and thus the risk premium required by investors in private infrastructure companies. Moreover, it is possible to decompose these risk premiums into the impact of several from a reduced number of risk factors that are common to all infrastructure projects but which are present with different (beta) weights in each of these projects. It is this difference in exposure to each factor that explains the differences in the overall risk premium for each project.

For example, while investors in the equity of infrastructure firms tend to charge a higher risk premium if a firm's debt ratio is higher (other things being equal), this exposure to debt can be seen as one of the systematic determinants of the risk premium for private infrastructure projects. Thus, the portion of the risk premium corresponding to the debt ratio of an infrastructure company on date *t* can also be used to value any other infrastructure company on the same date, based on the latter's indebtedness.

By estimating the prices of the various risk factors that explain the premiums observed in secondary markets and by observing the exposures to these same factors for each of the infrastructure projects, it is therefore possible to estimate the overall equity risk premium for all other infrastructure firms at the same date.

This method has several advantages over the standard CAPM-based approach described above:

- It uses market data specific to private infrastructure companies;
- It allows the determinants of risk premiums to be estimated without smoothing the data over long periods of time since these premiums are revalued each time a new transaction takes place;
- It is parsimonious, since the number of factors whose price must be estimated in each period is much lower than the number of firms for which a WACC must be calculated. This parsimony gives it a real statistical robustness;
- It can be combined with any approach in terms of risk-free rates whose variation it takes into account, including using the forward yield curve matching the horizon of the investment, i.e. most in line with the relevant market values and the IFRS 13 recommendations;
- Finally, this method applies to both equity and debt.

It should be noted that this approach requires the assumption that prices (and thus risk premiums) for investments in private infrastructure are formed in a single market. However, this assumption is much weaker than the one, implicit in the use of CAPM, which requires that the cost of risk of all companies, whether listed or not, be reflected in stock market returns.

Moreover, given the relatively homogeneous nature of the investors active in the private infrastructure market (pension funds, insurers and managers), this hypothesis is credible: when these investors express their preferences for the price of risk due to the debt ratio or the size of infrastructure projects, these preferences apply to motorways as well as to other types of infrastructure.

What risk factors explain the premiums required in infrastructure?

Since the CAPM poses the estimation problems noted above, a more general model includes the possibility of multiple factors as determinants of the risk premium.

$$r_{i,t} = Rf_{i,t} + \sum_{k=1}^{K} \beta_{i,k,t} \times \lambda_{k,t} + \varepsilon$$

So the return (e.g. on equity) is equal to the risk-free rate at date t[2] and the sum of K risk factors plus an idiosyncratic part of the price paid in the observed transaction and expressed by the random value ε. This model is remarkably close to the one proposed by Ross (1976) and known as Arbitrage Pricing Theory (APT).

This formulation is very generic and states just that a number of factors systematically explain the level of premiums (and therefore prices) depending on the level of exposure $\beta_{i,k,t}$ of each company i to each of these risk factors k, and the market price $\lambda_{k,t}$ of these same risks, at date t.

After several years of research and raw data collection, EDHEC*infra* has developed an application of this multifactor model of systematic risk premiums for investments in private infrastructure. The factors selected as systematic are first rooted in financial theory, and at the same time independent (decorrelated), persistent (they keep the same sign and change slowly over time) and statistically significant.

2 - In fact, at the risk-free rate forward curve of the country where the company is located, but here we keep a simplified non-matrix rating.

Measuring the cost of equity capital

For the risk premium of infrastructure companies' equity capital, these factors are as follows:

1. The **size** of the company represented by the book value of its assets.
   This factor represents the relative liquidity, complexity, and cost of transactions i.e. a solar farm representing €100m of investment is a simpler and more liquid operation than the acquisition of a road network representing several billions of assets. This factor has a positive impact on the risk premium: the larger the company, the higher it is.
2. The **debt ratio** represented by the ratio of the so-called 'senior' external debt (bank and bond) to the book value of the assets.
   In line with financial theory since Modigliani and Miller (1958), the firm's debt ratio should increase the risk premium of shareholders whose future dividends are even more at risk. This effect is confirmed here by our empirical studies.
3. The ratio of pre-tax **profits** to book value of assets.
   This factor increases the current and future value of companies and thus reduces the risk premium demanded by investors.
4. The ratio of **capital investment** (property, plant, and equipment) to book value of assets.
   This factor represents the effort to invest in new infrastructure and the risk taken by the company to carry out these programmes both in terms of budget and schedule. This ratio therefore has a positive impact on risk premiums since during periods of higher capital investment, owners are more at risk.
5. **Country risk** is represented by the difference between the 30-year sovereign rate and the three-month rate at the time of valuation.
   This term spread approximates the relative risk between countries at a date t. It gives rise to a higher premium if this difference is greater e.g. in 2012, short rates were low throughout Europe, but long rates were much higher in

Southern Europe, hence a higher "country premium".

6. **Sectoral control** variables.
For different sectors and business models (e.g. contracted or uncontracted revenues, etc.) the TICCS®[3] infrastructure company classification is used to control for certain purely sectoral effects e.g. renewable energies are subject, all other things being equal, including their indebtedness, profits, etc., to a lower risk premium, i.e. higher prices.

Exposure to all these factors is observable as these quantities are reported in the accounting records. Thus, for each transaction, we also know the factor exposures ($\beta_{i,k,t}$) of the firm i bought or sold for each factor k, at the time the transaction takes place.

Since each transaction involves an IRR, the IRR can then be first decomposed into the effect of (risk-free) interest rates and a risk premium. This overall risk premium observable in each transaction can then be statistically decomposed between the effects of each of these factors. Finally, once the market risk premiums $\lambda_{k,t}$ have been deducted from the prices observed in secondary transactions, these values are used to determine the risk premium for all unlisted infrastructure companies that request to be valued at that date, based on their own exposures to the same risk factors.

Thus, the cost of equity of the company j can be calculated as below:

$$r_{j,t} = Rf_{j,t} + \sum_{k=1}^{K} \beta_{j,k,t} \times \lambda_{k,t}$$

Values $\beta_{j,k,t}$ being determined from the relevant accounting and macro-economic data and those of $\lambda_{k,t}$ having been estimated based on the secondary market for all infrastructure undertakings.

3 - This classification was proposed by EDHEC*infra* and corresponds to eight sectors and 33 sub-sectors and 95 types of infrastructure assets. Its validation is based on the opinions of a committee of experts in which representatives of the main players in the infrastructure market participate (https://docs.edhecinfra.com/display/TICCS).

Measuring the cost of debt

For the risk premium on the debt of infrastructure companies, the same approach is possible. In the bond market, there are a number of securities issued by infrastructure companies (including French motorway concessions). In addition, it is possible to observe the premiums of bank debt issued for infrastructure projects.

It is therefore possible to carry out the same exercise and, knowing the market premiums, to update a multifactor model of these premiums in order to re-value the premiums of all the infrastructure companies' instruments according to their individual exposures to these different factors.

The following factors are used to determine the value of the risk premium in each period:

1. **Issue size**: Larger debt issues have, other things being equal, lower risk premiums. This is a stylised fact of academic research (see Strahan, 1999) and empirically confirmed for the debt of infrastructure companies (Blanc-Brude and Yim, 2019).
2. The **maturity** of the instrument is a measure of its duration (interest rate risk) and has a positive impact on risk premiums.
3. **Credit risk** is represented by a measure of 'distance to default' calculated by simulation for each instrument and has a positive impact on the risk premium.
4. The level of **three-month bank refinancing rates**: this factor is an important determinant of observed premiums.
5. **Country risk**: see above
6. **Sector control** variables: see above

Thus, once these risk premiums have been estimated, all debt instruments can be valued using up-to-date data on the latest developments in the private infrastructure debt market.

In the following section, we report the results of this method as part of the calculation of the WACC for motorway projects in Europe and France.

4. Empirical results: tolls that could be lower

EDHEC*infra* data

EDHEC*infra* implemented the method described in the previous section, having collected the following data:

- Detailed financial information for 650 infrastructure companies in 25 countries, dating back to the year 2000, including 113 motorway projects with a market value of USD 47 billion in 2020. Some 57 of these companies are in Continental Europe, including nine in France.
- More than 2,200 debt instruments (bank loans and bonds) are present on the balance sheets of the companies in question.
- More than 1,000 secondary equity buyouts of infrastructure companies.
- Over 5,000 private debt risk premiums for infrastructure projects.

Acquiring this data allowed the calibration of the multifactor models of equity and debt risk premiums described above. These results make it possible to calculate a WACC for each of these companies at the end of each quarter over the reference period.

In the remainder of this section we present these results for motorway concessions in France, Spain, and Italy.

Cost of capital of motorways in France and Southern Europe

Table 1 shows the average WACC, cost of equity and cost of debt for motorways in France, Italy and Spain over three reference periods. Chart 1, meanwhile, shows the average WACC for the same three countries since 2000, based on available data.

Charts 2 and 3 represent the costs of equity and debt, respectively, in the same countries. Finally, Chart 4 graph shows the average debt ratio of the same motorways over this period.

Firstly, we note that, despite different debt ratios, the average WACC for European motorways under concession is remarkably similar and follows a long downward trend.

This trend can be explained by several factors:

- The cost of equity capital, which peaked in 2012 when the European real economy was suffering the consequences of the 2008 financial crisis, then followed a sharp downward trend until 2017. This decline in the cost of risk coincided with the growing investor interest in infrastructure projects during this period. Despite their low liquidity, the share of these investments increased in institutional portfolios, and the assessment of the cost of risk moved towards a new equilibrium.
- In other words, until institutional investors became interested in these assets, they were cheap relative to the risks involved. Historical equity investors in this type of business also have a higher cost of capital. They are less able to diversify the risks of infrastructure projects since this is often their core business. Conversely, institutional investors can better diversify these risks and therefore require a lower return to take them on.
- The cost of debt for concessionary companies has also followed a downward trend since 2008 and in particular between 2014 and 2016 and after 2018. This decline is largely linked to the fall in risk-free rates, as shown in Chart C1 in the appendix, since the risk premium has remained fairly stable at around 2% at least since 2015.
- Finally, there is a trend increase in the debt ratio in France between 2008 and 2018. The opposite

Table 1: WACC, cost of equity and cost of debt in French, Italian and Spanish toll road concessions between 2005 et 2020.

	WACC	Cost of equity	Cost of debt	After-tax cost of debt*	Leverage ratio
2005-2010					
ESP	5,07%	9,77%	5,30%	3,97%	77,52%
FRA	5,51%	11,09%	5,46%	4,09%	77,17%
ITA	5,17%	7,93%	5,19%	3,89%	70,25%
2010-2015					
ESP	4,69%	10,50%	4,67%	3,50%	80,31%
FRA	4,26%	10,03%	4,30%	3,22%	84,14%
ITA	4,16%	8,27%	3,78%	2,83%	61,27%
2015-2020					
ESP	2,33%	4,71%	2,37%	1,77%	75,63%
FRA	2,28%	6,12%	2,31%	1,72%	86,48%
ITA	2,39%	5,67%	1,91%	1,43%	73,99%

Source : EDHECinfra, *Average corporate tax rate 25%

trend can be noted in Spain due to the disappearance of nine motorway concessions that went bankrupt in 2012-13 (see Garcia *et al.* 2018 for a detailed case study). This increase in the share of debt in the financial structure of motorway concessions naturally contributes to the decline in the WACC over time.

Thus, by calibrating the level of the WACC for motorways with contemporary market data, we can see that the average cost of capital in France was indeed around 6% in 2010, as recommended by the DTI of the Ministry of Transport. It can also be seen that this rate, having risen until the financial crisis of 2008-2010, then fell steadily in trend until it dropped below 2% at the end of 2019. It then rose at the beginning of 2020, to just above 2%, due to the Covid-19 crisis and its impact on the cost of capital of infrastructure companies, in particular those providing transport services.

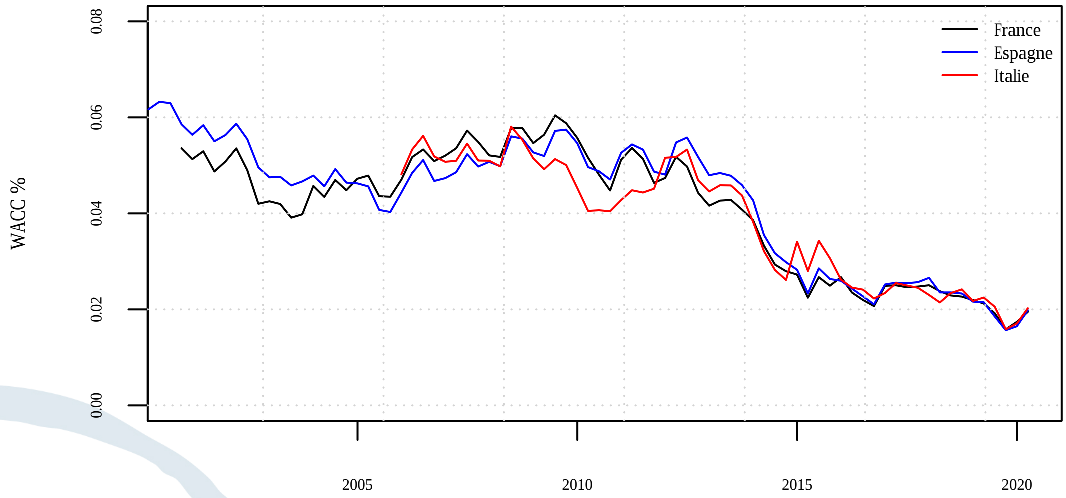
The current market rates therefore remain well below the WACC rates negotiated by the concession holders with the State. In its reply to the European Court of Auditors in April 2019, the Ministry of Transport reported a rate of 5.9% for the latest plan contracts, which may still seem high in the light of market data.

The standard method based on the CAPM model reveals its real limitations here: because of the use of raw data smoothed over long periods for the beta or the risk premium, or even for the risk-free rate, the resulting estimates are anchored in past market price levels and take all the longer to catch up with the reality of prices, especially as prices have changed rapidly. Thus, when the Regulatory Authority gives an opinion on the relevant cost of capital, it is also upstream of the negotiations and therefore based on data that only prove to be unsuitable several years later.

In the space of a few years, the risk premium for infrastructure projects has been significantly reduced. This decline comes mainly as a result of the increase in transaction prices due to the attractiveness of these investments for institutional investors, as well as the fall in interest rates.

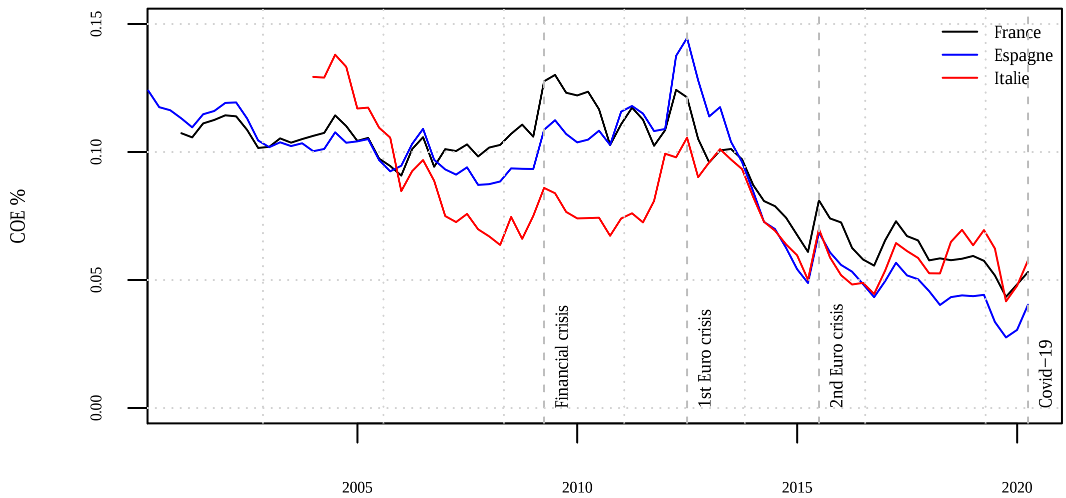
We therefore also see the limit in the traditional method of regulating concessions. This has consisted of fixing the cost of capital by contract – mainly on the basis of negotiations which are themselves driven by outdated estimates – and then no longer being able to change it. Meanwhile the concession holders for their part are subject to market prices, including on the capital markets.

Figure 1: Evolution of the WACC of european toll road concessions



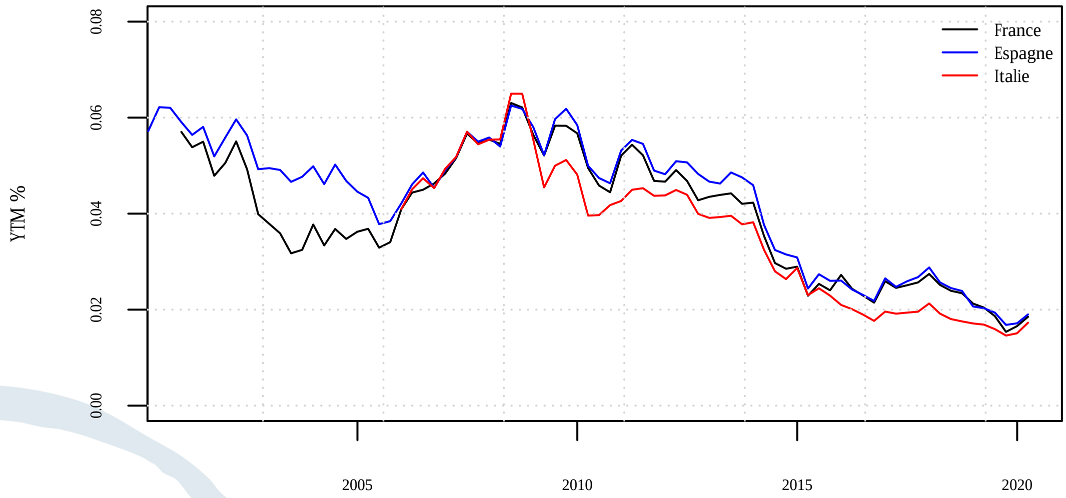
Source: EDHECinfra

Figure 2: Evolution of the cost of equity of european toll road concessions



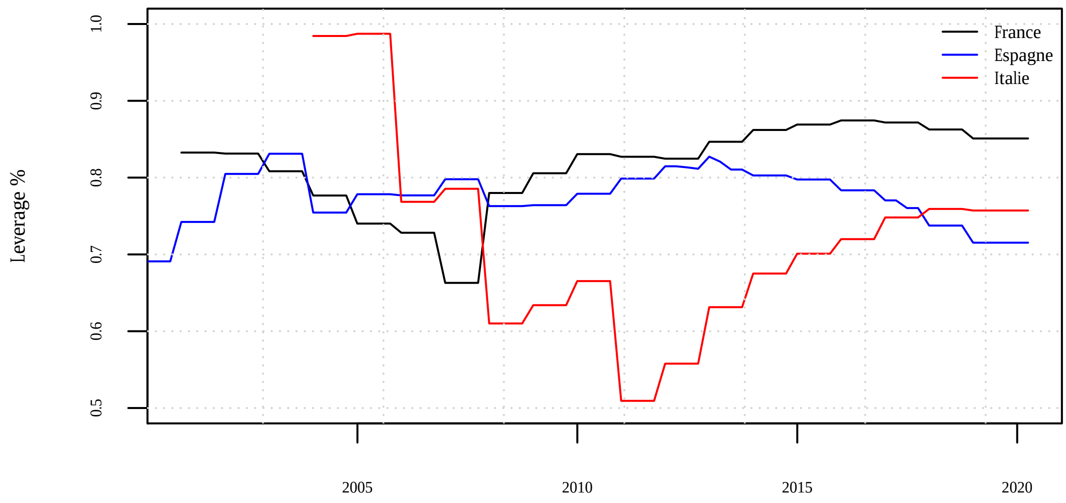
Source: EDHECinfra

Figure 3: Evolution of the cost of debt of european toll road concessions



Source: EDHECinfra

Figure 4: Evolution of the leverage ratio of european toll road concessions



Source: EDHECinfra

It should also be noted that the cost of equity and debt of the French concessions, estimated by the EDHEC*infra* method over the most recent period (see Table 1, 2015-20) are quite reasonable at 6.1% and 2.3% respectively. Of course, these results apply on average and may vary from concession holder to concession holder. The most recent concessions can be considered riskier both in terms of construction and operating costs and future traffic. In France, depending on the year, there is a difference between the WACC for the lowest and highest motorways of 100-200bp.

Conversely, using for example the data reported by the Regulatory Authority in its 2019 report on the summary of motorway concession accounts (page 38), with an average debt ratio of 82.2% in 2018, an average cost of debt of 2.6% and a WACC of 5.9% as that used for the MIP plan contracts, using the WACC formula, we obtain an implicit cost of equity capital of around 24% (see details of the calculation in Appendix A), which may seem very high in view of the market data available.

Sensitivity of discounted revenues to the choice of WACC

What are the implications of this clear difference between the concession holders' WACC as measured based on market data and the rates reported by the Ministry and in the concession contracts?

It should be noted that the WACC negotiated by the concession holders with the public body relates to each plan contract: in other words, the WACCs set out in the concession contracts and the reports of the European Court of Auditors refer to the discount rate for the difference in costs (additional construction works) and the additional revenue allowed by toll increases or contract extensions. The WACC as a whole, and ultimately opposed to the State by the concession holders, is not public. Nonetheless, the rates recently negotiated under the MIP appear to be significantly higher than those that can be measured based on market data.

It is therefore fair to ask what impact a reduction in the overall WACC for concession holders would have on the current level of tolls. This can be done, for example, by calculating the sensitivity of the NPV of future concession holders' revenues to a 1% change in the WACC. Thus, at constant construction works, traffic and operating costs, a reduction in the WACC implies an increase in the NPV of future revenues, which roughly corresponds to the potential toll reduction that would bring the concession back to equilibrium.

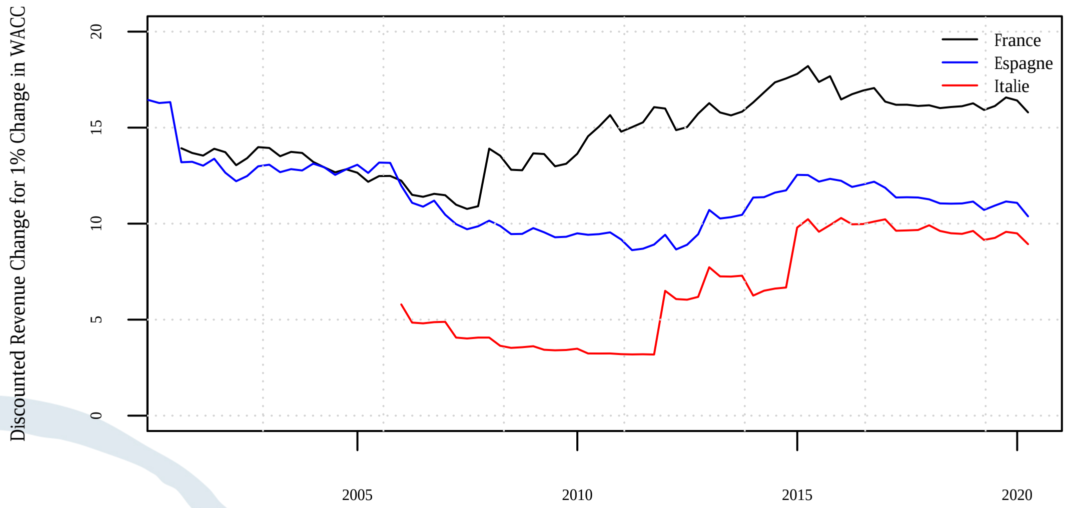
Chart 5 shows the evolution of the average sensitivity of the discounted revenues of French, Italian and Spanish motorways assuming a 1% change in the discount rate. This is the same calculation as for the modified duration of a bond but using future income and the WACC estimated by EDHEC*infra* as the discount rate (see Appendix B).

We can see that a 1% (100bp) reduction in the WACC applied to all concession revenues (tolls) would allow a reduction in tolls (at constant traffic and construction works) of more than 15% on average in the French case, and of 10-12% in the case of the Italian and Spanish concessions. The greater sensitivity of French concessions is due to higher revenue growth since 2010, as shown in Chart 6.

It should be noted that in the absence of an estimate of the overall WACC negotiated by the concession holders (as opposed to the WACC for each plan contract) it is difficult to know at what level the WACC could in principle be revised to reflect market data. However, in view of the rates posted by the Ministry of Transport in its response to the European Court of Auditors in April 2019, the margin of decline in the WACCs for French motorway concessions seems significant.

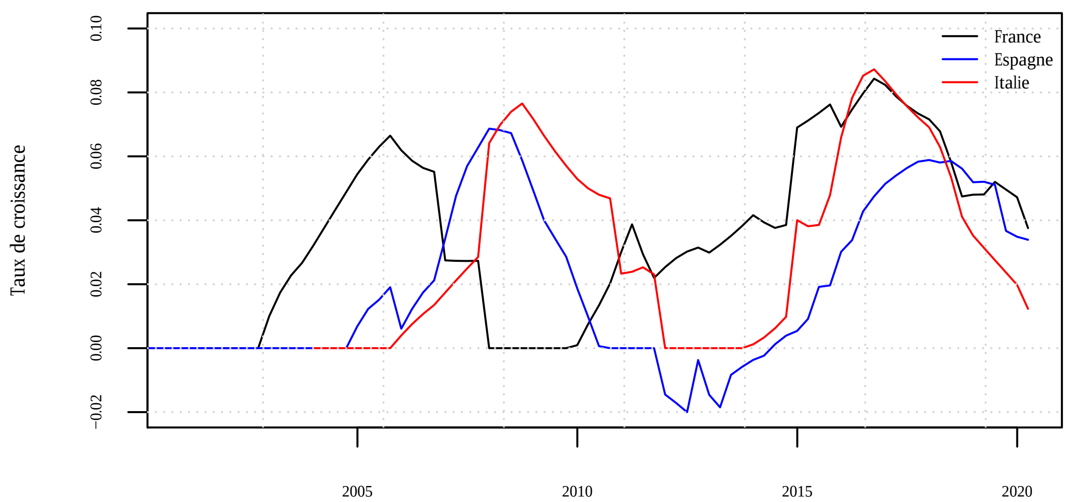
We therefore consider that the simulation of a 1% decline gives a relevant granularity for

Figure 5: Sensitivity of the discounted value of future revenues to a 1% change in teh WACC - Average value for multiple concessions



Source: EDHECinfra

Figure 6: Median revenue growth in European toll road concession



Source: EDHECinfra

the impact of a potential reconsideration of the overall WACC for concessions. On the other hand it is small enough that – given the very large difference between the actual WACCs used in existing contracts and the WACCs estimated by our model – there is no risk that it could lead to the use of a rate that would undermine the financial equilibrium of a concession. Of course, the same sensitivity analysis of the present value of revenues to the WACC on a project-by-project basis (i.e. rider-by-rider basis) could also be considered.

5. Conclusion

We have shown the importance of measuring the cost of capital in rebalancing motorway concession contracts in France. These rates are estimated based on an unsuitable and not very robust method (the CAPM) and, moreover, give rise to negotiations that make them completely *ad hoc*.

Instead we favour a discount rate set in relation to the market on the basis of a method adapted to unlisted assets and representative data from infrastructure projects and, in this case, motorway concessions. This choice makes it possible to better estimate the cost of capital of infrastructure concessions and to monitor their evolution over time without these estimates being anchored in increasingly outdated past data.

We propose a method already implemented by EDHEC*infra* to produce each quarter hundreds of performance indices of the different segments of the non-listed infrastructure market.[1] Our results use the world's largest database of financial flows and secondary transaction prices for infrastructure projects, covering hundreds of projects over nearly two decades. The data is used to calibrate a multifactor model of the cost of capital of infrastructure companies.

When applied to French and Southern European motorways, this method enables the estimation of their "mark to market" WACC. This shows that the discount rates negotiated by the concession holders with the French State are ultimately much higher than those induced by the markets. It can therefore be concluded that the compensation obtained by concession holders under recent plan contracts, including toll increases, could be lower based on available market data.

1 - See indices.edhecinfra.com

By retaining such elevated rate levels, the State has probably put an end to the litigation arising from its unacceptable position with regard to contract law taken in December 2014 and at the same time stimulated motorway investment. However, in the end this negotiation has been to the detriment of the (road) users.

It is unfortunate that, in order to conduct the most recent negotiations, the State did not provide itself with the expertise and information that are readily available to defend its interests, or at least those of the users it also represents in negotiations with motorway concession holders.

We show, for example, that a 1% (100bp) reduction in the WACC applied universally to concession holders, would bring it closer to market values. This cut should also make it possible to reduce tolls in France by more than 15% without fundamentally changing the economic equilibrium of the concessions.

These results also underline the need for a system for regulating concession contracts that can consider changes in market values, which are fundamental parameters for assessing the economic and financial equilibrium of such contracts. It should be noted that in the event of an increase in risk premiums reflected by the market, which is conceivable in a long-term perspective, such a mechanism would also protect concession holders.

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A. Calculation of implied return on equity

Knowing that:

$$
\begin{aligned}
CMPC =& \frac{E}{D+E} \times COE + \frac{D}{D+E} \times COD \times (1 - tax) \\
=& (1 - LEV) \times COE + LEV \times COD \times (1 - tax)
\end{aligned}
$$

With $LEV = \frac{D}{D+E}$ the firm's Leverage Ratio, COE the Cost of Equity and COD the Cost of Debt, the firm's overall cost of debt.

If $CMPC = 5.9\%$ as indicated by the Ministry of Transport (MdT, 2019), $tax = 28\%$ and according to the data published by the Transport Regulatory Authority $COD = 2.6\%$, and $LEV = 82.2\%$ (Arafer 2019, P. 38), then:

$$
\begin{aligned}
0.059 =& (1 - 0.822) \times COE + 0.822 \times 0.026 \times (1 - 0.28) \\
0.059 =& 0.178 \times COE + 0.021372 \times 0.72 \\
0.059 =& 0.178 \times COE + 0.01539 \\
COE =& \frac{0.059 - 0.01538}{0.178} \\
COE =& 0.245
\end{aligned}
$$

i.e. an implied cost of equity capital in the order of 24.5% in 2018.

B. Calculation of the sensitivity of the present value of income to the discount rate

The modified duration of a bond measures the change in its price for a one-percentage-point change in its rate of return. It is expressed as a percentage. This sensitivity is calculated by considering the derivative (log) of the price of the security in relation to its forward yield, i.e. its discount rate.

For a security of value V and maturity T, we have:

$$V = \sum_{i=1}^{T} PV_i = \sum_{i=1}^{T} CF_i.\exp^{-y.t_i}$$

With y the term yield and continuous capitalisation, the duration is obtained this way (see Fabozzi, 2012):

$$MOD \equiv -\frac{\partial \ln(V)}{\partial y} =$$

$$-\frac{1}{V}.\frac{\partial V}{\partial y} = -\frac{1}{V}. - \sum_{i=1}^{T} t_i.CF_i.\exp^{-y.t_i}$$

$$= \frac{\sum_{i=1}^{T} t_i.CF_i.\exp^{-y.t_i}}{V}$$

$$= \frac{\sum_{i=1}^{T} t_i.CF_i.\exp^{-y.t_i}}{\sum_{i=1}^{T} CF_i.\exp^{-y.t_i}}$$

Similarly, the sensitivity of the present value of the revenues of a motorway concession can be calculated in relation to the WACC, i.e. the relevant discount rate.

The sensitivity S is then calculated:

$$S = \frac{\sum_{i=1}^{T} t_i.Revenus_i.\exp^{-cmpc.t_i}}{\sum_{i=1}^{T} Revenus_i.\exp^{-cmpc.t_i}}$$

S, therefore, expresses the change in the present value of the concession's revenue, for a change in its discount rate, and therefore in the WACC, of one percentage point.

C. Components of the cost capital of motorways in France, Italy, and Spain

Figure 7: Components of the costs of equity in French toll roads

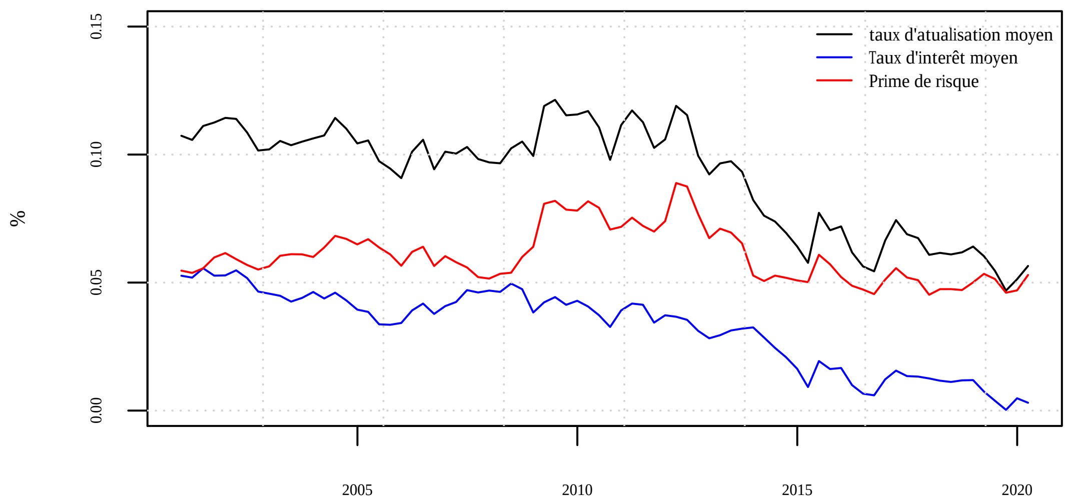


Figure 8: Components of the costs of equity in Italian toll roads

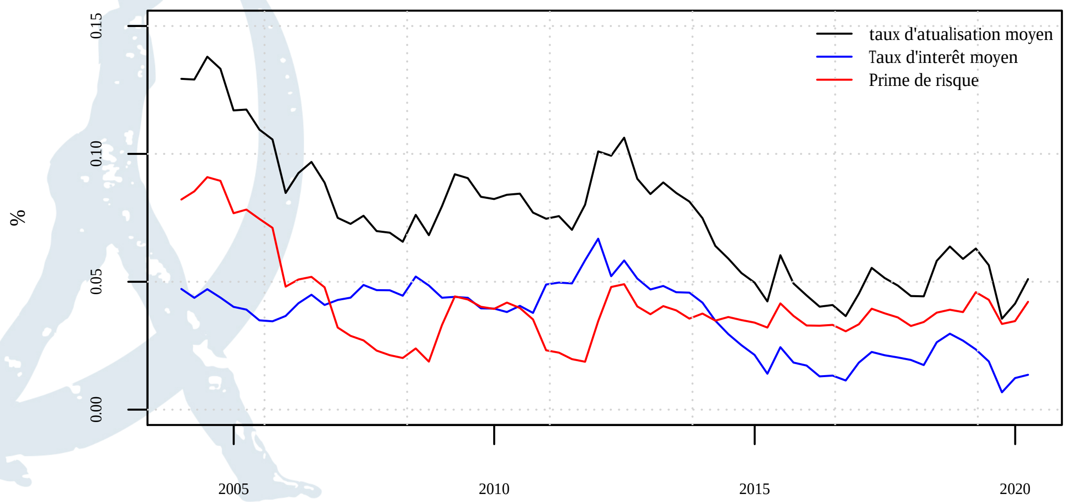
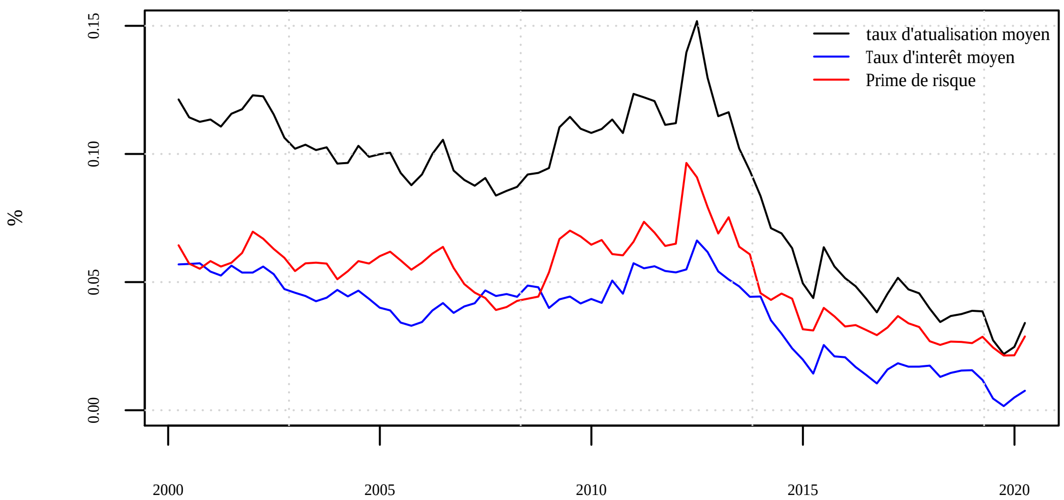


Figure 9: Components of the costs of equity in Spanish toll roads



Source: EDHECinfra

Figure 10: *Components of the costs of debt in French toll roads*

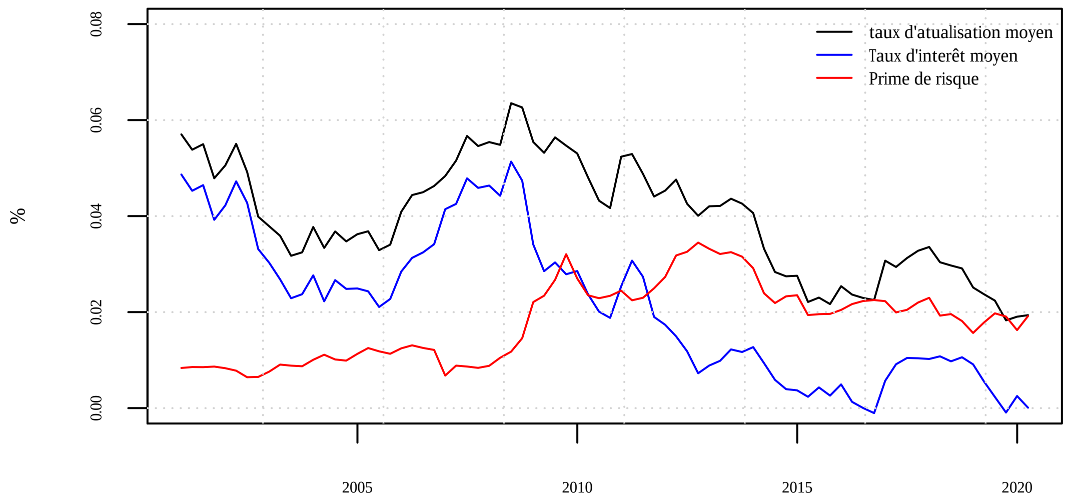


Figure 11: *Components of the costs of debt in Italian toll roads*

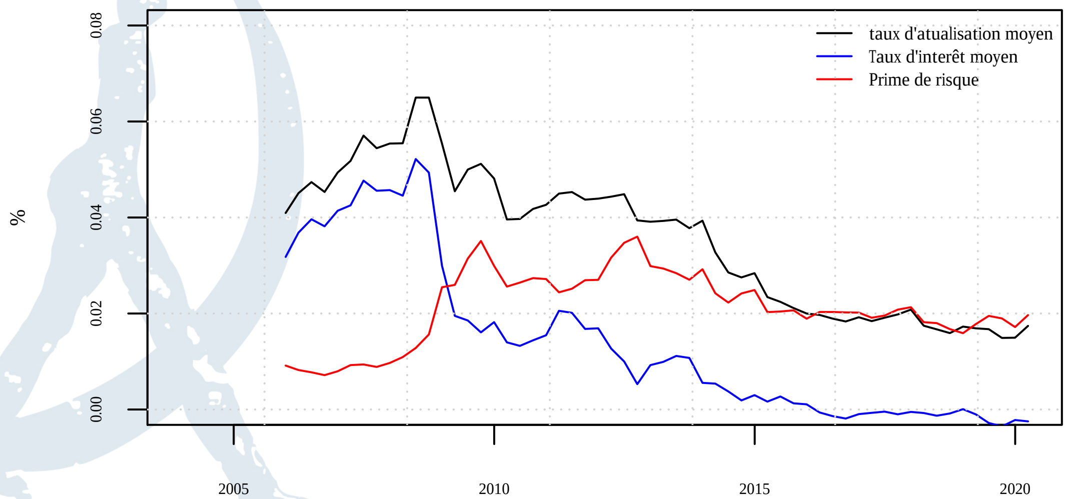
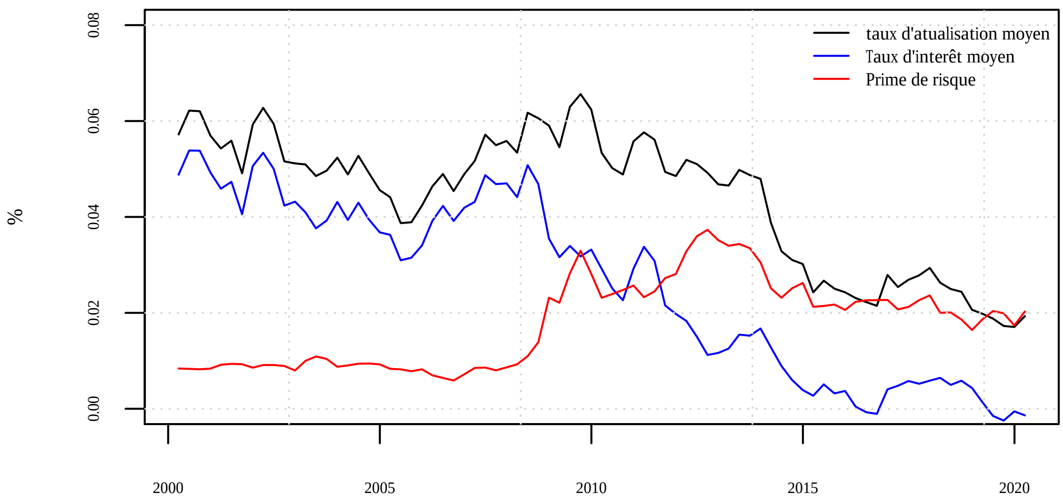


Figure 12: *Components of the costs of debt in Spanish toll roads*



Source: EDHECinfra

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- Credit Risk Methodology - April 2020
- Infrastrcuture Index Methdology Standard - Updated March 2020
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