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► To cite this version:

Alain Bonnafous. Analysis of the System of Transport Appraisal Implemented in France and some Methodological Innovations. ITF Roundtable “Broadening Appraisal to Capture the Full Impact of Transport Investments”, International Transport Forum (Paris), Sep 2021, Paris, France. pp.31-34, <10.1787/a0e2e0a6-en>. <halshs-03794945>

HAL Id: halshs-03794945

<https://shs.hal.science/halshs-03794945v1>

Submitted on 18 Oct 2023

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Preparatory report of the Round Table of the International Transport Forum

September 29 - October 1, 2021

Broadening the scope of transport appraisal to capture the full impact of investments:

Analysis of the system of transport appraisal implemented in France and some methodological innovations

Alain Bonnafous

1. Introduction

The purpose of this report is to clarify how the principles and methods of evaluating transport policy have evolved in France, by examining in particular the dimensions of evaluation that go beyond cost-benefit analysis (CBA), dimensions generally referred to as wider economic benefits (WEB). The parameters of WEB evaluation will be clarified by considering what ex-post evaluation can achieve and by focusing in particular on the use of permanent observatories of the socioeconomic effects of infrastructure projects.

The concept of WEB has been widely discussed, including in the ITF Roundtable meeting of October 2007 on “The Wider Economic Benefits of Transport” (ITF 2008) and the ITF Roundtable on “Quantifying the Socio-Economic Benefits of Transport” (ITF 2016). The theme has also been approached from the perspective of what ex-post analyses can provide (Weisbrod, G. 2016).

The literature on this topic is actually much older. It can even be argued that, since the seminal work of Jules Dupuit (1844) on CBA in the middle of the 19th century (Bonnafous A. & Rothenfatter W., 2018), transport economics has continued to develop by incorporating elements that could be considered as wider effects. To an assessment which initially took into account only monetary costs and revenues and user surpluses, various externalities were gradually added, such as effects on security in the 1960s, environmental effects in the 1970s, risk analysis in the 2000s, etc.

In short, a good way to take stock of the progress of CBA is to analyze how it has been able to integrate WEBs. This choice is particularly clear in recent methodological reviews (Venables, A. J. 2016).

In this report, the notion of WEB will be understood in the broad sense. Roger Vickerman (2018) underlined the difficulty of clearly distinguishing two ways of defining these broader effects. One is to consider that they are effects not taken into account by the CBA; the other is to define them as secondary consequences of direct effects, which, in turn, are generally assessed by the CBA. Thus, a new investment can cause an improvement in transport supply and an increase in demand, which are incorporated appropriately in standard assessment. These effects may, for example, result in land value increases in the areas served. In what follows we will consider such consequences on land values as

WEBs while they could also be interpreted as the internalization of a positive externality (internalization of user surpluses) already taken into account in the socio-economic evaluation of internal rates of return on investment (IRR).

This paper considers two categories of WEB (negative effects) that are too often ignored but which lend themselves to an ex post evaluation: on the one hand, the redistributive dimension of the benefits of an operation, whether social redistribution or spatial redistribution; on the other hand, when several candidate investments are involved in ex ante evaluations and the question of the optimal order of their implementation arises, it can be very instructive to measure ex post the possible losses that the actual order of implementation may have entailed.

The report begins (Section 2), with a quick historical presentation of developments in France in assessment practices and the laws and regulations that require them. The usefulness and implementation of ex post evaluations will then be discussed (Section 3), whether simply for feedback or out of methodological necessity, in particular for the WEBs that were expected to materialize which were a factor in the decision to invest. This methodological dimension will naturally lead to discussing the use of permanent observatories (Section 4), such as those now implemented in France after the construction of major motorway projects or new high-speed rail lines. The redistributive dimensions will then be discussed, in both their spatial and social dimensions (Section 5). The usefulness of an ex post evaluation of the order of completion of candidate projects, generally neglected by the literature and by official evaluation methods, will then be considered with a concrete illustration of the cost to the community of a sub-optimal ranking. Some provisional lessons will be identified in the conclusion (Section 6).

2. Stages of the quest to identify the full impact of investments in France

As in most industrialized countries, the economic evaluation of infrastructure projects reached methodological maturity in France half a century ago with the publication of an official Instruction on “Calculations of profitability of road investments” (Ministry of transport, 1970). It specified the approaches to be adopted in addressing the usual difficulties of *ex ante* evaluations (reference situation, growth assumptions, time values, crash costs, updated balance sheet rules, etc.). This was the result of a long methodological evolution, carried by the engineers of the Ministry of transport, since the paper by Jules Dupuit (1844), who initially proposed the concept of user surplus and thus gave an operational content to the collective utility of new infrastructure that is free at the point of use. This operational assessment of surpluses was adapted very easily to the case of toll roads, the toll being only an internalized portion of the users' surplus in the free situation.

2.1. Successive improvements

From the 1970s onwards, other effects were added to the assessment as advancing scientific knowledge made it possible to establish the monetary equivalents of their physical impacts. These are mainly externalities corresponding to effects of noise pollution, and local or global emissions. Continuously enriched by multiple studies conducted in OECD countries on external effects (UIC, 2018), the methodology has remained based, in each country, on the most recent results of their own research.

In France, the official guidelines on assessment are based on successive scientific reviews commissioned by the government, in particular the reports by Marcel Boiteux (1994 and 2001) and Emile Quinet (2014). The most recent Government directive (2014) thus incorporates the lessons of these scientific assessments and includes 37 guidance notes, which are instructions for use by assessors for each of the categories of effects. The list of these notes illustrates well the field of evaluation has evolved in France and is reproduced in Appendix 1 of this report. The guidance is updated regularly, as illustrated in note No. 6, which concerns “Provisional scenarios for the evolution of GDP for the performance of Covid sensitivity tests”, a sheet that was obviously not present in the initial edition of the directive in 2014. Table 1 sets out the headings under which the guidance notes are arranged, indicating their main content.

Table 1: Key elements of the French Government's transport project appraisal toolkit

Headings	Principal contents
1. Introduction	General principles for using the toolkits
2. Strategic analysis	Project objectives, definition of long-term reference situations (base cases), provisional post-COVID scenario.
3. Analyses necessary for the realization and evaluation of the project	Study area, transport demand analysis, capital and operating costs.
4. Qualitative and quantitative impact analysis	Effects on employment, health, safety, environment, local areas, economic activity, user comfort (14 guidance notes)
5. Monetisation	Recommended monetary values, opportunity cost of public funds, impact assessments for each affected group.
6. Financial analysis	Financial and risk analyses
7. Summary of the evaluation	Scenario analysis to facilitate the comparison of options
8. Ex-post evaluation	List of data to be collected as part of the ex-post evaluation

Source : <https://www.ecologie.gouv.fr/evaluation-des-projets-transport>

We can also observe that the question of wider effects is integrated into these recommendations, in particular in the notes under heading 4 and that their authors have endeavored to clarify the methodological precautions required in relation to cost/benefit analysis and to assess WEBs as effectively as possible. This is the result of much intensive research, commenced long ago.

2.2. Earlier research

The first publicly funded studies of WEB in transport projects were conducted in Europe half a century ago. The dominant problem was not then to broaden the socio-economic evaluation, but rather detection of effects that the standard evaluation cannot take into account and which were designated as indirect effects or structural effects of investments. The European Conference of Ministers of Transport anticipated (ECMT, 1969) and then supported these initiatives (ECMT, 1975).

This concern not to confine the analysis to a NPV (net present value) of the project did not arise by chance in this period. At the end of the 1960s, it particularly concerned new motorway projects in incomplete networks where the most urgent investments for relieving bottlenecks were already underway. It was observed that the new projects presented more modest rates of return. Ministries of transport, including in France, sought to identify unaccounted for benefits advantages of the projects, to better select the "best" of the candidate projects or to make the choices part of a regional planning policy. The aim, however, is not to introduce them into the monetized values of an updated balance sheet.

This led to a number of ex post studies on this theme for large projects (CEMT, 1969 and 1975). For example the Milan-Naples motorway (Autostrada del Sole) inaugurated in 1964, the M62 in the United Kingdom (Lancashire-Yorkshire Motorway), the Severn Bridge which connects Wales and England or the A7 motorway which runs alongside the Rhône Valley south of Lyon.

The issues examined in these studies provide some lessons. First, each case has characteristics that highlight a specific problem. The motorway linking Lombardy, one of the richest regions in Europe, to the Mezzogiorno, the one of the poorest, raised questions of regional rebalancing. The French Autoroute du Soleil (A7) or the British M62, serving areas of similar development, focused on impacts in the communities crossed by the new and existing roads, and for the second, questions of urban hierarchy. The Severn Bridge brought about such a "coming together" of two regions that the impact of expanding market areas naturally arose.

Second, all the studies concluded that there are no systematic mechanisms linked to these major projects or that it is difficult, when economic shifts are observed ex post, to specify the role of the new infrastructure in relation to other factors. For example, a certain concentration of activities near motorway interchanges could be interpreted as an effect of new infrastructure, but also as the attractiveness of urban centers located, in general, near interchanges.

The work of this period finally concluded that when regional development is observed, apparently induced by these investments, it could reasonably be considered that it was a displacement of activity towards a better served region rather than a net creation of activity. Therefore, it was not so much a question of evaluating a possible regional enrichment as of learning to use infrastructure investments as instruments of regional planning in the sense of regional rebalancing (Bonnafois, 1979).

The initial problem of underestimated or poorly estimated value creation has thus gradually turned into a problem, at least as demanding, of understanding regional development mechanisms and the precise role that transport supply can play in them.

It gradually became accepted that it was not sufficient to study a few cases where new infrastructure spectacularly modifies travel time but to proceed more systematically to ex-post impact studies whenever the transport system is significantly modified.

3. The legal obligation of ex-post evaluations

The systematic practice of ex post evaluation or, more generally of feedback, was not in the French tradition in terms of transport policy. Perhaps because this country has a tradition which is part of an engineering culture, and a bridge whose technical characteristics have been well calculated rarely

collapses, CBA was seen as sufficient to know whether it was judicious to build it and there was no obvious reason for CBA to be more uncertain than calculation of the characteristics of reinforced concrete.

At the same time, the issue of wider effects had not been overlooked. Thus, the official instruction already cited (Ministry of Transport, 1970) mentions the "indirect advantages which do not immediately concern the road user, but which reflect the positive or negative effects of the project in relation to land use planning, urbanization, transport policy and more generally national or local economic development".

But it made clear that it is not possible "at least for the time being" to translate these effects into monetary value and add them to the assessment of direct effects. It is also warned against double-counting benefits, evoking the classic case that real estate gains in particular often duplicate time savings, resulting from a transfer of benefits over time rather than additional benefits.

We can therefore say that the stakes were well identified but that the "veil of ignorance" was recognized. With comparable reflections at European level, notably at the initiative of the European Conference of Ministers of Transport, this state of mind has led to a legal obligation for ex-post evaluation.

3.1. The law and "LOTI balance sheets"

Ex post evaluations of large transport projects were made compulsory by France's transport act, the "Loi d'Orientation sur les Transports Intérieurs" (LOTI) of December 1982. In 2010, this obligation was taken up and clarified in a new law called the "transport code", which updated the whole of the legislative system organizing the transport sector in France, including everything concerning the production of evaluation results (balance sheets) under the LOTI evaluation process.

Firstly, the contracting authority of a large infrastructure project carried out with the assistance of public funding (when these projects cost more than € 83 million as of today) is required to establish an ex ante evaluation and an ex post review. The authority responsible for construction has a period of 3 to 5 years after commissioning to carry out this ex post review.

This ex post evaluation must be publicised, in particular on the website of the contracting authority, for example the SNCF Réseau website for the railway projects that concern it or the concessionaire's website for toll motorways. It gives rise to an official opinion from the highest authority of the ministry responsible for transport (the General Council for the Environment and Sustainable Development or CGEDD). This notice is also disseminated on site and published in two national newspapers.

The objectives of these ex post reviews are clearly explained:

- To inform the public on the outcome of the project, in particular on the discrepancies between the observed results and the forecasts, and identify the causes of these discrepancies;
- To report on the use of public funds by evaluating ex post the economic, social and environmental effectiveness of the investments made;
- To provide feedback for improving the ex ante evaluation methods employed for future projects.

The procedure follows the classic approach: it involves producing a critical analysis of the forecasts and evaluations that informed the decision to carry out the project. This could be a problem for the entity that owns the project, which may be responsible for both the forecasts and the critical appraisal. This difficulty is theoretically overcome by the fact that, for rail, different departments are given these tasks within SNCF Réseau (the network manager). The LOTI report is entrusted to the “Audit and Risks Department” which is, by function, independent from the services responsible for ex ante evaluations.

For the motorways, the private concessionaires are certainly in charge of ex ante evaluations for their own planning purposes, but the evaluations that inform the decision to carry out projects with public funding are the responsibility of State services. In all cases, the LOTI report is supplemented by the opinion of the independent body previously mentioned (CGEDD).

Whether it is the actors involved or the nature of the investments, the lessons that can be drawn from these exercises must be distinguished according to the major families of investments. In what follows we will limit ourselves to highway projects (par. 3.2.) and high-speed rail line projects (par. 3.3.), the other major projects being either few in number (railway electrification) or too specific (metros or trams) for general lessons to be drawn from them.

3.2. Some lessons learned from the “LOTI reports” for motorway projects

The very first lesson to be learned from the LOTI assessment of a project, of course, concerns its socioeconomic profitability. We have therefore chosen to focus our report on this dimension which is summarized in a table in Annex 2, which lists the projects whose ex post results have been the subject of an opinion by the CGEDD. These comprise 13 major projects, 15 in terms of ex ante evaluation because two projects were carried out in distinct phases. We can summarize things by observing that in a majority of cases, there was a drift in costs, but that for two thirds of the cases the traffic observed was higher than the traffic forecast.

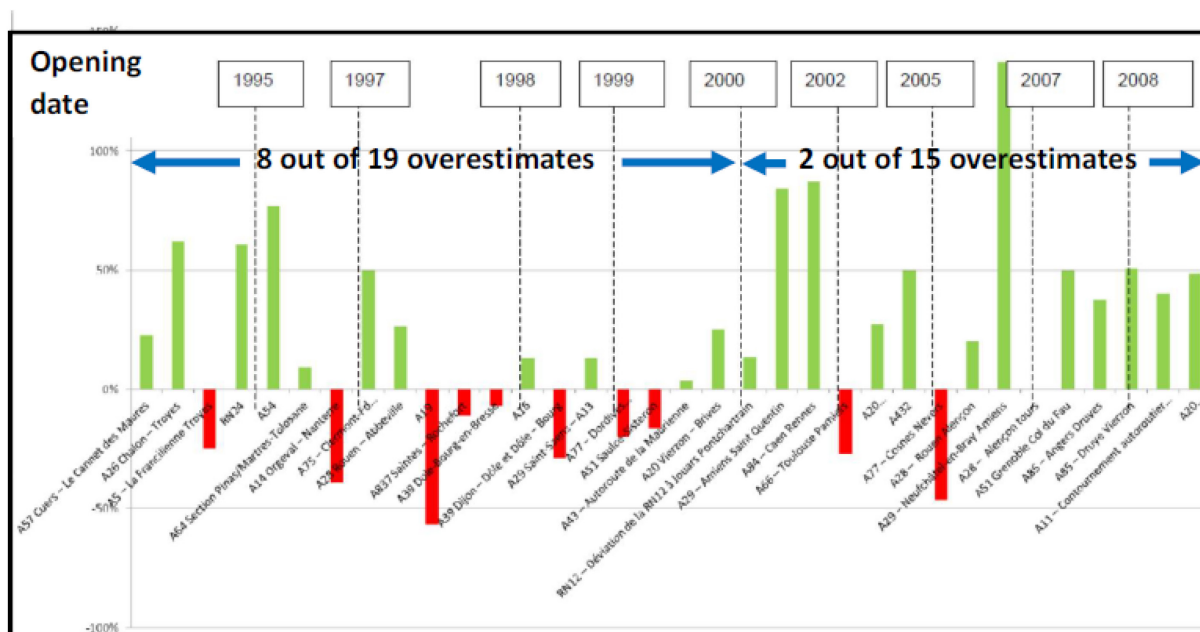
Regarding the cost drift it should be noted that the projects concerned in the table were almost all carried out by motorway concession companies, which until the beginning of this century did not operate in a competitive environment. Five companies, only one of which was privately owned, shared the territory and any new project was naturally entrusted to one of these companies. If its financial profitability was not sufficient to cover the costs, a process called “piggy-backing” consisted of asking the concessionaire to undertake this project without a subsidy with, in return, an extension of existing concessions.

Ending this practice was the result of the transposition of Community Directive 93-37, which abolished the protection from competition previously enjoyed by established motorway companies. Ending this method of financing was convenient for the public authorities because any new section could be financed by the profits generated by the elements of the network already depreciated. New calls for tenders for concessions have seen the appearance of competition from private operators, previously excluded, and but also subsidies which were previously camouflaged by the piggy-back system.

The first project awarded under the new system resulted from a European call for tenders for the Rouen–Alençon section of the A28 motorway. 125 km long, it was conceded to a private consortium and commissioned in 2005. The overall cost of building the section of 917 million euros was 60% financed by the concessionaire (own funds and loans), 20% by subsidies from the State and 20% by subsidies from

the regional authorities of Normandy. Traffic forecasts were met and costs were kept under control, resulting in an ex post socio-economic rate of return (ERR) higher than the planned ERR. We must wait for the results of more recent concessions awarded under this competitive regime to confirm that the concessionaire's responsibility for costs favors their control.

Figure 1 : Difference between observed motorway traffic and traffic forecast



Source : CEREMA (2018)

We observe that the proportion of overestimated forecasts is much greater in evaluations prior to the year 2000 (8 out of 19) than in the following decade (2 out of 15). Here is the mark of the usefulness of feedback. It is recognized that forecast errors have two main reasons, firstly the weaknesses of traffic simulation models and secondly errors in hypotheses for the evolution of the determining factors of mobility. On the first point, we can admit that constant progress has been made in traffic modeling, in particular in the modeling of price-time trade-offs and the estimation of the parameters of the discrete choice models.

However, the systematic comparison between forecasts and outcomes clearly concluded that the first cause of error was the long-term economic assumptions necessary for the definition of reference situations and the simulation of mobility (CEREMA 2018). It is in fact clear that the ex ante evaluations carried out in the 1980s (corresponding to commissioning in the 1990s) were based on overestimates of growth prospects. It is certainly one of the uses of the LOTI balance sheets to have given rise to more

cautious growth assumptions for the projects evaluated in the 1990s and put into service in the 2000s, to the point of having overestimated forecasts of traffic in only two out of 15 cases.

3.3. Some lessons learned from the “LOTI reports” for high-speed lines

The table in Annex 3 summarizes the ex ante and ex post values of the internal rates of return of the 6 projects concerned, whether it concerns financial profitability (internal rate of return, IRR) or socioeconomic profitability (economic rate of return, ERR). The two are obviously correlated because both depend on costs and traffic. It can be observed that for each of the six projects the observed rates of return were lower than the expected rates of return. According to LOTI reports, the differences in profitability between the planned and the actual are a result, on the one hand, of often poorly controlled costs and, on the other hand, of traffic that does not always meet what was planned for. These reports say little about delays in commissioning, while these have a mechanical effect in undermining IRRs and ERRs. This impact has been formally characterised and quantified in relation to the socioeconomic characteristics of projects (Bonnafeous A. & Faivre d’Arcier B., 2018). For a project that has an IRR close to 8%, a delay representing 20% of the duration of the works leads to a reduction of the IRR to 6%.

The table below suggests that a significant part of the IRR cuts are likely explained by this difficulty in meeting deadlines and, therefore, the CBA established ex ante. Delays are expressed as a percentage of the planned duration of the work¹.

Table 2: Delays in commissioning and loss of profitability

	Atlantique	Nord-Europe	Interconnexion Ile-de-France	Rhône-Alpes	Méditerranée	Est (Phase 1)
Delay (%)	13 %	7 %	50 %	9 %	75 %	28 %
IRR loss (%)	-4.4 %	-10.0 %	-7.3 %	-2.9 %	-3.9 %	-7.2 %

Source: CGEDD (2018) and LISEA (2018) and author's calculations.

Unexpected additional costs are added to these delays and frequently relate to infrastructure, which can sometimes be explained by additional investments or tight economic conditions in the public works market. They also relate to the costs of purchasing and operating rolling stock with cost changes whose unpredictability is hard to understand.

Four of these high speed line (HSL) projects were carried out by SNCF when it was an integrated company and the last two (LGV Méditerranée and LGV Est phase 1) by the network company RFF (which has since become SNCF Réseau). RFF was created by the 1997 reform, which organized a separation of the wheel and the rail. The 6 projects therefore had in common that they were carried out by a public enterprise benefiting, from a financial point of view from the State guarantee as a last resort.

Drifts in deadlines and costs probably played a role in the decision to carry out the last three high-speed line projects with various forms of public-private partnership: a concession for the Tours-Bordeaux line

¹ Il s’agit de la durée annoncée au début des travaux. Le retard est calculé sur la base de la date réelle de mise en service (source : LISEA, 2018).

(7, € 8 billion) and partnership contracts for the BPL line (Bretagne-Pays de Loire, € 3.3 billion) and for the CNM line (Nîmes-Montpellier bypass, € 2.3 billion). In all three cases, the commissioning took place in 2017 on the planned dates or with a little advance and no cost overruns were recorded.

One can however imagine that the lessons of the LOTI reports were not the only determining factor of the recourse to public-private partnerships, because in the case of France, the system of the motorway concessions constituted a favorable precedent. The high level of France's public debt ratio (under the terms of the Maastricht Treaty) has also favored this development, insofar as the debt of the rail system is likely to be consolidated in the public debt therefore because it benefits from a State guarantee.

3.4. The "LOTI balance sheets" and broader economic effects

Beyond consideration of traffic and elements of economic and financial profitability, the LOTI reports have endeavored to provide some information on the economic consequences of projects. The objective is, once again, to compare what could be observed after commissioning with what the project dossier promised.

Preparation of "public inquiry" files precedes the very official "declaration of public utility" to support the decision to carry out the project. They are presented to the populations concerned and generally mention elements that make projects attractive. Two main fields are concerned, economic activities and jobs linked to the site itself and then to the operation of the structure and, and on the other hand, all kinds of indirect economic effects foreseen. In both cases, the aim is to identify positive spin-offs in the regions crossed likely to compensate for the NIMBYism ("not in my back yard" opposition).

Regarding "direct jobs" we observe that the promised creations are generally not subject to observation. For example, for the six HSL projects listed in Annex 3, all of them reported in the public inquiry file a specific number of expected jobs. Only one of the six reports provides an ex post estimate: for the LGV Atlantique, a specific study estimated the site effect at 21,600 job-years, against 33,400 planned, and 11,000 job-years for equipment and rolling stock, against 20,000 planned. However, these results should be put into perspective because the retrospective reconstruction of such effects is formidably complex if it has not been the subject of data collection "in real time", as has been done more recently (see section 4).

The other indirect economic effects are very variable in nature, including in the often very ambitious public inquiry files on the expected consequences in terms of regional development. All the LOTI reports of high-speed lines are less conclusive about what is observed. The LGV Nord was supposed to strengthen the locations in Lille, but the balance between what left Paris to locate in Lille and the opposite movement is "very difficult to establish" according to the official text of the balance sheet. The Rhône-Alpes LGV was supposed to promote air-rail interchange at Lyon's Saint-Exupéry airport (served by the line) but the results show that only 0.5% of air traffic is concerned. The Mediterranean HSL was supposed to enable specific developments around the new stations of Valence, Avignon and Aix-en-Provence but the LOTI report does not indicate any significant effect. The LGV Est was reputed to reinforce Strasbourg's role as European capital and, perhaps in ironic terms, the LOTI report mentions a quote from the Strasbourg Chamber of Commerce evoking the fact that the city "has entered this class of large TGV towns".

In reality, when it comes to wider effects, these retrospective reviews have the greatest difficulty in establishing statistics or observations that would allow them to be either detected or invalidated. Each balance sheet feeds on data which, at best, requires heavy reconstruction and, at worst, no longer exists. LOTI reviews are thus reduced to picking up elements from academic studies which, fortunately, have been carried out at the initiative of local or national research institutes.

More generally, these reviews lead to the recording of methodological difficulties which join those encountered by retrospective studies conducted in various European countries and which were mentioned previously (see section 2.2.). These difficulties specific to retrospective studies quite naturally suggest the setting up of permanent observatories to develop the necessary expertise and record the necessary data.

4. The usefulness of permanent observatories illustrated with a few examples

The various ex post studies, including the LOTI reports, show difficulties in objectively establishing changes potentially attributable to the project studied. On reading this work, we can identify three families of difficulties.

4.1. The three handicaps of retrospective studies

In the first place, we must admit the ephemeral nature of certain data. This is simply because the phenomenon only lasts for a short while. For example, if we want to check what a project file promised in terms of job creation for the construction site, we can try to reconstitute the number of jobs of the companies solicited, although this can be onerous, and identify whether there have been many subcontracting arrangements that are the most important for the local economy. More generally, if we ask ourselves the question of what proportion of jobs mobilized are filled by the local population, it becomes more complicated to establish 4 years on.

Second, the retrospective study quite naturally comes up against what might be called the evaporation of data. There are obviously multitudes of files that are only available for a while and which then fall into a "recycle bin". The most significant is data on the tariffs offered to users, in particular when they are subject to yield management. In the case of air and high-speed trains, the range of fares offered for a trip on a given date varies according to the route, according to class, according to user categories and according to the chosen schedule. It thus gives rise to several hundred or even several thousand combinations for a given day of ticket purchase. The following day, each of the combinations may see its price change and the previous prices are no longer accessible.

The information has literally evaporated, including in the carrier's data stores, which only keeps this kind of information when a price-demand analysis is specially programmed.

Finally, the loss of memory of the actors involved represents a well-known difficulty in research. For example, identifying developments in the area served by the project that might have been inspired by it takes place over a long period: between the moment when news of planning for the infrastructure becomes probable to commissioning the project. This period is considered in France to be about ten years. This means that actors who have been able to play a particular role as local elected representatives or as company managers and who can be questioned in the period following the commissioning may have some difficulty in correctly reconstructing the chain of decisions.

4.2. Permanent motorway observatories

The retrospective studies already mentioned (ECMT 1969 & 1975) had clearly identified these difficulties and it is natural that one of the university teams concerned, the LET of the University of Lyon, took the initiative of a first experiment with a permanent observatory. Thanks to an ambitious national research program on "the observation of social change", the LET was selected for the experimental implementation of an observatory in a geographical area served by new motorway links in the Rhône-Alpes region. The work was launched at the same time as the entry into service of the A43 Lyon-Chambéry motorway (completed in 1974) and the A48 Lyon-Grenoble motorway (completed in 1975).

This observatory, which operated for 8 years, made it possible to monitor very closely a certain number of indicators sufficient to reveal demographic or economic changes in the 245 municipalities that made up the Lyon-Chambéry-Grenoble triangle (Gérardin et al., 1981). For example, industrial activity and its transformations were monitored by a monthly record of high and medium voltage electricity consumption for each municipality. This indicator was particularly effective in revealing local changes in industrial activity, such as an installation or a plant closure, and identifying changes sometimes several months before they were confirmed. For example through a drop in activity preceding a closure.

From a methodological point of view, this device has confirmed an explanatory power greater than that of a retrospective study. Indeed, this area was historically marked by the presence of an important community of textile industries scattered across small towns. The 1970s were marked by a deep crisis in France in the textile industry faced with competition from emerging countries. If a retrospective study had been carried out at the end of this period, we would have deduced from the effects of the motorway a loss of employment in the hinterland and a simple maintenance of activity near the interchanges. However, the immediate field surveys and subsequent to the detection of sudden changes in industrial production made it possible to sort out the local effects of the general textile crisis and those of the attractiveness of business areas located near the motorway.

More generally, this experience illustrated the greater effectiveness of permanent observation compared to ex post studies and confirmed that it was a relatively effective response to the ephemeral phenomena, to the evaporation of data and to the loss of memory.

This observatory also benefited, on the basis of its initial results, from the collaboration and then from financial assistance of the motorway company concerned, the Rhône-Alpes motorway company (AREA). Its interest in such an observatory went beyond the mere elements that determine the socio-economic profitability of the project and other motorway companies have gradually shared this point of view. They were naturally concerned because, in the 1980s, the decision-making process for large-scale infrastructure changed significantly, leaving more room for consultation and debate. This resulted in a requirement for knowledge because one of the main themes systematically addressed within the framework of these participatory procedures is obviously that of territorial development, which becomes an essential element of the social acceptability of the project.

This resulted in the gradual launch of motorway observatories by the Ministry of Equipment and by motorway concession companies. A dozen observatories were thus launched and have experienced varying degrees of success because these assessment systems were independent of any regulatory monitoring obligation except, for the concessionaires, their usefulness for the Loti balance sheet that

they were required to produce. A few observatories developed with university teams have, however, delivered valuable lessons.

This is how the A71 motorway observatory (Bourges – Clermont-Ferrand) operated between 1986 and 1997, with the participation of the CERAMAC laboratory of the University of Clermont-Ferrand and made it possible to identify several major effects in terms of territorial interaction (Varlet & Jamot, 2002). They documented, for example, the establishment of a chain hotel near the motorway and a tendency to bring motorway interchanges closer to companies located in the landlocked hinterlands and a "propagation wave" of second homes. The proximity of the motorway has clearly favored a process of urban sprawl marked by transfers of short-distance activities from urban locations.

Likewise, the A39 motorway observatory (Dole – Bourg-en-Bresse) operated, with the participation of the ThéMA laboratory of the University of Franche-Comté, from the start of the construction phase in 1993 until in 2004, six years after the last section entered into service (Bérion et alii, 2007). This is therefore a first case which has made it possible to obtain very precise results on the so-called site effects (local sourcing of equipment, staff consumption, payment of local taxes, etc.), then on the operation of the infrastructure (jobs mobilized by the concessionaire and subcontractors, payment of local taxes) and obviously on the levels and allocation of traffic.

The early start of this observatory made it possible to carry out an in-depth analysis of the effects on local production of the consolidation of agricultural land and to closely monitor the enhancement of the accessibility and proximity of the motorway for local development purposes. Regarding mobility practices or business logistics, the changes observed have been modest.

It should be noted that the production of the A39 observatory has considerably enriched the LOTI report by producing information that an ordinary ex post report would certainly not have been able to reconstruct.

For highway investments, the methodology of the permanent observatory is thus well proven. The accumulated experiences make it possible to clearly delimit the object of the observation of indirect effects, always very dependent on the potential of the spaces concerned and on exogenous determinants. Things are obviously different in the case of high-speed rail link investments.

4.3. The permanent observatories of the new high-speed rail lines

None of the six LOTI high-speed line reports mentioned in Appendix 3 has benefited from a permanent observatory. For a more recent project (the Rhine-Rhône HSL), a university observatory initiative should be noted (Richer, 2009). A number of retrospective studies have been conducted on the basis of university initiatives, from the first French high-speed line commissioned 40 years ago between Paris and Lyon (Buisson et al., 1986) to more recent lines such as the LGV Est from Paris to Strasbourg (Beckerich et alii, 2014). This abundant literature has in particular made it possible to specify the limits of retrospective analysis and to suggest that the new lines could give rise to a permanent observation of both direct and extended effects, in the same way as motorway projects.

There is also a political reason today to seek to identify broader benefits from high speed rail. This is because NIMBY opposition is gaining the upper hand over this category of investment while the first high-speed lines were relatively spared opposition. Even though they remain in great demand by the

regions and cities concerned, these high-speed lines leave "scars" on the territories crossed and can compromise natural spaces. Regional and local authorities are also systematically asked to contribute to the public part of the funding for these projects. They therefore quite naturally demand information on WEBs. They are also attentive to the evolution of the service offer once a project is in operation.

Thus, the launch of the most recent projects made it possible to initiate a permanent observatory system, in particular for the two most important lines whose contracts were signed in 2012 and which were put into service in 2017. The partnership contract for the BPL line (Bretagne-Pays de Loire, € 3.3 billion) and the concession contract for the line from Tours to Bordeaux called Sud-Europe Atlantique or SEA (€ 7.8 billion) included the obligation that the private operator set up and finance a permanent observation of the effects on the environment and on the economy of the territories concerned.

In the case of BPL, the obligation covers the 10 years after signing the contract, from 2012 to 2022, the year in which the operator must submit the LOTI balance sheet for the operation. In the case of Tours-Bordeaux, the obligation covers 5 more years, ie 10 years after entry into service. It should be noted that the grantor (RFF now SNCF Réseau) has voluntarily chosen to determine such a duration in order to take into account the fact that the extended effects are generally long-term effects.

In almost all of the work that we have mentioned so far, the authors have underlined difficulties arising from too little time passing from the date of commissioning. Thus, because of its duration, the socio-economic observatory set up by the LISEA concessionaire of this Tours-Bordeaux line (called OSE-LISEA), constitutes from a scientific point of view an unprecedented instrument for research, at least in France, which deserves examination.

4.4. The example of the Socioeconomic Observatory of the LGV SEA

The HSL from Tours to Bordeaux was put into service in July 2017. Its 300 km of new line allows full high speed from Paris to Bordeaux, which reduces the journey time from 3 hours to 2:05. The new line was the subject of a concession to LISEA, a subsidiary of VINCI. The concession contract provides for service to the city center stations of the current rail network, via a system of 10 connections between the HSL and the existing line which required 38 km of new lines. The main towns served by these connections are Poitiers and Angoulême (see the map in appendix 4).

In terms of financing, the concession system has made it possible to limit public debt. Of the total of 7.8 billion euros, the funding breaks down as follows:

- 3.8 billion contributed by LISEA, of which 20.3% in equity and the rest in loans;
- 1 billion provided by RFF based on a loan predicated on additional revenue from the expected increase in traffic on the pre-existing network;
- 3 billion in subsidies provided half by the state and half by the local authorities concerned.

It should be noted that the funding of local authorities concerned by TGV services using the new line aroused expectations from these authorities regarding the levels of service from which they should benefit. This aspect of things obviously has its importance in the economic and geographical scope of the observatory, which must thus cover the territories where there have been financial contributions.

The observatory was set up when work had barely started, which made it possible to avoid any loss of information on site effects. We can reasonably consider that the economic and social evaluation of

these effects was particularly complete, whether it concerns the multiplier effects of the works and their regional repercussions or the professional future of the employees employed on the site (Fouquerey, 2016).

The objectives of OSE-LISEA obviously go well beyond this first mission, which consisted in capturing all the ephemeral elements of this construction site effect. According to the terms of the concession contract, its purpose is to assess "the direct and indirect effects of the LGV SEA on mobility, the local economy and regional planning. The work drawn from the Observatory must be able to:

- be useful to local actors, so that they integrate the LGV as well as possible in their territory;
- participate in national reviews and arguments on the effects of high-speed rail lines and benefit from them as part of a forward-looking approach."

The result is an organization of the observatory that involves both state services and local partners. It is managed by a specific department of LISEA assisted by a scientific committee made up of academics² who help in the development of the work program. State services and local partners participate in a monitoring committee, which validates this program and evaluates the work. This work of OSE-LISEA is also the subject of regular feedback open to all interested local partners. The work program (LISEA, 2020) is organized around 6 axes.

A first axis concerns the construction site effects. We have already mentioned it and it is now considered complete.

The second axis concerns the supply of transport and traffic. This is obviously the most important topic for the future LOTI review. The information required concerns:

- the service offer within the meaning of the schedules offered in stations served by TGVs using the new line (given the strong competition with air travel on the longest connections, these schedules must be noted for both modes);
- the prices charged on this rail offer, but also on the offers of competing modes (which correspond to a typical case of information evaporation to which we will come back);
- demand, that is to say passenger traffic depending on the mode, which implies the organization of ex ante and ex post passenger surveys.

The third axis concerns the HSL station effects. Many observations have noted very significant urban developments (Bazin et alii, 2009, Richer et alii, 2009) near TGV stations. Town planning operations should therefore be closely monitored, taking into account that it may be useful to ensure this monitoring before commissioning given the expectations of stakeholders.

The fourth axis concerns the strategies of actors and organizations. The first contacts with local actors who spontaneously took an interest in the observatory's work program revealed very proactive behavior. They may have been inspired by an overestimation of the new transport offer. However, they can also result in real initiatives that deserve to be identified and analyzed because the "brand effect" of a TGV service has been noted in almost all the studies.

2 This scientific committee is chaired by the author of this report.

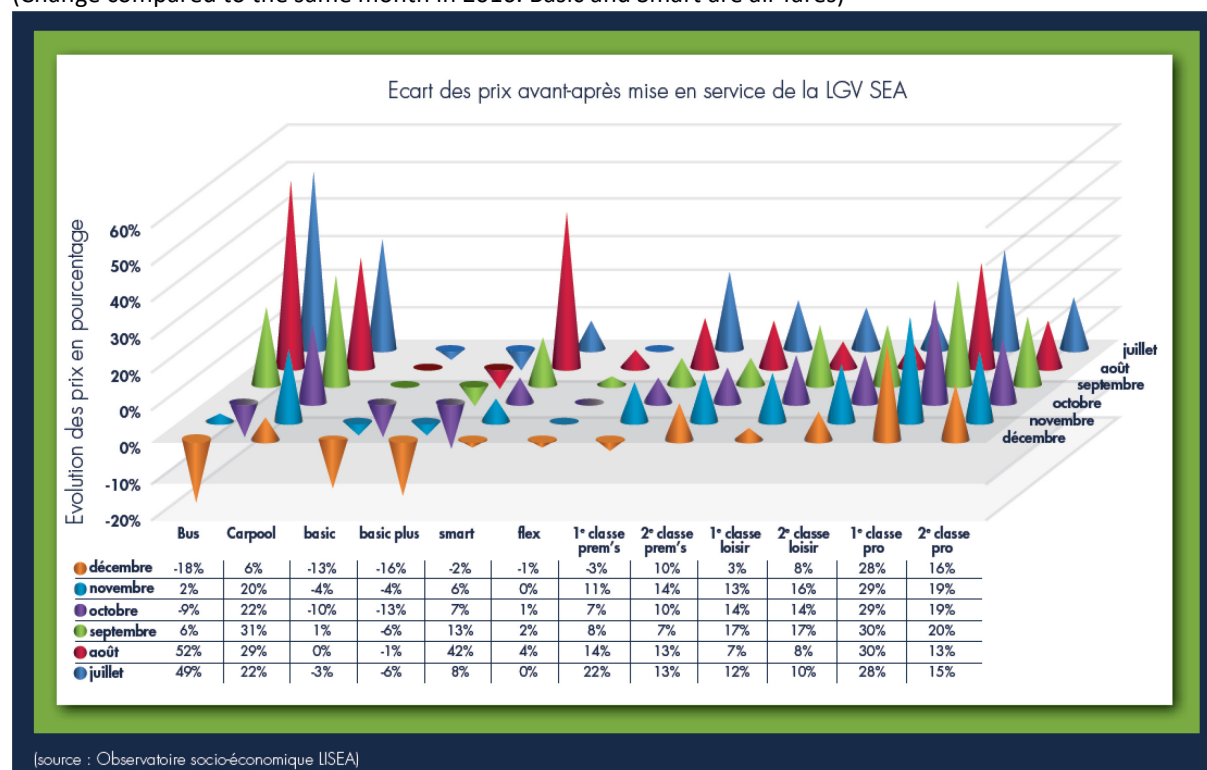
The fifth axis concerns metropolitan and territorial dynamics. This theme is essential when a HSL very significantly modifies the travel times between urban areas. Important results based on an ex ante / ex post study had been obtained from the first HSL in France (Buisson et al., 1986). The urban hierarchy, in which a regional capital like Bordeaux is involved, but also secondary cities which all have a particular relationship with Paris, is susceptible to profound transformations.

The sixth axis, finally, concerns the effects on tourism. This is a topic on which statistical sources are quite rich in France in terms of accommodation capacity or occupation rates. OSE-LISEA is however limited to areas likely to be strongly affected by the differences in rail supply and by the particular case of urban tourism.

For each of these axes, the observatory accumulates information from different sources: studies, student dissertations or theses and of course data collections. On this last point, ephemeral data is the subject of a special effort. For example, the data shown in Figure 2 represent the prices charged on the new line and on competing modes (including carpooling) in the months following entry into service. These prices were ascertained through requests on the sites of the various operators. Almost all of this data was no longer accessible in the days that followed, including in the databases kept by the operators.

Figure 2: Fares compared for different modes when the HSL came into service in 2017

(Change compared to the same month in 2016. Basic and Smart are air fares)



Source : LISEA (2018)

The OSE-LISEA has thus accumulated since 2012 an important database that will be particularly valuable for supplying the LOTI report, which must be produced in 2022. The concession contract also provides for the production of an “intermediate LOTI report” after the first year of commissioning. This was delivered and made public (LISEA, 2018) with relatively rich content. This content will obviously be further enriched in the actual Loti Report for 2022 with four additional years of observation. For example, an ex ante survey of air and train passengers carried out before entry into service will be of great interest when the ex post survey scheduled for early 2022 becomes available.

It should be noted in passing that the circumstances linked to the Covid 19 health crisis do not facilitate the mission of the observatory. It is clear, for example, that the ex post profitability calculations will be obliterated by the collapse of mobility in 2020 and that the LOTI balance sheet will only be credible on immediate rate of return calculations, the circumstances not having been “normal” since 2019. It is just as clear that, for all the themes mentioned above, the studies in progress are likely to be obliterated by the effects of the crisis, in particular as regards the state of mind of stakeholders. It remains that many initiatives linked to the new rail offer have been recorded and analyzed, in particular urban planning operations carried out near stations served by TGVs.

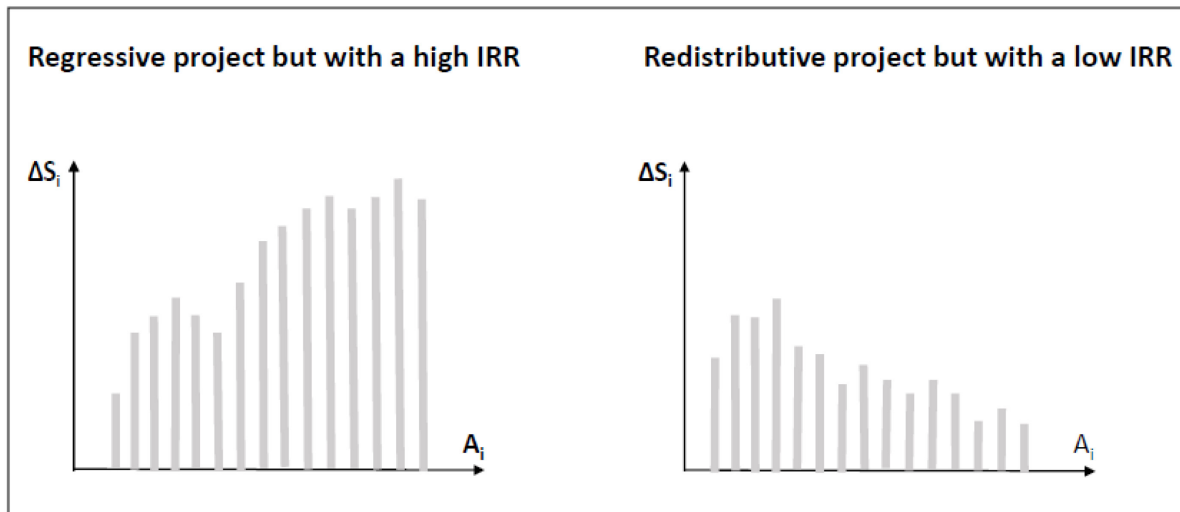
5. Spatial equity and redistribution

The sustainable mobility issue, which is only one particular aspect of the concept of sustainable development, combines the objectives of growth, environment and equity. When it comes to infrastructure investments, the objective of value creation is, by nature, contradictory to that of spatial equity. This deserves to be clarified with a minimum of formalization.

5.1. Conflicting objectives

Let us suppose that the question of a relevant system of zoning for the evaluation of territorial equity or inequities is solved and that for each of the zones i an accessibility indicator A_i is established in the sense of Hansen (1959). In a standard CBA, the net benefits of an investment broken down by zone are measured by the portion of user surplus benefiting the inhabitants of each zone i denoted by ΔS_i . We can briefly qualify the redistributive (vs regressive) character of the project if we observe a negative correlation (vs positive) between the values of ΔS_i and A_i . Two fictitious projects are thus represented in Figure 3 on which the zones i are arranged according to the increasing values of their indicator A_i relating to the ex ante situation.

Figure 3: Profitability vs spatial equity
(Fictitious values)



The project represented on the left of the graph is not redistributive insofar as the variation in the surplus enjoyed by each zone i is an increasing function of its accessibility, unlike what happens on the graph on the right. We will say that there is a conflict between the objectives of profitability and equity from the moment that the most profitable programs generally have a growing silhouette and that redistributive programs, on the contrary, generate smaller surpluses in productivity. In terms of infrastructure investment, there is a strong explanation for this conflict, which is due to the phenomenon of increasing returns to scale: the most profitable investments concern heavy axes and regions with high traffic generation. However, these are the ones that most often enjoy a good initial level of accessibility.

Based on a Wilson approach (1970), a formal proof of this contradiction has been proposed under relatively weak hypotheses (Bonnaïfous & Masson, 2003). This demonstration established on the one hand (apart from a situation of "abundance" of a network that would not experience any saturation) a positive link between the profitability of a project and the size of the traffic concerned; on the other hand, a positive link between traffic and accessibility. As a result, the most profitable projects most often serve areas that already benefit from high accessibility.

In the reality of transport policy, this contradiction in objectives translates very concretely into very political oppositions, for example between the development of the motorway network or the maintenance of secondary roads; between the creation of a new high-speed line or the renewal of low-traffic lines; between an extension of the metro or a better service of bus lines in the distant suburbs; etc.

If we stick to the problem of valuation, the question naturally arises as to how the objective of spatial equity can be taken into account by the instruments of the standard methodology. What follows will be limited to a methodological proposal.

5.2. Suggestions from neo-utilitarianism

If we take the breakdown of user surpluses mentioned above, we can formalize the creation of value (or variation of the well-being function) linked to a given project by the classic relationship:

$$\Delta W = \Delta R + \Delta C + \sum_i \Delta S_i \quad [1]$$

Where ΔR represents the variation in revenue linked to the project, ΔC the variation in monetary costs and ΔS_i the variation in surplus from which the inhabitants of zone i benefit.

We know that the additivity of ΔS_i values is based on the assumption that the economy places equal value on the marginal satisfaction of all individuals. Often referred to as the optimal income distribution hypothesis, it amounts to considering that the decision-maker does not ask himself the question of who benefits from the candidate projects but only that of knowing which project is the most profitable overall.

Asking the question of territorial equity amounts to removing this hypothesis and leads to amending the equation [1]. The solution that we suggested in an academic publication (Bonnafeous & Masson, 2003) was inspired by what is called the neo-utilitarian theory of justice (Wolfelsberger, 1995). We will content ourselves with indicating here how this approach can be applied in the case at hand so that this dimension is taken into account in the welfare function.

We always assume the existence of an economic sovereign, of an ideal observer, but who is able to weigh the preferences of individuals by taking into account the fact that some are poorly endowed and that they must receive a larger share of the variations in surplus. In our case, this amounts to overweighting the variations in surplus ΔS_i for areas with poor accessibility. Equation [1] then becomes:

$$\Delta W = \Delta R + \Delta C + \sum_i \Delta S_i \cdot A_i^{-\alpha} \quad [2]$$

This equation can then be interpreted very simply according to the values of α :

- for $\alpha = 0$, we find equation [1], in which all the variations in surplus are also weighted whatever the initial level of accessibility of the zone considered, and therefore the standard form of CBA;
- for $\alpha > 0$, the variation in surplus from which zone i benefits counts as much as its level of accessibility is low;
- when α tends towards infinity, only the zone of weakest accessibility is taken into consideration which, in the neo-utilitarian theory of justice corresponds to the principle of the maximin (consistent with Rawls' theory of justice) .

The aversion to spatial inequality is thus expressed by the sole value of this parameter α . However, it is necessary to imagine practical cases to glimpse the use that could be made of such amended evaluations. As soon as the breakdowns of variations in surplus by zone are available (which is only rarely the case), the evaluation between alternatives (projects or tariff policy for example) could be the

subject of simulations with different values of α so that the values for which the hierarchy of options would be upset are identified.

The weakness of this methodological proposal therefore is that it should be widely practiced to deliver relevant value ranges for the parameter α and to systematically establish a relationship between the objective of equity and the loss in value that it may imply. This problem will be touched on, using a concrete example in paragraph 6.2. below.

It should be noted that in the exercise cited in the introduction to update the evaluation methods practiced in France (Quinet, 2014), this spatial equity approach was mentioned but could not be retained in the practical recommendations (Government, 2014) because of the difficulties in systematically establishing the numerical values of the variations in surplus ΔS_i . We can thus observe that this question of spatial equity does not appear in the list of 37 tool sheets reproduced in Appendix 1 other than indirectly in sheet 31 ("Disaggregated impact analysis for each affected group").

Finally, note that the application of an equation close to equation [2] to deal with social equity would not pose a theoretical problem: it would suffice to replace the zoning by income brackets and the accessibility indicator by the income level of the considered bracket. We would thus find a formalization very close to what the neo-utilitarian approach proposes; but the difficulty would be comparable to that of the spatial approach concerning the calculations of ΔS_i .

6. The optimal ranking and ex-post evaluation of the actual ranking

The problem dealt with in this section has a double characteristic. On the one hand, as demonstrated by the example of ex post evaluation that we will present below (Cf 6.2.), it concerns issues of very large losses or social value gains. On the other hand, it has not been particularly well treated by the literature on economic valuation. The literature is very rich on the question of determining the optimal choice among alternative options (investments, pricing systems, etc.). On the other hand, when it comes to a set of candidate projects and the optimal order in which to carry them out, the literature is more modest (Roy, 2005). This may be because this issue is not critical in a country that does not have a strong tradition of planning at the national level.

The explanation stems above all from the fact that the question of the optimal order in which candidate projects should be carried out, that of the decreasing ratio of Net Present Value / grant (or value for money), was only belatedly dealt with, when demonstrations by numerical simulation (Bonnafeous & Jensen, 2005) or by theoretical demonstration (Roy, 2005) were produced in the 2000s.

6.1. An ex post indicator of an investment program

In a Round Table meeting held in November 2014, we proposed (Bonnafeous & Crozet, 2014) a method that makes it possible to assess ex post the social gains or losses that may have resulted from the order in which the infrastructure projects in relation to an optimal order of completion. We recall the essentials here.

The decision-maker had to choose among n projects i , characterized by their net present value ΔW_i and by their subsidy need Sub_i . Under the constraint of the B_t budget limiting public expenditure to year t , the value of the welfare gain ΔW generated by all the projects carried out can then be written:

$$\Delta W(x) = \sum_{i=1}^n x_{it} \Delta W_i \quad [3]$$

$$Avec \quad B_t = \sum_{i=1}^n x_{it} Sub_i$$

Where the x_{it} are variables which have a value of zero when the project is not carried out in year t and equal to unity when the project is carried out in that year. This value of $\Delta W(x)$ observed for the programming period is obviously to be compared with the value of W which would be released by an optimal program, i.e. W_o . This optimal program is easily established by assuming the projects carried out in decreasing order of the ratio $\Delta W_i / Sub_i$ and by saturating the budget constraint B_t each year. We can then define a global indicator of the effectiveness of the program by the relation:

$$IGE = W(x)/W_o \quad [4]$$

This indicator can also characterize the effectiveness of investments made over the duration of the program, by highlighting ex-post the loss in value compared to what an optimal program would have been, as well as characterize the effectiveness measured ex-ante of a program planned for a given period but deliberately set in a non-optimal order.

This last case may result, for example, from an objective of spatial equity as we mentioned in section 5. The indicator would then have the merit of proposing a measure of social loss, in the sense of the present loss of value clearly linked to this political choice.

6.2. A first concrete example

With the help of SNCF Réseau's economic services, this overall efficiency indicator was put to the test on a concrete case of programming investments and taking into account an optimal ranking. It turns out that this company has an obligation to respect certain rules in terms of infrastructure financing, in particular it can only make an investment if it does not compromise the balance of its accounts over time. Thus, when the expected toll revenues do not cover the full costs, the investment can only be undertaken if a subsidy ensures its financial equilibrium. All candidate projects are thus subject to a socio-economic evaluation, according to the regulations in force (Government, 2014) and a financial profitability evaluation resulting in the need for a subsidy.

We thus have a sample of 39 candidate projects having been the subject of a financial evaluation and an evaluation of socioeconomic profitability between 2007 and 2013. These data correspond to commissioning spread between 2010 and 2021 for the projects that have been selected and included in planning contracts between the State and the regions (CPER).

To calculate the overall efficiency indicator of the program thus implemented, i.e. the IGE defined by equation [4], we must calculate the net present value of the optimal program according to the definition we have for it, that is to say an order of realization, under budget constraint, according to decreasing values of the NPV / Subsidy.

We therefore established this optimal program according to the following particularly simple algorithm:

- 1) The sum of the subsidies for projects actually commissioned in year t defines the budget constraint B_t , in accordance with the second equation of the system [3].
- 2) The projects are assumed to be carried out in descending order of the NPV / Subsidy, using each year t the maximum possible B_t subsidies deemed available.
- 3) When the B_t constraint is not saturated, i.e. it could be overridden by the last project considered, this project is assumed to be carried over to $t + 1$ and the unused part of B_t is added to B_{t+1} .
- 4) The time series of NPVs thus produced is updated in the first year of the program.

The optimal program is thus established over a period for which the investments of the real program (referred to as CPER below) have been put into service or are in progress. This results in an optimal program with an overall NPV of 1270 million euros, while the actual program NPV over this period is only 110 million euros. This corresponds to an IGE of only 9%.

However, it should be noted that this result, which suggests a significant destruction of value of 91% compared to what could have been achieved, is largely explained by the presence, in the CPER program, of investments whose NPV is negative. If we simulate, under the same budgetary constraint, the real CPER program by removing investments with negative NPVs, the result is much less spectacular because the NPV amounts to 1,175 million euros, which corresponds to an IGE of 92%.

These results, summarized in Table 3 below, suggest that in the absence of optimal programming, a minimum requirement on the socio-economic profitability of the selected projects, for example the requirement of a positive NPV, would be likely to considerably improve the efficiency of the investment policy in terms of value creation.

Table 3: General Efficiency Index for 3 programs

	Ranking optimal	Ranking (CPER)	Ranking CPER + NPV >0
NPV of the programme	1270	110	1175
IGE of the programme	100%	9%	92%

One aspect not immediately obvious when we treat the projects anonymously (which was legitimately desired by the SNCF Réseau economic service) is optimal programming from a socio point of view. This would tend to favor dense regions (in this case, regions such as Ile de France, Alsace, Lorraine, Rhône-Alpes, or the Mediterranean coast) while the CPER programming presents more even territorial

distribution. In particular, we find the type of investments mentioned in section 5 which have no other justification than that of territorial equity.

In the absence of being able to rationally shed light on such choices, for example by promoting an evaluation with a parameter of aversion to inequalities, this ex post approach based on a general index of efficiency has at least the merit of revealing what the concern is, how much territorial equity can cost in terms of loss of social value.

7. Conclusion

As with any feedback exercise, the lessons that can be learned from ex post evaluations are useful in making some improvements on what to do ex ante. From the overview that we have proposed, which is limited to the case of France, we can derive both encouragement and identification of a challenge that remains unresolved.

The encouragement relates to the growing strength of CBA. We have observed that deficient traffic forecasts are less and less frequent. This seems to be linked as much to the technological development of forecasting models as to the generalization of cautious assumptions on expected reference situations. There is no doubt that the LOTI balance sheets have played a role in this improvement.

It can also be considered that these LOTI assessments have probably favored the use of public-private partnerships incentivized so that implementation times and costs are better controlled. Use of such partnerships with exclusively private operators has only recently been generalized for motorways and only very recently for high-speed rail lines. The number of projects for which validated LOTI reports are available is therefore still limited, but it can reasonably be considered that the development is going in the right direction.

The growing number of permanent observatories is equally promising. Already of proven value for motorways, they have made it possible to identify more clearly the structuring effects specific to the infrastructure, such as the development of areas close to interchanges and the propagation of second homes.

The experience of permanent observatories is very recent in the field of high-speed rail lines, but it already seems that the study of the economic impacts of the worksite on the territories concerned is of unprecedented precision. It also seems that the effectiveness of observatories in processing ephemeral data, in particular the price changes for the different modes, will deliver completely new analyses. The identification of everything that can be considered as WEBs is in progress and it is only with the production of the Loti Reports in 2022 that we will be able to judge the overall effectiveness of France's permanent observatories for high speed lines.

Finally, note that a few challenges remain, such as taking into account spatial equity, which we have seen poses a problem of the operational nature of the indicators. At least we have an instrument for measuring what the cost of changing the order of carrying out projects is, when for the sake of spatial equity this departs from the order which optimizes the creation of social value. The previous section suggests that one underestimates the collective cost of choosing not to make the investments in the sequence based on value for money. Perhaps this is where our contribution touches on the most important economic issues.

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Annex 1: French Government tool sheets for the evaluation of transport projects

<https://www.ecologie.gouv.fr/evaluation-des-projets-transport>

I. Introduction

1. Grille de lecture des fiches outils (PDF - 34.93 Ko)
2. Principes d'utilisation du cahier outil (PDF - 70.78 Ko)

II. Analyse stratégique

3. Situation existante, scénario de référence et option de référence (PDF - 95.1 Ko)
4. Objectifs du projet : définition et hiérarchisation (PDF - 53.09 Ko)
5. Cadrage du scénario de référence (PDF - 220.62 Ko)
6. Scénarios provisoires d'évolution du PIB pour la réalisation de tests de sensibilité Covid (PDF - 785.67 Ko)

III. Études nécessaires à la réalisation et à l'évaluation du projet

7. Aires d'études (PDF - 43.65 Ko)
8. Analyse de la demande de transport (PDF - 85.67 Ko)
9. Coûts d'investissement (PDF - 87.14 Ko)
- 10 Coûts d'entretien et d'exploitation (PDF - 88.14 Ko)

IV. Analyse qualitative et quantitative des effets

11. Effets sur l'emploi et les compétences (PDF - 42.02 Ko)
12. Effets sur la santé (PDF - 34.11 Ko)
13. Effets sur la sécurité (PDF - 58.86 Ko)
14. Effets sur l'accès aux emplois, biens et services essentiels (PDF - 71.8 Ko)
15. Effets sur l'urbanisme (PDF - 112.56 Ko)
16. Effets sur les émissions de gaz à effet de serre (PDF - 68.29 Ko)
17. Effets sur la pollution locale de l'air (PDF - 50.17 Ko)
18. Effets sur le bruit (PDF - 71.42 Ko)
19. Effets sur les eaux superficielles et souterraines (PDF - 53.37 Ko)
20. Effets sur la biodiversité (PDF - 48.42 Ko)
21. Effets sur le paysage et le patrimoine (PDF - 59.16 Ko)
22. Effets en termes de risques naturels et sismiques (PDF - 44.3 Ko)
23. Effets pour les usagers en termes de confort (PDF - 40.01 Ko)
24. Effets sur la localisation et le niveau de l'activité économique.pdf (PDF - 78.78 Ko)

V. Monétarisation

25. Monétarisation des effets et indicateurs socio-économiques (PDF - 237.94 Ko)
26. Valeurs de référence prescrites pour le calcul des indicateurs socio-économiques (PDF - 243.7 Ko)
27. Valeurs recommandées pour le calcul des indicateurs socio-économiques (PDF - 168.19 Ko)
28. Prise en compte des risques dans l'analyse monétarisée (PDF - 752.6 Ko)
29. Coût d'opportunité des fonds publics et prix fictif de rareté des fonds publics (PDF - 42.56 Ko)
30. Date optimale de mise en service (PDF - 47.12 Ko)
31. Bilan désagrégué par catégorie d'acteurs (PDF - 63.21 Ko)
32. Effets sur les finances publiques et impacts fiscaux (PDF - 310.45 Ko)
33. Fiabilité des temps de déplacements des voyageurs (PDF - 601.02 Ko)

VI. Analyse financière

34. Calcul d'analyse financière (PDF - 219.65 Ko)
35. Analyse des risques financiers (PDF - 86.98 Ko)

VII. Synthèse de l'évaluation

36. Présentation de la synthèse des effets du projet (PDF - 69.29 Ko)

VIII. Évaluation ex-post

37. Données à recueillir pour l'évaluation ex-post (PDF - 145.38 Ko)

Annex 2: Ex ante / ex post comparison of the economic returns of motorways

Source : CGEDD (2018) (<https://www.vie-publique.fr/sites/default/files/rapport/pdf/184000274.pdf>)

Section d'autoroute	Ecarts ex-ante/ex-post	Principale explication
A49 Grenoble Valence (En service en 1992)	TRE immédiat prévu : 14 % TRE immédiat observé : 19 %	Coûts très contrôlés et trafics supérieurs aux trafics prévus.
A57 Cuers-Le Cannet des Maures (En service en 1992)	TRE prévu : 20 % TRE ex-post : 14,8 %	Trafics supérieurs aux trafics prévus mais très forte dérive des coûts.
A54 St Martin de Crau-Salon de Provence (En service en 1996)	TRE immédiat prévu : 30 % TRE immédiat observé : 15,4 %	Coûts contrôlés mais trafics très inférieurs aux prévisions.
A837 Saintes-Rochefort (En service en 1997)	TRE immédiat prévu : 13 % TRE immédiat observé : 5 %	Trafics très inférieurs aux prévisions.
A83 Nantes-Niort (En service en 2001)	TRE ex-post : 15 % Supérieur au TRE prévu non précisé dans le bilan	Dérive des coûts plus que compensée par un trafic très supérieur au trafic prévu.
A20 Brive-Montauban (En service en 2003)	TRE prévu : 8 % TRE ex-post : 8 %	Dérive des coûts compensée par un trafic très supérieur au prévu.
A28 Alençon-Tours (En service en 2005)	TRE prévu : 15,5 % TRE ex-post : 10 %	Dérive des coûts.
A 85 Angers-Vierzon (Mise en service de janvier 1997 à janvier 2007)	Angers-Tours : TRE prévu : 11,8 % TRE ex-post : 13,5 % Tours-Vierzon : TRE prévu : 12,5 % TRE ex-post : 8,6 %	Dérive des coûts surtout pour Angers-Tours mais trafics supérieur au trafic prévu.
A 77 Cosne – Cours sur Loire – Nevers (mise en service de février 1984 à septembre 2004)	TRE immédiat prévu : 46,8 % TRE immédiat observé : 22,6 %	Dérive des coûts de la partie autoroutière mais le projet a été revu à la baisse. Trafic surestimé.
A 28 Alençon – Rouen (Mise en service octobre 2005)	TRE prévu : 15,5 % TRE ex-post : 18,3 %	Coûts maîtrisés, trafics dans l'hypothèse haute.
A 43 (mise en service de janvier 1997 à juillet 2000)	TRE prévu : 3,16 % TRE ex-post : 1,23 %	Coûts sous-estimés, trafic poids lourds surestimé.
A29 Neufchâtel en Bray – Amiens – Saint Quentin (mise en service de juin 2001 à janvier 2005)	TRE immédiat prévu : Sur A29 est : 8,1 % Sur A29 ouest : 12,3 % TRE immédiat observé sur A29 complète : 8,4 %	Dérive des coûts (25 % dans la partie ouest) mais trafics sous-estimés.
A 432 La Boisse-Saint Laurent-de-Mure (Mise en service en 1991 et 2003)	TRE immédiat prévu : 21 % TRE immédiat observé : 24 %	Coûts de construction surestimés, coûts d'exploitation sous-estimés Trafics sous-estimés

Annex 3: Ex ante / ex post comparison of the economic returns of high-speed lines

Source : CGEDD (2018) (<https://www.vie-publique.fr/sites/default/files/rapport/pdf/184000274.pdf>)

Projet de LGV	Ecart ex-ante/ex-post		Principale explication
	TRE	TRI	
LGV Atlantique (En service en 1992)	Prévu : 23,6 % <i>Ex-post</i> : 14 %	Prévu : 12,9 % <i>Ex-post</i> : 8,5 %	Trafics et recettes supérieurs aux prévisions mais forte dérive de tous les coûts (supérieure à 20 %).
LGV Nord-Europe (En service en 1993) (Liaison avec la Belgique en 1996)	Prévu : 20,3 % <i>Ex-post</i> : 5 %	Prévu : 12,9 % <i>Ex-post</i> : 2,9 %	Trafics inférieurs aux prévisions mais avec des tarifs accrus, une recette presque confirmée mais +20 % en coûts d'infrastructure.
Interconnexion Ile-de-France (En service en 1994)	Prévu : 14,1 % <i>Ex-post</i> : 6,9 %	Prévu : 22,3 % <i>Ex-post</i> : 15 %	Gains de trafic inférieurs aux prévisions et dérive des coûts du matériel roulant et de l'exploitation.
LGV Rhône-Alpes (En service en 1994)	Prévu : 14 % <i>Ex-post</i> : 10,6 %	Prévu : 9 % <i>Ex-post</i> : 6,1 %	Trafics de référence inférieurs et dérive des coûts du matériel roulant et de l'exploitation.
LGV Méditerranée (En service en 2001)	Prévu : 11 % <i>Ex-post</i> : 8,1 %	Prévu : 8 % <i>Ex-post</i> : 4,1 %	Trafics de référence confirmés mais gains de trafic inférieurs et dérive des coûts du matériel roulant et de l'exploitation.
LGV Est (En service en 2007)	Prévu : 8,5 % <i>Ex-post</i> : 4,2 %	Prévu : 7,2 % <i>Ex-post</i> : 5,9 %	Dérive des coûts (+20,2 %) en partie compensée par un trafic supérieur au prévu.

(Source: LISEA, 2018)

<https://www.lisea.fr/wp-content/uploads/2020/04/Bilan-LOTI-intermediaire-dec-janv-19.pdf>

