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Planning, evaluation and financing of transport infrastructures: Rethinking the basics

Ginés de Rus
(Universidad de Las Palmas de Gran Canaria
FEDEA
Universidad Carlos III de Madrid)

M. Pilar Socorro
(Universidad de Las Palmas de Gran Canaria)

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Ginés de Rus
Universidad de Las Palmas de Gran Canaria
FEDEA
Universidad Carlos III de Madrid

M. Pilar Socorro
Universidad de Las Palmas de Gran Canaria

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ABSTRACT

This paper revises some of the common views on transport infrastructure investment and proposes alternative ways to achieve a more efficient planning, evaluation and financing of transport infrastructures in a world where planners may pursue their own interests, there exist different levels of government, and budget constraints are pervasive. We focus on the need for public planning and independent economic evaluation, and the importance of deciding the pricing scheme in the planning phase. We also discuss the institutional design and its effect on investment decisions, particularly, the financing of projects under different levels of government and its perverse consequences on infrastructure capacity choices. We use as an example the development of the HSR to serve medium-distance trips in corridors where air transport is a very close substitute.

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1. Introduction

The transport system is a central element for the normal functioning of the economy and everyday life. None will dispute its crucial role as support of the productive activity and ordinary interaction of individuals in a modern society. The transport sector contributes to the reduction of costs of goods and services, and the increase of productivity through economies of scale and agglomeration; it also widens the choices of workers, consumers, and firms, among others social benefits (Glaeser and Kohlhase, 2004; Venables, 2007; Winston, 2013).

The relationship between an efficient transport system and social welfare is unquestionable. Nevertheless, there are empirical evidence and theoretical developments to moderate the over-optimistic beliefs about the economic impact of transport infrastructure investments. Firstly, we would like to highlight the necessary updating of the causality chain between transport investment and growth. Economists are less enthusiast today with respect to the economic impact of transport infrastructure on productivity and economic growth than they were in the nineties (Aschauer, 1989; Munnell, 1990; and many others). This is not only due to the endogeneity problem associated with the empirical estimation of the effects of transportation infrastructure improvements on economic development, but mainly to the difficulty of identifying the effect of transportation infrastructure on growth and the reorganization of economic activity (Redding and Turner, 2014).

Moreover, when main networks are already built, the benefits of enlarging them are subject to the law of diminishing returns (Melo *et al.*, 2013). Secondly, even in the case of finding significant average positive benefits with the aggregate econometric approach, the construction of a new infrastructure project requires, first identifying all possible alternatives, and second the economic evaluation of such a project and its alternatives (Gramlich, 1994). Thirdly, the construction of transport infrastructures and the provision of public transport services, as well as the normal operation of private transport markets, also have significant negative externalities. Finally, the allocation of public funds for the financing of both transport infrastructure and operations requires

considering the undesirable effects on the economy produced by the distortionary effects of taxation as well as the possibility of inefficiencies in the subsidized companies

Transport infrastructure is a long-term, very expensive and irreversible investment with significant impact on the environment. Market forces alone cannot solve the problem of what, where and when to invest. Transport networks need planning. The government must decide the extension and the structure of the network, identifying all transport alternatives and carefully evaluating its social desirability. Sometimes the government provides directly the transport infrastructure as in the case of rail. In other cases, it leaves to private firms the construction and the operation of transport infrastructures, through concessionary contracts or privatization. In any case, the government retains the power of regulating prices and some standards related to the quality and safety of service.

In a fast-changing world, governments must review those methods of intervention that, though appropriate in the past, might be no longer valid in the present. Technological advances, the experience with regulated industries, recent developments in economic theory, and tighter budget constraints, force governments to rethink the way they plan, evaluate and finance transport infrastructures. In this paper, we discuss some of the conventional thinking in the economics of transport infrastructures and propose some alternatives to achieve a more efficient planning, evaluation and financing.

It seems to be an undisputed truth that railways are more environmentally friendly and more cost-efficient than land or air transport and, therefore, that the substantial contributions of governments to finance railways in Europe is justified. The economic rationale for the subsidization of railways is based on: identifying relief from burdens not borne by competing modes of transport, public service obligations, economies of scale, relief of externalities produced by other modes of transport, economic development benefits and option values (Nash, 2018). But as near everything in economics, the devil is in the details. There are circumstances in which railways are the best option (e.g., corridors with high demand, or heavy congestion in

suboptimal priced alternative modes of transport), but there are other in which this is questionable.

Today the discussion on whether some conventional existing rail lines should have been constructed or not is somewhat irrelevant. Nevertheless, the present expansion of railway networks in passenger services through high-speed technology, should be carefully evaluated (de Rus and Nash, 2007; de Rus, 2011). Given changes in the regulatory system (such as the introduction of the emission trading system in the air transport industry), economic crisis and budget constraints, and technological advances in all transport modes, governments should not accept the received view that the railway option is always superior to airports or roads without a careful economic evaluation of the available alternatives to solve a common transport problem.

Moreover, the common institutional design of the ministry of transport in many countries, with a separation of the modes of transport in different general directorates, contributes to the explanation of why transport networks are developed today in the way they do (Engel *et al*., 2014). With the present type of governance, it is perfectly possible to have a simultaneous and suboptimal expansion of the high-speed rail (HSR), roads and airport networks even in the case of mutually exclusive projects to address the same transport problem.

How can this be possible and what can be done to avoid this waste of resources in a society with tight budget constraints and growing social demands? Although the conceptual discussion is valid for any type of large infrastructure projects, this paper deals particularly with the case of railway infrastructure, usually operated as public monopolies, with a technology characterized by high upfront and sunk costs and large economies of traffic density. Sunk costs and economies of traffic density are features that usually appear in the infrastructure side of the industry rather than in the operation of train services,[1] so vertical unbundling isolates the natural monopoly characteristic of the railways and allow a separate treatment of these two main

[1] Although economies of density usually appear in the infrastructure side, they are not limited to infrastructure (see Wheat and Smith, 2015).

components of the industry (see Gómez-Ibañez and de Rus, 2006). Therefore, even with private competition in the operation of train services, the government retains crucial decisions concerning the type and extension of the infrastructure network, which can have long-lasting consequences in the shaping of the transport system.

There are different stages in infrastructure provision, such as planning, design, evaluation, deciding different ways of private participation, construction, maintenance and operation, and regulation in a broad sense (from price and quality regulation to contract enforcement). The involvement of the government in the different phases of infrastructure provision are examined in Engel *et al.* (2014) and Winston (2013).

Winston (2013) analyses whether the United States has the optimal mix of public and private provision of transportation, and Engel *et al.* (2014) cover in depth the economics of public-private partnership, including the crucial aspect of the institutional design of the ministry of public works from planning to enforcement and conflict resolution. In this paper, we concentrate our effort on the first two phases, planning and evaluation (section 2), which includes the issue of pricing in the planning phase, given the impossibility of separating pricing and investment in the economic evaluation of projects (section 3). Then, we discuss the institutional design and its effect on investment decision, particularly, the financing of projects under different levels of government and its perverse consequences on infrastructure capacity decisions (section 4). Finally, section 5 concludes.

2. Planning and economic evaluation of transport infrastructures

Many reasons have been given to justify the restriction of competition in transport markets. The incumbents both in air and rail markets had in the past the support of the government to become the unique suppliers in their own countries, as public monopolies. The rationale was the existence of natural monopoly in the industry or the more slippery concept of wasteful competition.

The success of air liberalization or freight transport by road has shown that the arguments behind the restriction of competition had no solid foundation. The enormous costs that society has had to pay for the presence of business and union

lobbies in the different modes of transport have been highlighted by the results of the liberalization and privatization of the air, sea and land transport markets combined with a regulation at the entrance of qualitative type (Winston, 1998, 1993, 2010, and 2013; and Winston and de Rus, 2008).

Nevertheless, despite the potential of competitive markets to meet the transport needs of society, state intervention in the field of infrastructure is still necessary for reasons of network and spatial planning, as well as for equity reasons (such as ensuring accessibility). The internalisation of externalities, security and environment impact will also continue to require state intervention, though in some cases private initiatives can solve the problem by investing in better technology.

This paper deals with planning, which is the responsibility of the public sector for reasons of network design, to avoid duplication, or to ensure the construction of segments that are socially necessary but not profitable for private firms. Although the public sector does not have to be directly responsible for the construction of such networks, it should be responsible for regulating private participation.

The government intervention in the railway industry[2] was not only due to the economies of traffic density and large sunk costs. Government involvement was also justified because railways have always seemed associated with economic growth.[3] Nevertheless, these were not the unique reasons for the protection and public financing of railways. Railway management and trade unions also played their role to protect railways from competition. The government support not only avoided the decline of railways but also contributed to the loss of the commercial edge of the public operators. Other external causes contributed to the loss of relevance of railways as a transport mode, both in the case of freight and passenger traffic. Economic growth and technical change were reducing the importance of the traditional demand of railways (high-volume, low-value, high-weight traffic). Thus, economic growth and higher incomes induced the shifting to speedier and more convenient services supplied by alternative modes (Gallamore, 1999; de Rus, 2006).

[2] See Schäfer and Götz (2018) for an analysis of the public funding structure of the railways in 8 European countries.
[3] For a different view see Fogel (1962).

The European Commission has targeted the revitalization of the railway industry,[4] by trying to enforce vertical unbundling and allowing the construction of a new high-speed network with significant government contributions, as a policy to deal with the challenges posed by congestion and environmental issues. This is something that has been widely accepted by national governments and the general public, in spite of the finer approach of comparing the value of this policy with its alternatives, including first best policies as road pricing.

In this paper, we do not dispute the value of rail as a transport solution for congested corridors (urban or intercity) with enough volume of traffic to compensate the fixed and external costs of this irreversible investment. Our position is to underline the need for an efficient planning and economic evaluation of projects, incorporating all possible alternatives (which include not only other transport modes but also its optimal timing), and highlighting the long-term effects of short-term investment decisions to avoid the misallocation of resources (Winston and Maheshri, 2007; de Rus, 2011).

The economies of traffic density deliver their benefits in high volume demand corridors and, therefore, the average cost per passenger goes down. The problem is that the same source of decreasing average costs is a heavy burden when the traffic is weak. In corridors with low traffic, rail average costs rise as traffic declines, making the system unsustainable at low volumes. Moreover, the railway lobby has alleged that environmental benefits justify the construction of new rail lines given the more environmentally damaging alternatives. Nevertheless, the need for high traffic volumes also applies in the case of these environmental benefits. The evidence shows again the need of high traffic volumes to make the railways a better environmental option for intercity transport (Kageson, 2009). The argument about the environmental advantage of railways also loses strength when we take into account environmental regulatory changes in alternative transport modes, such as the introduction of the air

[4] Before the first railway package of 2011, the situation of the railways in Europe was critical: "…railways continued to be seen as a problem in most of Europe. They steadily lost market share, falling from 10 per cent to 6 per cent of passenger kilometres and 20 per cent to 8 per cent of freight ton kilometres over 30 years. They also required high and increasing levels of subsidy (…) less than half of the total costs of the rail transport in Europe were borne directly by passenger and freight customers" (Nash, 2006, pp.26).

transport industry in the European emission trading system since 2012, or the technological advances in cleaner (electric) vehicles in the road sector.

In the provision of public infrastructure, the government must decide the type, the place and the timing of projects, and to design the contracts for the construction, maintenance and operation during the life of the projects. There is an overwhelming body of evidence of government failure to deal with these problems (Engel *et al*., 2014). The evidence shows that public intervention in the transport system is far from being optimal. Wasteful investment, inefficient pricing, poor regulation and a poorly designed private participation in the construction and operation phases of infrastructure provision have been common features in many countries all over the world.

Government policies have not always been positive for the transport system. They have also implied negative effects, through increasing time and money costs and excessive public expenditure. Winston (2013) summarized why government has been unsuccessful at solving the problems associated with public infrastructure delivery: "Instead of developing a broad thematic strategy to improve the transportation system's performance based on efficiency criteria, policymakers are considering a piecemeal combination of options that seek to increase transportation funding and infrastructure spending. Some policies may improve transportation efficiency, others may not, but none offer the potential to rid the system of decades of inefficient practices and to spur innovations in operations and technology that may substantially benefit the traveling public and other economic sectors."

The use of a piecemeal of options instead of a broad strategy has important long-term consequences. There is an important problem associated with large projects which in principle seems to be manageable through efficient planning and evaluation. The existence of multiple equilibria in the long-run and the possibility of ending up in a bad equilibrium when the evaluation concentrates on individual projects and loses the larger picture of the long-term intermodal effects needs to be highlighted. This is again a warning of the inadequacy of dealing with a project in isolation, ignoring relevant

interactions with other markets and the dynamic process during the lifespan of the project (de Rus, 2017).

Mackie *et al* (2014) describes the principles of cost-benefit analysis defending its use for an informed transport policy. The appraisal technique is considered useful for the evaluation of a programme like highways but "when it comes to mega projects such as high speed rail, CBA can run into difficulties. This is partly because it is not easy to say what alternative form of expenditure the scheme is being compared with - quite possibly not in the transport sector at all. It is partly because mega projects are expected to have transformational and macroeconomic effects which are hard to handle using microeconomic tools. But also such projects tend to become politicised early, making cool dispassionate assessment of such projects problematic".

Leaving the interference of politics in the economic evaluation of projects for section 4, and accepting that it is easier to apply CBA to a set of similar projects, the investment in HSR infrastructure *has* to be compared with alternatives within the transport sector; otherwise, the CBA of the project is misleading, as it ignores other ways to solve the main goal (to solve a transport problem).

Nash (2014) mentions the example of high speed rail in Britain as "a good illustration of the complications of rail appraisal". In his review of the British experience in the appraisal of the rail sector, indicates that "there are many options in terms of alternative high speed rail systems designed to relieve capacity on the most congested parts of the network and offer time savings between the major cities (…). Similarly, there are numerous alternatives in terms of conventional rail, again including building new routes and upgrading existing systems. Other options include investing in alternative modes of transport and using pricing policy to manage demand." All these alternatives should be included in the analysis.

In the case of the introduction of HSR in Spain, the largest HSR network in Europe and the second one around the world after China, the evidence shows considerable losses in welfare. The evaluations available (de Rus and Inglada, 1997; Levinson *et al*., 1997; de Rus and Roman, 2005; de Rus and Nash, 2007; de Rus and Nombela, 2007; de Rus, 2011; Albalate and Bel, 2015; Betancor and Llobet, 2015,

Albalate and Bel, 2017) shows that the marginal savings of HSR with respect to air transport in Spain come from a reduction of the monetary component of the generalized price, since time savings are too small to explain the modal shift. Moreover, contrary to what happens in the air transport industry, the ticket price of the HSR only includes a part of the cost of the infrastructure: its maintenance and operating cost, and little else. In this case, the advantage of the train over the plane is explained by the fact that train users do not pay (or only do it in a small part) for the expensive infrastructure they use. Thus, in this case, the railroad gains the battle of the modal distribution with significant losses of social surplus.

The political benefit generated by the construction of HSR lines in Spain explains the current expansion of the network in extremely low demand corridors, relying on a public opinion that continues to positively value large infrastructure projects, partly because of ignorance of their true social costs and, perhaps, because of some kind of irrational beliefs (Flyvbjerg, 2013). Other elements that explain this situation are: the absence of ex-ante economic evaluation, both rigorous and accessible to citizens; an inadequate allocation of risk for private participation in the construction of the infrastructure; and an institutional incentive system with various levels of government (supranational, national and regional) and a separation between who demands the investment and who pays for it.

To ignore the results of independent economic evaluations in the final political decision is not only applicable to the Spanish case. Although the systematic use of CBA to examine options is well developed in other European countries, and specially in Britain, Nash (2014) concludes his review with the following assertion regarding the cost-benefit analysis of HSR in Britain: “Finally, the example (HSR) also illustrates the importance of political factors in rail decision taking. The decisions on linking the HSL to Heathrow and to the high speed line to the Channel Tunnel appear to have been taken without regard to the appraisals, whilst in justifying the investment politicians tend to emphasize wider economic benefits and greenhouse gas savings, neither of which plays a major part in the appraisal”

A high component of fixed costs and the irreversibility of investment explain why suboptimal technological options can displace better alternatives (de Rus, 2017).

The economic planning of infrastructure and the evaluation of projects need to look carefully to the dynamic process associated with the initial decisions. Large transport infrastructure projects present these characteristics, and the decision concerning a particular project influences the future with a type of dynamic process in which initial investment favors subsequent investments in, perhaps, a less efficient technology than the next best alternative. This is the case of attending the medium distance intercity mobility in low population density countries with regional air transport or a HSR network (de Rus, 2011).

The long-run effects on the allocation of resources can be dramatic. The case of HSR versus air transport is illustrative in countries where both systems can be considered mutually exclusive. In countries with low population density, the usual base case is a network of airports with enough capacity to provide infrastructure for point-to-point medium distance trips. HSR infrastructure is a technology for high volume corridors; it is expensive and a high proportion of its costs is sunk. The irreversibility of investment is one of its main characteristics. Compared to HSR, sunk costs and irreversibility are lower for the air transport infrastructure. The reason is twofold: On the one hand, the cost of building airports depends on the level of demand, since the higher the level of demand, the higher the size of the airport. On the contrary, the costliest part of the HSR infrastructure are the rail tracks, and thus the cost of constructing the rail infrastructure varies little with the level of demand. On the other hand, once two regions have been connected with airports, only one more airport is needed to connect a third region (half of the previous investment). However, once two regions have been connected by rail, the cost of connecting the third region is almost the same (de Rus and Socorro, 2017).

Hence, unless the HSR project is carefully evaluated looking at all alternatives and the long-term consequences of the investment, it may well be that the initial decision of building HSR lines ends up with an undesirable equilibrium in which the wrong technology displaces a cheaper, more efficient, financially sustainable and reversible alternative. HSR is a technology to solve transport problems as well as air transport. Technical neutrality has to be a key component in the planning process.

3. Pricing and investment

An efficient planning of public infrastructure requires to deal with pricing and investment simultaneously. The reason for the non-separability of pricing and investment is very simple. The price to be charged for the use of the infrastructure is required to predict the demand for such an infrastructure, or the choice of capacity in case there is more than one option. This is the case of Dupuit (1844) when analyzing the social welfare of a toll-free bridge. The case of the "Dupuit´s bridge" with zero marginal cost and free access in order to maximize consumer surplus is only optimal under some restrictive conditions, such as the absence of congestion (Hotelling, 1938), or a shadow price of public funds equal to zero. If the government is subject to a budget constraint and a toll is required, the demand will be lower, as well as the consumer surplus, and it may well be that, in these circumstances, the project is now socially unprofitable.

Pricing affects demand and, hence, the social welfare associated with a particular project. There are cases in which two groups of infrastructures (in addition to the road network) have been constructed to solve the same mobility problem for medium-distance interurban domestic trips but using different pricing schemes. Airports and HSR networks usually overlap in a set of origins-destinations in which HSR infrastructure is always built after airports. The effects on modal split have been very favourable for the HSR, having captured in some lines practically all demand. However, this shift in demand may be due to the fact that HSR users do not pay for the construction cost of the rail infrastructure while in large airports (that is, those competing with HSR) air transport users do.

The lower construction cost of airports, less indivisibility, their multiproduct nature, their less use of land, and lower barrier effect on the territory, make attending the interurban mobility of medium distance with air transport a superior option in many cases, even if the HSR is priced just to cover variable costs. A necessary condition

for the HSR to be a superior alternative is to serve a corridor with a high demand volume. If the HSR is forced to cover both variable and construction costs a much higher volume of demand would be required. Preston (2017), based on Crozet (2014), shows that in order to make a commercial return the demand threshold is around 20 million passengers per annum. In their study this threshold is only passed by 42 percent of the HSR lines examined. The majority of them are from East Asia. According to Albalate and Bel (2015), Paris-Lyon is the only HSR route in Europe covering all costs (including construction, operating and maintenance costs).

The problem of meeting the needs of medium-distance and long-distance mobility with investments in airports, or HSR, or both, has to be solved simultaneously considering the investment in capacity and the choice of transport technology with the type of pricing that is going to be applied. The pricing scheme will influence the economic evaluation of projects. An error in the initial choice of technology may lead to a suboptimal and irreversible equilibrium in the long-term: once the construction of one of the networks is started it is optimal to continue using the network (or even constructing new sections), though this ex-post equilibrium is socially inferior to the alternative of not having such a network.

The discussion on what prices should be charged for the use of transport infrastructures and services remains one of the most controversial in the literature and is still far from being resolved. Although the "golden rule" from the point of view of economic efficiency is that prices should be equal to social marginal costs, but these can be defined in the short or long-term. In addition, there are budget constraints and incentive problems. Alongside this, and regardless of what criteria applies, the optimal charging of a given transport infrastructure should be made taking into account the existence of other complementary or substitute modes of transport (de Rus and Socorro, 2014).

An efficient pricing leads the user to make their travel decisions according to the social opportunity cost. This affects the journey, the day and time, and the transport mode; and even, to travel or not. Assuming that the transport service operators follow the principles of optimal pricing, how much should the airport

authority and the rail track administrator charge for these competing alternatives in medium distance trips (suppose for simplicity that there are no externalities or problems of equity)? The answer is apparently simple: the marginal social cost of using the infrastructure. The problem is that, due to the presence of indivisibilities, high fixed costs and the shadow price of public funds, pricing according to marginal social cost is a complex task. Charging the marginal cost in the short-term, in addition to the practical difficulties involved, is incompatible with the recovery of fixed costs when there is excess capacity, a characteristic common to some airports and especially to HSR lines, whose capacity is very high, higher than its present and, presumably, future demand in some of the existing and projected lines in Europe.

An alternative is to charge the long-term marginal cost. The short-run marginal cost equals the change in total cost when demand is increased, keeping the infrastructure capacity constant. The long-run marginal cost is the change in total cost when demand is increased, allowing an optimal capacity adjustment. The marginal costs in the short and long-term are the same, assuming a prediction of perfect demand and perfect divisibility of the infrastructure. Both assumptions are unrealistic in transport and the consequences of choosing one of the two options have important implications in practical terms (see Nash, 2003; or Rothengatter, 2003).

Ideally, with fixed capacity, any user willing to pay his additional marginal cost should be given access to the network. When capacity exceeds demand, short-term marginal cost is lower than average cost. Although it is theoretically optimal to charge a price equal to short-term marginal cost and finance fixed costs with taxes, there are some reasons to deviate from this optimal first-best tariff principle (Laffont and Tirole, 1993): (1) financing fixed costs with distorting taxes has an associated cost, the deadweight cost of taxation.; 2) if subsidized costs are covered, the company's effort to minimize costs is reduced; 3) problems of fairness when those who do not use the infrastructure pay the costs of those who use it, and 4) the dynamic problem of capacity expansion in the long term. Moreover, when it is planned to price short-term marginal social cost, it should be ensured that users are willing to pay the investment costs of providing the capacity.

There are other reasons to depart from short-run marginal costs. Firstly, the financial burden limits the capacity of the companies to act and may produce inefficiencies. Infrastructure costs are not covered with access charges in Europe though the degree of cost coverage varies from 3% in Norway to 95% in Germany. Government contributions and debt issued by the infrastructure manager remains as the two main sources for the financing of rail infrastructure investment in many countries (Schäfer and Götz, 2018). Secondly, private participation in the development of railways is compromised when the companies are not able to recover a significant share of total costs (Casullo, 2018).

The departure from short-run marginal social costs can be justified for the enumerated reasons. The requirement of a mark-up on the short-run marginal cost makes less relevant from practical pricing decisions to focus the problem on the calculus of the long-run marginal cost. A practical approach could be evaluating the social and the financial net present values of a project within a range of prices from the lowest possible optimal price to the one that complies with the budget constraint.

4. The public governance

What reasons can explain why governments have deviated from a welfare-maximizing behaviour? Several hypotheses, not necessarily mutually exclusive, can be formulated. The first is that the government tries to maximize the probability of re-election (Downs, 1957; Niskanen, 1971; Sobel, 1998; and Robinson and Torvik, 2005). In the case of transport investment, the typical project "…takes a little from a large group (e.g. all taxpayers) while hugely benefiting a small group (e.g. a specific subset of travellers). Since any single investment is politically rational in this way, over-investment is the expected outcome" (Mackie *et al*, 2014). The second is the capture theory (Stigler, 1971) and/or the interest groups pressure to guide government policies to their advantage (Becker, 1983). In some cases, a third reason could be added, concerning the absence of economic principles in the public agencies of transport infrastructure. In many countries, the institutional design of the ministry of public works has favoured the dominance of an engineering view in planning, disregarding

the existing economic knowledge on economic evaluation and the problems of incentives for contract design and regulation in a context of asymmetric information, and different agents and objectives (see Engel *et al*., 2014).

A related and highly relevant subject concerning institutional design is the presence of various levels of government and who is financing the infrastructure. Projects are evaluated within a framework in which different levels of governments are implied (for example, national and regional governments, or supranational and national agencies), and where the objectives of the agents involved are not usually aligned. Assuming that a positive net present value is a requirement to get the project through, and the objective of a regional government (or a national government) is to get his project approved and totally financed by the national government (or partially funded by the supranational agency), the incentives to overestimate benefits and underestimate costs are obvious, as well as the loss of incentives to reduce costs and charge users to raise revenues. This separation between who promotes and who pays also affects decisions on infrastructure capacity and the kind of technology chosen (de Rus and Socorro, 2010a,b; Flyvbjerg, 2014).

In order to pursue optimal investment and pricing policies in transport infrastructure provision, a deep restructuring of the ministry of public works in many countries would be necessary. It is the government's responsibility to plan the infrastructure network, but it does not make much sense to evaluate the projects within the same ministry or to build, or exploit, them directly as monopolists in the case of services that can be offered by firms competing in the market. If competition in the market is not possible, competition for the market should be introduced, by awarding a temporary monopoly to the best bidder chosen through a well-designed bidding mechanism.

The separation in general directorates by modes of transport must disappear for investment or regulation purposes (or, in other words, be reduced to technical engineering aspects). Instead, two new units must be created: an independent unit, with sufficient means and unquestionable technical reputation, must jointly evaluate and prioritize all transport investments. In the economic evaluation all alternatives

should be included (which implies including not only all possible transport modes to solve the mobility problem but also the possibility of postponing the investment), and all costs should be considered (independently of who is paying and the different levels of governments involved). Another independent unit, different from the previous one, would be responsible for designing, awarding and managing concession contracts for private participation in all modes of transport, providing the appropriate incentives.[5]

These two units, the evaluation and the management of private participation, must operate with total autonomy and independence if we do not want them to become useless bureaucracies. Finally, the increase of private participation must be accompanied by an improvement in regulation, a task that is the responsibility of the regulators in advanced countries. A single cross-sectoral agency or several sectoral agencies may be created since increased private participation forces greater vigilance when markets are not very competitive to avoid the exercise of market power. This is one of the challenges that the government has with respect to private participation in industries with limited competition: the beneficiaries should be the taxpayers and the users, and not only the private firms.

The institutional infrastructure required by modern societies requires independent regulators. This is commonly accepted but it is also necessary an independent agency that guarantees the rigorous selection of investments. Then, private participation has to be based on auctions, and contracts designed in accordance with best international practice. The objective is to reduce the political interference in the technical phase of project evaluation, to guarantee the selection of good projects and its implementation by the most efficient firms.

5. Conclusions

Transport infrastructure investment are planned and evaluated within a framework in which different levels of government are implied (national, regional, and supranational), and where the objectives of the agents involved are not necessarily

[5] For a complete description of this alternative governance structure see Engel *et al.* (2014, p. 132)

aligned. When who promotes the project differs from who pays for it, there will be incentives to overestimate benefits and underestimate costs, and no incentives to charge users to raise revenues or make efforts to reduce costs. To avoid these inconveniences, a change in the institutional design affecting the ministry of public works in some countries would be necessary.

This paper stresses the importance of establishing the right link between planning and the economic evaluation of infrastructure projects. Although both stages are intertwined, infrastructure planning belongs to the government but the economic evaluation has to be independent of the government. Moreover, the selection of the pricing scheme is essential for a sound process of economic evaluation but belongs to the planning stage. We also discuss the institutional design and its effect on investment decision, particularly, the financing of projects under different levels of government and its perverse consequences on infrastructure capacity decisions. Without the appropriate institutional design, the cost-benefit analysis of infrastructure project losses its relevance.

Optimal investment decisions in infrastructure cannot be taken without a prior pricing scheme. This very simple economic principle has been ignored in very large infrastructure projects leading to over-capacity and subsequently to the justification of price reduction given the irreversibility of the investment. This is the case of the expansion of the high-speed network to serve medium-distance trips in corridors with insufficient demand where air transport is a very close substitute. Planning requires a joint evaluation of the alternatives but the institutional design in many countries has allowed taking crucial investment decisions in different units within the public works department in isolation and without taking into account the long-term consequences on the transport system.

Airports and the railway infrastructure have market shares that vary substantially with small changes in their relative prices. The decisions on the expansion of the HSR network should not be taken without a proper consideration of the different options available, particularly in corridors where there exists a well-developed airport network, low volumes of demand, and tight budget constraints. The

economic evaluation of constructing both airport and HSR networks requires a volume of users, and willingness to pay, much higher than that currently existing in many of the existing or planned corridors in Europe. Although the irreversibility of the investment is common to both airport and rail infrastructure, the problem is more acute in railways. Not only because airports are less costly than a HSR line but because adding new sections is cheaper in the case of airports serving much more destinations than in the case of a HSR line. In addition, railways present a problem of indivisibility more severe than in the case of airports. There are different sizes of airport infrastructure for different size of population but in railroads it is necessary to build basically the same for one million passenger-trips than for one hundred million.

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