INNOVATIVE FINANCING TECHNIQUES: EUROPEAN URBAN RAIL PROJECTS AND THE CASE OF ATHENS METRO EXTENSIONS

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1. INTRODUCTION

In the last two decades, the attraction of private capital, as a way to finance transport infrastructure projects, is reawakened in Europe. There are numerous reasons for this revival. The assumption of financial risks by private parties in this field reduces the risk exposure of the public sector. The awareness of the true costs and the risk profile of transport projects increases. A financial responsibility of the private sector in the project implementation results in efficiency gains, for instance, reduced cost and schedule overruns. The aim of the present paper is to discern the particularities of urban rail projects from the perspective of a public-private collaboration, as well as the risk factors involved.

The revival of project financing is more evident in road projects. There is less experience with public-private collaboration in the urban rail sector, especially outside U.K. A further goal of the paper is to examine the reasons for this unbalanced development and to assess the potential for the realization of co-financed urban rail projects. The findings, and especially the arising risk allocation strategies, are instrumental in the context of new collaborative urban rail projects.

Basic contributions of the paper pertain to the (a) in-depth comparison of urban rail vs. road project risks from the point of view of a public-private development framework, (b) novel set of attributes impacting the urban rail traffic risk.

The structure of the paper is as follows:

In section 2, a typology of public-private (PP) collaboration forms for transport infrastructure projects is developed. The asymmetric relationship of PP partnerships is discussed. The third section presents the sources of financing and refunding PP transport projects. The issue of public sector borrowing limits is considered in this connection. Section 4 specifies the risk components of collaborative urban rail projects and provides the base for the assessment of alternative procurement forms. The fifth section discusses the scope and scale of collaborative urban rail investments. Section 6 compares urban rail versus road project risks from the perspective of the PP collaboration. Moreover, traffic risk components of urban rail projects are analyzed. The next section compares European urban rail projects developed with private capital along dimensions, such as scale, scope and form of PP collaboration, mainly from England, France and Iberic peninsula. The paper closes with an extensive description of three relevant Greek transport infrastructure projects and the case of the planned Athens Metro extensions.

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2. PUBLIC – PRIVATE COLLABORATION FORMS

In a typical public-private collaboration form, the private party is entitled to design, build, finance, maintain and operate (DBFMO) a new transport project for a fixed period of years. At the end of this, usually long-term, period the transport facility is transferred to the public sector. Few transport infrastructure projects are so far close to the end of this contractually set period ("concession"), so the conclusions that might be drawn about the net benefits of such forms of public-private collaboration are still of a rather tentative character.

Between the pure procurement forms of privatization (e.g. Build/Own/Operate in perpetuity) and traditional public procurement, a typology of more innovative forms of collaboration between public and private parties may be defined. The risks assumed by each party varies according to the form of collaboration. The typology distinguishes, first, concession projects where a risk allocation between both parties applies, for instance the private party assumes all commercial risks and the public party the non-commercial risks (e.g. political risks). An example is the Croydon Tramlink south of London. Another form are concession projects where a risk sharing applies, for instance the private party assumes a portion of the commercial risk, whereas the public sector bears the remaining, directly (e.g. through shadow payments) or indirectly (e.g. through guarantees). The Dockland Light Rail extension to Lewisham is covered by a DBFM concession and illustrates this form. A third option are mixed forms of collaboration where the private party (mainly construction companies and suppliers) assumes the financial risks, as well as the management during the implementation phase and is adequately compensated upon satisfactory completion (e.g. through a privately placed long bond). A variant of this DBFT model has been recently suggested by the Strategic Rail Authority in Britain for enhancements to the network. The public party would control, as shareholder, the project development company (called Special Purpose Company, SPC). A way to make then the equity returns more attractive would be to share potential cost savings with the contractors. Another variant is the German “Bundmodell” with private pre-financing of the construction. Both variants focus on the optimization of construction and financial risks.

In the procurement form of concessions, the private investment costs are recovered during the concession period by means of future revenue streams (non-recourse financing of commercially viable projects) and/or public support to reach financial viability (limited recourse project financing). The public support may take the form of a one-off capital grant (e.g. Croydon Tramlink) or periodic availability payment (e.g. Nottingham Express Transit) or both (e.g. Leeds Supertram). In all mentioned types of public-private collaboration, the full ownership of the transport infrastructure project is transferred to the public sector after a fixed period.

A pertinent issue, arising frequently in concessions, is the coupling of the concession length with the return on investment achieved by the private party. Such a mechanism is difficult to implement in reality. Private parties have the tendency to hold back financial information, such as effective cost development, i.a. due to rules of commercial confidentiality. An asymmetry of information between the public (principal) and the private party (promoter or agent) arises. A principal-agent relationship rather than an equal partnership characterizes both parties in a collaborative project of a long duration. Lenders and sponsors of such projects typically request a verification of the contractor’s information by independent engineers. The independent engineer valuates then the physical
progress and quality of the project. Diverging, even antagonistic interests may arise among equity holders too. For instance, lenders secure that they will be serviced by cash inflows before the shareholders. Construction companies or suppliers have an interest to downsize their equity share and increase construction or equipment costs respectively. An analysis of conflict patterns (e.g. form, intensity, involved stakeholders) defining mechanisms to mitigate potential disputes is essential in this respect.

Market competition in collaborative projects prevails when the bids of private parties are offered. The concessionaire, afterwards, comes up to a state of a monopolist using often his market position to present (financial or other) information according to his interest. This is an important reason to close the negotiations about the contractual terms (e.g. performance monitoring procedures) and activities before signing the contract agreement. A related issue concerns the re-negotiations required by the lenders before signing the financial agreement. It is advisable in this connection to involve potential lenders already in the pre-tendering phase. The whole process implies high transaction time and costs. A clear statement of public sector’s goals and requirements is beneficial in this respect.

3. FINANCING AND REFUNDING TRANSPORT PROJECTS

Transport infrastructure has a long lifecycle and is financed by project equity and debt. Debt funding may take the form of bank loans and/or financing from bond issuance (REUTER/WECKER, 1999). Earlier, bank debt was more dominant with a tenor of about 20 years and typical margin, say, 1,3% above base rate. Nowadays, capital markets dominate, the maturity reaches 30 years, and the margin has significantly declined in line with the reduced cost of money. In fact the common European currency has expanded the issuance of bonds denominated in Euro and has cut down the cost of funding. More important became also credit ratings by specialized agencies, so called monoline insurers of debt repayment, as well as risk management (Basel II)². Bonds typically exhibit interest rate certainty, have the potential to be rated, and they can be used on more than a single project. Bank debt on the other side, is a flexible instrument in case of a cash shortfall.

Equity investment reveals normally higher risks (and corresponding returns) than debt, and as such is more expensive than the costs of using debt. Lenders on the other hand, demand for investments with higher project-specific risk a larger proportion of equity vs. debt. Project equity required typically in the past a return of, say, 15%. Thinly capitalized contractors were (and are) unwilling to tie capital for many years and prefer a low equity share. At present, equity returns of about 10% are considered as adequate, due to reduced expectations and cost of money. Institutional investors and lenders (e.g. insurance companies, investment and pension funds) presenting long-term liabilities are more willing to assume long-term commitments in project financing, especially when the construction phase of the project is over and there is no completion risk.

A relevant issue, with regard to debt finance of infrastructure investments, is the borrowing limit imposed on Euro-zone states. The EU Stability Agreement targets a public debt ratio limited up to 60% of the national GDP. The Agreement constrains the public borrowing to avoid supposedly adverse macroeconomic effects, such as the increase in the base (interest) rate. This argument is not always evident, however. The US debt quadrupled from the beginning of the 80s till the end of 90s, but the US rates declined from 16% to less than 3%. The OECD economy with the highest debt (Japan) has a rate
Diagramme 1: Financial transactions of PPP stakeholders (urban rail DBFMO model)
level just above nil. One could argue furthermore that macroeconomic effects of infrastructure investments are the same, whether they are undertaken by means of public or private borrowing. Greater validity but less relevance has the argument that rating agencies degrade the credit rating of countries with increased debt ratio, so that the future cost of borrowing becomes higher. In any case, collaborative infrastructure investments reduce the public sector borrowing requirements and the public debt ratio. Especially the use of Special Purpose Companies enables parent entities to set up transactions outside of their balance sheet (based on the current accounting standards) and, therefore, to display lower debt ratios. The use of SPCs provides flexibility to parent entities, if prudently exercised (the case of Enron being a negative example in this respect).

Public support for urban rail projects is justified because of their net social benefits, such as road de-congestion and environmental improvement. Potential public sources of recovering urban rail investments are one-off capital grants, periodic availability payments, or earmarked taxes, for instance cross-subsidies originating from the charging of road use. The land value increase around the urban rail stations produces positive externalities that could be internalized to refund the investment. Land surplus value may be captured either by compulsory taxation or by voluntary cost sharing for joint development purposes. Private sources of refunding are i.a. farebox revenues from users, as well as revenue sharing from auxiliary opportunities (e.g. advertising, P+R charges). Important financial transactions of public and private stakeholders in the case of an urban rail concession are presented in Diagramme 1. It is assumed that construction companies and equipment suppliers participate with equity capital in the concession structure.

4. EVALUATION OF PROCUREMENT FORMS

4.1 Risk Assessment

There exist few studies comparing forecasted and actual costs, revenues or traffic of existing transport infrastructure projects, especially when the procurement form is considered. At the phase of the detailed design, the construction method and quality level of an infrastructure project are essentially determined. Total project cost estimates contain then certain (or fixed) and uncertain cost components. Uncertainties may refer either to (in)efficient use of (sub)optimally priced input resources or to genuine contingencies and risks (e.g. local ground conditions, traffic demand, capital market situation). In general, the private sector performs more efficiently than the public sector in the management of labour. Public and private parties are equally exposed to macroeconomic fluctuations and risks. However, the public sector borrows capital of substantially lower cost than the private sector, due to the wider risk spreading through the taxation system.

Uncertainties and risks in infrastructure projects have been traditionally treated in a simplified deterministic form, either through the use of contingency factors or through sensitivity analysis. Risks are of probabilistic nature and are better represented in the form of a distribution of possible outcomes with "guesstimated" or known probabilities. There is a broad literature on risk typology, risk analysis and their applications in engineering and project finance (VOSE, 1991). Risks may be associated with losses (downside risks) or rewards (upside risks). Equity holders face both types of risks, lenders downside risks
only. Important project risks related to the implementation of urban rail infrastructure, are construction risks affecting the construction cost or schedule, as well as financial risks such as floating rates and macroeconomic conditions which impact the project financing. These types of risks influence each other. For instance, schedule delays act unfavourably upon the project cost. An underestimation of schedule overruns leads to overestimating the rate of return of the project. Construction cost overruns impact the cost of project financing and the overall project cost. A large-scale statistical study of the cost performance of 258 road and rail projects (mainly from North America and Europe) finds out a 45% cost overrun of urban rail projects on the average (FLYVBJERG, SKAMRIS and BUHL, 2003). The analysis does not differentiate, however, between forms of procurement for the project implementation.

Another North-American study develops a numerical example of the risk analysis process concerning an urban rail transit project (TOURAN and BOLSTER, 1994). The interrelated construction and financial risks are identified as risks of concern. Most project cost items are quantified as lognormal probability distributions. The Monte Carlo simulation has been used for modelling the variable cost components. Total project cost is modelled as the sum of the cost components. The simulation has been run several hundred times using the @RISK software package, and in every run a value of the total cost has been then computed. A frequency and a cumulative distribution function (CDF) have been constructed for the total cost. The CDF has been used to estimate the probability, say 90% of completing the transit project below a certain budget or, in other words, the contingency cost which is needed to assure at the 90%-confidence level that the project will not suffer cost overrun. The model is extended with a project financing part and a financial plan is developed, covering the construction and debt repayment years. The probability of having negative cash balance at any year is assessed by means of the simulation once more. In the sense of cashflow management, the risk contingency plan suggests as option the early issuance of additional bonds. It is implied that a high level of certainty (confidence) and risk aversion leads to a great contingency cost. Overall, the study exemplifies convincingly the process of risk identification, quantification, modelling, analysis and plan development.

In the context of PP collaborative investments, the risk analysis process is to be extended with the development of risk allocation strategies. Risks should be borne by those who understand their nature better and can manage them at lower cost. After the transfer of certain risks to the private party, the overall project risk becomes the sum of the risk shifted to the private sector and the risk hold by the public sector. There is a need to investigate comparatively the expected value of project risk components, when borne by public or private parties, respectively.

The construction risk of transport infrastructure projects and its interrelation with the financial risk is best controlled, in general, by the private party. Therefore, a risk transfer to the private party is meaningful in this respect. In underground metros, especially, the technical and the completion risk (e.g. unforeseen local ground conditions) is considered by far as the most significant project risk. That means that the private sponsors should be financially robust, because the risks involved are far larger than those for conventional turnkey contractors. Care is needed however to realize cost efficiency gains, because construction companies, if not sufficiently bound to the project as investors, have an interest to inflate the construction costs.

Financial engineering distinguishes systematic and project-specific components of financial risks. Systematic components such as the interest and the inflation risk are project risks external to the project as such. Inflation is a risk normally
borne by the users in concessions involving Operations and Maintenance (O&M). The bearing of the interest risk depends on the procurement form. Public procurement is favourable in this respect, as mentioned earlier.

During the recent transfer of the infrastructure responsibility to the private sector at the London Underground, a particular way has been followed in order to assess the maintenance risk for the existing system. The condition of the existing assets has been reviewed and graded in five classes, so that the corresponding risk could be evaluated with greater accuracy (BRIGINSHAW, 2002).

Standard & Poor’s elaborated a Traffic Risk Index to assess the expected ratio of effective vs. forecasted traffic volumes for toll-road projects (PROJECT FINANCE TRANSPORT REPORT SUPPLEMENT, 2002). In a first step, quality attributes of toll roads have been defined, which influence the traffic forecast certainty. The intensity of the attributes indicates the magnitude of systematic forecast errors (assuming a minimum adequacy of the transport model mechanism). In a second step, the attributes have been subjectively rated along a scale from 0-10 (reflecting increasing uncertainty) for 13 bank-commissioned and 16 sponsor/bidder-commissioned project forecasts worldwide. A close correlation between the forecast error and the average rating of the project attributes (=Traffic Risk Index) resulted. On the average, traffic forecasts commissioned by banks or sponsors/bidders are to be adjusted downwards by 18% or 34% respectively. The same methodology may be applied to assess the expected cost of a minimum traffic guarantee for the public sector. In Chapter 6, there are defined qualitative attributes for urban rail projects which impact their traffic risk.

4.2 Comparators of Procurement Forms

The net present values (NPV) of alternative forms of procurement for a transport infrastructure project are to be compared in order to derive the most advantageous one for the public interest. Public procurement (and operations, eventually) represents the base case. The alternatives are PP collaborative forms of differing scope and scale.

The main items of the financial analysis are the direct project costs, costs of parallel works (e.g. access links, transfer stations), land acquisition costs, O&M costs, cost of capital, risk costing, shadow or real (e.g. fare) payments. Tax benefits representing a loss of public revenues are real costs too. The broader the scope and scale of the project, the higher the transaction time and costs for the realization of the PP collaboration (e.g. advisers fees, contract formation & management costs, performance monitoring costs). The annualized cost of a full government guarantee for private debt equals the amount borrowed times the difference of interest rates for nonguaranteed and guaranteed debt respectively (IRWIN et. al., 1997). Guarantees are equivalent to insurance and cover debt finance (but not equity or quasi-equity, such as subordinated debt).

A critical issue for the NPV analysis is the selection of a plausible discount rate. The latter usually comprises the rate of the 10-year government bond, the systematic risk premium (currently less than 1%), and the project-specific risk premium. Therefore, the discount rate increases with the risk of the project.

The Dutch Ministry of Finance compares procurement forms for a project of a specified quality level at two distinct stages of the procurement procedure. At the strategy assessment stage of the pre-tendering phase, the NPV analysis (called Public Private Comparator, PPC) uses preliminary information. The analysis compares the public procurement with PP collaborative forms of
varying scope and scale. If public procurement is more advantageous, then the complex and resource-consuming PP procurement procedure may be avoided. At the evaluation stage of economic offers, the NPV analysis (called Public Sector Comparator, PSC) uses much more information based on the bids submitted by the private parties (market prices). The analysis compares the public procurement with the bids of a procurement form having a fixed scope and scale. The evaluation outcome demonstrates in a transparent way which procurement form minimizes overall the financial burden of the state.

5. STRATEGIC CHOICES FOR URBAN RAIL INVESTMENTS

The strategy formulation, assessment and selection referring to alternative forms of provision of urban rail infrastructure is discussed. The strategic questions concern:

(a) Selection of the scope of PP collaboration. The functional areas considered are Design, Build, Finance, Transfer, Maintenance and Operation of the project. There is a rich literature about the synergies or diseconomies of scope of vertical integration or separation of infrastructure, operations and maintenance. A DBFM concession is an interesting option, i.a. due to the incentive to balance initial investment costs and future maintenance costs. However, the urban rail lifecycle is typically longer than the concession period. This means that an optimal use of lifecycle costing is likely only in the case of full privatization, where no transfer to the public sector takes place. The incentive of the concessionaire to maintain the system decreases when the expiration of the concession is in sight. A key issue here is the capture of some traffic risk in the formula of the shadow payment to the concessionaire (=variable usage fee). The DBFMO concession on the other hand, exploits synergies of integrated operations and maintenance activities, but it is heavier exposed to the traffic risk.

(b) Selection of the scale of PP collaboration. On the cost-side, a horizontal integration of sub-projects (e.g. extensions, subsystems) provides economies of scale, whereas a split between more than one concessionaires gives rise to co-ordination costs. On the revenue-side, the combination of unattractive extensions having low profitability with commercially viable extensions is a promising strategy. The strategy assessment shows whether tenders should be launched once for all sub-projects, in parallel, or successively. A comprehensive approach is adequate in this respect, because each sub-project is not fully justifiable or viable without consideration of the whole system. A major issue here is the pooling together of new extensions and existing network in the concession, which could lead to the spreading of the traffic risk. Proven ridership level and revenue streams of existing systems reduce of course the commercial risk in the case of a system integration. Moreover, cost economies of network size could prevail. Urban rail extensions derive most of their value because of the existence of the base network. A high proportion of an extension’s benefits are due to the journeys to other parts of the network. The transfer risks (e.g. industrial relations) and interface risks of the integration with the existing system are to be weighted against the positive network effects. The maintenance risk of existing systems depends on their age and past maintenance practices. New, well-maintained systems contain a far lower maintenance risk than old systems with a record of deferred re-investments. Finally, the capital base needed for the additional acquisition of an existing system is much larger than the capital base necessary for the simple financing of extensions.
Certain immanent urban rail characteristics are critical from the point of view of a PP development framework. Urban rail constitutes the backbone of the urban transport infrastructure. Its *importance* constitutes a large residual risk for the public sector. In case of a default or breach of obligations and unwilling lenders, the public party must assume responsibility to assure continued provision of the essential service i.e. an implicit government guarantee is inevitable, even if not deliberately given. This could encourage the concessionaire to get advantage of the situation. Urban rail systems contain also a high level of *complexity*. This implies high costs of co-ordination between more than one concessionaires or costs of integration with an existing system. It implies further high monitoring costs because any performance-based output specifications must be necessarily very extensive.

### 6. URBAN RAIL VS. ROAD PROJECT RISKS

The recent revival of PP collaboration for transport infrastructure investments is more evident concerning road projects (see Table 1). There is less experience with public-private collaboration in the urban rail sector, especially outside U.K.

<table>
<thead>
<tr>
<th>PPP transport infrastructure</th>
<th>Financial volume share</th>
</tr>
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<tbody>
<tr>
<td>Airports</td>
<td>32%</td>
</tr>
<tr>
<td>Roads &amp; tunnels</td>
<td>40%</td>
</tr>
<tr>
<td>Urban rail</td>
<td>2%</td>
</tr>
<tr>
<td>Rail</td>
<td>14%</td>
</tr>
<tr>
<td>Ports</td>
<td>12%</td>
</tr>
</tbody>
</table>

Table 1: Worldwide financial volume share 2001
(Source: PROJECT FINANCE TRANSPORT REPORT SUPPLEMENT, 2002)

Comparing urban rail vs. road project characteristics from the perspective of the PP collaboration may give an explanation of this unbalanced picture. Urban rail exhibits in general, a higher functional complexity (sub-system interfaces) and a lower compatibility among supplier technologies. It contains a higher *construction risk*, especially in the case of capital-intensive underground metros. The already mentioned large-scale project cost review (FLYVBJERG et al., 2003) comes up to an average cost overrun of 45% for urban rail vs. 20% for road projects. The absolute figures do matter too, because the unit construction costs are typically higher for urban rail than for roads.

With regard to the post-implementation phase, the urban rail operation produces non-user benefits outside of the (imperfect) market mechanism. Such benefits concern de-congestion on competing systems, intermodal accident savings and air quality improvement. On the other hand, cars do not pay the full social costs of their use. The unpaid (negative) externalities are equivalent to hidden car subsidies. An unfair competition between car and urban rail (or even public transport as a whole) arises. Urban rail is then underused and, other things being equal, cannot recover its total costs. In other words, the social returns of the urban rail exceed its financial returns. A “second-best” instrument to
increase the social welfare in that case, is to provide public support to the urban rail at a justifiable level, i.e. sufficient to close the gap between its social benefits and its financial income. In the typical case, urban rail cannot be self-financed, but only co-financed by the private and the public party (limited recourse financing). The same line of reasoning explains why the urban rail operation is more heavily regulated than road operation. Tariff levels are set and subsidized by the public sector. Public support may be conditioned also by factors other than the social surplus benefits. Examples are the concessionary travel, the service of transit-dependent population, even an inefficient public management. Administered pricing may also hinder the extraction of a monopolistic rent through the operator. Overall, the urban rail contains a higher regulatory risk than roads. Other reasons speaking for a wider private provision of service in case of roads rather than of urban rail are, for instance the higher maintenance risk of the urban rail and the advantage of a more advanced electronic toll collection compared with an electronic fare collection technology.

There are many free route alternatives to urban toll roads within a dense urban network. The flexible network topology speaks for an increased traffic and revenue risk of toll roads. Private providers of toll roads normally set a toll level capable of recovering both capital and operating costs. Tolls are then orientated to the long-run marginal costs of road provision and include the return on capital. As a consequence, the effective price to road users is likely to be above the short-run marginal cost, i.e. the level which optimizes the road use. A higher than justified level of charges will exclude, in general, some potential users from the toll road. Distance-independent flat tolls will exclude potential short-distance users from the toll road too. Inadequate charging structures induce misallocation of resources and traffic. To avoid emerging inefficiencies and subsequent problems of political acceptance, some states (e.g. Great Britain) adopt, instead of user-paid tolls, the so called shadow tolls. The private provider receives then usage payments from the government. While the unit payment (per vehicle movement) is fixed, the traffic of course varies, so that the provider still bears part of the traffic risk.

In the case of a limited recourse financing, feasible is, also, a fixed periodic availability payment to the provider (offsetting a service supply obligation), instead of a one-off capital grant during the construction period. Combined forms of public support are possible too, whereby the public grant usually takes the form of an equity contribution. Similar capital recovery structures are applicable also to co-financed urban rail projects.

The traffic risk of urban rail investments is a more challenging issue. Qualitative attributes of urban rail projects, which influence the traffic forecast certainty, are to be defined. The occurrence and intensity of the following project attributes indicate the magnitude of traffic forecast errors:

1. **Road traffic congestion.** A high level of congestion on the corridor of concern pushes car users to the urban rail alternative. Time savings are especially sizeable on radial corridors.

2. **Service reliability.** The regularity of service is more or less given when there is no conflict with road traffic, as in the case of metro or grade-separated LRT. Light rail transit running on-street sections is in conflict with intersecting road traffic. Due to irregular headways, delays and lower commercial speed it is then more exposed to car, taxi or bus competition in terms of travel time. An absolute green light priority for on-street LRT, when approaching intersections, is essential in this respect.
3. **Controlled competition regime.** Urban rail ridership level is at risk in a deregulated environment, where, for instance, a low-fare bus competition along the corridor of interest prevails. A public transport (PT) regulatory authority would grant exclusive rights of operation to a provider (say, after a competitive bidding) and, at the same time hinder the extraction of any monopoly rent. The provision of urban rail infrastructure has natural monopoly features and the urban rail is characterized by a stable network topology (as opposed to roads).

4. **System coverage.** Residential settlements, service and commercial poles, which are directly accessible by urban rail, built up the primary ridership potential of the latter mode. The relevant indicators are population and job positions served by urban rail stations within a, say, 500m walk distance.

5. **Proven traffic and revenue streams.** The integration of extensions with an existing system provides more certainty about the commercial prospects.

6. **Connection with urban gates.** The direct service of the central station, intercity bus terminal, airport or harbour provides urban rail with a sizeable share of visitors, local employees and external traffic.

7. **Integrated transport services.** The provision of Park&Ride facilities and bus terminals at nodal stations reduces the transfer penalty and enhances the urban rail ridership level. Bus feeder lines extend the ridership potential of urban rail beyond walk distance.

8. **Strategic transportation plan.** Base network or extensions are the result of a comprehensive multimodal planning study rather than of intuitive ‘political’ alignment.

9. **Parking management and enforcement.** Parking time and supply constraints, as well as parking charges in CBD areas internalize externalities of public land occupation and promote a modal switch of the car users.

10. **Road pricing and car access restrictions.** Toll charging or road pricing on corridors of concern, as well as car access restrictions for the CBD area (e.g. odd-even plate scheme in Athens, area-based charging in London) reduce road congestion and enhance the traffic level of urban rail.

11. **Integrated through ticketing.** Ticketing integration in conjunction with a reliable revenue protection and allocation mechanism (e.g. gating and electronic ticketing) facilitate system use and reduce transaction costs.

12. **Flat demand profile.** A low peak to offpeak ratio, in conjunction with efficient management of optimally priced resources, potentially improves the operating results.

13. **Availability of service.** A frequent service without cancellations reduces the generalized costs of travel and increases the competitive position of urban rail.

14. **Comfort of service.** Cleanliness, security and ambience of stations and vehicles are genuine quality attributes of urban rail systems.

Referring particularly to capital-intensive underground metros, private parties are better able to bear their high construction risks. On congested or tolled corridors, metros contain lower traffic risk than roads, and there is less need to
transfer this type of risk to private parties. A recent study reviews the U.K.
experience in private financing of transport infrastructure at large (DEBANDE,
2002). The study concludes that the gains from recourse to the private sector
are essentially concentrated in the design and construction phase. There is little,
if any, empirical evidence on the performance during the subsequent operational
phase, which would support or weaken such gains. Focusing on road
concessions, the review does not observe a real transfer of traffic risk to private
parties. An Australian road tunnel concession is also mentioned, where the
private party does not assume an effective traffic or revenue risk.

7. EUROPEAN COLLABORATIVE URBAN RAIL PROJECTS

European urban rail projects in operation, under construction, or in an advanced
stage of planning are contained in Table 2. Their common characteristic is that
private parties bear construction and financial risks at least. It is apparent from
this synoptic table that the UK projects dominate, followed by French and
planned Iberian projects (BRIGINSHAV, 2002a). Light rail projects prevail over
heavy metros by far. The latter concern essentially an extension of the Madrid
Metro to Arganda (MONZON and GONZALEZ, 2000) and the planned Dublin
Metro. Intermediate driverless light metros are developed in France (Vehicle
Automatique Léger, VAL). The Toulouse light metro Line A is not considered,
because of the early concession termination after 4 years of operation
(VARNAISON, 1999). In France there take also place mixed forms of PP
collaboration, such as the construction pre-financing of the Grenoble LRT Line 2
and the joint venture of the Strasbourg LRT Line B. In the DBFM business
model for the Dockland Light Rail extensions, the periodic service payment
consists of a fixed availability fee and a variable usage fee, the latter bearing a
part of the traffic risk. Competitive bidding for the award of concessions is the
rule, direct awarding (combined with level-of-service and pricing regulation)
being again a French exception.

The typical concession length amounts to about 30 years. An exception is the
Croydon Tramlink with a concession length of 99 years, where the full traffic risk
is transferred to the private party. Most of the urban rail concessions receive
public support solely in the form of a one-off capital grant. The Nottingham
Express Transit where a partial traffic risk is transferred, receives only a periodic
availability payment combined with a performance-based system of penalties
and awards. The recent trend in the UK concessions to mitigate the traffic risk,
is a support mix of capital grant and periodic availability payments. In the case
of the Barcelona Light Rail, the state holds a part of the traffic risk by means of
a minimum traffic guarantee for the half of a definite ridership shortfall.
<table>
<thead>
<tr>
<th>Project</th>
<th>Scope</th>
<th>Size (km)</th>
<th>Operation</th>
<th>Project costs (bi €)</th>
<th>Contract period (years)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dockland Light Rail extension</td>
<td>DBFM</td>
<td>27</td>
<td>1987</td>
<td>n.a.</td>
<td>24</td>
<td>Grade-separated Lewisham extension; new extension to London City Airport by 2005</td>
</tr>
<tr>
<td>Manchester Metrolink</td>
<td>DBFMO</td>
<td>74 (Phase 3)</td>
<td>1992 (Phase 1)</td>
<td>0,75 (Phase 3)</td>
<td>15 (Phase 2)</td>
<td>LRT Phase 2: 2000 / Phase 3: 2003</td>
</tr>
<tr>
<td>Croydon Tramlink</td>
<td>DBFMO</td>
<td>28</td>
<td>2000</td>
<td>0,30</td>
<td>99</td>
<td>Capital grant only: full traffic risk transferred</td>
</tr>
<tr>
<td>Nottingham Express Transit</td>
<td>DBFMO</td>
<td>15</td>
<td>2003</td>
<td>0,36</td>
<td>30</td>
<td>Availability payment only: partial traffic risk transferred</td>
</tr>
<tr>
<td>South Hampshire LRT</td>
<td>DBFMO</td>
<td>14</td>
<td>2006</td>
<td>0,29</td>
<td>n.a.</td>
<td>Rapid Transit phase 1</td>
</tr>
<tr>
<td>Leeds Supertram</td>
<td>DBFMO</td>
<td>28</td>
<td>2007</td>
<td>0,75</td>
<td>31</td>
<td>Public grant + annual availability payment</td>
</tr>
<tr>
<td>Grenoble LRT</td>
<td>DBFT</td>
<td>6</td>
<td>1990</td>
<td>n.a.</td>
<td>not applicable</td>
<td>Line 2, direct awarding, pre-financed construction</td>
</tr>
<tr>
<td>Rouen Metrobus</td>
<td>DBFMO</td>
<td>16</td>
<td>1994</td>
<td>n.a.</td>
<td>30</td>
<td>LRT Line 1, competitive tender</td>
</tr>
<tr>
<td>Rennes Metro VAL</td>
<td>DBFMO</td>
<td>9</td>
<td>2002</td>
<td>0,53</td>
<td>n.a.</td>
<td>Automated driverless light metro system</td>
</tr>
<tr>
<td>Strasbourg LRT Line B</td>
<td>Joint Venture</td>
<td>10</td>
<td>2000</td>
<td>0,28</td>
<td>n.a.</td>
<td>Publicly controlled SPV, direct awarding</td>
</tr>
<tr>
<td>Madrid Metro Line 9</td>
<td>DBFMO</td>
<td>18</td>
<td>1999</td>
<td>0,12</td>
<td>30</td>
<td>Suburban at-grade/UG metro extension</td>
</tr>
<tr>
<td>Barcelona Light Rail</td>
<td>DBFMO</td>
<td>33</td>
<td>2004</td>
<td>0,43</td>
<td>25</td>
<td>Two lines / one concession per line</td>
</tr>
<tr>
<td>Seville Metro</td>
<td>DBFMO</td>
<td>19</td>
<td>Planned</td>
<td>0,36</td>
<td>35</td>
<td>LRT system</td>
</tr>
<tr>
<td>Lisbon South Tagus LRT</td>
<td>DBFMO</td>
<td>13</td>
<td>Planned</td>
<td>0,32</td>
<td>27</td>
<td>Phase 1 figures</td>
</tr>
<tr>
<td>Dublin Metro</td>
<td>DBFMO</td>
<td>70 (incl. 13km UG)</td>
<td>2007 (Phase 1)</td>
<td>2,5 (Phase 1)</td>
<td>n.a.</td>
<td>Full metro system by 2016</td>
</tr>
</tbody>
</table>

Table 2: European PPP urban rail projects

(n.a.: not available)

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The table does not consider the mere contracting out of O&M, as in the (driverless) cases of the Copenhagen light metro or the Barcelona Metro Line 9. An atypical PP collaboration, but actually the largest one in the UK, concerns the London Underground which was characterized by massive underinvestment in the last decades. The PP collaboration pertains to the maintenance and upgrading of the existing system and rolling stock (BRIGINSHAW, 2002). The contracts with the two private consortia Metronet and TubeLines are of 30 years' length. There are performance-based availability payments foreseen, which are fixed only for the first 7.5 years and negotiated then every 7.5 years. The operation of trains, signalling and stations are retained by the public sector. The five equal shareholders of Metronet will be also suppliers of the respective infrastructure companies BVC and SSL. TubeLines, being responsible for the JNP Infraco, will procure equipment globally. Both consortia suggest a total investment of €17 bi in the first 7.5 years, split between renewal and maintenance. Safety issues, whether the availability payment should be partly traffic-related, or the amount of risk transfer to the private parties in general, are disputed matters in this PP collaboration.

8. GREEK COLLABORATIVE TRANSPORT INFRASTRUCTURE PROJECTS

8.1 Projects under Construction or in Operation

Greek transport infrastructure projects in operation or under construction are contained in Table 3. Their common characteristic is that they are results of public-private collaboration. Already in full operation is the new Athens International Airport at Spata, which is essentially a joint venture of the Greek state and a private consortium, governed by a development contract. The consortium holds in fact the management of the new Airport, being at the same time a 45% - minority shareholder. The other two projects are governed by typical concession contracts (DBFMO). The partly in operation Attiki Odos is a 65km long peripheral toll-road relieving the city center of Athens from through traffic and providing road access to the new Athens Airport. The 2.5km long cable-stayed Rio Bridge connects Peloponnesus at Rio (near Patras) with north-western Greece at Antirrion, across the Gulf of Corinth. The Rio Bridge is still under construction and a tolled operation is foreseen by 2004. The two concession contracts contain a RPI-adjusted fixed price mechanism. A cap on tolls is contractually set and the inflation risk is borne by the users.

All three projects enjoy VAT and revenue tax exemptions. They are all products of competitive bidding and their contract length ranges from 23 to 42 years. The time passed between project and financial agreement ranges from 1 year for the Airport to more than 3 years for Attiki Odos, an exceptionally long period. Main funding sources for all three projects are public grants and EIB loans. The European Investment Bank has financed the projects with advantageous conditions in terms of cost of capital and longer maturity period (up to 25 years). The EIB contributed overall 4,4% of Greek investments between 1996 and 2000, mainly transport infrastructure projects. The short-term bank loans during the construction period of the three PP collaborative projects have been guaranteed through commercial bank syndicates. During the operation period, when the traffic risk emerges, the extent of the Greek state guarantee ranges from 50% to 100% of the refinanced debt.
<table>
<thead>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>New Athens Airport</td>
<td>Jul.95</td>
<td>Sept. 95</td>
<td>Jul. 96</td>
<td>Mar. 01</td>
<td>30</td>
<td>6</td>
<td>6000pa/p.h.</td>
<td>2.10</td>
<td>8.6%</td>
<td>55.0%</td>
</tr>
<tr>
<td>Attiki Odos</td>
<td>May 96</td>
<td>Dec. 96</td>
<td>Mar. 00</td>
<td>Dec. 03</td>
<td>23</td>
<td>5</td>
<td>160.000 daily vehicles</td>
<td>1.40</td>
<td>11.4%</td>
<td>29.4%</td>
</tr>
<tr>
<td>Rio Bridge</td>
<td>Jan. 96</td>
<td>Apr. 96</td>
<td>Dec. 97</td>
<td>Aug. 04</td>
<td>42</td>
<td>7</td>
<td>10.000 daily vehicles</td>
<td>0.74</td>
<td>9.3%</td>
<td>41.7%</td>
</tr>
</tbody>
</table>

Table 3: Greek PPP transport infrastructure projects
The Greek legal framework sets limits to political and legal risks of private investors (VERVENIOTIS, 1995). Additional political and legal certainty came from the approval of all three project contracts by the Greek Parliament. The Greek legal system introduced recently through Law 3156/2003 a new financial instrument in the form of the securitization of future cash flows or revenue streams. Corporations may sell their future claims or cash flows to Special Purpose Companies. The SPCs pay the claims through the issuance and private placement of bonds. The bonds are secured through the future revenue streams as collateral asset. In case of an investment grade SPC rating, mutual funds and institutional investors may figure as long-term bondholders. The law provides SPCs with strong tax benefits. The revenue-backed bond financing reduces the cost of borrowing, as well as the need for bank loans and improves the liquidity of the project company.

8.2 Planned Athens Metro Extensions

The 18km long base network of Attiko Metro Lines 2&3 began operation early in the year 2000. The 1st generation of extensions currently under construction, as well as the 2nd generation of planned extensions, are results of the Metro Development Study (MDS), which is essentially the strategic transportation plan of the Attika region. The comprehensive multimodal MDS has developed a solid transportation model which provides i.a. ridership projections.

The planning horizon for the completion of the 2nd generation of extensions is the year 2010. The Line 3 northern extension along Kifissias and the western extension to Piraeus, as well as the Line 2 northern extension to Galatsi, contain 21 underground route kms and 16 new stations. They will directly serve about 181,000 residents and 102,000 job positions by 2010, whereas the additional ridership will amount 330,000 daily passengers. The estimated construction cost, including rolling stock, reaches € 2 bi.

Sufficient EU grants allowed the use of the public procurement for the implementation of the base project and the extensions under construction. However, the availability of EU grants for further extensions will substantially decrease in the near future. Moreover, the public debt ratio reached the 104,9% and the public debt guarantees the 5,5% of the Greek GDP by 2002, respectively. The need to decrease the financial burden of the state makes alternative procurement forms a plausible option for the 2nd generation of the Athens Metro extensions.

The principal sponsor (Attiko Metro) recently appointed a financial advisory team (incl. engineering and legal advisers) to support the development of a PP collaboration in this connection. The related tender was quality- and cost-based to 50% respectively and foresees, apart from the fixed adviser's fee, a success fee equal to 0,75% of the invested equity and debt, the latter constrained to the part without (in)direct public guarantee.

The financial advisory services refer to two distinct stages. At the first stage, a strategy for the realization of the 2nd generation of Metro extensions through mobilization of private funds is to be developed. The strategic questions to be answered pertain to the suitable scope, scale, and length of the PP collaboration. An extensive use of the MDS transportation model is anticipated. Key issues for the comparative assessment of alternative strategies are the adequate allocation of risks between the parties and the NPV analysis of alternative procurement forms (in the way of a Public Private Comparator). At a second stage, the implementation of the selected strategy is foreseen. It should be noted that the transfer stations to the planned Metro extensions are included.
in the tender scope. After the tender preparation and submission of offers, this stage proceeds with the evaluation of the offers. The NPV analysis compares then the public procurement with the bids (in the manner of a Public Sector Comparator). The financial advisory services in the case of a successful PP collaboration expire with the signing of the project and financial agreement.

9. CONCLUSIONS

The study concludes that the social returns of the urban rail typically exceed to a considerable degree its financial returns, mainly due to nonuser benefits. That means, that urban rail cannot be self-financed but only co-financed by the private and public party (limited recourse financing). Other things being equal, the risk profile of urban rail projects is better matched through bank loans in the (shorter) construction phase and long bonds in the (longer) post-implementation phase. With regard to the scope of a PP collaboration, a pooling together of new urban rail extensions provides cost economies and reduces coordination costs. As far as the scope of a PP collaboration for underground metros is concerned, metros contain a higher construction risk than roads. This is an important reason for the wider spreading of collaborative road projects. In any case, private parties are more efficient when assuming the high construction risks. On congested or tolled corridors, metros contain lower traffic risk than roads, and there is less need to transfer this type of risk to private parties. The case of transferring the maintenance risk in the urban rail context is inconclusive. The related collaborative project of London Underground is based on a 30-year contract and has just begun, so it is early to draw definitive conclusions. In general, the broader the scope and scale of the PP collaboration, the more the risks involved, the less competition in the tendering phase, and the more difficult to keep a consortium together till the expiration of the concession.

Relevant areas that need further investigation refer mostly to risk comparisons. A potential field of statistical inquiry is the assessment of the expected value of project risk components, when borne by private or public parties respectively. On-going research refers to the ex-post comparison of traffic forecast errors for co-financed urban rail schemes with average ratings of the 14 qualitative attributes developed in this paper. Experience is needed also in the analysis of diverging interests within PP collaboration schemes, as well as in the development of mediation and other conflict resolution mechanisms.
REFERENCES


Disclaimer

The views expressed in this paper do not represent official views of Attiko Metro A.E., the authors being solely responsible for views expressed herein.

Notes

1. This variant has been used for the construction of German highways with a total budget of € 4,5 bi (per November 2002). The construction companies get intermediate bank loans till the commissioning of the project. Afterwards they transfer their claims (against the public party) to the banks and pay off their credit. Then the public party assumes the obligation to pay off the loan in annual rates (usually 15 years tenor).
2. According to the prospective Basel II agreement, banks have to assign (after 2006) their debtors to risk classes. Bank loans for debtors with lower credit ratings will become more expensive in the future.
3. A Greek example is the private sponsoring for the “Kifisos” station’s construction of the Athens - Piraeus metro line, close to a planned activity center.
4. A way to mitigate the default risk is the establishment of a National Guarantee Fund to transport infrastructure collaborative projects, as proposed in Spain (MATE and VASSALLO, 2002). Such a Fund would collect premiums paid by the pool of concessionaire companies, provide a partial guarantee concerning debt repayment, and guarantee the issuance of concession bonds. The European Investment Fund (EIF) plays a similar role too, especially for the financing of the trans-European networks (TENs).
5. Self-supporting urban rail schemes in Far East are highly idiosyncratic (e.g. extreme land scarcity in the case of the Hong-Kong metro).