ECONOMIC IMPACT AND PROJECT FINANCING EQUILIBRIUM TO ASSESS LARGE TRANSPORT INFRASTRUCTURE PROJECTS

Dimitrios J. DIMITRIOU [(1)],

Assistant Professor, Department of Economics, Democritus University of Thrace, Panepistimioupoli, Komotini, 69100, Greece, Tel: +30 25310 39507, Fax: +30 25310 39830, E-mail: ddimitri@econ.duth.gr

Abstract

Supply chain and logistics transport infrastructures are key components of the national asset portfolio. In most of the cases the decision to invest in a transport infrastructure is not simple, mainly, because the complications in planning process, the amount of capital need to invest before the business establishment and the high number of stakeholders involved in decision process. The decision process is more complicate in large transport infrastructure projects, where the project survivability is strongly related to financial viability as well as economic development prospects and in medium-long time horizon. This paper deals with the methodology approach to support strategic decisions about develop a new large transport infrastructure project. According a systematic approach, the analysis framework where the decision key issues are evaluated and the key messages to decision makers are presented. Conventional wisdom is to present a systematic approach appropriate to apply is relevant projects, providing the essential tool to support decisions at level of strategic planning. This paper attempts to fill gaps faced by stakeholders and decisions makers in the evaluation and decision making process of developing large transport infrastructure projects. According to a consequences analysis and systemic approach the relationship of supply chain and logistic center infrastructure development, financial viability and economic system development and stakeholder's expectation is analyzed. The application provides the methodology outputs presenting the proposed framework for a strategic new freight infrastructure including new rail line and freight center in sea port in North Greece.

1. Introduction

Delivering transport infrastructure is a complex process involving many stakeholders namely; Government and planning agencies, finance organizations, private contractors, system operators. The top level goal of the decision making process is the delivery of cost effective, reliable, sustainable, efficient, convenient and safe transport infrastructure. Time and especially cost forecasts are difficult to estimate, and often prove to be wrong as Locateli at al. [1] analyze. The risk of cost overrun should be incorporated in the project evaluation and decision-making as Berechman et al. [2] emphasizes. Mishra et al. [3] analyzes that transport infrastructures are irreversible investments and require long-time commitment maintenance and operation.

Transport infrastructure and especially freight transport projects require significant capital investment as well as ongoing funding for operations and maintenance [4]. From a financial point of view, many freigh transport projects have a "funding gap" and require other sources of funding in order to be sustainable [5]. Many of these projects generate very large non-market public benefits, such as improved connectivity, mobility and accessibility, regional economic development, reduced congestion and reduced environmental impacts. Although these public benefits can create a strong incentive for investmetns in such projects, they do not on their own generate funding sources to pay for such projects.[4]

On the other hand investing in large transport infrastructures is a key driver in strengthening the national economy and enhancing nation's productivity, as they creates economic benefits and additional income [6, 7, 8]. In national level, the assets portfolio is helping to enhance productivity and competitiveness through the funding of significant infrastructure projects and a comprehensive regulatory reform agenda. However, such a decision often must be made in environments that are much more fraught with uncertainty. The key question in such decisions is if new large sustainable transport infrastructures could

be able to boost economic development.

2. Ex Ante Quantitative Equilibrium Analysis Framework

Large transport Infrastructures ex-ant evaluation focus on project rationale and strategic issues, costs and benefits, risks and uncertainties, financial sustainability and economic impact analysis [9]. While financial analysis of large transport infrastructure investment projects is concerned primarily with whether the overall net economic benefits are positive, the economic analysis of large transport infrastructure projects goes a step further to analyse how their benefits and costs are distributed and where is the equilibrium point between economic benefits and financial sustainable analysis, as depicted in figure 1.

As multiple stakeholders have to agree on and coordinate the institutional and financing schemes of large transport infrastructure projects, the ex-ant evaluation of the project gives a tool to stakeholders to ensure that can anticipate net gains from the project in question and helps to alleviate coordination failure and ensure project financial sustainability [10]. In particular, it is important to identify possible net losers and build in necessary adjustments for socioeconomic and financial viability.

Freight Transport has become a major contributor to economic growth that requires operational productive and efficient infrastructures and services [11, 12]. These forecasting approaches are based on quantitative methodologies using causal econometric and financial approaches [13].

Decision process to invest in freight transport projects is conceptualized as a system with sub-systems consisting of different constituents. By capturing the dynamic behaviours, uncertainties and interdependencies of these constituents, the evaluation of such projects can be evaluated as described analytically in Fig. 1.

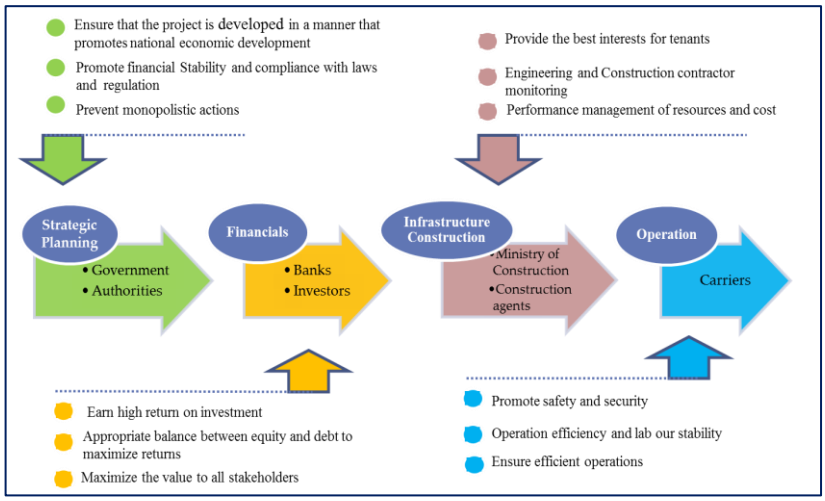

Fig.1: Phases in the decision making process along a cross border rail project life cycle [14].

Assessing concrete steps across a project's investment decision making process can be a powerful way of making it more resilient and ultimately more profitable for all of the stakeholders and agents across the value chain. Decision process to invest in large transport infrastructure projects is conceptualized as a multi parameter analysis with the following pillars:

Strategic Planning

Governments are responsible for the strategic planning in order to develop projects with correct forecasts and assumptions (for example, on demographics, demand, prices, revenues,

capital expenditure, or operating expenditure), and a high understanding of market dynamics. They have also to plan for volatility and adverse scenarios [15].

Other challenges of the government and authorities include planning and management of future interface risks, caused by early-stage decisions regarding project structures and design. In addition, the risk of contractors, and private investors, who are essential, has to be taken into account in the phase of strategic planning.

A system of system approach involves making decisions using a risk-based perspective. Specifically, in the earliest design and planning phases of a large transport infrastructure project, this may require a conscious effort to identify, assess, and, quantify all the risks the project will be exposed to across its life cycle. This includes reflection on potential adverse circumstances and scenarios that has to be made by governments and authorities. The objective is to create a decision-making process to select the most suitable investment that will achieve the national targets and ensure the project is developed in a way that promotes regional economic development.

Financial analysis

The main purpose of the Financial Analysis is to use the project cash flow forecasts to calculate suitable net return indicators; focusing on the Financial Net Present Value (FNPV) and the Financial Internal Rate of Return (FIRR).

The Financial Analysis contrasts the financial inflows with the financial outflows.

Financial inflows are:

- any possible revenues for the sale of goods and services (Tolls, fares and charges)
- the net cash from the management of financial resources (Government Transfers)

Financial Outflows are:

- investment Costs
- operation costs
- reimbursement of loans and interest paid,
- taxes
- other disbursements (e.g. dividends).

The first step in the Financial Analysis is to estimate the total cost of investment and the time horizon for the investment, which is the number of years for which forecasts are provided. The reference time horizon for example for railway projects are 30 years and for roads, ports and airports 25 years.

The calculation of total operating costs and revenues is the second step of a Financial Analysis. These costs do not take the form of an investment and are consumed within each accounting period; the operating costs comprise all the data on the disbursements foreseen for the purchase of goods and services.

A project is financially sustainable if it does not incur the risk of running out of cash in the future. The crucial issue here is the timing of cash proceeds and payments. Project promoters should show how sources of financing (including revenues and any kind of cash transfers) will consistently match disbursements year-by-year over the project time horizon. Financial sustainability is ensured if net flow of cumulated generated cash flow is positive for all the years considered. The last step in the Financial Analysis is the appraisal of the financial return on capital, which aims to look at the project performance from the perspective of the assisted public and possibly private entities.

Economic Impact analysis

The Economic Impact Analysis appraises the project's contribution to the economic welfare of the region or country. It is made on behalf of the whole of society instead of just

the owners of the infrastructure, as in the Financial Analysis. In the case of an economic evaluation based on a cost-benefit analysis, which takes the perspective of society as a whole, the market pricing of a good is not a good indicator of its true value to society as so-called external effects also play a significant role. Yet the valuation of these effects is crucial for Economic Analysis and may be important for the appraisal of the project. In order to internalise these externalities, the external effects have to be identified, quantified and have a realistic monetary value assigned to them. The economic impact footprint analysis includes additional indirect effects (if relevant) and monetisation of non-market impacts [16]. The goal is the equilibrium point between the financial sustainability and contribution to economic system. As depicted in Figure 2.

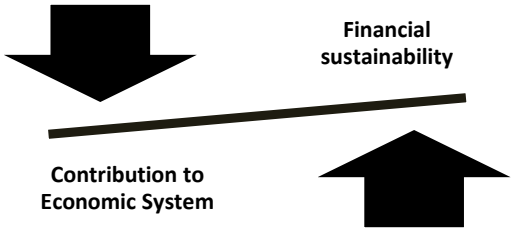

Fig. 1 Equilibrium of transport infrastructure between financial sustainability and economic contribution to economic system

3. Scenario development

Whether driven by revenue growth, improved performance, better cost management or increased competitive advantage, it is critical for viable transport infrastructure to identify both the long-term benefits and impact on the overall business, services and strategy by developing different financing scenarios. The infrastructure financing market has gone through a process of radical transformation starting from the mid-2000s. Different reasons – including a changed macroeconomic environment, more strikt financial regulations and long-term asset investments – have led to a reallocation of flows from the banking sector to the institutional investors sector.

There are many of ways to finance transport infrastructure development. The public sectors role can vary and there are a number of hybrid forms. The literature on private provision of infrastructure has proved many different aspects why social welfare under public provision and PPPs may be different. First, since the same investor constructs and operates the project under a PPP, it has incentives to consider life cycle cost considerations during the construction phase, and on the other side service quality provide a good argument in favor of PPPs. The reason is that the investor has an incentive to define the life cycle costs and, at the same time, cannot reduce on the quality of service. [15].Pellegrino et al [17] proposed a new “dynamic” risk management approach for PPP projects based on real options that improves the traditional risk management techniques by supporting the decision makers in finding a cost-effective combination of real options (or forms of flexibility) to embed in a PPP investment in order to optimally control risk and maximize investment value.[17]. The alternative funding schemes are:

- **Public funding**

Direct public funding includes State budget money invested in the project. The budgetary funds owners may be local governments, subdivisions of ministries, public organizations, or other institutions. The Central Government gives finances according to the state budget to the budgetary funds owner, who uses it to finance transport and logistics infrastructure projects. The assets of investments will be owned by the State.

- **Funding from Investment Bank and financial institutions**

Domestic Bank financing may be difficult with financial restrictions due to the narrow, concentrated and illiquid nature of the domestic banking sectors. The tightening of banking regulations in the aftermath of the financial crisis could also impede international financing of infrastructure projects. Once the projects proved to be viable, large international banks such as European Investment Bank will be another scenario for finance.

- **Public-Private Partnership**

A public–private partnership (PPP) is a cooperative arrangement between one or more public and private sectors, typically of a long term nature. However, the past few decades has seen a clear trend towards governments across the globe making greater use of various PPP arrangements. The financial crisis of 2008 onwards brought high interest in PPPs. Financing constraints on public resources due to recession, while highlighting the importance of new infrastructure investments in order to boost regional and economic development are increasingly interest and financing mechanisms to the private sector as an alternative additional source of funding in order to meet all the funding gap.

- **Private investment**

Private investment is the financial model where a private investor will finance the project. Such private investors may be private companies and enterprises or individuals. In this model, the private investor uses its own money or borrows it from the financial market and invests it in its own infrastructure object.

4. Case study

4.1. Key Features

Greece stands on the crossroad of three continents (Europe, Asia, Africa), connecting, since early antiquity, people, goods and cultures. For that reason, Greece has long been a strategic node for the development of transportation in the greater region. The geographical position of North Greek port allows the offering of competitive sea freight cost for transported containers, while offering access to a set of growing economies in the broader region. Continuing investment in road and rail infrastructure means that Greece's major ports are now directly interconnected with modern road and rail links, facilitating intermodal transport of cargo onwards to their final destination quickly and cost-effectively. Finally Greece is part of the EU's Orient/East-Med Corridor that connects the maritime interfaces of the North, Baltic, Black Sea and Mediterranean. In this environment, Greece's geographical position as a gateway between East and West render it highly attractive for investments in logistics and transport to take advantage of these increasing trade flows in an efficient and cost-effective manner.

The Region of Eastern Macedonia and Thrace [REM-T] (Anatoliki Makedonia - Thraki) is situated along the crossroads of Europe and Asia and is predominantly an

agricultural area. It is a border region which gradually transforms into a gateway of the country and the European Union. The structure of the production model of the region displays concentration trends in lowland areas, large agricultural holdings and monocultures where the production is done vertically, and urban centers as centers of trade and services. East Macedonia and Thrace has invested strategically to a large extent on inclusion in the International transport networks.

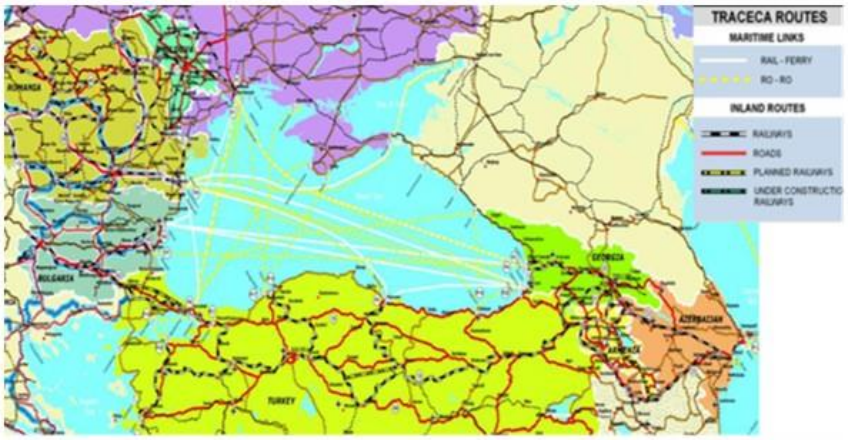

Fig 2: Connection of the new logistic center with Bosporus

Regional development policy in the wider study area sets as a key priority the development of transnational partnerships and collaborative networks for evaluating policies, strategic planning but also the development and management of infrastructure. Accessibility is the basis for economic competitiveness, social and regional cohesion and cultural development. The intermodal transportation and logistics between Bulgaria and Greece can play an important role in the socioeconomic development of the two countries and the wider region.

The analysis framework is applied in a strategic logistics center in north Greece. The objective of the decision making framework has been to assess strategically the overall need and potential for developing a logistics hub in North Greece to support multimodal transportation between Greece and Bulgaria. The development of transit hubs include infrastructure development of integrated management of goods and connect them through multimodal land (road and rail) with the network of international ports in the region. Finally it should be noted that cross-border countries, Greece and Bulgaria identified significant deficiencies in each of these priority areas, and this makes the upgrading of the rail axis a step near to the integration of the competitiveness of the country.

4.2. Risk likelihood in financial and economic analysis

The financial and economic analysis of large transport infrastructures involve a wide range of different risks. Scenario analysis implies the variation of several variables simultaneously and allowing the consideration of possible exogenous trends, therefore all the large transport infrastructure decisions are required to be based on several possible future scenarios.

For the purpose of this case study firstly, a scenario analysis regarding demand growth was required in the assessment process in order to identify different demand and transport growth variables. There were developed 6 scenarios for transport demand growth S1, S2, S3, S4, S5, S6. Secondly, as alternatives to public investments, possible alternative solutions are expected to cover the financing gap with other financing schemes. There were developed 12 alternative scenarios with different interest rates:A1,A2,A3,B1,B2,B3,C1,C2,C3,D1,D2,D3. The scenarios in group A are based on national budget, the scenarios in group B and C are

supported by European Investment and national funds, the group scenarios D are based on private sector finance.

Three zones demonstrate the likelihood for the financing scenarios. Zone A demonstrates maximum likelihood for the financing scenarios; zone B demonstrates medium likelihood; and zone C demonstrates low likelihood. Evaluating the risk financing and external economic conditions for each scenario, each financing scenario is placed in a likelihood zone The likelihood for the scenarios A1,A2,D2,D3 is low, for the scenarios A3,B1,D1,C3 is medium and for the B2,B3,C1,C2 is max. In addition each transport demand growth scenario is placed in a likehood zone. The likelihood for the scenarios S1, S6 is low, for the scenarios S2, S5 is medium and for the scenarios S3,S4 is max.

The application of financial appraisal and Economic Impact analysis for the combination of 12x6 scenarios (76scenarios) showed that the equilibrium likelihood point between financial and economic contribution is when simultanesly the total amount of revenues for scenarios in group B and C are between €1.5 -3.5 Mio and the economic contribution for scenarios S3,S4 range is between €1.5 -3.5 Mio. The likelihood equilibrium point between the financing survivability of the project and the contribution to the economy is illustrated in figure 4.

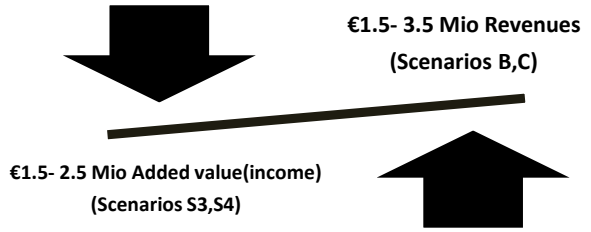

Fig. 4 Likelihood Equilibrium point between financial sustainability and economic contribution to economic system

5. Conclusions

Developing intermodal and logistics transport logistic centres is a complex enterprise involving two aspects: the financial viability and the contribution of the project to the whole economy. A three level analysis facilitated a bottom-up approach for evaluation assessment by aggregating the multiobject agents and interdependencies of constituents as analytical described at the level of network planning, taking into account all the financial issues and economic impact caused by the project. Applying this approach in the new freight center in North Greece, with scenario development analysis based on 76 scenarios, showed that the equilibrium likelihood point between financial and economic contribution is when the total amount of revenues for scenarios B and C with mixed financing scheme is in equilibrium point with the total economic contribution for moderate assumptions for demand growth for scenarios S3,S4.

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