EX-POST IMPACT EVALUATION OF RAILWAY PROJECTS

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Abstract

Railway infrastructure projects have the potential to significantly impact the economy, environment, and society. Such projects play a crucial role in achieving cohesion policy goals and climate neutrality in Europe by 2050. However, whether the projects that have already been implemented fulfil their original assumptions or what other effects their implementation has had has not been systematically ascertained. While ex-ante impact evaluation is a common practice for projects applying for grants, ex-post evaluation is only sporadically conducted to meet the regulatory obligations of funders. Given the substantial financial investments in transport infrastructure, a systematic ex-post evaluation at the management level of these programs would be appropriate.

Evaluation is a process used to assess the effectiveness and efficiency of public sector financial interventions. The goals of evaluation vary. For example, an evaluation of a program may aim to determine whether the defined outcomes have been achieved, whether financial support has been used effectively and efficiently, and what impact the intervention has had on different stakeholders. Evaluations are conducted ex-ante, mid-term, or ex-post.

This study explores the use of different methods of ex-post impact evaluations for railway infrastructure investments over the last 20 years.

Key words: CIE, transport policy, evaluation

JEL Code: R58, C10, L91

Introduction

A growing emphasis on reducing greenhouse gas emissions and promoting sustainable transportation modes is evident in contemporary interventions – from all we could mention that green transport is in line with EU policy priorities as one of the key areas to deliver European Green Deal (Montero-Pascual et al., 2021). Governments are investing in renewable energy sources for transportation, supporting the development of e-mobility and other clean

technologies, and promoting public transit, cycling, and walking infrastructure (e.g. Milewicz et al., 2023).

Rail transport is considered greener compared to other modes of transport - for example, it produces less greenhouse gases than road or air transport (Strauss et al., 2021). European rail freight transport produces even 9 times less CO_2 per transport volume than road transport (Finger et al., 2019). Trains are typically quieter than road vehicles, reducing the impact of noise pollution on residents around transport arteries. A rail line can carry a greater volume of goods and more passengers in a smaller area than is needed for the same number of vehicles on the road. In addition, rail transport is generally more energy efficient than road transport, meaning that it uses less energy to transport the same amount of goods or passengers.

Although the last decade shows a growing investment in green transport infrastructure and technologies used in public transport services, still we do not know much whether these investments achieved the planned goals and what other impacts do they have. Central governments should learn from assessment of completed infrastructure projects to aid in selection of future projects (Yoshino & Abidhadjaev, 2017). In summary - transport policy decisions hold immense power in shaping the efficiency, accessibility, and sustainability of transportation systems by deciding, which projects will be supported from programs. However, ensuring the efficiency, effectiveness, relevance and impacts of transport policy interventions requires a robust evaluation process (Volden & Welde, 2022). Completion of infrastructure projects does not guarantee their success (Volden & Welde, 2022). It is necessary to assess whether the stated goals have been obtained and if so, whether this has been achieved through the project implementation. In transport, this may be, for example, to answer the question of whether there has been an overall increase in freight or passenger transport capacity, whether the new capacity is sufficiently used or whether the project is meeting its environmental or social objectives. The need for evaluation may also arise from new or persistent problems after project implementation - for example, delays in public transport, traffic jams on roads

Method

The systematic-review on use of ex-post impact evaluation in railway sector was conducted by reading and analysing peer-reviewed articles and conference articles. The articles are summarized in Table 2. The review is not limited only to use of ex-post impact evaluation in railway sector, but it intends to provide a comprehensive understanding of ex-post impact

evaluation in railway transport concerning transport policy interventions. Following the key words and the research criteria, 49 studies were selected.

Databases used

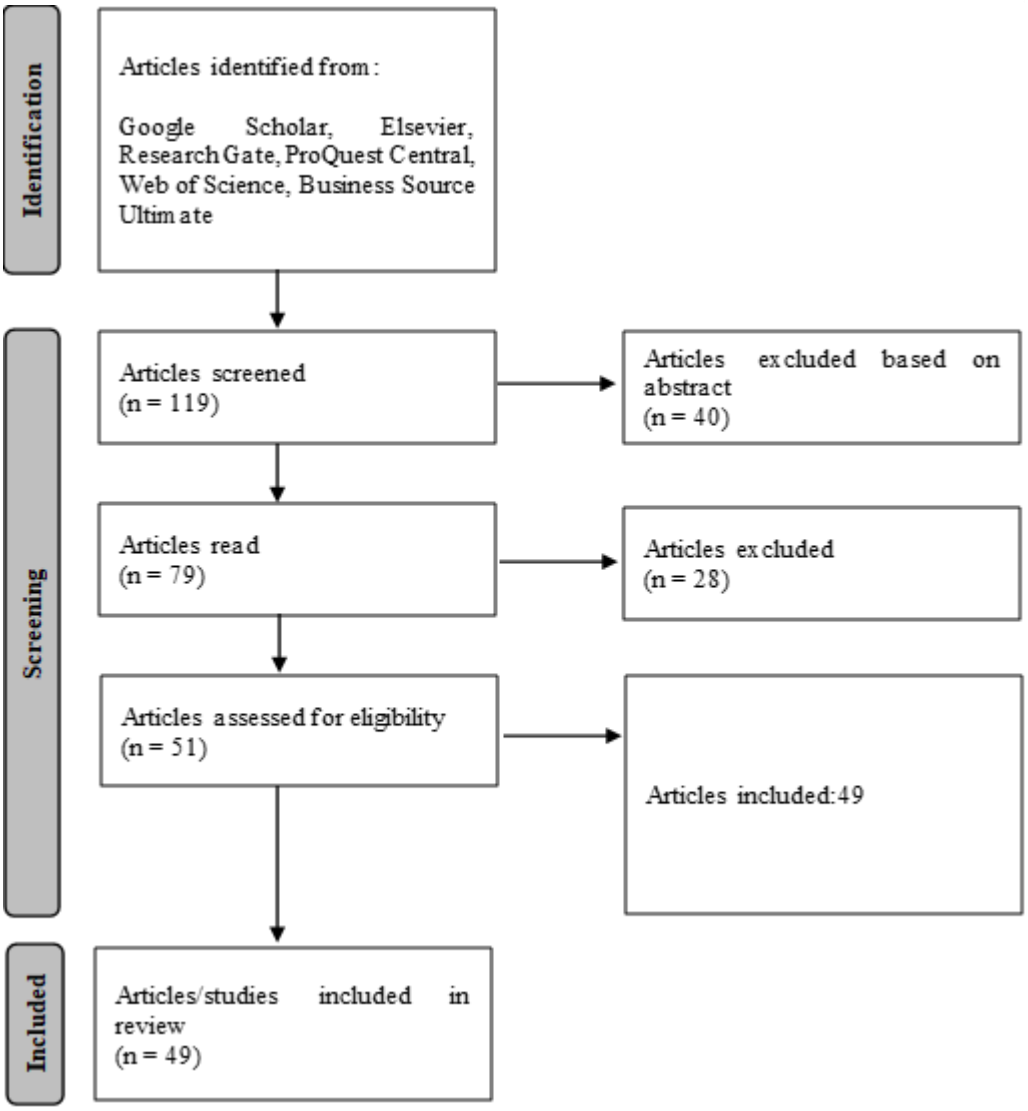
Google Scholar, Elsevier, Research Gate, ProQuest Central, Web of Science, Business Source Ultimate

Selection process

We've searched for papers written in English language between 2013 - 2024 (peer-reviewed articles, conference papers, in-process papers). In the screening process, we manually checked titles, keywords and abstracts and refined the selection by removing articles about non-relevant transport modes, and railway non-infrastructure projects (e. g. modernisation of trains). We've used Zotero citation editor for collecting the papers.

Figure 1 shows flow diagram according the PRISMA model (www.prisma-statement.org) and represents the search strategy. We divided the articles in two categories, according their content – category of studies concerning (only) the impact of railway projects and category of studies mentioning also transport policy interventions. Table 1 presents the information about the articles (area, country, article name, authors name and year of publication, type of study and method).

Figure 1: Flow diagram



Tab. 1: Articles included in the review

Area	Country	Author(s)	Article name	Type of study	Methods
Impact of railway projects	China	(Chan et al., 2021)	Evaluating the value of new metro lines using route diversity measures: the case of Hong Kong's Mass Transit Railway system	Empirical case study	Ex-post econometric analysis
Impact of railway projects	China	(He et al., 2022)	Time is money: Impact of China-Europe Railway Express on the export of laptop products from Chongqing to Europe	Empirical study	Multiple linear regression model
Impact of railway projects	China	(Liu & Zhang, 2018)	High-speed rail impacts on travel times, accessibility, and economic productivity:	Empirical study	Regression model

Area	Country	Author(s)	Article name	Type of study	Methods
			A benchmarking analysis in city-cluster regions of China		
Impact of railway projects	China	(Meng et al., 2018)	The resource redistribution effect of high-speed rail stations on the economic growth of neighbouring regions: Evidence from China	Empirical study	Counterfactual impact evaluation - PSM-DID
Impact of railway projects	China	(Strauss et al., 2021)	High-speed Rail's impact on airline demand and air carbon emissions in China	Empirical study	Regression analysis
Impact of railway projects	China	(Tian et al., 2019)	The Impact of High-Speed Rail on the Service-Sector Agglomeration in China	Empirical study	Counterfactual impact evaluation - HCW
Impact of railway projects	China	(Xin et al., 2021)	Impacts of COVID-19 on urban rail transit ridership using the Synthetic Control Method	Empirical study	Counterfactual impact evaluation - SCM
Impact of railway projects	China	(Yan & Park, 2023)	Does high-speed rail reduce local CO2 emissions in China? A counterfactual approach	Empirical study	Counterfactual impact evaluation
Impact of railway projects	China, EU	(Cheng et al., 2015)	High-speed rail networks, economic integration and regional specialisation in China and Europe	Empirical case studies	Ex-post econometric analysis
Impact of railway projects	Czech Republic	(Hromádka et al., 2016)	Environmental impacts in the evaluation of transport infrastructure projects	Review	comparing of existing approaches for reflection of the environmental impact into the economic assessment (CBA)
Impact of railway projects	EU	(Finger et al., 2019)	Green Finance and Sustainability – Which Role for Railways?	Review/Report	Comments, summary of forum
Impact of railway projects	EU	(Jong et al., 2019)	Ex-post evaluation of major infrastructure projects	Empirical case studies (10 projects in 10 countries)	Mix of CBA and qualitative analysis
Impact of railway projects	EU	(Kelly et al., 2015)	What lessons can be learnt from EU Cohesion funded transport projects?	Empirical case studies (10 projects in 8 countries)	Comparing of ex-ante and ex-post CBA
Impact of railway projects	EU	(Sangiorgio et al., 2020)	A new index to evaluate the safety performance level of railway transportation systems	Empirical study	Analytic Hierarchy Process
Impact of railway projects	EU	(Vignetti et al., 2020)	Analytical framework for ex-post evaluation of transport projects: Lessons learnt on retrospective CBA	Empirical study	CBA

Area	Country	Author(s)	Article name	Type of study	Methods
Impact of railway projects	Hungary	(Béres et al., 2019)	Spatial econometrics: transport infrastructure development and real estate values in Budapest	Empirical study	counterfactual impact evaluation - PSM
Impact of railway projects	Hungary	(Mátrai, 2013)	Cost benefit analysis and ex-post evaluation for railway upgrade	Empirical study	CBA
Impact of railway projects	India	(Jaiswal & Bensch, 2019)	A methodological framework to address gaps in the evidence on infrastructure impacts: the case of an Indian railway project evaluation	Empirical case study	Combination of surveys, document analysis, interviews, focus groups
Impact of railway projects	India	(Navalkar et al., 2023)	Impact of railways on land use and land cover change: Evidence from India	Empirical case study	Counterfactual impact evaluation - DID method
Impact of railway projects	Italy	(Di Matteo et al., 2023)	Transport infrastructure and economic performance: An evaluation of the Milan-Bologna high-speed rail corridor	Empirical study	Counterfactual impact evaluation - Synthetic control method, PSM-DID
Impact of railway projects	Italy	(Birolini et al., 2019)	Access mode choice to low-cost airports: Evaluation of new direct rail services at Milan-Bergamo airport	Empirical study	Mixed multinomial logit model
Impact of railway projects	Italy	(Cascetta et al., 2020)	Economic growth, transport accessibility and regional equity impacts of high-speed railways in Italy: ten years ex post evaluation and future perspectives	Empirical case study	Multiple linear regression models
Impact of railway projects	Poland	(Rokicki & Stępniak, 2018)	Major transport infrastructure investment and regional economic development – An accessibility-based approach	Empirical study	Regression model
Impact of railway projects	Sweden	(Berger & Enflo, 2015)	Locomotives of Local Growth: The Short- and Long-Term Impact of Railroads in Sweden	Empirical study	Counterfactual impact evaluation - DID
Impact of railway projects	UK, China	(Chen & Vickerman, 2016)	Can transport infrastructure change regions'economic fortunes: some evidence from Europe and China	Comparative empirical case study	Ex-post econometric analysis
Impact of railway projects	Uzbekistan	(Yoshino & Abidhadjaev, 2017)	An Impact Evaluation of Investment in Infrastructure: The Case of the Railway Connection in Uzbekistan	Empirical study	Counterfactual impact evaluation - DID
Impact of railway projects	Worldwide	(Catalano et al., 2019)	Efficiency, effectiveness, and impacts assessment in the rail transport sector: a state-of-the-art critical analysis of current	Literature review	Combination of systematic review techniques (snowball search, database search)

Area	Country	Author(s)	Article name	Type of study	Methods
			research		
Impact of railway projects	Worldwide	(Ermagun & Levinson, 2017)	"Transit Makes you Short": On Health Impact Assessment of Transportation and the Built Environment	Empirical study	Binary logit model, Multiple linear regression
Impact of railway projects	Worldwide	(Milewicz et al., 2023)	Environmental Impact Evaluation as a Key Element in Ensuring Sustainable Development of Rail Transport	Essay	Database search, document analysis
Impact of railway projects	Worldwide	(Polyzos & Tsiotas, 2020)	The contribution of transport infrastructures to the economic and regional development: a review of the conceptual framework	Review	Database search
Impact of railway projects	Worldwide	(Stankov et al., 2020)	A systematic review of empirical and simulation studies evaluating the health impact of transportation interventions	Systematic literature review	Database search (Medline, Ovid, Scopus, TRID and Lilacs)
Impact of railway projects	Worldwide	(Zhang et al., 2019)	Impacts of High-speed Rail on Airlines, Airports and Regional Economies: A Survey of Recent Research	Literature review (survey of recent research)	Database search
Transport policy interventions	Belgium	(te Boveldt et al., 2020)	Between fairness, welfare and feasibility: an approach for applying different distributive principles in transport evaluation	Review/essay	Database and documents search
Transport policy interventions	EU	(Montero-Pascual et al., 2021)	European Green Deal: What Implications for State Aid in the Rail Sector?	Review/Report	Comments, summary of forum
Transport policy interventions	Netherlands	(Mouter et al., 2015)	Managing the insolvable limitations of cost-benefit analysis: results of an interview-based study	Case study	Mixed-methods, interviews
Transport policy interventions	Norway	(Volden & Welde, 2022)	Public project success? Measuring the nuances of success through ex post evaluation	Essay	Literature and data search, discussions
Transport policy interventions	Schengen area (European border control-free travel area)	(Avogadro et al., 2021)	Replacing short-medium haul intra-European flights with high-speed rail: Impact on CO2 emissions and regional accessibility	Empirical study	Ex-ante econometric analysis
Transport policy interventions	Singapore	(Diao, 2019)	Towards sustainable urban transport in Singapore: Policy instruments and mobility trends	Review	Literature review
Transport policy interventions	Sweden	(Bondemark et al., 2020)	Do impact assessments influence transport plans? The case of Sweden	Empirical study	Binary logit models and interviews
Transport	Sweden	(Nilsson, 2022)	The Weak Spot of	Empirical case	CBA

Area	Country	Author(s)	Article name	Type of study	Methods
policy interventions			Infrastructure BCA: Cost Overruns in Seven Road and Railway Construction Projects	study	
Transport policy interventions	Sweden, England, Scotland	(Akgün et al., 2019)	Influences on urban freight transport policy choice by local authorities.	Exploratory case studies	A multiple case study design, 11 cities
Transport policy interventions	UK, Norway	(Nicolaisen & Driscoll, 2016)	An International Review of Ex-Post Project Evaluation Schemes in the Transport Sector	Systematic literature review	Snowball sampling method
Transport policy interventions	Worldwide	(Bešinović, 2020)	Resilience in railway transport systems a literature review and research agenda	Literature review	Database search (Web of Science and Scopus)
Transport policy interventions	Worldwide	(Browne & Ryan, 2011)	Comparative analysis of evaluation techniques for transport policies	Comparative analysis, literature review	Database search
Transport policy interventions	Worldwide	(Fisch-Romito & Guivarch, 2019)	Transportation infrastructures in a low carbon world: An evaluation of investment needs and their determinants	Empirical study	Ex-post econometric analysis
Transport policy interventions	Worldwide	(Flyvbjerg, 2021)	Top Ten Behavioral Biases in Project Management: An Overview	Essay	Database search, discussion
Transport policy interventions	Worldwide	(Rothengatter, 2019)	Megaprojects in transportation networks	Review	Documents and literature review

Results and Discussions

Although the number of impact evaluations of transport projects has been increasing in recent years, their use remains limited compared to, for example, social sector (Raitzer et al., 2019). There are countries that have systems in place for ex-post evaluations of transport infrastructure projects, but there are not many - in Europe these include the UK and Norway (Jong et al., 2019). In general, transport policy makers often don't use quantitative impact evaluation methods, relying instead on qualitative ones (e. g. Kaszubowski, 2012), expert and personnel judgment and political considerations. Yet, ex-post evaluations are very useful for improving management and for determining whether projects are delivering the expected goals (Mátrai, 2013). Especially in railway sector there is a need for more of ex-post evaluations to fully understand the impacts (Mátrai, 2013). Despite their potential benefits, impact evaluation methods remain underutilized in transport projects (Jong et al., 2019).

Research gap 1: What are the factors behind the lack of use of ex-post impact evaluations in railway transport area?

Research gap 2: What would motivate the transport policymakers and transport managers to use the ex-post impact evaluations?

Research gap 3: Why is comparative cost-benefit analysis the most common method of quantitative ex-post impact assessment in Europe and econometric models including counterfactual impact assessment in Asian countries?

Conclusion

Given the financial volume of transport infrastructure grant calls, it would be appropriate to carry out a systematic ex-post evaluation at the management level of these programmes. However, this is not common in practice, even though it is a great tool for transport policy management. Further research into the factors behind this would be beneficial.

There are certain limitations that exist in the systematic review. The generally low number of available studies means that the results must be interpreted with caution. Another issue is geographical location of case-studies – all of them are in Europe and Asia

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