

Proposal for Data Retrieval Methodology in Terms of Cross-border Commuter Mobility: A Perspective of Czech Employees

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Abstract

Labor mobility between the Czech Republic and Germany represents a significant factor for the economic and social integration of cross-border regions. The manuscript focuses on the proposal of a methodology in the context of retrieving and analyzing data on labor mobility, with the aim of creating a strategy to support cross-border cooperation. Through a combination of specific quantitative and qualitative methods, the manuscript analyzes the key determinants of mobility, barriers, challenges and factors affecting the commuter decision-making. The findings show that the major obstacles to cross-border mobility include administrative burden, differences in working conditions, and institutional misalignment. The manuscript also discusses the possibility of optimizing the current data retrieval system using advanced technologies and analytical tools. The conclusions of the study provide suggestions for streamlining cross-border mobility and supporting labor market integration in the Czech-German border region.

Keywords

cross-border mobility, commuter, data retrieval, Czech Republic, Germany

1 Introduction

A topic of cross-border commuter mobility poses a crucial issue of spatial labor (also known as occupational) mobility, in particular in regions wherein national boundaries are closely located. This aspect encompasses persons who live in one specific country whilst work somewhere else, when dealing with a variety of socio-economic, infrastructural as well as legal challenges. Such a commuting is affected by a wide array of socio-economic indicators, involving social insurance, labor market circumstances, tax laws and so on (Karacan, 2023). The existence of cross-border commuters (also known as "pendlers" in German) in a particular household can considerably influence the likelihood of other members of the household becoming such commuters as well (Gottholmseder and Theurl, 2007). Furthermore, aspects such as salaries, accessibility, similarity of languages, unemployment rates, as well as commuting distance can play major roles when specifying patterns related to cross-border commuting activities (Edzes et al., 2022).

Cross-border commuter mobility can lead to labor mobility, as seen, e.g., in Central Europe, wherein com-

muters from countries such as the Czech Republic, Poland, Hungary, and Slovakia commute to Austria or Germany for their employment (Böhm and Opiola, 2019). These workers often occupy mid-level professions and qualifications in segments with high labor demand, such as construction, transport and logistics or healthcare. In spite of strive to diminish regional disparities in unemployment, inequalities, and poverty or unemployment rates continue to affect such commuting (Wiesböck and Verwiebe, 2017). The dependence on private cars for cross-border commuter mobility entails substantial challenges, comprising negative environmental impacts. A need for advanced public transport systems to improve cross-border mobility emerges. Current public transport possibilities often suffer from non-attractive fares, long travel times, insufficient integration of transport modes, which confine their attractiveness in comparison with private commuting approaches (Cavallaro and Dianin, 2019; Cavallaro and Dianin, 2020). In Geneva, in spite of a robust public transport network, cross-border commuters mainly use private cars, when emphasizing the

necessity for advanced integration of individual transport modes (Kouti and Ramirez, 2009).

Cross-border commuter mobility has an eminent potential to enhance resource allocation in terms of labor market and economic performance in cross-border regions, while decreasing territorial disparities and economic inequalities. Nevertheless, the impacts are relatively insignificant given the generally low number of commuters. The effect on inequalities differs substantially across various demographic groups, with some groups experiencing confined profits or even growing inequalities (Edzes et al., 2022). Cross-border commuter mobility affects the sociocultural dynamics of cross-border regions as well. For instance, in Luxembourg, cross-border mobility helps towards developing cross-border territory, when influencing social contacts and the spatial organization of usual practices (Wille and Roos, 2020). The implementation of social media information has provided new knowledge and understanding into habits, patterns and effects of cross-border mobility, while offering valuable data on policy and urban (regional) planning in these regions (Järv et al., 2023).

This issue represents a complex phenomenon shaped by a series of factors, including socio-economic conditions, infrastructure, and personal conditions. While it offers opportunities for occupational mobility and regional development, it also presents significant challenges requiring coordinated policy responses and advanced sustainable transport solutions.

The present paper focuses on the analysis and optimization of labor mobility between the Czech Republic and Germany, with the goal of promoting cross-border cooperation. The research is designed to provide a deeper understanding of motivations, working conditions, social factors, and challenges faced by commuters. The findings aim to contribute to improving these conditions and to developing strategies that support more effective labor mobility. The primary objective of the paper is to present methods for more efficient data retrieval and analysis concerning the mobility of cross-border workers, which can then be used to inform strategies that promote labor mobility.

The subsequent sections of the paper, namely Sections 2, 3 and 4, present the key theoretical approaches to cross-border mobility, outlines the data retrieval methods, discusses the results of the analysis, and proposed measures to optimize labor mobility in the Czech-German cross-border region. The findings can serve as a foundation for developing strategies at both regional and national policy levels, which contribute to strengthening economic

ties between the two countries and enhancing the attractiveness of cross-border employment.

2 Literature review

There are a lot of scientific papers and journal articles, which deal with the issue of cross-border commuter mobility, especially in comparison with their traffic behavior, commuter satisfaction, economic and territorial inequality between countries, exchange rate effects, border control, directives and legislation or health outcomes. Many scientific works and studies deal with the legislation of the European Union and the transposition of its directives into the national regulations of the member states in order to remove legislative barriers for employees who regularly commute to neighboring countries for work. For example, scientific articles (Chen et al., 2021; Delfino, 2020; Dubois, 2017; Nonnenmacher et al., 2021; St-Louis et al., 2014) deal with cross-border worker mobility in Europe, specifically between countries such as Italy, France, Germany, Switzerland and the Benelux countries. The study (St-Louis et al., 2014) makes an interesting observation that Switzerland is the country in Europe which hosts the largest number of cross-border workers. Research on border regions focused mainly on the macroscopic aspects of cross-border relationships, such as economic integration or cross-border cooperation, leaving partly aside the effects that cross-border work has on territories or their citizens. In other articles, the authors describe the satisfaction of commuters with respect to the chosen mode of transport or perform a structural analysis of their complex transport behavior. The manuscript (Rafiq and McNally, 2022) investigates how the determinants of commuter satisfaction differ across six different modes of transportation (walking, bicycle, automobile, bus, metro, commuter train). In the paper (Novotný, 2021), a structural model was developed for transit commuters, which allows for the characterization of commuters based on the complexity of work tours and an assessment of the influence of household and person-level socio-demographic characteristics, built environment variables, and activity-travel demand on tour complexity.

No less interesting are the outputs and conclusions presented in (Edzes et al., 2022; Haist and Novotný, 2023; Novotný, 2022) exploring the impacts of closed borders and border restrictions on Czech cross-border commuters and their day-to-day work during the Covid-19 pandemic. The results provide unique insights into the difficulties and experiences of cross-border commuters in a time of crisis and suggest that border closures and related measures and

the inability to travel abroad were unconstitutional, which also damaged commuters, mainly economically.

Furthermore, it is possible to view the issue of cross-border commuting from the perspective of economic impacts and potential economic and territorial inequalities. As stated in (Edzes et al., 2022), cross-border commuting might be a way to improve an efficient allocation of labor resources, improve the economic performance of border regions and reduce economic and territorial inequality. Studies and scientific papers (Buch et al., 2009; Chilla and Heugel, 2022; Pierrard, 2008; Pigeron-Piroth et al., 2017; Wilde et al., 2025) state that cross-border commuting in a region generally increase labor market integration and present a methodology that combines the analysis of official labor mobility data with qualitative data obtained from interviews with cross-border commuters, with the aim of finding explanations for the different attitudes towards cross-border mobility within concerned countries (Pires and Nunes, 2018; Ocskay, 2024).

Some studies (Yamaguchi and Kambara, 2024; Karácsóny et al., 2021) describe commuting to a "familiar" foreign country as an enhancer for cross-border commuter mobility due to many common characteristics of their inhabitants such as ethnic identity, language and culture on both sides of the border. Another paper (Bello, 2020) focuses on the question whether cross-border commuters are responsive to changes in the exchange rate between the home and host countries' currencies. According to the article (Sundo and Fujii, 2005), the effects of a compressed working week workday also significantly impact activity-travel patterns of cross-border commuters. Further research published in (Lim et al., 2024) investigates night shift workers' commuting patterns by identifying heterogeneous working patterns in passive mobility data.

These studies and other professional scientific articles thoroughly clarify the issue of cross-border commuting to work and outline possible methods and areas for potential data retrieval on worker mobility in order to create a unified methodology, the aim of which is to create a strategy for streamlining cross-border mobility and supporting labor market integration in the Czech-German border region.

3 Data and methods

Research methodology in the social sciences typically encompasses two primary categories of data retrieval, specifically quantitative and qualitative approach. Each of them has distinct advantages and applications, and their integration allows for a more comprehensive understanding of the issue (Witt, 2023):

1. Quantitative data retrieval:

- Characteristics: the quantitative approach focuses on numerical data, enabling statistical analyses. Its objective is to measure variables, identify patterns, and test hypotheses based on statistical significance.
- Methods: commonly employed methods include structured questionnaires, large-scale databases, secondary data analysis, and experimental methods.

2. Qualitative data retrieval:

- Characteristics: qualitative methods aim to achieve a deeper understanding of respondents' behaviors, attitudes, and experiences. This approach is more flexible and facilitates the interpretation of complex social phenomena.
- Methods: in-depth interviews, focus groups, case studies, and ethnographic observations are employed.

The present research adopts a mixed-methods approach, combining both quantitative and qualitative techniques to provide a comprehensive understanding of cross-border mobility. Quantitative methods were employed to gather a broad range of data on commuters, while qualitative methods provided deeper insights into the motivation and barriers faced by workers in cross-border employment (Poliak et al., 2024).

The paper aims to analyze and optimize work commuting between the Czech Republic and Germany to support cross-border cooperation and improve the working conditions of commuters. Given the dynamic changes in the labor market and the increasing demand for flexible employment, it is essential to understand the critical factors influencing workers' decisions to engage in cross-border commuting for work.

The project specifically focuses on the motivation of commuters, their working conditions, social factors, and the challenges and barriers they encounter. Special attention is given to modes of transport, commuting time, and associated costs. Furthermore, the project seeks to develop an effective data retrieval methodology to assess information on commuter mobility.

Data retrieval will be conducted *via* a questionnaire survey targeting commuters on both sides of the border. The data obtained will inform the development of strategies to enhance cross-border mobility and address the daily challenges faced by commuters.

The diagram (see Fig. 1) illustrates the various modes of commuting used by commuters between the Czech Republic

and Germany. It categorizes the types of transport, including private car transport, public transport, and shared transport.

In addition to the types of transport, the diagram also presents three key factors:

- **Prevalence:** the frequency with which each mode of transport is used by commuters.
- **Commuting time:** the average duration of the daily commute.
- **Cost:** the average financial cost associated with each mode of transport.

This information provides insight into the popularity, benefits, and drawbacks of each commuting option, and helps identify areas where improvements are needed. Based on these findings, targeted measures can be proposed to enhance the efficiency of cross-border commuting.

4 Case study

This research employed a mixed-methods approach to data retrieval and analysis, allowing for a comprehensive understanding of cross-border mobility of workers. The methods combine quantitative and qualitative approach, with an emphasis on the validity and reliability of the retrieved data (Chilla, 2023) (see Fig. 2).

4.1 Steps of the methodology

The developed methodology seeks to comprehensively analyze the mobility of commuters between the Czech Republic and Germany. It employs a multi-faceted approach to data collection, beginning with the retrieval of statistical data from official sources like the Czech Statistical Office to establish a foundational understanding of commuter demographics. To gain deeper, qualitative insights, a detailed questionnaire is designed

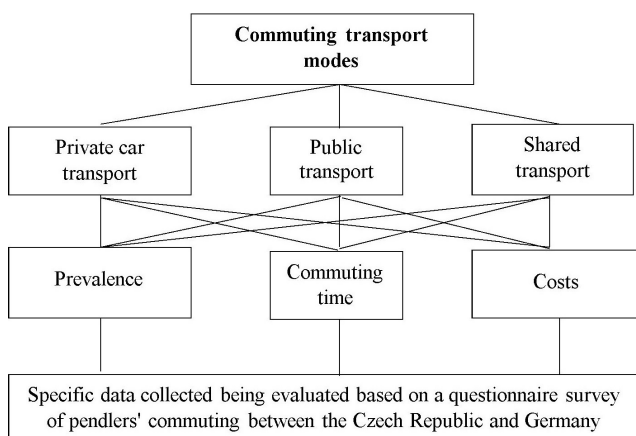


Fig. 1 Diagram of various modes of commuting used by commuters between the Czech Republic and Germany

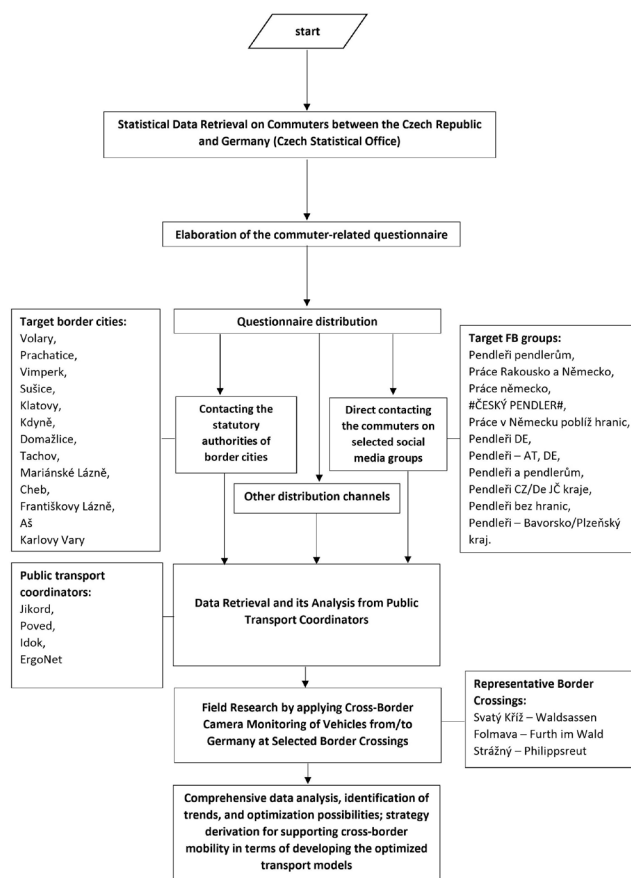


Fig. 2 Research methodology

and distributed through a variety of channels, including municipal websites and targeted social media groups, focusing on the motivations, challenges, and daily experiences of these cross-border workers. Complementing this, the methodology also considers the data from public transport coordinators to map out travel patterns and habits. Finally, field research using camera monitoring at key border crossings provides real-time, quantitative data on vehicle traffic, offering a complete picture of the scale and flow of cross-border commuting:

1. Statistical data retrieval on commuters between the Czech Republic and Germany:
 - **Communication with Statistical Offices:** establish cooperation with the Czech Statistical Office and/or other relevant institutions to obtain statistical data on the number, age, gender, education, professions, and destinations of commuters.
2. Elaboration and distribution of commuter-related questionnaires:
 - **Design of the "Czech-German worker (commuter; employee) mobility questionnaire":** focus on specific questions regarding the reasons for mobility, modes of transport, frequency of travel,

working conditions, and barriers to cross-border working/moving.

- Distribution of the questionnaire in border cities:
 - Contact municipalities in border areas to request the publication of the questionnaire on their websites, official Facebook profiles, and other relevant social media platforms.
 - Target cities: Volary, Prachatice, Vimperk, Sušice, Klatovy, Kdyně, Domažlice, Tachov, Mariánské Lázně, Cheb, Františkovy Lázně, Aš, and Karlovy Vary.
- Distribution of the questionnaire in specific social media groups:
 - Directly address specific Facebook groups focused on commuters and work in Germany (e.g., "Pendleři pendlerům", "Práce Rakousko a Německo", "Práce Německo", "#ČESKÝ PENDLER#", "Práce v Německu poblíž hranic", "Pendleři DE", "Pendleři-AT,DE", "Pendleři a pendlerům", "Pendleři CZ/De JČ kraje", "Pendleři bez hranic", "Pendleři -Bavorsko/Plzeňský kraj").
 - Other distribution (social) channels.
- 3. Data retrieval and its analysis from public transport coordinators:
 - Contacting public transport coordinators:
 - To obtain data on transport trends and passenger volumes between the Czech Republic and Germany, focus on transport coordinators in the South Bohemian, Pilsen, and Karlovy Vary regions (JIKORD, POVED, IDOK).
 - Analysis of the data provided by carriers (public transport operators):
 - Process and analyze the retrieved data to examine the transport patterns and habits of commuters traveling to Germany for work.
- 4. Field research through cross-border camera monitoring of vehicles from/to Germany at selected border crossings
 - Representative border crossings:
 - Svatý Kříž – Waldsassen;
 - Folmava – Furth im Wald;
 - Strážný – Philippsreut.

By combining these methods, the research provided a comprehensive understanding of cross-border mobility, forming a solid foundation for strategic recommendations aimed at improving conditions for commuters (Wulandari et al., 2024).

When researching commuter mobility, the interplay of qualitative and quantitative methods offers a rich and nuanced understanding. Quantitative methods, such as surveys and traffic flow analysis, can provide statistical insights into commuting patterns, travel times, and modal choices. However, these methods often lack the depth to explain why commuters make certain decisions. Qualitative methods, such as interviews and focus groups, fill this gap by exploring the lived experiences, perceptions, and motivations of commuters. By combining these approaches, researchers can develop a more comprehensive picture. For instance, quantitative data might reveal a trend of increased car usage, while qualitative interviews could uncover the underlying reasons, such as inadequate public transport infrastructure or a perceived lack of safety (Malhotra and Khandelwal, 2022).

This mixed-methods approach allows for the validation and contextualization of findings, leading to more robust and actionable conclusions for urban planning and transportation policy, even to developing a data retrieval methodology as in case of this study.

5 Conclusion

The proposed methodology integrating both quantitative and qualitative approaches has proven to be an effective tool for gaining a comprehensive insight into worker mobility. The findings underscore the need to improve transport infrastructure, streamline administrative procedures, and enhance coordination between Czech and German institutions. In addition, the results indicate that supporting language training, improving working conditions, promoting mental health, and introducing flexible working arrangements are key factors in facilitating cross-border mobility. It was found that effective data retrieval on commuter mobility is essential for the development of strategies aimed at fostering cross-border cooperation and labor market integration.

Recommendations for further research include the following steps:

- Language training support: further research should analyze the effectiveness of language courses and training programs designed for workers operating in cross-border environment.
- Improving working conditions: it is recommended to conduct comparative studies on different working conditions in the Czech Republic and Germany in order to identify potential improvements in the work environment.
- Promoting mental health: it is necessary to investigate the psychological impact of cross-border

employment and develop targeted strategies for promoting mental well-being in such work contexts.

- Flexible working hours: further research should assess the impact of flexible working hours on commuter mobility and improving work-life balance.

Additional challenges and key findings identified through the development of methodology for retrieving data on cross-border commuter mobility include the following ones: motivation to commute, working conditions, social integration, personal difficulties, traffic congestion,

delays and road closures, transport costs, and safety concerns. These aspects represent important factors that must be taken into account when researching the complex issue of cross-border commuting.

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