# The Impact of Public Transport Subsidies on Highway Traffic: Evidence from Germany

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# Motivation

- In 2022, the German government temporary introduced a nationwide local public transport ticket (9€-ticket) for three months.
- Key Facts:
  - Unlimited usage of local public transport for 9 Euro per month for travellers between June and August 2022
  - Direct costs: 2.5 billion Euros
  - Main goals: financial relief for citizens, simplifying existing tariff structures, giving an incentive to switch to public transport.
- Potential issues:
  - Intervention might cause a missing price signal previously used to capture the value of services
  - Missing information about the demand side for the optimal formation of a capacity, which can lead to capacity problems and a lower service quality
  - Unclear effect on the motorized individual traffic (to internalize its negative external effects).
- This paper: By employing a Difference-in-Differences (DiD) approach, we want to identify whether such a type of very low-cost nationwide public transport tickets might have an impact on the decision of individuals to shift from car to public transport.

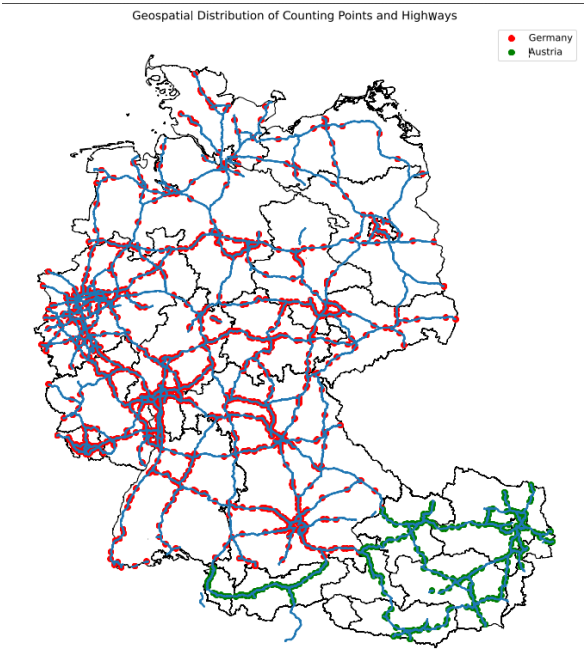
# Related Literature

- Public demand subsidies to lower public transport prices might be reasonable if
  1. a positive externality of a higher public transport frequency due to lower opportunity costs for the passengers (Button (2010), Mohring (1972)) or,
  2. the public subsidies internalize the negative externality of the motorized individual traffic by making the public transport traffic relatively more appealing (Basso and Silva (2014), Parry and Small (2009)).
- Evidence on the effect of uniform price settings:
  - Small demand increase in public transport usage after ticket price decrease, especially at low-income residents (Cats et al. (2014), Fuji and Kitamura (2003), Hess (2017))
  - Almost no evidence for mode substitution (Bull et al. (2021), Busch-Geertsema et al. (2021)).
- Evidence on the 9€-ticket:
  - Positive effect on air polution in Germany (Aydin and Kürschner Rauck (2023), Gohl and Schrauth (2022))
  - Increase in leisure train journeys, adverse effects on rail infrastructure quality (Liebensteiner et al. (2024))
  - Modal shift (only from survey data so far): About 20% of ticket users substituted at least some private transport trips with public transport (Loder et al. (2024)).

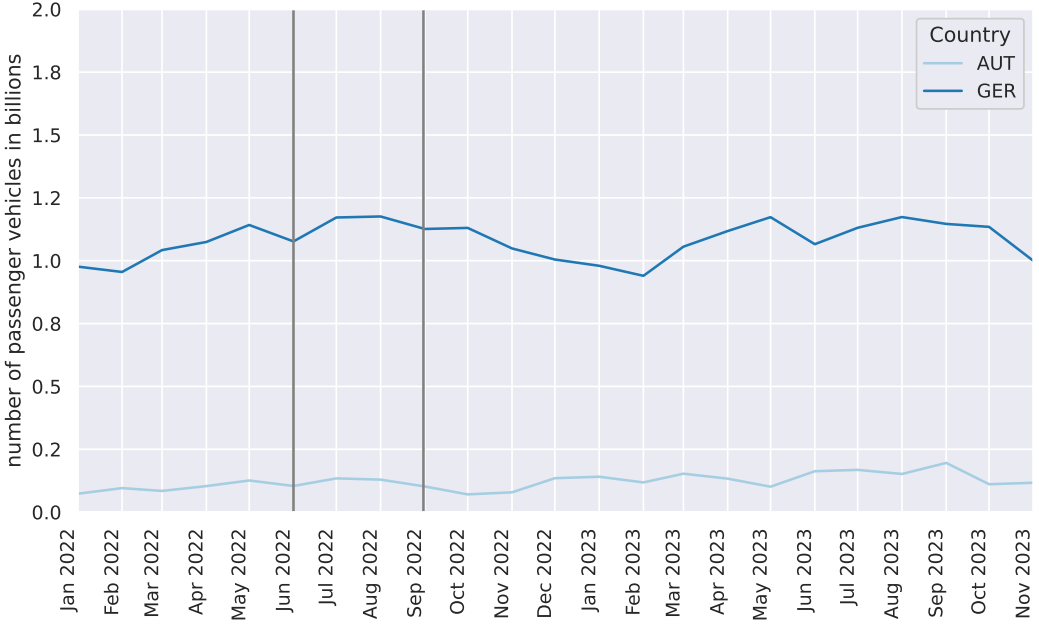
# Data

- We employ data from three different sources:
  1. Counting data from the Federal Highway Research Institute (BASt) on all motor vehicles from German motorways
     - All vehicles (up to nine different types) are permanently counted at 2,108 automatic counting points
     - Data is available on a hourly basis for every traffic line and direction.
  2. Counting data from the Motorway and Expressway Financing Corporation (ASFiNAG) for Austria
     - All vehicles (two different types) are permanently counted at 270 automatic counting points
     - Data is available on a monthly basis for every traffic line and direction.
  3. Historical monthly average gasoline consumer prices for Austria and Germany from the information platform Fuelo.
- Our final panel dataset contains monthly highway traffic data for Austria and Germany for the observation period January 2022 to December 2023 on counting point level (22,591 observations).

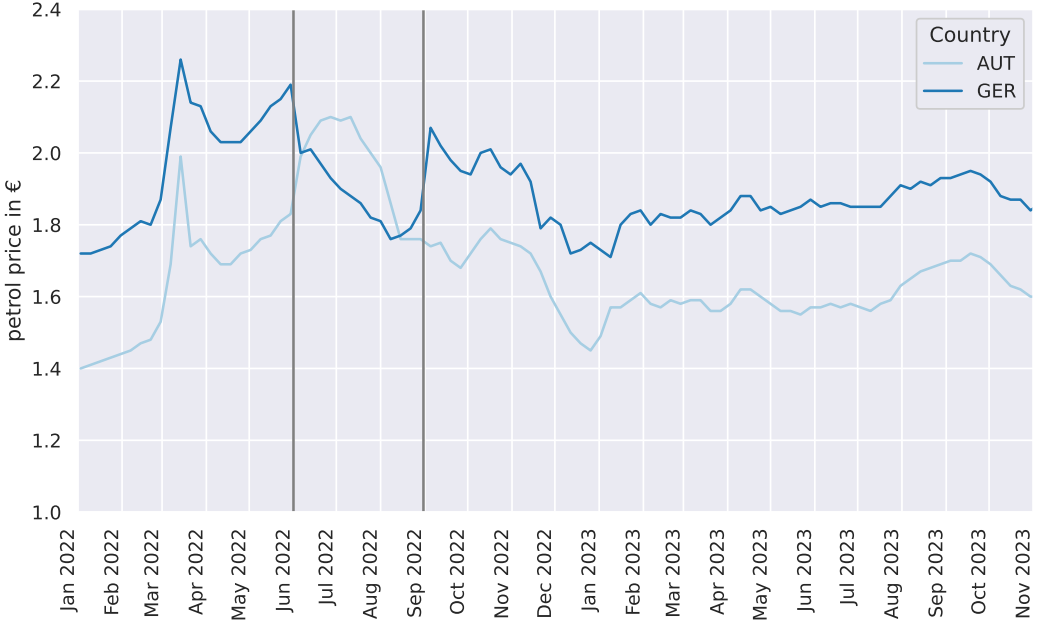
# Descriptive Statistics I



# Descriptive Statistics II



# Descriptive Statistics III



- Empirical Approach:
  - We apply a DiD approach by using Austria as a control country
  - We use an event study design (dynamic DiD) to check the key identification assumption of parallel trends.
- Baseline DiD regression model:

$$\mathrm{T}_{\mathrm{ijt}} = \mathrm{X}'\beta + \tau \cdot \mathrm{Ticket}_{\mathrm{it}} + \eta_{\mathrm{ij}} + \lambda_{\mathrm{t}} + \epsilon_{\mathrm{ijt}}. \tag{1}$$

- Event study design:

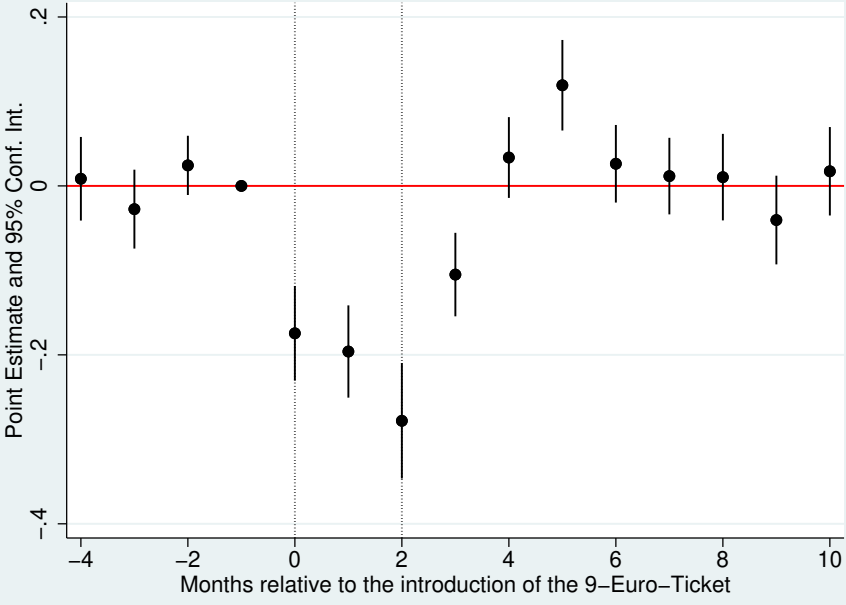
$$\begin{aligned}\mathrm{T}_{\mathrm{ijt}} = \mathrm{X}'\beta + \eta_{\mathrm{ij}} + \lambda_{\mathrm{t}} + \mathrm{D}_{\mathrm{i}} \times [ &\sum_{\mathrm{k}=-4}^{-2} \pi_{\mathrm{k}} 1(\mathrm{Month}_{\mathrm{t}} = \mathrm{k}) \\ &+ \sum_{\mathrm{k}=0}^{10} \tau_{\mathrm{k}} 1(\mathrm{Month}_{\mathrm{t}} = \mathrm{k})] + \epsilon_{\mathrm{ijt}}.\end{aligned} \tag{2}$$

# Results I

| | Dependent variable: $\text{Traffic}_{i,j,t}$ | | |
|---|---|---|---|
| | (I) | (II) | (III) |
| DiD | -0.179*** | -0.213*** | -0.186*** |
| | (0.021) | (0.023) | (0.021) |
| Deutschland ticket | | -0.101*** | -0.100*** |
| | | (0.016) | (0.016) |
| Gasoline Price (t − 1) | | | 0.174** |
| | | | (0.078) |
| Constant | 13.819*** | 13.851*** | 13.762*** |
| | (0.003) | (0.006) | (0.048) |
| Time FE | Yes | Yes | Yes |
| Country Counting FE | Yes | Yes | Yes |
| Deutschland ticket | No | Yes | Yes |
| Gasoline Price (t − 1) | No | No | Yes |
| R-squared | 0.75 | 0.75 | 0.76 |
| Obs. | 22,570 | 22,570 | 21,535 |

Standard errors (in parentheses) are clustered at the country counting point level.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

# Results II


Point Estimate and 95% Conf. Int.
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0
−.2
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−4
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2
4
6
8
10
Months relative to the introduction of the 9−Euro−Ticket

# Conclusion

- Our results imply that the introduction of the 9€-ticket led to a significant decrease in highway passenger traffic by more than 18%.
  - Effect is robust across different model specifications
  - Event study results show that the effect has been temporary and provide empirical support for the parallel trend assumption.
- Policy implications:
  1. Low-cost public transport initiatives can effectively stimulate modal shift
  2. Simplified and uniform price settings in public transport can facilitate decision-making for travellers.
- However, efficiency of this governmental intervention remains questionable:
  - High direct costs, which might be better used for supply-side investments
  - Missing price signal has triggered some capacity issues at peak times
  - Alternative proposal: Let the price mechanism operate, internalize negative external effects by pricing carbon dioxide and support low-income citizens via direct transfers.
- Next steps:
  - Use daily counting data (using trucks as control group) to get a better understanding on who really used the ticket (preliminary results suggest that our effect is driven by more leisure train journeys)
  - Incorporate data on carbon dioxide to examine the environmental effects of the ticket.