Effects of a mileage tax for trucks

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Abstract

In 2010, 3,675 persons died on American roads in accidents involving large trucks. Trucks emitted 3.8m tons of nitrogen oxides (18% of all U.S. emissions) and 389.3m tons of carbon dioxide (6% of all U.S. emissions). In Switzerland with a road network that is hundreds of times smaller than the American one, the respective figures are 28 fatalities, 11,886 tons of nitrogen oxides (14% of all Swiss emissions) and 2.9m tons of carbon dioxide (7% of all Swiss emissions). Moreover, road freight traffic is a major cause of noise, congestion and road wear and tear. The external costs of road freight largely depend on the distance travelled with additional factors being emission standards of vehicles (local air pollution), fuel efficiency (local and global air pollution), weight (accidents and road wear and tear) as well as location and time.

Politicians and regulators attack these externalities with various command-and-control policies, such as fuel economy and emission standards or driving restrictions, and with incentive-based policies such as fuel taxes and congestion charges. Incentive-based policies are more cost effective as they take into account heterogeneity in compliance costs and typically exploit more behavioral responses. In contrast, command-and-control policies often affect only one margin, which increases compliance costs and may lead to perverse effects. Fuel economy standards increase distance-related externalities by reducing mileage costs, strict standards for new vehicles delay the retirement of old polluting cars, or driving restrictions based on license plates create incentives for extra vehicles. Indirect links between externalities and behavioral responses to policies also plague fuel taxes. Fuel taxes affect both fuel economy and distance travelled and are, therefore, less effective in combating distance-related externalities.[1] Against this backdrop, vehicle miles travelled or mileage taxes compare favorably and several European countries introduced mileage taxes for heavy-duty trucks, starting with Switzerland in 2001.

Since 2001, Switzerland has levied a distance-related fee on vehicles with a maximum permissible total weight of more than 3.5 tons (henceforth trucks). In contrast to the more recent schemes in other European countries, the fee is not restricted to major highways. The rates depend on the maximum permissible total weight and emission category of vehicles. The rates are substantial and range from 4.5% to 24.7% of operating and vehicle costs per mile. The rates are not differentiated by time or location. Nevertheless, the policy is arguably much closer to an ideal pricing scheme than many existing alternatives. It is, therefore, of considerable general interest to know how effective this policy was in curbing road freight traffic and related externalities. An evaluation of a comprehensive mileage tax scheme seems particularly timely in light of

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[1] The drawbacks of fuel taxes compared to mileage taxes are less pronounced in the case of trucks compared to cars. Because of low fuel economy, fuel-related external costs are of greater importance. Further, emission standards are defined in units per engine output which depends on fuel efficiency and fuel use.

recent endeavors in U.S. states such as Nevada, Oregon, and Washington to implement comparable schemes for cars.

In this paper, we estimate the effects of the Swiss mileage tax for trucks on the volume of road freight traffic. Our main analysis is based on a regression discontinuity design with daily traffic count data for the years 1997-2004. We focus on a relatively narrow time window and control for time-varying effects of other factors on traffic volume by including a very flexible polynomial in time. So long as the effects of other factors change smoothly around the date of the abrupt policy change, observations just before this date are good comparisons for observations just after this date.

We find that the introduction of the Swiss heavy vehicle fee reduced the number of trucks on the roads by 4.7% to 5.1% (see Table 1). Except for very short sample periods that make it impossible to adequately estimate seasonal traffic patterns, the estimates are not sensitive to changes in the length of the sample period or order of the time polynomial. We find no significant effects on car traffic or on time-shifted placebo policy changes. Looking at subsamples of heavy goods vehicles and monitors, we find the effects of the heavy vehicle fee to be larger for longer vehicles (> 12.5 meters) and monitors on the North-South transit routes. However, none of the estimated effects for the subsamples are statistically significant. We find suggestive evidence for an increase in rail freight traffic but no evidence for traffic diversion to neighboring countries.

The regressions discontinuity design allows us to capture the short-term response but is not suited to estimate longer-term effects. Further, estimates may be biased by anticipation effects. To address these concerns, we complement the regressions discontinuity analyses with estimates based on the synthetic control method. Figure 1 illustrates the results using this method. The traffic density of trucks in Switzerland was 2.05% lower compared to the counterfactual development in the synthetic control unit in the first year after the implementation. In subsequent years, the traffic density in Switzerland remains between 3.58% and 8.47% below the counterfactual. However, the estimated difference between the actual and the counterfactual development is not exceptionally large when compared to placebo estimates for other countries. Thus, the two approaches yield a very consistent picture of a small but insignificant reduction in traffic of 2.05% to 5.1%.

In addition to the estimates on road traffic, we also estimate the effects of the heavy vehicle fee on accidents and local air pollution. We find that the number or accidents with trucks involved has increased by 2.19% due to the introduction of the heavy vehicle fee. The number of dead or injured in accidents with trucks involved did not change significantly. We find no significant effect of the heavy vehicle fee on sulfur-dioxide, carbon-monoxide (CO) and nitrogen-oxides (NOx) when controlling for weather conditions. However, when looking at subsamples of pollution monitors, i.e. “traffic” or “background”, we find a significantly negative effect for NOx in the proximity of arterial roads of 4.9% as well as a significantly negative effect for CO monitors classified as “background” of 5.2%.

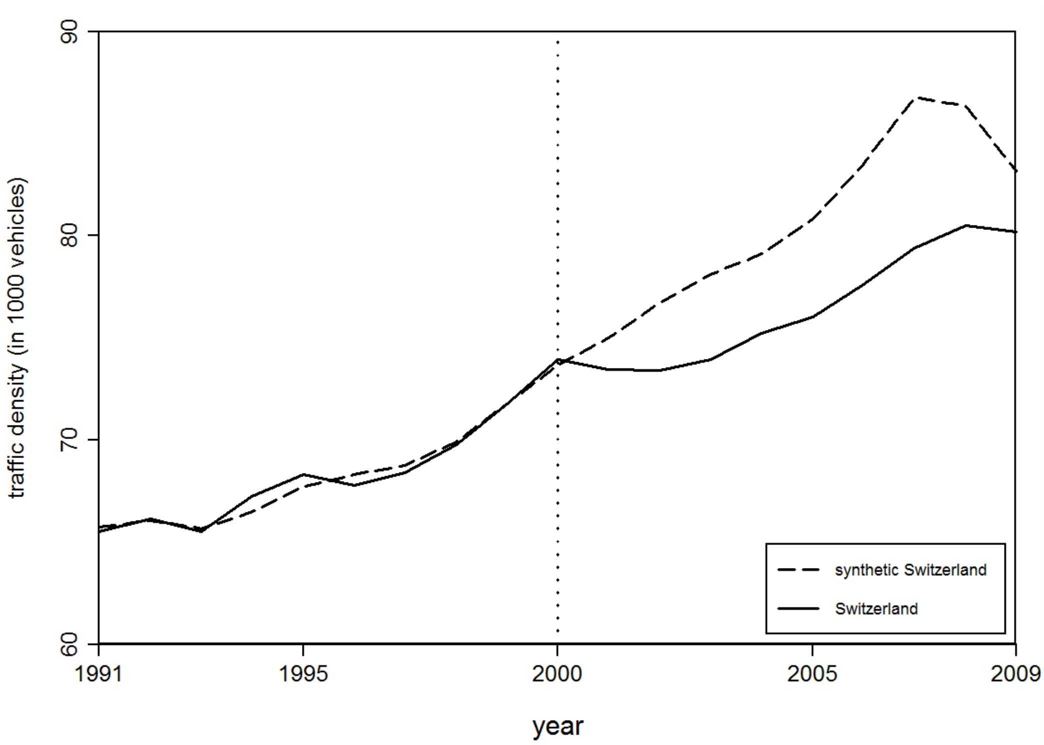
This paper contributes to growing body of literature assessing the effectiveness of policies against road traffic externalities. It is the first paper evaluating a comprehensive scheme of a mileage tax from an ex post perspective. Thus, it helps to inform decisions on mileage taxes in other contexts. There is one study on the Swiss heavy vehicle fee commissioned by the Swiss government after the implementation of the policy (Federal Office for Spatial Development 2007). The study combines estimates of mileage costs increases with published price elasticity estimates. Thus, although commissioned ex post, the study has the character of an ex ante evaluation. Nevertheless, it is interesting to note that the results are comparable to our ex post evaluation.

Table 1: RDD Baseline Results

Dependent variable: Log number of trucks	(1)	(2)
Heavy vehicle fee	-0.051	-0.047
	(0.052)	(0.051)
Controls		
8th order Polynomial	Yes	Yes
Weather	No	Yes
Month effects	Yes	Yes
Day of week effect	Yes	Yes
Christmas & New Year days effects	Yes	Yes
Observations	349,728	349,728
Number of monitors	130	130
R-squared	0.705	0.706

Notes: Estimated using OLS regressions. Dependent is log number of trucks per day. A truck is defined as a vehicle > 6m in length. Controls are eight order time polynomial, weather, month effects, day of the week effects, Christmas days effects, New Year days effects and July-June year effects. Weather contains the weather variables minimum and maximum temperature per day (°C), daily precipitation (mm/day), average wind speed (m/s) and snow depth (mm). Christmas days and New Year days effects are dummy variables for the dates December 25/26 and January 1/2 respectively. Standard errors in parentheses are robust to heteroskedasticity and clustering on date
Source: Own calculations based on Swiss Federal Road Office and MeteoSwiss data.

Figure 1: Trends in Traffic Density: Switzerland vs. Synthetic Switzerland



Source: Own calculations based on International Transport Forum and national statistics data.