The Accident Externality of Driving: Evidence from Observance of the Jewish Sabbath in Israel*

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Abstract

We document and measure an externality of driving, whereby a driver's decision to take to the road affects fellow drivers' risk of accident. Because religious Jews refrain from driving during the Sabbath, traffic on Israeli roads decreases sharply when the Sabbath begins each Friday, at a precisely defined time before sundown, and increases after the Sabbath ends on Saturday evening, at a precisely defined time after sunset. Using plausibly exogenous variation in traffic volume associated with the Sabbath, we estimate the effect of traffic volume on the risk of fatal or injurious accident. We find that a positive accident externality emerges only at the Sabbath exit, when traffic volumes are greater. Remarkably similar results arise when the analysis is confined to non-Jewish drivers, whose travel choices are not bound by the precise timing of the Sabbath, supporting the interpretation that our findings reflect an externality. Finally, the effect emerges mainly on a class of road sections that is considered highly perilous, suggesting that the interaction of traffic volume and road perilousness is important for understanding this issue and shaping implicated policy.

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1 Introduction

Increased transportation capacity generates substantial social benefits (Venables, 2007), and in the contemporary human environment motorized transportation by road, in particular, is fundamental. But the use of roads comes at a cost. An especially undesirable consequence of road usage is ubiquitous traffic accidents. For the past several decades the annual national fatality count from traffic accidents in the United States has hovered near 40,000 people per year, and for people under the age of 40 in the U.S. it is the leading cause of death (Parry, 2004). In addition to their immediate harm to life, such accidents generate a negative and persistent effect on the subsequent employment and earnings of the people involved (Halla and Zweimller, 2011), and often result in traffic jams that affect a much broader group of people. Unsurprisingly, traffic accidents have attracted a great deal of attention from both policy makers and academics. Economists have recently made progress in estimating the influence of various factors on the incidence and severity of accidents, such as drunk driving (Levitt and Porter, 2001; Adams and Cotti, 2008), mandatory seat belt laws (Cohen and Einav (2003)), minimum wage laws (Adams et al., 2012), compulsory insurance and the level of accident liability (Cohen and Dehejia, 2004), text messaging (Abouk and Adams, 2013), and even the sheer weight of vehicles (Anderson and Auffhammer, 2014).

An important factor that potentially influences the likelihood of accidents is the amount of traffic. Every time a driver takes to the road his or her presence may affect fellow road users' risk of accident, thereby generating an externality. Neither the existence nor the direction of this externality are a-priori clear. All else equal, adding vehicles to the road may increase the odds of an accident, but if congestion is sufficient then additional vehicles may slow traffic down, thereby reducing the risk. Even considering only roads on which traffic flows freely, it is not obvious whether adding cars to the road increases the per-vehicle likelihood of accident more or less than proportionally to the increase in the number of vehicles.Vickrey (1968) notes that the increased risk generated by additional vehicles may be offset by a greater degree of caution or discipline on the part of drivers.

Vickrey (1968) identified the importance of the relationship between traffic volume and accidents for optimal road use pricing: if such a positive externality does exist, then road users should pay more for their use to account for the additional social costs associated with their decision to take to the road. This notion was later formalized by Jansson (1994). Newbery (1990) notes that the accident externality may be as large as all other road use externality costs taken together and that "Given the huge costs involved and the potential gains from lowering accident rates, identifying such relationships should have overwhelming research priority".

In this study we seek to improve the empirical evidence on this issue and to estimate the direction and size of the accident externality of driving. We do so by estimating the effect of traffic volume on the likelihood of severe (i.e. injurious or fatal) accidents using plausibly exogenous variation in traffic volume derived from a unique setting in Israel. For religious reasons, a sizeable share of the Jewish population in Israel refrains from driving on the Jewish Sabbath. Every Friday the Sabbath begins at a precisely defined time before sundown, which varies by date with predictability that is literally astronomical. At that time there occurs a sharp drop in traffic volume throughout the country (the magnitude of the drop varies by the local population share of observant Jews). Conversely, every Saturday evening the Sabbath ends after sundown, precisely 25 hours after it began, and throughout the country traffic volume rises sharply. We use these two roughly discrete changes in traffic volume induced by the Sabbath to identify the causal effect of traffic volume on the incidence of severe accidents by way of a regression discontinuity design with two thresholds: One threshold at the "entry" of the Sabbath and the other at its "exit." We implement this strategy using a decade of administrative data on traffic accidents compiled from police reports and matched with a national database of traffic counts.

We find that upon the Sabbath entry and exit, the elasticity of per-vehicle risk with respect to traffic volume is -0.3 and 1, respectively, where the former is statistically insignificant and the latter is marginally significant. Thus, a positive accident externality emerges only at the Sabbath exit, when traffic is heavier by roughly 13%. The results could indicate that traffic volume affects the risk of accident non-linearly, generating an accident externality only when traffic volume is heavy.[1]

As the travel choices of non-Jewish drivers are not bound by the precise time of

[1]The last statement refers to heavy traffic that is still free-flowing.

Sabbath entry and exit, changes in the probability of severe traffic accidents involving non-Jewish drivers, indicate the presence of an accident externality. We use evidence regarding non-Jewish drivers to corroborate our interpretation of the previous results as evidence of an externality, as well as our estimate of its magnitude. Consistent with our earlier results, we find that this subset of accidents, too, is similarly affected by variation in traffic volume upon Sabbath entry and exit, showing an increase of 17% in the probability of being involved in a severe accident at Sabbath exit, but with no change at Sabbath entry. These results imply elasticities of per-vehicle risk with respect to traffic volume around the Sabbath entry and exit of 0 and 1.3, respectively.

A valid concern is that observant Jews may differ from the general population in their likelihood of getting into an accident around the Sabbath entry and exit thresholds. Ultimately, a causal interpretation of our estimates hinges upon the assumption that any such differences are negligible. we validate the assumption by testing for discrete changes, around the Sabbath thresholds, in the observable characteristics of accidents, vehicles and passengers involved in those accidents. We find no evidence of such changes. This result supports the view that, around the Sabbath entry and exit thresholds, observant Jewish drivers do not differ from the general population in relevant respects. Moreover, Israel's 2009 Social Survey includes a module on religiosity that allows us to compare the characteristics of observant Jewish drivers to those of other drivers. We find no evidence that observant Jewish drivers differ from the rest of the drivers population in characteristics likely to be associated with accident risk.

When we distinguish between more and less perilous roads according to a commonly used external measure, we find that while the effect of the Sabbath on traffic volume is similar in both road types, the effect of traffic volume on the risk of accident is different. Particularly, on perilous roads, the elasticities of per-vehicle risk with respect to traffic volume at the Sabbath entry and exit are 0.4 and 2.5, respectively. On non-perilous roads these elasticities are statistically indistinguishable from zero. Thus, our result show that an accident externality arises only on perilous roads with no evidence of such an externality on roads that are not particularly hazardous. The result is consistent with a theory of limited driver attention or skill, whereby the challenges posed by dangerous roads and heavier traffic volume impact the risk of accident additively. It is also consistent with recent experimental evidence on the issue (Werneke and Vollrath, 2012).

Considering the human and economic importance of the matter, there is surprisingly little empirical evidence on the magnitude and sign of the accident externality from driving (Parry et al., 2007). In the economic literature, the seminal work of Edlin and Karaca-Mandic (2006) estimates the traffic accident externality using state-level panel data from the U.S. on insurance premiums and loss costs. By asking whether greater annual traffic volume raises the associated insurance costs the authors provide a dollar estimate of the traffic accident externality, finding that the addition of one typical driver is costlier - in terms of insurance premiums and costs - in states with greater traffic volume. Parry et al. (2007) argue, however, that using insurance costs may be inadequate as they mostly reflect property damages that account for a small part of the cost of accidents. Using data on traffic and accidents in London, Dickerson et al. (2003) divide roads into four groups and analyze the correlation between traffic volume and accidents separately for each group. They find evidence of a driving externality only in high traffic volume areas. However, their analysis does not explicitly address the omitted variables problem. Namely, they draw causal inference by relying on the correlation between traffic and accidents and controlling for specific issues such as seasonality and hour of day.[2]

Several studies in the transportation literature examine the relationship between accident rates and traffic volume. Studying French highways, Martin (2002) finds that accident rates increase with roads' annual traffic flow, but that within a 24 hour period crash rates per vehicle peak when hourly traffic flow is lightest. Studying roads in southern California, Golob and Recker (2003) find that accident severity and traffic volume are negatively correlated, and Wang et al. (2009), who study London's M25 orbital motorway, find that traffic congestion has little or no impact on the frequency of accidents. Overall, this literature presents mixed evidence on the correlation between traffic volume and accidents and fails to address the identification of underlying causation.

This study complements and extends the foregoing literature and sheds new light on the micro-foundations of the relationship between traffic volume and accidents. Particularly, it shows, for the first time to our knowledge, that a positive relationship between

[2]We are unaware of any other study that examines the relation between traffic volume and accidents that explicitly address this issue.

traffic volume and accidents has a greater tendency to arise on roads that are more perilous. Consistent with existing evidence, it finds that the externality arises when traffic volume is heavy. In other words, the results suggest that on roads that are not perilous and at times at which traffic is relatively light, drivers are able to offset the increased risk generated by additional vehicles.

The study informs the public discourse about road use costs and pricing. The results imply that on roads that are not particularly hazardous, traffic volume is not associated with increased accident risk and therefore should not be a major consideration for road use pricing. On the other hand, on perilous roads and particularly when traffic is heavy, traffic volume generates social costs in terms of increased accident risk for which optimal road use pricing should account. Alternatively, and perhaps more realistically, making perilous roads safer can potentially reduce or even eliminate the interaction between traffic volume and accident risk because on safer roads drivers appear to be able to offset the increased risk of accident.

The remainder of the paper is structured as follows. Section 2 describes the data; section 3 describes the empirical strategy; section 4 reports the main results; section 5 reports the results from a direct measure of accident externality analyzing non-Jewish drivers; section 6 provides evidence on the accident risk of observant Jewish drivers relative to the rest of the driver population; section 7 addresses the mechanism underlying our results and section 8 concludes.

2 Data

2.1 Traffic volume data

Our measure of traffic volume is based on data which is obtained from traffic counts on a representative sample of 663 inter-city road sections in Israel from 1999 to 2010.[3] The traffic counts are carried out by Israel's Central Bureau of Statistics using specialized pneumatic counting devices.[4] Each road section is observed annually at a different time

[3]Despite being called "inter-city" roads, many of the roads are in fact urban highways serving multiple municipalities within the same metropolitan area.

[4]A pneumatic counting device is a rubber tube laid across the width of a road that measures axle crossings. The traffic count protocol interprets every two axle crossings as a vehicle, abstracting from vehicles whose

of year, so that each road section is observed at least once in every quarter over a four year sampling cycle. The traffic counts are carried out in 1 hour intervals over a continuous stretch of time spanning a week or more. In order to account for differences in traffic volume that arise from differences in road section length, we combine information on the length of each road section and calculate a measure of vehicle kilometers traveled (hereinafter "VKT"). In total, our traffic volume data comprise over a million hour by road section observations. In the analysis that follows, we use VKT as our measure of traffic volume and we use the two terms - VKT and traffic volume - interchangeably. We also note that, for a given road section, VKT is simply traffic flow multiplied by a constant, the section's length.[5]

Figure 1 shows the average hourly volume of traffic in our data as a share of the maximal traffic volume by time of the week. In Israel, most people work from Sunday through Thursday (including), with Friday and Saturday serving as the weekend. On workdays the average hourly traffic volume presents a visually apparent cyclical pattern. Traffic volume rises around 8 a.m., decreases at 10 a.m. and then peaks again at 4 p.m. Although Friday morning traffic volume approaches the levels of workday rush hour, weekend traffic volumes appear to be substantially smaller than those on workdays. This is particularly true on Fridays between 3 p.m. and 8 p.m., during which the Sabbath typically enters, and on Saturdays between 4 p.m. and 9 p.m., during which the Sabbath typically exits. The typical average volumes upon Sabbath entry and exit are 52% and 59% of the maximal traffic volume, respectively.

2.2 Police report data on accidents

Our measure of the probability of severe (i.e. injurious or fatal) accidents is obtained from administrative data, compiled by the Central Bureau of Statistics from police accident reports from the years 1999-2010. The data contain records for the full universe of traffic accidents reported by the Israeli police in which one or more people were injured. The data include characteristics of the accidents such as the time and location they occurred and the type of road and its condition, as well as contemporary local weather conditions.

number axles is greater than two.

[5]Using the "raw" traffic flow data instead of VKT as Dickerson et al. (2003) and Martin (2002) do, provides almost identical results.

The data also include characteristics of people involved in the accidents (necessarily including drivers, hurt or not), such as their age, gender and ethnicity, as well as the severity of their injuries, their locality of residence and in the case of drivers their years of driving experience. Finally, the data contain characteristics of the vehicles involved in the accidents, such as their year of manufacture, engine capacity and so forth. We limit the sample to accidents that occurred on inter-city roads - for which we have traffic data - and we create a panel of accidents by time and location which we ultimately match with the traffic data.

Figure 1 also shows the average hourly count of severe accidents in our sample over the week. The positive correlation between the number of severe accidents and the volume of traffic is visually striking. To complete the picture, Table 1 reports summary statistics with respect to accidents. There are a total of 55,733 severe accidents in the data, and the mean number of vehicles involved in an accident is just over 2 whereas the mean number of people injured per accident is almost 3. The mean number of people killed per accident is 0.06. Even though roughly 60% of licensed drivers in Israel were male during the sample period, a full 80% of the drivers involved in severe accidents are male.[6] The median age of involved drivers is between 30 and 34, and the median driving experience of involved drivers is 11 years. The median vehicle involved in an accident was 6 years old.

3 Empirical Strategy

3.1 Framework

Let f denote traffic volume on a section of road during a given time period and $r(f)$ the *per-vehicle* risk of getting into an accident as a function of traffic volume. $\epsilon_{r,f}$ is the elasticity with respect to traffic volume of the per-vehicle risk of accident. If $\epsilon_{r,f}$ is greater than 0 then traffic volume - reflecting drivers' decisions to take to the road - generates a positive accident externality.

[6] The Central Bureau of Statistics reports that 62% and 58% of Israeli driver licenses were held by males in 1995 and 2010, respectively.

The expected number of accidents on the road section is

$$a = r(f)f. \tag{1}$$

Provided that the given time period (the duration of traffic volume measurement) is sufficiently short, such that the occurrence of more than one accident on the road section within this time period is unlikely, then a also approximates the probability of an accident.[7] $\epsilon_{a,f}$ is the elasticity with respect to traffic volume of the expected number of accidents and of the probability of accident. Some straightforward algebraic manipulation yields that

$$\epsilon_{a,f} = 1 + \epsilon_{r,f} \tag{2}$$

Thus, the empirical "signature" of a positive accident externality from driving is $\epsilon_{a,f} > 1$. Intuitively, if an increase of 10% in traffic volume increases the probability of accident by *more* than 10% then a positive accident externality from driving exists.[8] The condition above adds to this intuition by showing that, in addition to the presence and direction of the accident externality from driving, the *magnitude* of the per-vehicle accident risk elasticity, $\epsilon_{r,f}$, can be precisely inferred from the estimated elasticity $\epsilon_{a,f}$ as well.[9]

3.2 Identification

Consider the following empirical model of the relationship between traffic volume, f, and the per-vehicle accident risk, r,

$$r = \alpha + \beta f + X\gamma + \eta, \tag{3}$$

where X is a vector of observable covariates and the parameter β captures the effect of traffic volume on the per-vehicle accident risk. An OLS estimate of β is likely to

[7] In all that follows, the probability of accident refers to this approximation.

[8] In practice we test whether we can reject the null $H_0 : \epsilon_{a,f} = 1$.

[9] Note, that an accident externality may arise even if the probability of accident increases proportionally with traffic volume because drivers may offset the increased accident risk by exerting more effort to avoid an accident. Such an "externality" is not captured by our approach. Put differently, we examine whether there is evidence of accident externality that is not offset by drivers' added caution.

be biased. The volume of traffic on different road sections may be confounded by road characteristics. Traffic volumes and accident rates are both likely to differ systematically between major urban thoroughfares near Tel-Aviv and winding mountain roads in the rural Galilee, for example. Similarly, the volume of traffic on a fixed road section may be confounded by time varying factors. For example, traffic volume tends to be low at 2 a.m., but drivers are tired then and therefore more likely to be involved in a car accident. Such confounding effects may persist even after controlling for the richest available set of observable covariates.

To identify the causal effect of traffic volume on the per-vehicle risk of accident, we take advantage of plausibly exogenous variation in traffic volume generated by two natural experiments that occur in Israel each Friday and Saturday evening. In Israel, traffic volume falls sharply every Friday at the onset of the Sabbath when religious Jewish drivers abandon the roads, and then rises sharply 25 hours later at the Sabbath's outset. Both the entry and the exit of the Sabbath occur in the afternoon or evening, before and after sundown respectively. The precise timing of Sabbath entry and exit shifts gradually from week to week over the annual cycle, occurring earlier in winter and later in summer.[10] The precise times of Sabbath entry and exit are the subject of astronomical calculation. They are known precisely years in advance, and are conveniently advertised on the front pages of most daily newspapers.

We exploit the Sabbath's entry and exit econometrically using a three step procedure, which conceptually mimics a two sample two stage least squares analysis (Angrist and Krueger, 1991).[11] First, we use a regression discontinuity design at the Sabbath's entry and exit to estimate the elasticities of traffic volume with respect to the Sabbath, using our traffic data. Second, we use the same design to estimate the effect of the Sabbath's entry and exit on the average probabilities of accident per road section, using our accident data. To complete the procedure we take the ratio of the two previous estimates, thereby obtaining estimates of the effect of traffic volume on the probability of accident at the entry and exit of Sabbath. We interpret this effect using Equation (2), which sheds light

[10] There is also a slight difference in the timing of the Sabbath by geographic location within Israel, but we abstract from it in our analysis by attributing the Tel-Aviv area's timing to the entire county.

[11] See Devereux and Hart (2010) for a similar approach.

on our object of interest, the effect of traffic volume on the per-vehicle risk of accident.[12]

As the Sabbath time is predictable, observant Jewish drivers obviously plan their trips with respect to the exact timing if its entry and exit. Our identification hinges upon the assumption that the sharp changes in traffic volume upon Sabbath entry and exit are uncorrelated with any factors that independently influence the probability of accident. More concretely, this assumption implies that the pool of drivers (and vehicles) does not change systematically at the thresholds in a way that influences the risk of accident. To validate this assumption, we provide empirical evidence with respect to observable characteristics of drivers and vehicles involved in accidents before after Sabbath entry and exit.

3.3 Empirical Model

Let t denote unique calendar time intervals, such as 13:00-14:00 on Friday, December 30th, 2006, and let $\tau \equiv \tau(t)$ be a function of time interval t that relates it to the onset of the nearest Sabbath. On Friday, December 30th, 2006, the onset of the Sabbath occurred at 16:07 in the afternoon. Given the coarseness of our data we round 16:07 to 16:00, $\tau(t)$ for $t =$ "30 Dec. 2006, 13:00-14:00" is -3, because t begins 3 hours before the onset of the nearest Sabbath. We refer to τ as *the Sabbath-relative time of* t.

In the first step of our procedure we estimate the effect of Sabbath entry and exit on log VKT (our measure of traffic volume). Let f_{it} denote the traffic volume on road section i at calendar time t. Let the Sabbath entry indicator S_t^{Entry} equal 1 if $\tau(t) \geq 0$ and 0 otherwise, and let the Sabbath exit indicator S_t^{Exit} equal 1 if $\tau(t) \geq 25$ and 0 otherwise. We estimate the model

$$\begin{aligned} (4) \qquad \log(f_{it}) = {} & \alpha^f + \beta^f S_t^{\text{Entry}} + g^f(\tau) \\ & + \gamma^f \cdot \mathbb{1}(\tau \geq 13) + \delta^f S_t^{\text{Exit}} + h^f(\tau - 25) \cdot \mathbb{1}(\tau \geq 13) + X_{it}\psi^f + \eta_{it}^f. \end{aligned}$$

$g^f(\tau)$ and $h^f(\tau - 25)$ are flexible, continuous control function of Sabbath-relative time τ that account for the continuous variation in traffic around the Sabbath thresholds. The

[12] in Section A.3 of the appendix we use heterogeneity in the degree of observance across sub-districts to apply an additional identification strategy using difference-in-discontinuities.

coefficients of interest are β^f and δ^f. They capture the discontinuous effect of the Sabbath entry and exit on traffic volume, because $g^f(\tau)$ and $h^f(\tau - 25)$ are 0 at the entry and exit of Sabbath respectively. X_{it} is a vector of covariates and η^f_{it} is an error term.

In the second step we estimate the effect of the Sabbath on the probability of accident.[13] Let $a_{sd,t}$ denote a binary outcome variable that equals 1 if one or more accidents take place in administrative sub-district sd during calendar time interval t and 0 otherwise. We estimate the linear probability model

$$\text{(5)} \qquad a_{sd,t} = \alpha^a + \beta^a S_t^{\text{Entry}} + g^a(\tau) + \gamma^a \cdot \mathbb{1}(\tau \geq 13) + \delta^a S_t^{\text{Exit}} + h^a(\tau - 25) \cdot \mathbb{1}(\tau \geq 13) + X_{sd,t}\psi^a + \eta^a_{sd,t},$$

which parallels Equation (4). The coefficient of interest is β^a and δ^a, which capture the discontinuous effect of the Sabbath entry and exit on the total probability of accident. In contrast to the first step, in which we use observations at the hour $\times$ road section level, we use hour $\times$ sub-district observations in this step, which allows us to greatly reduce the computational intensity. with very little informational cost.[14]

In the third step we combine our estimates to obtain the effect of traffic volume on the total probability of accident,

$$\text{(6)} \qquad \hat{\epsilon}_{a,f} = \frac{\widehat{\%\Delta a}}{\widehat{\%\Delta f}},$$

at the Sabbath's entry and exit, where we transform β^a and δ^a to an estimate of the percent change in accident risk, $\%\Delta a$ by dividing it by a_0, the baseline probability of accident, taken as the average probability of accident during the hours preceding either Sabbath entry or exit (i.e. during any calendar hour t such that $\tau = -1$ or $\tau = 24$). For $\%\Delta f$ we use our estimates of β^f and δ^f.[15] In order to combine our accident and traffic estimates as we do here, we implicitly make the additional assumption that traffic volume

[13] The approximation mentioned in section 3.1 whereby the expected number of accidents observed on a road section (or aggregately in an administrative sub-district) in a sufficiently short period of time approximates the probability of accident is empirically supported in our sample. Of the sub-district $\times$ calendar hour observations in which one or more accidents is observed, almost 97% have exactly one accident.

[14] We observe roughly 60 million road section $\times$ hour units, only a tiny fraction (approximately 0.0007%) of which involve severe accidents.

[15] The standard error of $\epsilon_{a,f}$ is obtained using the Delta method. A similar approach was used, for example, by Devereux and Hart (2010). See Section A.11 of the online appendix for more details.

in the different sub-districts is similar. In Section A.8 of the appendix we show that when we relax this assumption, the results do not change.

4 Main Results

4.1 The effects of Sabbath entry and exit on traffic volume

In order to quantify the effect of the Sabbath on traffic volume numerically, we estimate the following specification of Equation (4), in which we approximate $g^f(\tau)$ and $h^f(\tau - 25)$ using a k^{th}-order polynomials, fully interacted with the Sabbath entry and exit dummies, respectively.

(7)

$$\begin{aligned}\log(VKT_{it}) = {} & \alpha_0^f + \beta_0^f S_t^{\text{Entry}} + \sum_{k=1}^{k} \left[\alpha_k^f (\tau)^k + \beta_k^f (\tau)^k \cdot \mathbb{1}(\tau \geq 0)\right] \\ & + \gamma_0^f \cdot \mathbb{1}(\tau \geq 13) + \delta_0^f S_t^{\text{Exit}} + \sum_{k=1}^{k} \left[\gamma_k^f (\tau - 25)^k \cdot \mathbb{1}(\tau \geq 13) + \delta_k^f (\tau - 25)^k \cdot \mathbb{1}(\tau \geq 25)\right] \\ & + \sum_{w(t)} \phi_w^f + \sum_{k=1}^{3} [\theta_k^f (dusk)^k + \phi_k^f (dawn)^k] + \eta_{it}^f.\end{aligned}$$

$w(t)$ is a function mapping calendar time t into hours of the week and ϕ_w^f is a set of fixed effects for each of 168 hours of the week comprising the range of $w(t)$, reflecting the weekly cycle. Sabbath entry and exit times are tied to the timing of dawn and dusk by construction. Unlike the Sabbath, however, dawn and dusk occur every day of the week, allowing to identify the influence of dawn- and dusk-relative time separately from Sabbath-relative time. In Equation (7), the functions *dawn* and *dusk* capture dawn- and dusk-relative time, akin to Sabbath-relative time. We use 3rd-order polynomials to control for lighting conditions as they vary throughout the year.

Since in our setting traffic counts are reported in round hour intervals, we choose the regression model by implementing the procedure suggested by Lee and Card (2008) and Lee and Lemieux (2010) for a "running variable" that is inherently discrete or only reported in coarse intervals and find that a third-degree polynomial is optimal.[16] In

[16] Appendix Table A.3 reports the results of this procedure. When we include a third-degree polynomial, the procedure's p-value jumps from zero to 0.26 suggesting that this function is flexible enough to fit the data. We

addition, we cluster standard errors by Sabbath-relative time as Lee and Card (2008) and Lee and Lemieux (2010) suggest.

Because Sabbath-relative time is rounded to fit the time intervals, observations right next to the cut-off may include a mix of above- and below-threshold traffic which may bias our estimates downwards. For example, if Sabbath enters at 16:29, we round the entry time to 16:00. We consider the time interval 16:00-17:00 as "treated" while, in fact, it contains a mix of 29 minutes of before Sabbath entry traffic and 31 minutes of after Sabbath entry traffic. This may lead, in turn, to overstatement of our measure of the accident externality. To address this issue we discard observations just at the cut-offs that are "mixed", i.e., observations of time intervals that have more than a quarter of an hour of both Sabbath and non-Sabbath traffic. We report the results with and without discarding "mixed" observations.[17]

To illustrate the results we regress log hourly road section VKT on a set of Sabbath-relative time indicators, while controlling for the same key observables we include in equation (7). Figures 2a and 2b plot the estimated β_τ^f parameters against Sabbath-relative time 12 hours before and after the entry and exit of Sabbath, respectively. We fit two third-order polynomials to the right and left of the thresholds, for visual reference. The figures show that Sabbath entry appears to feature a decrease in average traffic volume that is roughly on the order of 25%. After Sabbath exit traffic appears to jump by about 15%.

Table 2 presents estimates of β_0^f and γ_0^f. The estimates are consistent with the graphical evidence in Figure 2. The most stringent specification, shown in Column 3 of Panel b, yields an estimated 25% drop in traffic volume upon Sabbath entry and an estimated 14% rise in traffic volume upon Sabbath exit.[18]

4.2 The effects of Sabbath entry and exit on accidents

As in the previous section, we report our findings with respect to the effect of the Sabbath entry and exit on accidents first graphically and then numerically. Implementing again

note however that, as the table shows, results are quite similar for a second or a fourth degree polynomial.

[17] See Dong (2015) for a similar approach.

[18] We validate these results by running a placebo analysis using Monday as Friday. Reassuringly we find that traffic trends smoothly around the thresholds. See Section A.5.

the procedure shown by Lee and Card (2008) and Lee and Lemieux (2010) we find that a second order polynomial is optimal for the regression model.[19]

To illustrate the effect visually we regress the mean hourly road section accident rate, averaged at the sub-district level, on a full set of Sabbath-relative time indicators, while adhering to the same set of controls as before (in Figure 2 and Equation (7)).

Figures 3a and 3b visually illustrate the effect of the Sabbath on the probability of an accident. Upon Sabbath entry, the average probability of accident drops sharply by approximately 0.7 percentage point, and upon Sabbath exit there occurs a sharp increase of about one percentage point.

We continue the accident analysis analogously, using a model as in Equation (7) and report the estimates in Table 3. Column 5 shows the most stringent specification. Consistent with the graphical evidence, the results indicate a drop of about 0.7 percentage point in the probability of accident upon Sabbath entry and an increase of one percentage points upon its exit.[20] In order to transform this estimate into a percent change, we divide it by the average probability of accident right before the entry and exit of Sabbath (i.e. during any calendar hour t such that $\tau = -1$ or $\tau = 24$), which is our baseline of choice. This calculation is reported in Column 6, with a 16.5% decrease in the probability of accident upon Sabbath entry and an increase of 27% upon its exit. We use a linear probability model to simplify the IV approach, however, when we redo the analysis with a Poisson model using the actual accident count data instead of our approximation with an accident dummy and we obtain very similar results.[21]

4.3 The impact of traffic on accidents

Combining these results, we estimate that the elasticity of the probability of accident with respect to traffic volume, $\hat{\epsilon}_{a,f}$, at the Sabbath entry is approximately 0.7 and insignificantly different from one; at the Sabbath exit $\hat{\epsilon}_{a,f}$ is 2 and it is marginally significant with a p-value of 0.09.

[19] Appendix Table A.4 summarises the results, showing that with a second-degree polynomial the procedure's p-value increases from 0 to 0.287, suggesting that this function is flexible enough to fit the data.

[20] As we noted earlier, we estimate the accident data at a higher level of aggregation than we use for the traffic analysis. This simplification should not, however, affect our estimates. Indeed, when we redo the accident data analysis at the road section level we find almost identical results. see Section A.8 of online appendix

[21] See Table A.6 in the appendix.

The results indicate a stark difference between Sabbath entry and exit. While they provide no evidence of an accident externality from driving at Sabbath entry, the results indicate a positive (harmful) accident externality from driving at the Sabbath exit. At the Sabbath's entry the estimates imply that $\hat{\epsilon}_{r,f}$, the *per-vehicle* risk of accident elasticity is -0.3. The finding that $\hat{\epsilon}_{a,f}$ equals 2 at the Sabbath's exit implies that, under the circumstances that prevail at that time $\hat{\epsilon}_{r,f} = 1$, i.e. a 10% increase in traffic volume induces a 10% increase in the *per-vehicle* risk of accident, (using the framework in Section 3.1).

A possible explanation for the disparity between the Sabbath entry and exit results is that the effect of traffic volume on the risk of accident is non-linear. As shown in Figure 1, average traffic volumes at Sabbath exit are 13% greater than at Sabbath Entry.[22] Therefore, an increasing marginal effect of traffic volume on the risk of accident in the relevant traffic volume range would explain our findings. However, while we find this explanation to be the most plausible one, other factors may be relevant in explaining this result.

5 A direct measure of accident externality

Non-Jewish drivers have no religious motivation to refrain from driving on the Jewish Sabbath, yet they share the road with religiously observant Jews whose contribution to traffic volume subjects non-Jewish drivers to an externality. In this section we take advantage of this unique setting to examine directly the existence and magnitude of an accident externality of driving by studying the impact of Sabbath entry and exit on non-Jewish drivers.

As the data allow us to identify accidents involving non-Jewish drivers,[23] we proceed by conducting an exercise similar to that in section 4.2, while considering only accidents involving at least one non-Jewish driver as the outcome.[24] The probability of accidents involving non-Jewish drivers is presumably affected by the variation in traffic induced by

[22] 59% vs. 52% of the maximal traffic volume

[23] In the relevant time period, drivers' ethnicity (e.g. Jewish or Arab) was administratively recorded and available to the researchers.

[24] Data are available for the period 2001-2010; we observe roughly 19,000 severe accidents involving at least one driver whose descent is non-Jewish, and comprising approximately a third of our severe accident sample.

the entry and exit of Sabbath only through changes in the per-vehicle risk of an accident. Therefore, the results that follow may be regarded as a direct measure of the magnitude of the accident externality inflicted on non-Jewish drivers–a well-defined and perfectly identifiable set of drivers in the data. Intuitively, the changes in the expected number of accidents involving non-Jewish drivers around Sabbath may be attributed to the increased per-vehicle risk as these drivers' traffic volumes do not change discontinuously around the Sabbath thresholds.

More formally, let the per vehicle probability of an accident involving non-Jewish drivers be $r_{nj}(f)$, where f remains traffic volume. Thus, as before, if $\epsilon_{r_{nj},f} > 0$, then traffic volume generates positive externality. However, we do not observe $\epsilon_{r_{nj},f}$, instead, we observe $\epsilon_{a_{nj},f}$, the elasticity of the expected number of accidents involving non-Jewish drivers with respect to traffic volume. In Section A.7 of the appendix we illustrate that $\epsilon_{r_{nj},f} = \epsilon_{a_{nj},f}$, allowing us to examine the existence of an accident externality.

Figure 4 is analogous to Figure 3, in which we visually illustrate the effect of Sabbath entry and exit on the probability of accident, except that Figure 4 is limited only to accidents involving at least one non-Jewish driver. The figure reveals no apparent effect of Sabbath entry on the probability of accident, but it shows a sharp increase of roughly 0.6 percentage points in this probability upon Sabbath exit. The results correspond to those in section 4.2, which showed evidence of an externality at the exit of the Sabbath, but not at its entry. Table 4 confirms the graphical results. The estimates in Column 1 of Table 4 indicate an insignificant effect of Sabbath entry on the probability of accidents involving non-Jewish drivers, but they also indicate a 0.6 percentage point increase in this probability upon Sabbath exit, reflecting a 17% increase relative to the appropriate baseline (shown in Column 2). The results are robust to the inclusion of additional controls in the remaining columns, corresponding to those in Table 3.[25] Combining these estimates with our traffic volume estimates we find that $\hat{\epsilon}_{a_{nj},f}$ is roughly 0 around Sabbath entry and around Sabbath exit it is 1.3.

[25] A possible concern is that non-Jewish drivers refrain from driving on the Jewish Sabbath for non-religious reasons, such as the closure of retail establishments in Jewish areas. In the absence of data on non-Jewish traffic volumes - as opposed to accidents - we cannot entirely rule out this possibility, but we do not believe it is consequential. In particular, retail establishments in Jewish areas tend to close several hours prior to Sabbath entry, providing no reason for non-Jewish traffic volumes to drop sharply precisely upon Sabbath entry and jump upon Sabbath exit.

6 Is accident risk of observant Jewish drivers different?

Our identification strategy hinges upon the assumption that the Sabbath entry and exit affect the risk of accident only through the magnitude of the traffic volume, not by altering the composition of the driver pool comprising the volume or by changing drivers' behavior. To be clear, the Sabbath does alter the composition of the driver pool: it clears it of religiously observant Jewish drivers.[26] However, we assume that without an accompanying change in the magnitude of traffic volume, a change in composition alone does not affect the risk of accident, i.e. keeping traffic volume fixed while substituting non-religious drivers for religious ones leaves the risk of accident unchanged.

Although this assumption can never be substantiated beyond doubt, we provide evidence of its validity by examining observable characteristics of accidents and the drivers and vehicles involved in them around the Sabbath entry and exit thresholds. Additionally, we analyze the religiosity module of Israel's 2009 Social Survey, which allow us to compare the characteristics of drivers who refrain from driving on Sabbath with those of the rest of the driver population.

6.1 Accident characteristics

The accident characteristics we observe are likely to correlate with the involved drivers' risk of accident. If any of the accident characteristics we observe show a sharp change around the Sabbath thresholds, it would raise concerns about our identification assumption. If, for example, right before Sabbath or right after it, drivers involved in accidents are more likely to be male, to drive older vehicles, have limited experience behind the wheel or appear to exhibit reckless behavior, then one might be concerned that the Sabbath entry and exit affect the risk of accident for reasons other than altered traffic volume.[27] If, on the other hand, we observe that these characteristics are trending smoothly at the thresholds, this implies that the characteristics of the drivers populations around the the Sabbath

[26] In Section A.4 we show that consistent with notion the share of Jewish drivers changes around the Sabbath entry and exit.

[27] Below we show results for driver experience, driver gender, vehicle age and "reckless" accidents (such as collision with stopped unparked vehicle) but we find similar insignificant results for other observables that are likely to correlate with accident risk.

entry and exit thresholds do not differ on average. This would suggest that, around the Sabbath thresholds, these drivers' risk of accident does not differ either, consistent with our identifying assumption.

To examine how observable accident characteristics trend around Sabbath entry and exit we first perform a graphical analysis analogous to the analysis in Figures 2 and 3. Namely, we regress driver, vehicle and accident characteristics on the same control variables used in Equation (7). Figures 5a and 5b plot the coefficients of this regression using the driving experience of drivers involved in accidents (measured as years elapsed since first obtaining a license) as the dependent variable. The figures do not reveal a sharp change in this characteristic upon Sabbath entry or exit. Nor do Figures 5c and 5d, which plot the coefficients of this regression with the share of male drivers among those involved in accidents as the dependent variable. Shifting to vehicle characteristics, Figures 5e and 5f plot the coefficients of this regression with the average age of vehicles involved in accidents as the dependent variable and show no sign of sharp changes at the thresholds either. Figures 5g and 5h plot the coefficients of this regression with the share of accidents of uncommon type (such as crash with inanimate object or with stopped unparked vehicle) as the dependent variable; they also show no sign of sharp changes at the thresholds.[28]

Table 5 confirms the visual evidence by showing that the effect of Sabbath entry and exit on all of these observable accident characteristics is statistically insignificant. All four characteristics presented in Figures 5a-5h and in Table 5 are intuitively correlated with the risk of accident or reckless driving, and the absence of any sharp changes in these variables upon Sabbath entry and exit supports the view that religious Jewish drivers do not systematically differ from the remaining driver population with respect to their risk of accident and that they do not greatly alter their driving behavior just around Sabbath entry and exit.

[28] We also plotted the simple averages of these variables as a function of Sabbath-relative time and found that they trend smoothly around the two thresholds.

6.2 Evidence from the 2009 Social survey

The Israel Social Survey has been conducted annually since 2002. The survey population is a sample of about 7,500 individuals that is representative of the population of persons over age 20 in the country. The 2009 survey included a module on religiosity, which provides an opportunity to compare the characteristics of drivers who refrain from driving on Sabbath to those of the rest of the drivers population.[29] Table 6 summarises the results of this analysis. The share of women among observant Jewish drivers is 42%, similar to the rest of the population. The employment rate and household income of observant Jewish drivers is also statistically indistinguishable from the rest of the population, as is the share of drivers with health problems. Observant Jewish drivers are 1.7 years older, 5 percent more likely to own a house and they have, on average, about half a year less of schooling. They are also about 7 percent less likely to use a computer or the internet.[30] Overall, the comparison does not reveal striking differences in socioeconomic characteristics between observant drivers and the general driver population.

7 Perilous roads and accident externality

In this section we ask whether the accident externality from driving is intensified or diminished on roads known to be perilous. Ex-ante, the direction of this relationship is not obvious. On one hand, perilous roads may preoccupy and distract drivers, limiting their capacity to respond to fellow drivers' behavior and increasing the risk of accident.[31] If this is the case then, all else equal, an increase in traffic volume would raise the per-vehicle risk of accident on perilous roads more than it would on safer roads.

On the other hand, perilous and non-perilous roads may invoke different driver states of mind. For example, drivers may be more focused when they face the difficult task of driving on perilous roads and less so when they drive on less taxing, non-perilous roads. In this case, since drivers would be more alert on perilous roads they would be likelier to respond adequately to the added danger imposed by heavier traffic volume. This would

[29] see Section A.2 in the appendix for a detailed description of the sample.

[30] This result is unsurprising as Ultra Orthodox Jewish drivers typically refrain from using the internet.

[31] Using driving simulators, Werneke and Vollrath (2010) provide experimental evidence consistent with this conjecture.

imply that, all else equal, an increase in traffic volume would raise the per-vehicle risk of accident on perilous roads *less* than it would on safer roads.

We classify our observed road sections as perilous or non-perilous based on an external measure of road safety that is used by the National Road Company of Israel, a government-owned corporation charged with the planning, construction and maintenance of most of the road infrastructure in the country. This measure is based on standard methods of identifying road sections with the greatest potential for safety improvement (see e.g. Hauer et al. (2002) for a review of such methods), and it labels road sections that were found to be the most perilous as "red roads".[32] We label road sections in our data as perilous if they are included in the list of "red roads" and non-perilous otherwise.

With perilous and non-perilous roads clearly distinguished, we perform the same analysis as we do in section 4, first for perilous roads and then separately for non-perilous roads. Figure 6 provides the graphical evidence of the traffic analysis performed separately for perilous and non-perilous roads. Although the effect of the Sabbath on traffic volume appears to be greater on non-perilous roads, the Sabbath reduces the volume of traffic sharply and substantially on both types of road. The estimates reported in Table 7 corroborate the graphical evidence, and indicate that the Sabbath's entry reduces traffic volume on perilous and non-perilous roads by approximately 20% and 25%, respectively. At the Sabbath's exit traffic increases by about 10% on perilous roads and by about 17% on non-perilous roads.

Figure 7 reports the graphical evidence of the accident analysis, also performed separately for perilous and non-perilous roads. The Sabbath entry appears to reduce accident risk by 7% and 0% on perilous and non-perilous roads, respectively. The Sabbath exit appears to increase accident risk by 8% and 0% on perilous and non-perilous roads, respectively. The corresponding estimates in Table 8 corroborate this graphical evidence as well. On perilous roads, the Sabbath's entry reduces the risk of accident by roughly 27% and its exit increase it by 35%. On non-perilous roads, on the other hand, the effect of both the Sabbath entry and exit on the risk of an accident is statistically insignificant.

These results suggest that an increase in traffic volume raises the per-vehicle risk of accident on perilous roads substantially more than it does on safer roads.[33] Applying

[32]see Section A.10 of the online appendix for further discussion of this classification.
[33]In Section A.13 we show that imposing the same coefficients on the two groups gives very similar results.

Equation (6) to estimate the elasticities of the risk of accident with respect to traffic volume, $\hat{\epsilon}_{a,f}$, yields elasticities of 1.4 ($p - value = 0.06$) and 3.5 ($p - value = 0.01$) upon the Sabbath's entry and exit, respectively for perilous roads, versus elasticities of 0.2 and 0.7 for non-perilous roads, both statistically insignificant.

8 Conclusion

In this study we provide empirical evidence on the existence and magnitude of an accident externality from driving. Specifically, we use plausibly exogenous identifying variation stemming from religious observance of the Jewish Sabbath in Israel to estimate the effect of traffic volume on the probability of severe (injurious or fatal) accident. We find statistically significant evidence of accident externality only around the Sabbath exit. We interpret the findings as evidence that the effect of traffic volume on the risk of accident increases with the volume of traffic non-linearly. Namely, causing an accident externality only around the Sabbath exit when the average volume of traffic is substantially greater than around its entry.

We directly estimate the magnitude of the accident externality by examining a well-defined subset of drivers that is likely to be affected by traffic changes only through per-vehicle risk. We do so by estimating the effect of the Sabbath on accidents involving non-Jewish drivers, whose presence on the road does not change discontinuously upon Sabbath entry and exit. We find that these drivers, too, experience an effect of Sabbath-induced changes in traffic volume on their risk of accident, which would not be the case if the per-vehicle risk of accident were fixed.

The effect of traffic volume on the risk of accident is far more pronounced on perilous roads, suggesting that such roads preoccupy and distract drivers, limiting their capacity to respond to fellow drivers' behavior.

In addition to improving our understanding of the relationship between traffic volume and the risk of accident, our analysis is informative with respect to road use pricing. It implies that on roads that are not particularly hazardous, traffic volume does not appear to be strongly associated with increased accident risk and therefore it is not a major

Furthermore, if Section A.12 we show that these results are not driven by the differences between high- and low-volume roads.

consideration for road use pricing. On the other hand, on roads that are perilous and particularly when traffic is heavy, traffic volume generates social costs in terms of increased accident risk and optimal road use pricing should account for that. Alternatively, and perhaps more realistically, making perilous roads safer can potentially reduce or eliminate the interaction between traffic volume and accident risk because on safer roads drivers appear to be able to offset the increased driving risk.

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Table 1: Summary Statistics of Accident Data

Characteristics of severe accidents	
Mean injured	2.95
Mean killed	0.06
Mean number of vehicles	2.03
Characteristics of drivers involved in severe accidents	
Share male	0.80
Share Jewish	0.70
Share Arab	0.28
Share other	0.02
Median age	32.5
Median driving experience (yrs)	11
Characteristics of vehicles involved in severe accidents	
Share of trucks	0.14
Median age of vehicle (yrs)	6
Observations	55,733

NOTE. The table includes all accidents in non urban roads in the years 1999-2010.

Table 2: The Distinct Effects of Sabbath Entry and Exit on Traffic Volume

LHS var: ln(VKT)	(1)	(2)	(3)
Panel a: all observations			
Sabbath entry	-0.196**	-0.196**	-0.196**
	(0.032)	(0.032)	(0.033)
Sabbath exit	0.089**	0.089**	0.089**
	(0.033)	(0.033)	(0.032)
Dusk & dawn cubics	No	Yes	Yes
Year-month FE	No	No	Yes
Sub-district FE	No	No	Yes
Observations	1,011,538	1,011,538	1,011,538
Panel b: discarding "mixed" observations			
Sabbath entry	-0.255**	-0.243**	-0.247**
	(0.025)	(0.026)	(0.027)
Sabbath exit	0.131**	0.142**	0.135**
	(0.034)	(0.038)	(0.035)
Dusk & dawn cubics	No	Yes	Yes
Year-month FE	No	No	Yes
Sub-district FE	No	No	Yes
Observations	1,004,043	1,004,043	1,004,043

Notes: All columns report estimates of effect of the Sabbath on traffic volume, as per Equation (7). All specifications include a constant, and dummy variables for each hour of the weekly cycle. The Year-month fixed effects consists of a dummy variable for each of 132 calendar months in our data. Standard errors clustered by Sabbath-relative-time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

Table 3: The Distinct Effects of Sabbath Entry and Exit on the Probability of Accident

	Baseline		Controls		Full Controls	
LHS var:	Estimate	Δ%	Estimate	Δ%	Estimate	Δ%
accident dummy	(1)	(2)	(3)	(4)	(5)	(6)
Sabbath entry	-0.007**	-0.167**	-0.007**	-0.165**	-0.007**	-0.165**
	(0.002)	(0.044)	(0.002)	(0.040)	(0.002)	(0.041)
Sabbath exit	0.010*	0.265*	0.010**	0.268**	0.010**	0.268**
	(0.004)	(0.107)	(0.004)	(0.099)	(0.004)	(0.099)
Dusk & dawn cubics	No		Yes		Yes	
Year-month FE	No		No		Yes	
Sub-district FE	No		No		Yes	
Observations	1,466,262	1,466,262	1,466,262	1,466,262	1,466,262	1,466,262

Notes: All columns report estimates of effect of the Sabbath on the probability of accident, as per Equation (7). All specifications include a constant and dummy variables for each hour of the weekly cycle. The Year-month fixed effects consists of a dummy variable for each of 132 calendar months in our data. Standard errors clustered by Sabbath-relative-time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

Table 4: The Effect of the Sabbath on Accidents involving Non-Jewish Drivers

	Baseline		Controls		Full Controls	
LHS var:	Estimate	Δ%	Estimate	Δ%	Estimate	Δ%
accident dummy	(1)	(2)	(3)	(4)	(5)	(6)
Sabbath entry	-0.002	-0.040	-0.002	-0.040	-0.002	-0.040
	(0.003)	(0.058)	(0.003)	(0.058)	(0.003)	(0.058)
Sabbath exit	0.006*	0.170*	0.006*	0.171**	0.006*	0.171**
	(0.003)	(0.070)	(0.002)	(0.065)	(0.002)	(0.064)
Dusk & dawn cubics	No		Yes		Yes	
Year-month FE	No		No		Yes	
Sub-district FE	No		No		Yes	
Observations	1,222,900	1,222,900	1,222,900	1,222,900	1,222,900	1,222,900

Notes: All columns report estimates of effect of the Sabbath on the probability of accident, as per Equation (7). All specifications include a constant and a dummy variables for each hour of the weekly cycle. The Year-month fixed effects consists of a dummy variable for each of 132 calendar months in our data. Standard errors clustered by Sabbath-relative-time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

Table 5: Systematic Selection around Sabbath Entry and Exit

	Characteristics of severe accident participants							
	Share male		Driving experience		Vehicle age		Accident type	
	Controls	Full Controls	Controls	Full Controls	Controls	Full Controls	Controls	Full Controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sabbath entry	0.007	0.016	0.111	-0.444	-0.330	-0.591	-0.023	-0.004
	(0.031)	(0.031)	(0.885)	(0.878)	(0.405)	(0.400)	(0.051)	(0.050)
Sabbath exit	0.054	0.060	0.939	0.698	0.219	0.279	0.006	0.011
	(0.032)	(0.032)	(0.918)	(0.911)	(0.420)	(0.415)	(0.053)	(0.052)
Dusk & dawn cubics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-month FE	No	Yes	No	Yes	No	Yes	No	Yes
Sub-district FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	100,296	100,296	98,092	98,092	96,642	96,642	50,141	50,141

Notes: In this table we show results from regressing various driver, vehicle and accident characteristics against the same control variables we used in Equation (7). All specifications include a constant, dummy variables for each hour of the weekly cycle and dusk and dawn cubics. The Year-month fixed effects consists of a dummy variable for each of 132 calendar months in our data. Standard errors clustered by Sabbath-relative-time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

Table 6: Characteristics of Observant Jewish Drivers and Drivers Belonging to the Rest of the Population

	Observant Jewish drivers	Rest of population drivers	Diff
	(1)	(2)	(3)
Share women	0.42	0.42	0.00
			(0.02)
Share employed	0.74	0.76	-0.02
			(0.02)
Share house owner	0.88	0.83	0.05**
			(0.02)
Share with health problems	0.31	0.28	0.03
			(0.02)
Share use computer	0.78	0.85	-0.07***
			(0.02)
Share use internet	0.74	0.81	-0.07**
			(0.02)
Years of schooling	13.4	14.0	-0.6***
			(0.1)
Mean age	44.5	42.8	1.7*
			(0.7)
Mean net household income (NIS)	147,324	141,657	5,666
			(16,310)
Observations	491	3,227	

Notes: This table was created using data from Israel's 2009 social survey.

Table 7: The Effect of Sabbath Entry and Exit on Traffic Volume by Road Perilousness

	Perilous roads			Other roads		
	Baseline	Controls	Full Controls	Baseline	Controls	Full Controls
LHS var: ln(VKT)	(1)	(2)	(3)	(4)	(5)	(6)
Panel a: all observations						
Sabbath entry	-0.150**	-0.140**	-0.143**	-0.226**	-0.223**	-0.223**
	(0.036)	(0.035)	(0.033)	(0.036)	(0.035)	(0.034)
Sabbath exit	0.058*	0.064*	0.063	0.101**	0.106**	0.106**
	(0.028)	(0.031)	(0.033)	(0.032)	(0.037)	(0.031)
Dusk & dawn cubics	No	Yes	Yes	No	Yes	Yes
Year-month FE	No	No	Yes	No	No	Yes
Sub-district FE	No	No	Yes	No	No	Yes
Observations	366,137	366,137	366,137	645,401	645,401	645,401
Panel b: discarding "mixed" observations						
Sabbath entry	-0.201**	-0.190**	-0.196**	-0.261**	-0.245**	-0.266**
	(0.032)	(0.034)	(0.029)	(0.030)	(0.031)	(0.031)
Sabbath exit	0.097**	0.106**	0.100**	0.169**	0.189**	0.167**
	(0.034)	(0.038)	(0.034)	(0.033)	(0.037)	(0.032)
Dusk & dawn cubics	No	Yes	Yes	No	Yes	Yes
Year-month FE	No	No	Yes	No	No	Yes
Sub-district FE	No	No	Yes	No	No	Yes
Observations	363,376	363,376	363,376	640,667	640,667	640,667

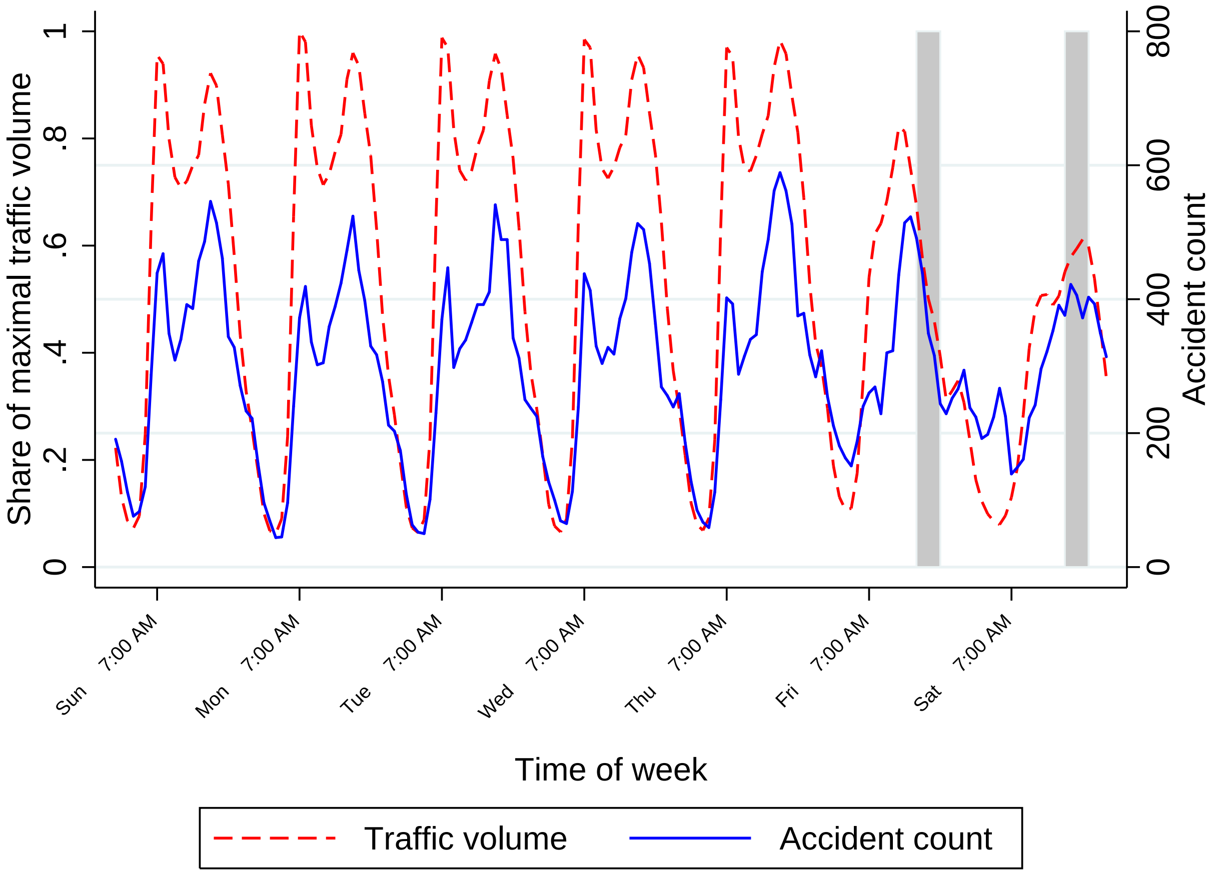
Notes: All columns report estimates of effect of the Sabbath on traffic volume, as per Equation (7). The classification of perilous and non-perilous roads follows the definitions of the National Road Company of Israel. All specifications include a constant and dummy variables for each hour of the weekly cycle. The Year-month fixed effects consists of a dummy variable for each of 132 calendar months in our data. Standard errors clustered by Sabbath-relative-time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

Table 8: The Effect of Sabbath Entry and Exit on Accidents by Road Perilousness

	Perilous roads				Other roads			
LHS var:	Baseline	Δ%	Controls	Δ%	Baseline	Δ%	Controls	Δ%
accident dummy	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sabbath entry	-0.007**	-0.268**	-0.007**	-0.266**	-0.001	-0.052	-0.001	-0.053
	(0.001)	(0.049)	(0.001)	(0.046)	(0.002)	(0.093)	(0.002)	(0.091)
Sabbath exit	0.008**	0.346**	0.008**	0.348**	0.002	0.118	0.002	0.119
	(0.003)	(0.121)	(0.003)	(0.114)	(0.002)	(0.106)	(0.002)	(0.100)
Dusk & dawn cubics	No		Yes		No		Yes	
Year-month FE	No		Yes		No		Yes	
Sub-district FE	No		Yes		No		Yes	
Observations	1,466,262	1,466,262	1,466,262	1,466,262	1,466,234	1,466,234	1,466,234	1,466,234

Notes: All columns report estimates of effect of the Sabbath on the probability of accident, as per Equation (7). The classification of perilous and non-perilous roads follows the definitions of the National Road Company of Israel. All specifications include a constant and dummy variables for each hour of the weekly cycle. The Year-month fixed effects consists of a dummy variable for each of 132 calendar months in our data. Standard errors clustered by Sabbath-relative-time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

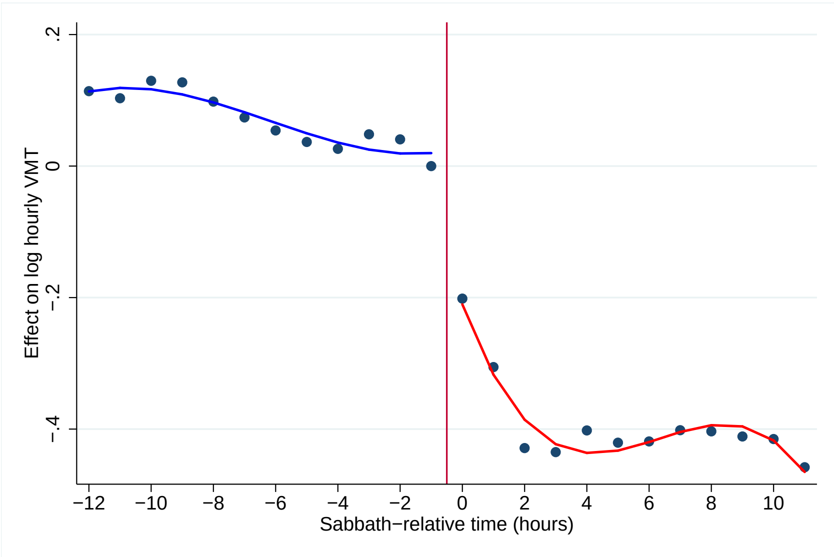
Figure 1: Traffic Volume and Severe Accident Count over the Weekly Cycle



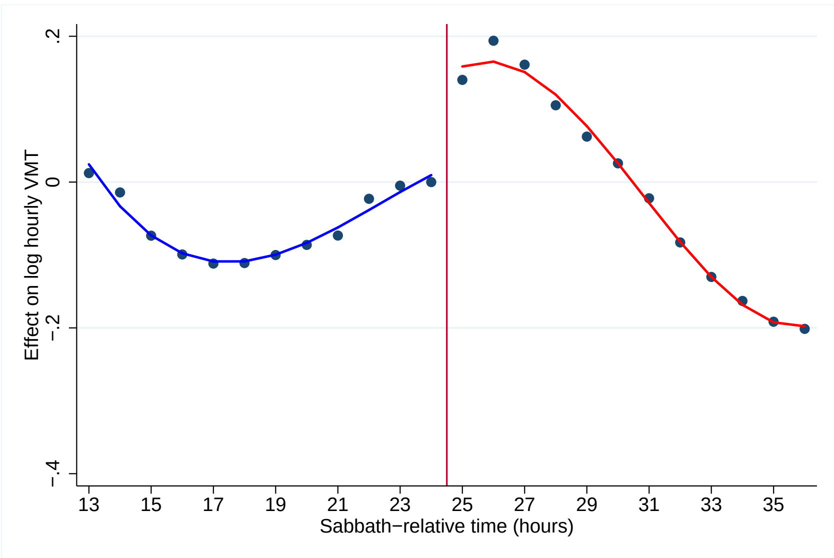
The figure plots hourly average traffic volume and accident counts over the weekly cycle. The dashed curve reports average traffic volume per road section at each hour of the weekly cycle for each of 663 observed inter-city road sections during 1999-2010, as a share of the maximal observed traffic volume. The solid curve reports the number of accidents that occurred on inter-city roads in each hour of the weekly cycle during 1999-2010. The two gray shaded areas denote the typical range of entry and exit times of the Sabbath (Fridays between 3 p.m. and 8 p.m. and Saturdays between 4 p.m. and 9 p.m.).

Figure 2: The Effect of the Sabbath on Traffic Volume

(a) Sabbath entry



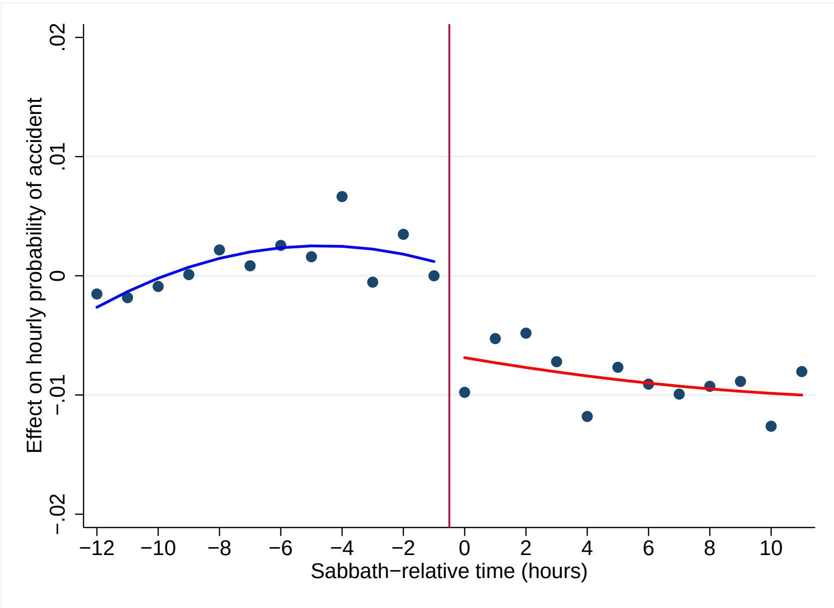
(b) Sabbath exit



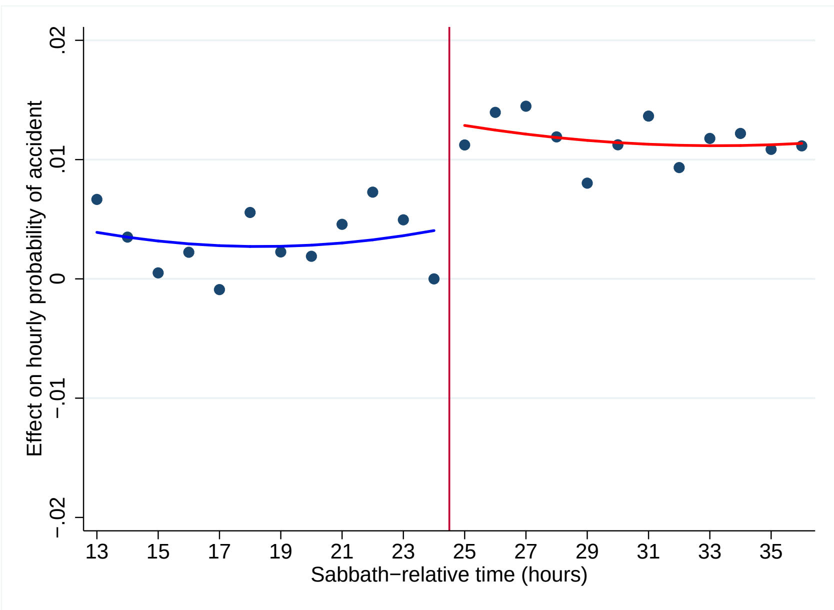
Panels (a) and (b) of this figure report the Sabbath-relative time coefficients (β_{τ}^{f}s) from an OLS regression of traffic volume on Sabbath-relative time effects, akin to Equation (7). The vertical lines denote Sabbath entry and exit.

Figure 3: The Effect of the Sabbath on Accidents

(a) Sabbath entry



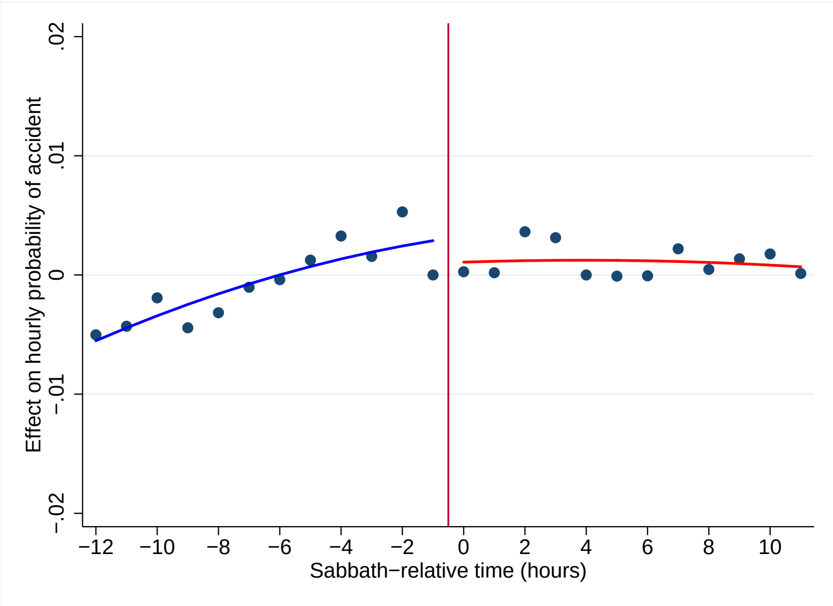
(b) Sabbath exit



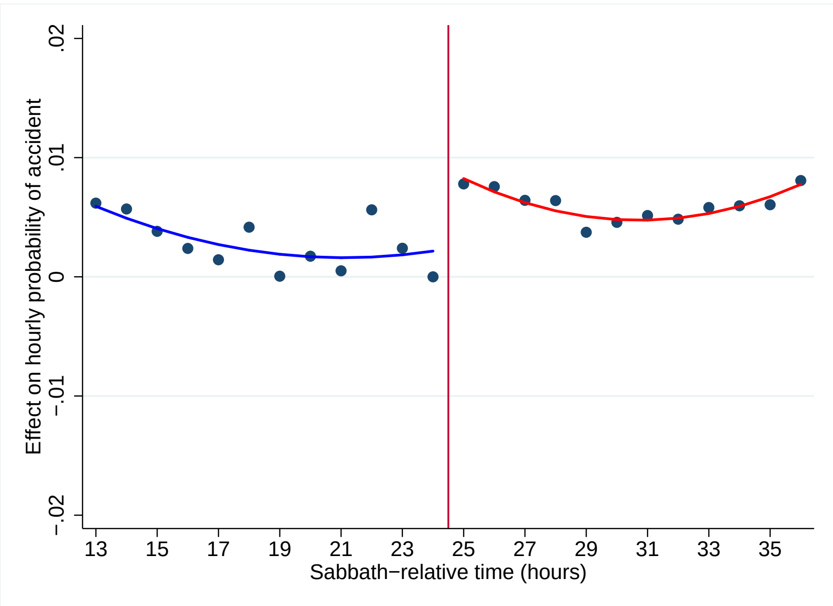
Panels (a) and (b) of this figure reports the Sabbath-relative time coefficients (β_{τ}^{f}s) from an OLS regression akin to Equation (7). The vertical lines denote Sabbath entry and exit.

Figure 4: The Effect of Sabbath on Accidents involving Non-Jewish Drivers

(a) Sabbath entry



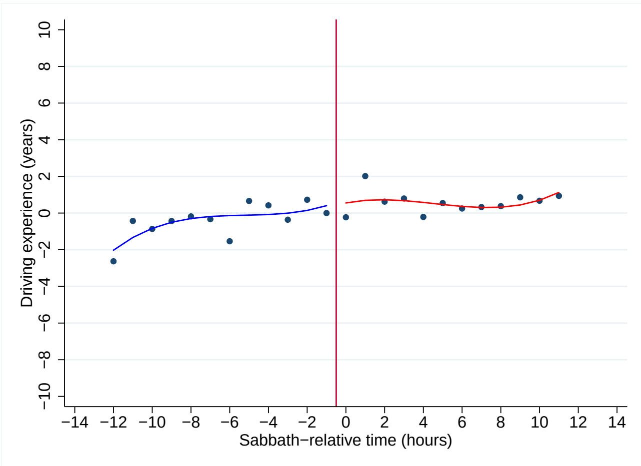
(b) Sabbath exit



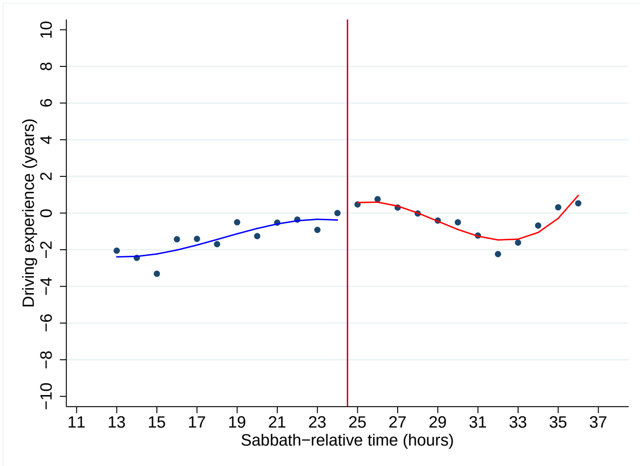
Panels (a) and (b) of this figure report the Sabbath-relative time coefficients (β_{τ}^{a}s) from an OLS regression akin to Equation (7). The sample is limited to accidents in which at least one non-Jewish driver was involved in the time period 2001-2010, for which this information is available in the data. The two vertical lines denote Sabbath entry and exit.

Figure 5: Systematic Selection around Sabbath Entry and Exit

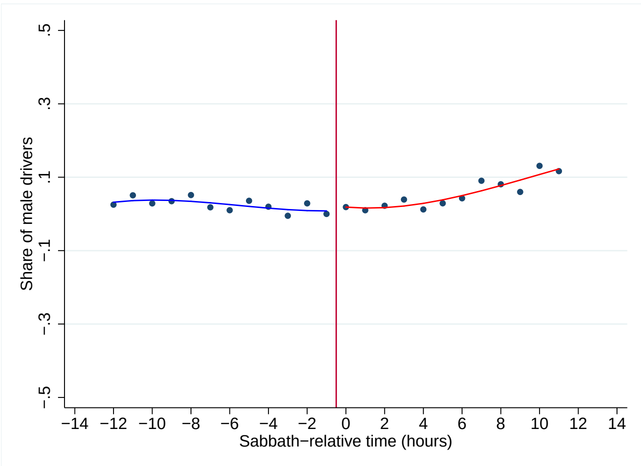
(a) Driving experience entry



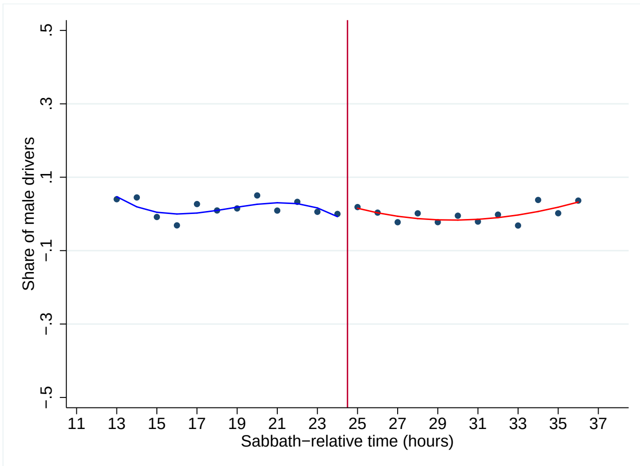
(b) Driving experience exit



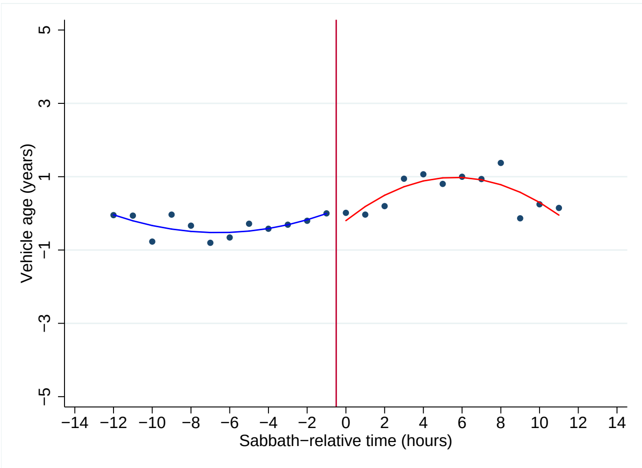
(c) Share of male drivers entry



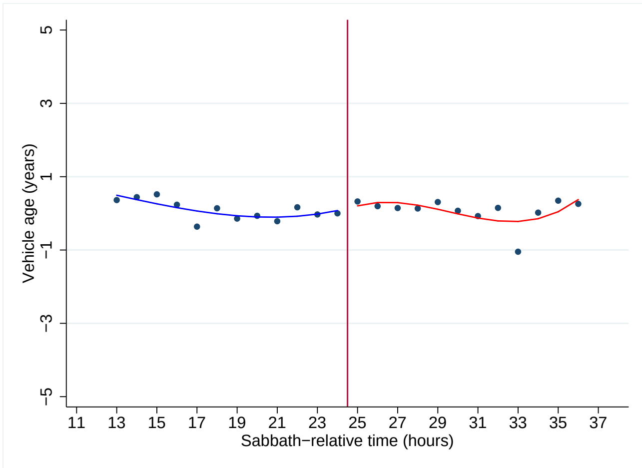
(d) Share of male drivers exit



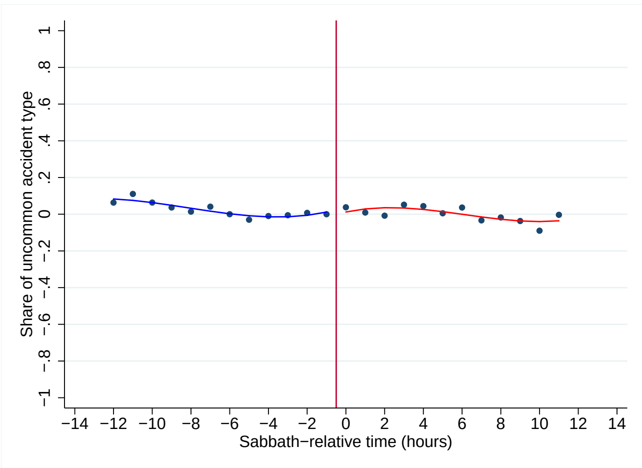
(e) Vehicle age entry



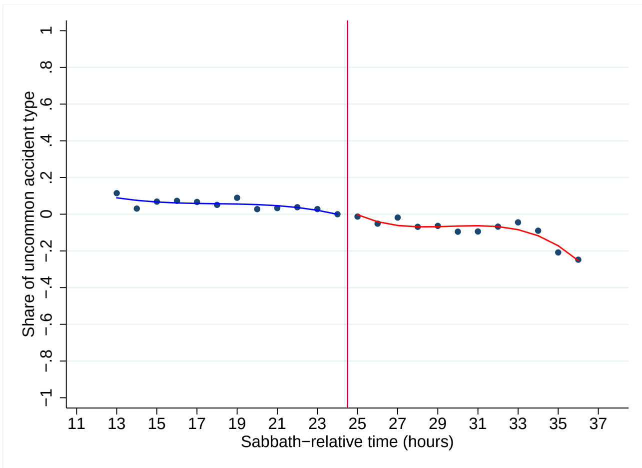
(f) Vehicle age exit



(g) Share of accidents of uncommon type entry



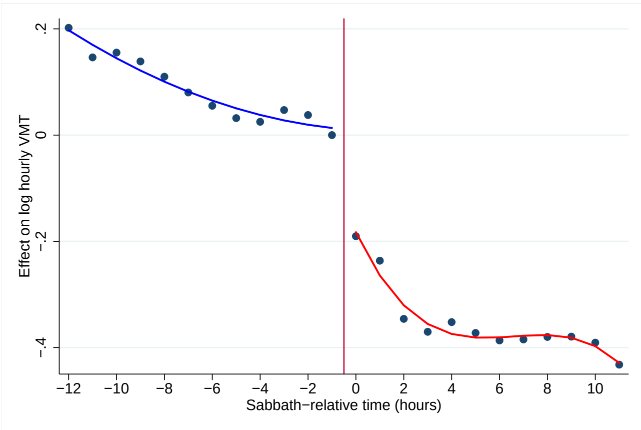
(h) Share of accidents of uncommon type exit



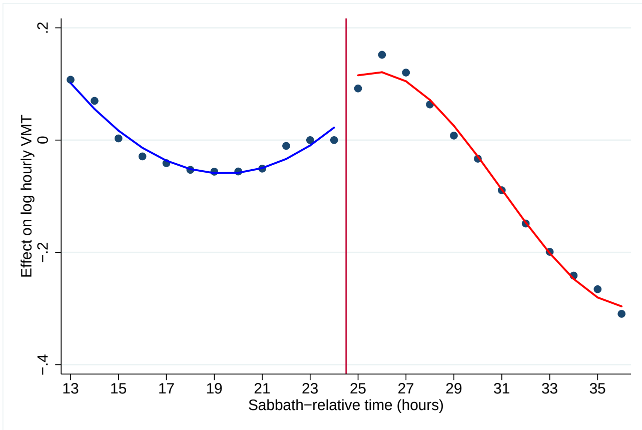
Panels (a)-(h) of this figure show how observable accident characteristics trend around Sabbath entry and exit. All panels depict the Sabbath-relative time coefficients (β^a_τs) from an OLS regression akin to Equation (7). The vertical lines denote the times of Sabbath entry and exit.

Figure 6: The Effect of Sabbath on Traffic volume by Road Perilousness

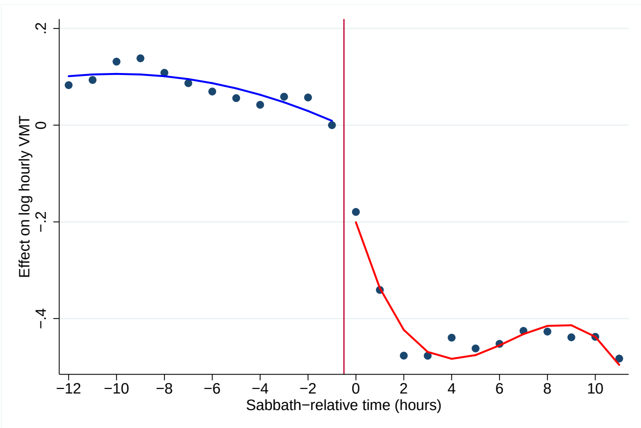
(a) Perilous roads entry



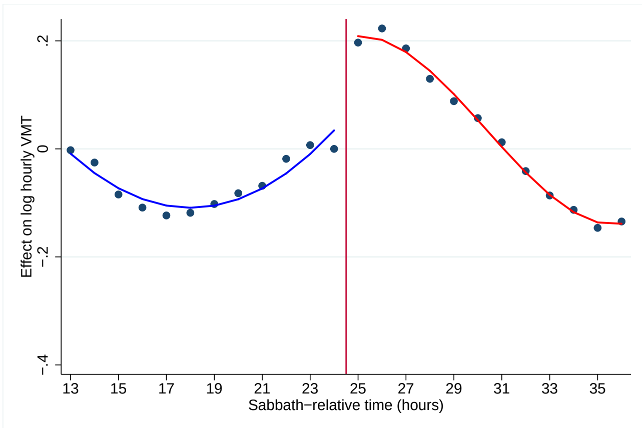
(b) Perilous roads exit



(c) Non-perilous roads entry

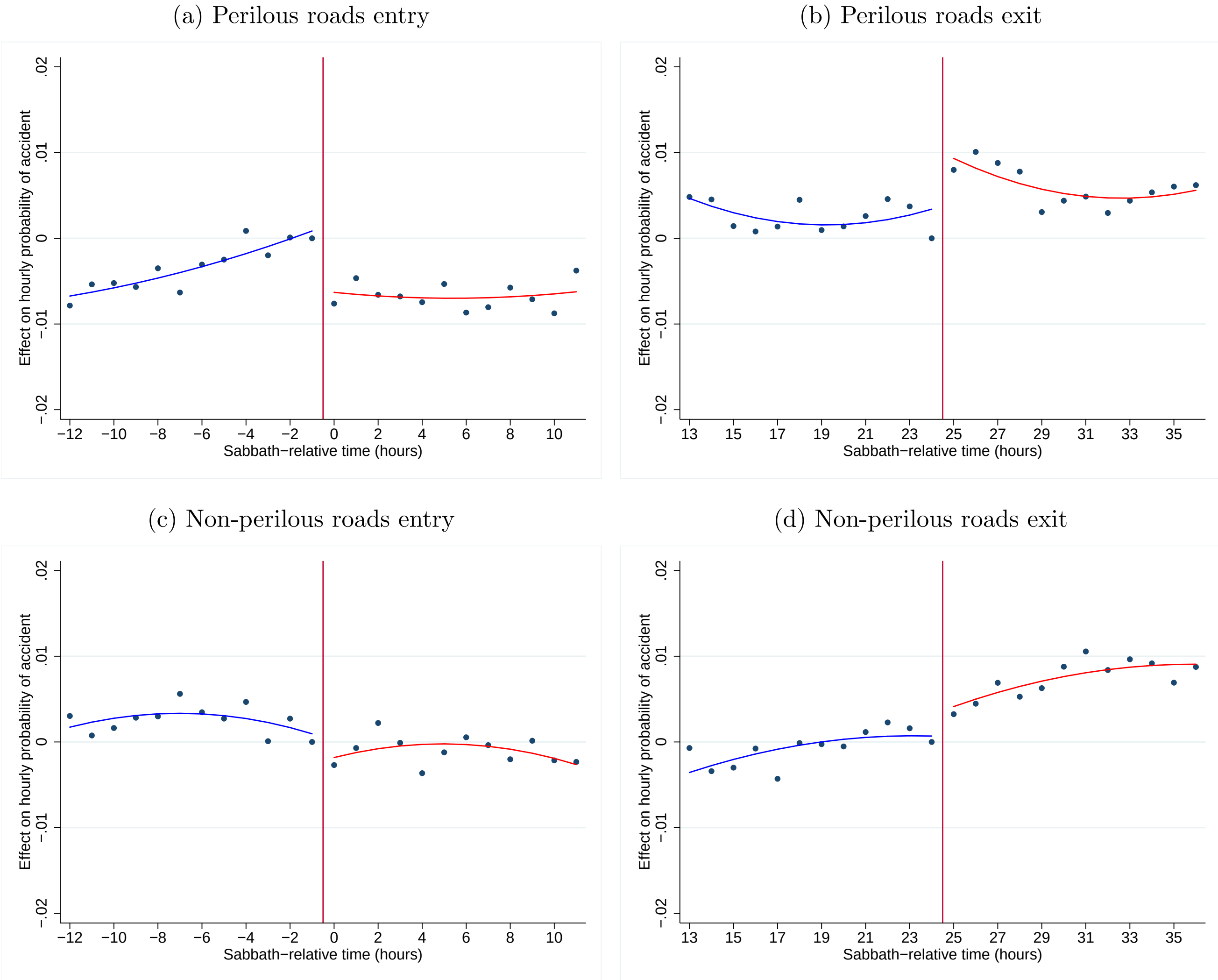


(d) Non-perilous roads exit



This figure repeats the graphical analysis of traffic volume in Figure 2, while separating perilous and non-perilous roads. The classification of perilous and non-perilous roads follows the definitions of the National Road Company of Israel. As in Figure 2, this figure reports the Sabbath-relative time coefficients (β^f_τs) from an OLS regression akin to Equation (7). The vertical lines denote Sabbath entry and exit.

Figure 7: The Effect of Sabbath on Accidents by Road Perilousness



This figure repeats the graphical analysis of accidents in Figure 3, while separating perilous and non-perilous roads. The classification of perilous and non-perilous roads follows the definitions of the National Road Company of Israel. As in Figure 3, this figure reports the Sabbath-relative time coefficients (β^a_τs) from an OLS regression akin to Equation (7). The vertical lines denote Sabbath entry and exit.

A Appendix A

A.1 Choosing the control function

We implement a procedure to choose the degree of polynomial of the control function. The procedure was suggested by Lee and Card (2008) and Lee and Lemieux (2010) for a "running variable" that is inherently discrete or only reported in coarse intervals. This suits our setting in which traffic counts are reported in round hour intervals. Tables A.3 and A.4 summarise the results of this analysis for the traffic and accident samples, respectively.

A.2 The 2009 social survey

We take advantage of a unique source of information about observant Jewish drivers. Israel's social survey has been conducted annually since 2002. It is run on a sample of roughly 7,500 individuals aged 20 or older that are representative of the country's population above this age with the main goal of providing information about the welfare of Israelis and on their living conditions. Typically the survey's questionnaire has two parts: a core questionnaire covering the main areas of life such as health, housing, employment, economic situation, and a variable module devoted to a different topic each year. The 2009 module's topic was Religiosity and Family Life. In our analysis we look at drivers, that we define as those who answer the question: Are you driving a car? either "often" or "sometimes" and who report that at least one car is owned by their household. The Religiosity module asks respondents to specify the extent they refrain from driving on Sabbath. We classify those who answer either "to a very great extent" or "to a great extent" as observant Jews. Using this information we create the summary statistics in Table (6).

A.3 Distinguishing areas by level of religious observance

Our identification strategy relies on the notion that religious Jews' observance of the Sabbath is the source of variation in traffic volume that we observe upon the Sabbath's entry and exit. To validate this notion we distinguish between more and less religiously observant parts of Israel, and we estimate difference-in-differences versions of our traffic volume models between groups that correspond to more and less observant parts of the country. In doing so we capture the differential effect of the Sabbath on traffic volumes between more and less religious areas, while differencing out any effect of the Sabbath that is not correlated with an area's degree of religious observance. If the notion underpinning our identification strategy holds true, then we expect to find that the effect of Sabbath on traffic volumes is more pronounced in more religiously observant areas.

Using data from the 2009 Israeli national elections, we proxy for different observations' level of religious observance by classifying the administrative sub-districts to which they belong according to the share of votes given to Jewish religious parties.[34] Figure A.1 shows the share of votes for religious parties by sub-district. The Jerusalem area for example is particularly dark, indicating that a large share of its population is Jewish and religiously observant, as reflected by the voting pattern. Based on this political proxy, we classify sub-districts as above- and below-median in terms of their Jewish religious tendency, and then similarly classify road section observations according to their associated sub-district.

[34] We label the following as religious parties: United Tora Judaism, The Jewish Home, The National Union and Shomrei Sfarad (Shas).

We then run the following difference-in-differences regression:

$$\text{(A1)} \qquad \log(VKT_{it}) = \alpha_0^v + \beta_0^v \text{Religious}_i + \sum_{\substack{\tau \\ \tau \neq 0}} [\alpha_\tau^v + \beta_\tau^v \cdot \text{Religious}_i] + \eta_{it}^v$$

in which α is constant term, Religious_i is an indicator that equals 1 if road section i is located in an administrative sub-district with an above-median share of votes for Jewish religious parties and 0 otherwise, and the superscript v stands for validity check.

Figure A.2 reports the β_τ^v's from this regression, which capture the differential effect of the Sabbath in more religious areas. The analysis confirms our expectation straightforwardly by showing that the Sabbath reduces traffic volume in religious areas substantially more than it does elsewhere.

These results lend themselves to an alternative identification strategy. One may elicit the effect of traffic on accidents by estimating the differential effect of Sabbath on traffic and accidents in more and less religiously observant parts of Israel. We note that in order to rely on this approach one must assume that the effect of traffic on accidents around Sabbath is exactly equal in more and less religiously observant parts of Israel. Still, it is of interest to corroborate our main results by applying this approach.

Specifically, one may estimate a differeces-in-discontinuities model (much in the spirit of Lemieux and Milligan (2008)) as follows

$$\text{(A2)} \qquad \begin{aligned} \log(VKT_{it}) = \{&\alpha_0^f + \beta_0^f S_t^{\text{Entry}} + \gamma_0^f \cdot \mathbb{1}(\tau \geq 13) + \delta_0^f S_t^{\text{Exit}} \\ &+ \sum_{k=1}^{k} \left[\alpha_k^f (\tau)^k + \beta_k^f (\tau)^k \cdot \mathbb{1}(\tau \geq 0) + \gamma_k^f (\tau - 13)^k \cdot \mathbb{1}(\tau \geq 13) \right. \\ &+ \left. \delta_k^f (\tau - 25)^k \cdot \mathbb{1}(\tau \geq 25)\right]\} * \text{Religious}_i + \eta_{it}^f, \end{aligned}$$

where the coefficients of interest are the interaction terms of Religious_i with the two thresholds S_t^{Entry} and S_t^{Exit}.

Table A.1 reports the estimates of the traffic analysis. As the table shows, around Sabbath's entry, traffic volume falls by 19-31% and the Sabbath exit traffic volume rises by 8-9%. Turning to the accident analysis, we report in Table A.2 a decrease of 26% in accidents around Sabbath's entry and and increase of 16% around the Sabbath's exit.

With these results, we estimate (using column 1 in both tables) that the elasticity of the probability of accident with respect to traffic volume, $\hat{\epsilon}_{a,f}$, at the Sabbath entry is approximately 1.4; at the Sabbath exit $\hat{\epsilon}_{a,f}$ is 0.9 and in both cases, it is insignificantly different from one. Qualitatively, these results are similar to our main results, showing no significant evidence to the existence of accident externality.

A.4 Additional validation checks - the share of Jewish drivers around Sabbath

Another way to validate our empirical approach is to examine whether the share of Jewish drivers changes around Sabbath entry and exit as our approach predicts. Namely, that it drops upon the entry of Sabbath and increases sharply after the exit of Sabbath. We do so in Figure A.3 which examines the share of Jewish drivers that are involved in accidents around Sabbath. The figure is created in the same way the figures in the selection analysis in section 6 were created. It illustrates that, as our empirical approach suggests, around the Sabbath entry the share of Jewish drivers decreases and around the Sabbath exit it jumps.

A.5 Additional validation checks - placebo using Monday as Friday

Another way to validate our approach is to examine whether the changes in traffic we observe around Sabbath do not occur around the same times in other week days. We examine this issue by running a placebo analysis in which we treat Mondays as if they were Fridays and repeat our analysis (throwing out observations of Fridays and Saturdays). Figure A.4 shows the graphical results of this exercise. The figure shows that the estimates are trending smoothly around the cut-offs with no apparent change in traffic volume at the entry and exit of "Sabbath". Table A.5 provides the corresponding estimation results. The estimates are consistent with the visual impression showing no statistically significant change in traffic around the Sabbath entry and exit cut-offs.

A.6 Count data analysis

Another, perhaps more natural, approach to perform the accident analysis is to implement a count data analysis such as a Poisson regression. Here, we redo our analysis using a Poisson regression. Table A.6 summarises that the estimates from this analysis showing a 20% decrease in accidents upon the Sabbath entry and a 23% increase in accident risk upon the Sabbath exit. Reassuringly, the Poisson analysis estimates are very similar to those from the OLS analysis.

A.7 A direct measure of accident externality explained

The per vehicle probability of an accident involving non Jewish drivers is $r_{nj}(f)$, which is a function of all traffic, f. Thus, as in the case of all drivers, if $\epsilon_{r_{nj},f} > 0$, then traffic volume generates positive externality. However, we do not observe $\epsilon_{r_{nj},f}$. Instead, we observe $\epsilon_{a_{nj},f}$, the elasticity of the expected number of accidents involving non-Jewish drivers with respect to traffic volume, where $a_{nj} = r_{nj}(f) \cdot f_{nj}$. Below we illustrate the intuition for our test for the existence of accident externality based on this observed elasticity. Namely that $\epsilon_{r_{nj},f} = \epsilon_{a_{nj},f}$

The elasticity of the expected number of accidents involving non Jewish drivers with respect to all traffic volume is given by

$$\text{(A3)} \qquad \begin{aligned} \epsilon_{a_{nj},f} &= \frac{\partial a_{nj}}{\partial f} \cdot \frac{f}{a_{nj}} \\ &= \frac{\partial r_{nj}(f)}{\partial f} \cdot f_{nj} \cdot \frac{f}{r_{nj} \cdot f_{nj}} \\ &= \frac{\partial r_{nj}(f)}{\partial f} \cdot \frac{f}{r_{nj}} \\ &= \epsilon_{r_{nj},f} \end{aligned}$$

where we assume that traffic volume of non Jewish drivers around the Sabath thresholds does not change, namely $\frac{\partial f_{nj}}{\partial f} = 0$.

A.8 Aggregation level correspondence

We perform our traffic analysis in the road section level while the accident analysis is done in the subdistrict level. Here we examine if the results are sensitive to this issue. We do so by re-running our accident data at the road section level. The results are summarized in

Table A.7. As the table shows, the results are almost identical to our previous estimates. Additionally, we run the accident analysis with weights for sub-district traffic volume. The results also remain virtually unchanged (see Table A.8).

Table A.1: The Distinct Effects of Sabbath Entry and Exit on Traffic Volume, a DD-RDD Approach

LHS var: ln(VKT)	(1)	(2)	(3)
Panel a: all observations			
Sabbath entry	-0.135	-0.138	-0.138
	(0.169)	(0.469)	(0.468)
Sabbath exit	0.090**	0.078**	0.077**
	(0.024)	(0.016)	(0.015)
Dusk & dawn cubics	No	Yes	Yes
Year-month FE	No	No	Yes
Sub-district FE	No	No	Yes
Observations	1,011,538	1,011,538	1,011,538
Panel b: discarding "mixed" observations			
Sabbath entry	-0.186	-0.274	-0.311
	(0.201)	(0.504)	(0.497)
Sabbath exit	0.181**	0.170**	0.136**
	(0.014)	(0.011)	(0.014)
Dusk & dawn cubics	No	Yes	Yes
Year-month FE	No	No	Yes
Sub-district FE	No	No	Yes
Observations	1,004,043	1,004,043	1,004,043

Notes: All columns report estimates of effect of the Sabbath on traffic volume, as per Equation (A2). Standard errors clustered by Sabbath-relative-time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

Table A.2: The Distinct Effects of Sabbath Entry and Exit on the Probability of Accident, a DD RDD Approach

	Baseline		Controls		Full Controls	
LHS var:	Estimate	Δ%	Estimate	Δ%	Estimate	Δ%
accident dummy	(1)	(2)	(3)	(4)	(5)	(6)
Sabbath entry	-0.012**	-0.264**	-0.012**	-0.264**	-0.005**	-0.118**
	(0.001)	(0.021)	(0.001)	(0.021)	(0.002)	(0.039)
Sabbath exit	0.006	0.158	0.006	0.158	0.006	0.158
	(0.005)	(0.131)	(0.005)	(0.131)	(0.005)	(0.131)
Dusk & dawn cubics	No		Yes		Yes	
Year-month FE	No		No		Yes	
Sub-district FE	No		No		Yes	
Observations	1,466,262	1,466,262	1,466,262	1,466,262	1,466,262	1,466,262

Notes: All columns report estimates of effect of the Sabbath on the probability of accident, as per Equation (A2). Standard errors clustered by Sabbath-relative-time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

Table A.3: The Distinct Effects of Sabbath Entry and Exit on Traffic Volume, Specification Test

Polynomial degree	Zero	First	Second	Third	Fourth
LHS var: ln(VKT)	(1)	(2)	(3)	(4)	(5)
Sabbath entry	-0.252**	-0.231**	-0.212**	-0.196**	-0.208**
	(0.020)	(0.021)	(0.025)	(0.034)	(0.037)
Sabbath exit	0.160**	0.172**	0.092**	0.089**	0.099*
	(0.020)	(0.021)	(0.025)	(0.034)	(0.050)
P-value	0.000	0.000	0.000	0.265	0.395
Dusk & dawn cubics	Yes	Yes	Yes	Yes	Yes
Observations	1,011,538	1,011,538	1,011,538	1,011,538	1,011,538

Notes: All columns report estimates of effect of the Sabbath on traffic volume, as per Equation (7). All specifications include a constant, a third order polynomials in dawn- and dusk-relative time, as well as dummy variables for each hour of the weekly cycle. Standard errors are reported in parentheses. P-values calculated using the goodness-of-fit test in Card and Lee (2008). One or two asterisks indicate significance at 5% or 1%, respectively.

Table A.4: The Distinct Effects of Sabbath Entry and Exit on the Probability of Accident, Specification Test

Polynomial degree	Zero	First	Second	Third	Fourth
LHS var: accident dummy	(1)	(2)	(3)	(4)	(5)
Sabbath entry	-0.009**	-0.009**	-0.007*	-0.005	-0.004
	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)
Sabbath exit	0.009**	0.010**	0.010**	0.017**	0.019**
	(0.002)	(0.003)	(0.003)	(0.004)	(0.006)
P-value	0.000	0.000	0.287	0.518	0.566
Dusk & dawn cubics	Yes	Yes	Yes	Yes	Yes
Observations	1,466,262	1,466,262	1,466,262	1,466,262	1,466,262

Notes: All columns report estimates of effect of the Sabbath on the Probability of Accident, as per Equation (7). All specifications include a constant, a third order polynomials in dawn- and dusk-relative time. We use dummy variables for each hour of the weekly cycle. Standard errors are reported in parentheses. P-values calculated using the goodness-of-fit test in Card and Lee (2008). One or two asterisks indicate significance at 5% or 1%, respectively.

Table A.5: The Distinct Effects of Sabbath Entry and Exit on Traffic Volume, Placebo

	(1)	(2)	(3)
Sabbath entry	-0.052	-0.042	-0.045
	(0.034)	(0.034)	(0.032)
Sabbath exit	-0.064	-0.056	-0.055
	(0.034)	(0.034)	(0.032)
Dusk & dawn cubics	No	Yes	Yes
Year-month FE	No	No	Yes
Sub-district FE	No	No	Yes
Observations	716,274	716,274	716,274

Notes: All columns report estimates of effect of the Sabbath on traffic volume, as per Equation (7). The Year-month fixed effects consists of a dummy variable for each of 132 calendar months in our data. Standard errors clustered by Sabbath-relative-time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

Table A.6: The Distinct Effects of Sabbath Entry and Exit on the Probability of Accident, Poisson Regression

	(1)	(2)	(3)
Sabbath entry	-0.212**	-0.203**	-0.202**
	(0.053)	(0.046)	(0.046)
Sabbath exit	0.196*	0.233*	0.235*
	(0.097)	(0.099)	(0.099)
Dusk & dawn cubics	No	Yes	Yes
Year-month FE	No	No	Yes
Sub-district FE	No	No	Yes
Observations	1,466,262	1,466,262	1,466,262

Notes: All columns report estimates of effect of the Sabbath on the number of accidents using a Poisson regression. The specification is similar to that in Equation (7). Standard errors are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

Table A.7: The Distinct Effects of Sabbath Entry and Exit on the Probability of Accident, Road Section Level

	Baseline		Controls		Full Controls	
LHS var:	Estimate	Δ%	Estimate	Δ%	Estimate	Δ%
accident dummy	(1)	(2)	(3)	(4)	(5)	(6)
Sabbath entry	-0.000223**	-0.199560**	-0.000221**	-0.197222**	-0.000221**	-0.197241**
	(0.000056)	(0.049732)	(0.000048)	(0.043207)	(0.000049)	(0.043764)
Sabbath exit	0.000245*	0.262900*	0.000248*	0.265841*	0.000248*	0.265743*
	(0.000106)	(0.113189)	(0.000098)	(0.104946)	(0.000098)	(0.104693)
Dusk & dawn cubics	No		Yes		Yes	
Year-month FE	No		No		Yes	
Road-section FE	No		No		Yes	
Observations	60,116,742	60,116,742	60,116,742	60,116,742	60,116,742	60,116,742

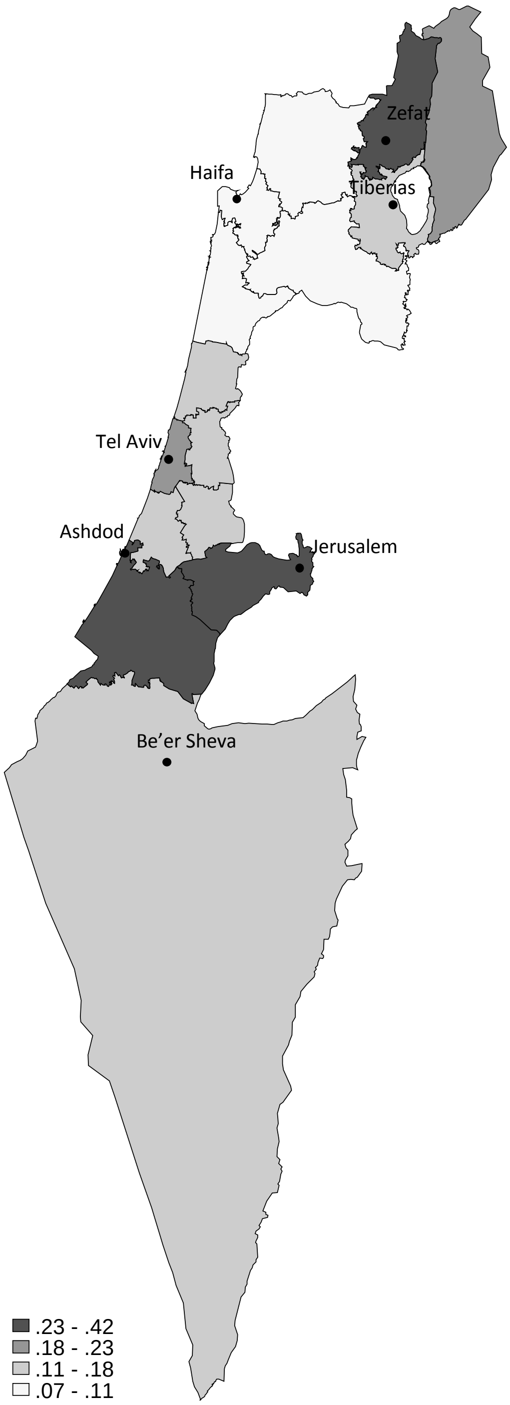
Notes: All columns report estimates of effect of the Sabbath on the probability of accident, as per Equation (7). All specifications include a constant and dummy variables for each hour of the weekly cycle. The Year-month fixed effects consists of a dummy variable for each of 132 calendar months in our data. Standard errors clustered by Sabbath relative time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

Table A.8: The Distinct Effects of Sabbath Entry and Exit on the Probability of Accident, Weighted by Traffic

	Baseline		Controls		Full Controls	
LHS var:	Estimate	Δ%	Estimate	Δ%	Estimate	Δ%
accident dummy	(1)	(2)	(3)	(4)	(5)	(6)
Sabbath entry	-0.007**	-0.152**	-0.007**	-0.149**	-0.007**	-0.149**
	(0.002)	(0.042)	(0.002)	(0.038)	(0.002)	(0.039)
Sabbath exit	0.010*	0.233*	0.010*	0.236*	0.010*	0.236*
	(0.005)	(0.112)	(0.004)	(0.105)	(0.004)	(0.104)
Dusk & dawn cubics	No		Yes		Yes	
Year-month FE	No		No		Yes	
Sub-district FE	No		No		Yes	
Observations	1,466,262	1,466,262	1,466,262	1,466,262	1,466,262	1,466,262

Notes: All columns report estimates of effect of the Sabbath on the probability of accident, as per Equation (7). All specifications include a constant and dummy variables for each hour of the weekly cycle. The Year-month fixed effects consists of a dummy variable for each of 132 calendar months in our data. Standard errors clustered by Sabbath-relative-time are reported in parentheses. One or two asterisks indicate significance at 5% or 1%, respectively.

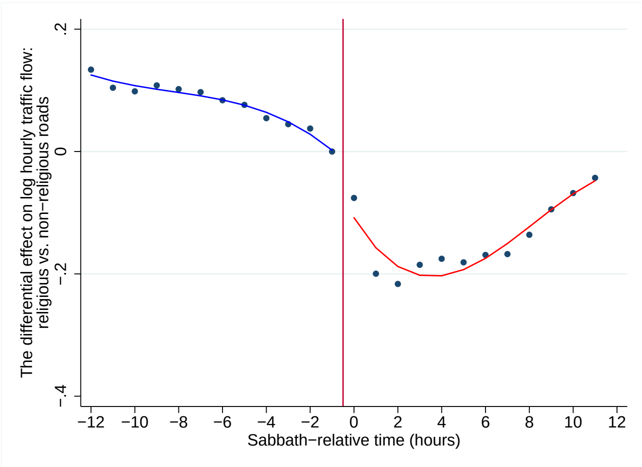
Figure A.1: The Share of Religiously Observant Jewish Voters by Sub-District



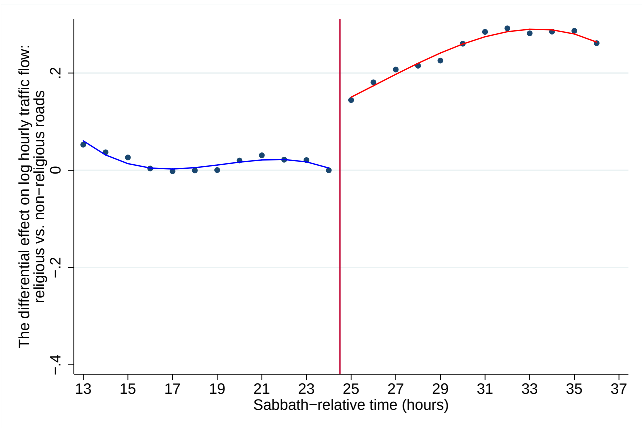
The figure reports the share of voters in each administrative sub-district who voted for Jewish religious parties in the 2009 Israeli national elections. Darker shades indicate a greater share of such voters.

Figure A.2: The Differential Effect of the Sabbath on Traffic Volume by Areas' Religious Tendency

(a) Sabbath entry



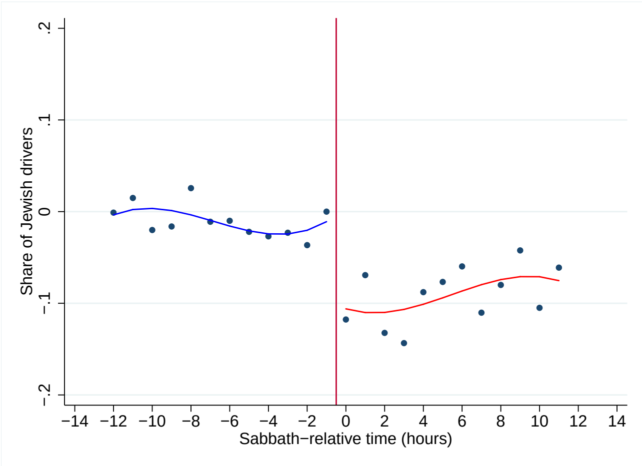
(b) Sabbath exit



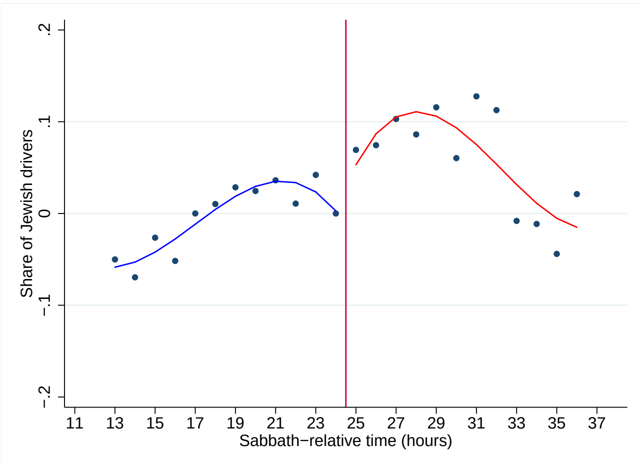
The figure reports the differential effect of Sabbath-relative time on traffic volume between religious and non-religious areas. Specifically, it reports the coefficients (β_{τ}^{v}s) for Sabbath-relative time interacted with an indicator for religious sub-district (defined as sub-districts with above-median voting for Jewish religious parties), from an OLS regression of log VKT on a constant, an indicator for religious sub-districts, Sabbath-relative time effects and the said interactions. The vertical lines denote Sabbath entry and exit.

Figure A.3: Share of Jewish Drivers Involved in Accidents

(a) "Sabbath entry"



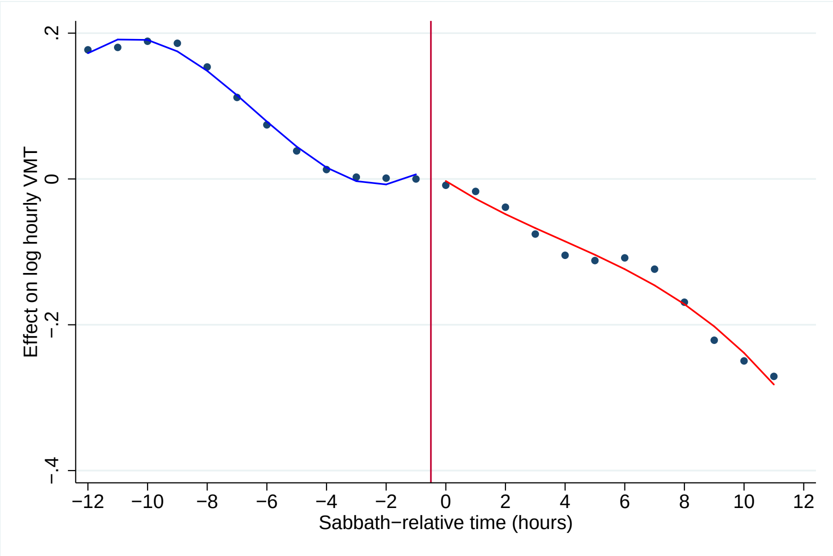
(b) "Sabbath exit"



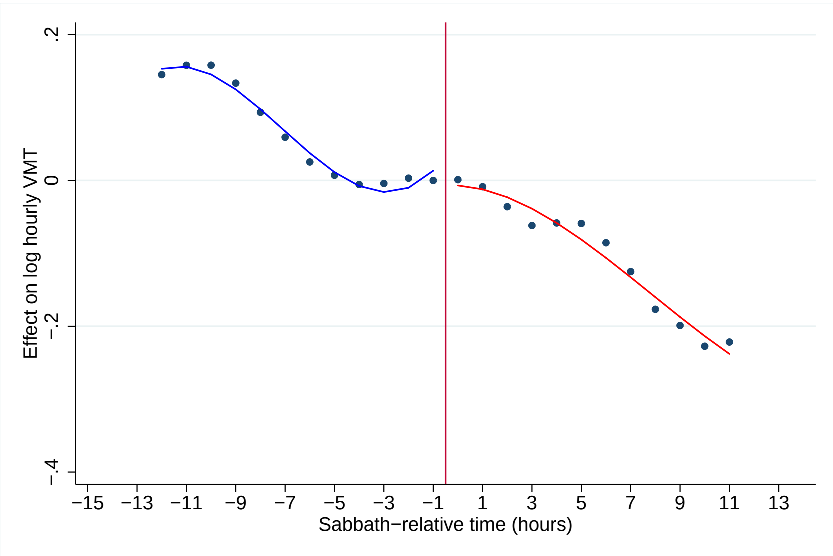
The figure reports the effect of Sabbath-relative time on the share of Jewish drivers involved in accidents. Both panels depict the Sabbath-relative time coefficients (β_{τ}^{a}s) from an OLS regression akin to Equation (7). The vertical lines denote the times of Sabbath entry and exit.

Figure A.4: The Effect of the Sabbath on Traffic Volume, Placebo Monday as Friday

(a) Sabbath entry



(b) Sabbath exit



In this figure we report the results from the placebo analysis, in which we treat Mondays as if they were Fridays. Panels (a) and (b) of the figure show the "Sabbath-relative time" coefficients (β_{τ}^{f}s) from an OLS regression of traffic volume on Sabbath-relative time effects akin to Equation (7). The vertical lines denote Sabbath entry and exit.