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Speed limits and vehicle accidents in built-up areas: The impact of 30 km/h zones*

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Abstract

Vehicle accidents represent an important source of externalities from driving. Using a detailed dataset on accident location and characteristics in Switzerland, we estimate the effect of switching from a 50 km/h speed limit to a 30 km/h limit on the probability of vehicle accident injuries. After an initial country-wide analysis, we exploit the quasi-experimental variation of the timing of introduction of 30 km/h zones in the municipality of Basel, using a difference in differences strategy. We find a significant reduction in accident severity due to lower speed limits, and substantial heterogeneities based on the circumstances of the accident.

JEL Classification: R41, R42, R48, H41

Keywords: Speed limits; vehicle accidents; 30 km/h zones; externalities; road transport; urban roads

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1 Introduction

Vehicle accidents represent an important source of externalities from driving, along with congestion, air pollution, and carbon emissions (Parry, Walls, & Harrington, 2007). While several factors contribute to the frequency and the severity of road accidents, average speed plays an important role in the frequency and the severity of road accidents (Aarts & van Schagen, 2006; Elvik, Vadeby, Hels, & van Schagen, 2019). For this reason, tighter speed limits are often suggested as an effective measure to improve road safety (WHO, 2018).

Starting from the 1990s several municipalities in Europe and North America introduced speed limit zones in urban areas, lowering the maximum allowable speed from 50 km/h to 30 km/h.[1] These policies have the goal of reducing vehicle externalities such as accidents, noise and air pollution, and in the past years the number of 30 km/h zones grew considerably. The introduction of a 30 km/h limit lowers the speed of transiting motor vehicles, which can potentially reduce accident severity in two ways: first, by allowing more time to drivers to react to potentially dangerous situations, such as obstacles or other vehicles on the road. Second, by reducing the force of an impact and thus mitigating its consequences.

The 30 km/h zones differ considerably from the canonical speed limits in extra-urban roads. First, they are introduced in built-up areas with already lower speed limits, typically 50 km/h. Second, vehicle accidents are more frequent in built-up areas and have different characteristics. Third, 30 km/h zones can include also the implementation of auxiliary measures, like speed bumps, to enforce those limits.

While 30 km/h zones have the potential of generating benefits in terms of reduction in noise, air pollution, and accident frequency and severity, their implementation involves also some costs: the monetary cost of installation and maintenance on one side, and the cost in terms of time lost due to lower speed on the other side. The presence of costs and benefits potentially affecting a large number of individuals produced significant disagreement among various interest groups on whether to implement 30 km/h limits and up to which extent. In Switzerland, the country object of

[1] In the United States the speed limits for residential areas are around 30 km/h, but vary across locations and states.

this study, the introduction of these zones has been object of several lawsuits and referendums at the local and national level. In a landmark 2018 case the Federal Court upheld the implementation of 30 km/h zones in the city of Basel, explicitly mentioning the reduction of accident frequency and severity as one of the motivations for its decision (Bundesgericht, 2018). More recently, with the upcoming revision of the road traffic regulation, an association of health professionals suggested to introduce a generalized 30 km/h limit in all built-up areas in Switzerland (Orellano, 2020). Given the central role of vehicle accidents in the decision on whether to implement the lower speed limits or not, it is important to analyse if specifically the change of the speed limits from 50 km/h to 30 km/h has been really effective in improving road safety. The estimates of the effect of lower speed limits could be then used in a broader cost-benefit analysis of 30 km/h zones. Indeed, the damages due to accident injuries, and thus the benefits from avoiding them, can be substantial: an analysis by the Swiss Council for Accident Prevention suggests an average cost for a person with light injuries due to a traffic accident of about 15,277 CHF, and about 405,708 CHF in case of serious injuries (Niemann, Lieb, & Sommer, 2015, p. 63).[2]

While there is already an important literature in economics, engineering and public health on the effect of speed limits on accident frequency and severity in highways and extra-urban roads (Ossiander & Cummings, 2002; Ashenfelter & Greenstone, 2004; Malyshkina & Mannering, 2008; Elvik, 2012; De Pauw, Daniels, Thierie, & Brijs, 2014; van Benthem, 2015), the impact of speed limit measures in urban roads and in built-up areas is less studied, or is focused on less stringent speed limits in main traffic roads (Vis, Dijkstra, & Slop, 1992; Peter, 2005; Grundy et al., 2009; Sun, El-Basyouny, Ibrahim, & Kim, 2018; Ang, Christensen, & Vieira, 2020). Yet, urban areas account for an important share of traffic accidents and fatalities. In the EU, about 69% of vehicle accidents and 38% of vehicle fatalities occurs in urban areas (European Commission, 2011, 2018). Also in Switzerland local roads in urban areas account for an important share of total accidents. Official 2017 statistics reported 12236 accidents with material damages and 5016 accidents with injuries or deaths in those type of roads, respectively the 31.93% and 28.18% of the total number

[2]This amount is an average between the reported accident cost for adult men and adult women. For light and serious injuries the costs are quite similar across gender and age groups.

of accidents (ASTRA, 2018).

The goal of this paper is to assess the impact of 30 km/h limit zones on road safety, in particular accident severity - the probability that an accident results in injuries of any kind, or in serious injuries. To do so, we use a rich set of data from Switzerland on all vehicle accidents occurred from 1995 to 2016, which includes information on the type of accident and its consequences, and on the vehicles and individuals involved. For each accident we have also information on the speed limit in place, and at least since 2011 the exact geographic coordinates for each accident. This information is integrated with data on the road network and its characteristics, on neighborhood characteristics, estimates of average road traffic and municipality characteristics.

Our empirical analysis is divided in two parts: the first part shows descriptive evidence on the effectiveness of 30 km/h zones by involving the whole dataset of vehicle accidents in Switzerland from 2011 to 2016, the years in which the data is most complete. We use a linear probability model to estimate the impact of 30 km/h limits - compared to 50 km/h limits - on the probability of injuries from an accident. We control for a large number of accident and location characteristics to reduce the risk of omitted variable bias, along with several robustness checks.

The second part provides stronger causal evidence about the effectiveness of 30 km/h zones by using a difference in differences model with accident data from 1995 to 2016 for the municipality of Basel, the third largest Swiss city, for which we have also geographic information on the location and the date of introduction of each 30 km/h zone. This data allows to measure for each accident not only the speed limit when the event took place, but also whether and at which point in time the speed limit changed. Therefore, we are able to exploit the quasi-experimental variation in the introduction of the 30 km/h zones to evaluate the effectiveness of lower speed limits. In our difference in differences model we compare ”treatment” accidents occurred in roads that switched from 50 km/h to 30 km/h, with ”control” accidents where limits stayed at 50 km/h. Using a standard parallel trend test, we provide evidence that the timing of 30 km/h implementation is unrelated to accident severity.

We find similar results in both parts of the empirical analysis: switching from 50 km/h to 30 km/h has a meaningful, significant effect in reducing the probability that an accident caused an injury to any person involved. We observe also a reduction on the probability of serious injuries, but such finding is not as robust to all specifications. The effect seems also to occur gradually over time.

Further analysis using both approaches detects relevant heterogeneities in the effect of 30 km/h limits: in particular, switching to lower limits seems to reduce the severity of accidents between vehicles in the same lane or for vehicles entering or exiting a road, accidents involving cars or motorbikes, accidents occurred in high traffic roads and accidents in roads with a priority rule, with a slope, or in humid, wet, snowy and icy roads. On the other hand, we find that 30 km/h limits are not effective in mitigating accident severity for the highest risk situations, such as accidents involving pedestrians, cyclists, or children, and accidents where individuals were not wearing helmets or using seatbelts.

The remainder of the paper is structured as follows. Section 2 provides the institutional background of the implementation of 30 km/h zones in Switzerland. Section 3 describes the accident data and the other datasets used in the analysis. Section 4 illustrates some baseline accident summary statistics in Switzerland. Section 5 introduces the baseline empirical strategies and discusses potential identification challenges. Section 6 shows the baseline OLS results for the Swiss-wide analysis. Section 7 presents the difference in differences strategy and the results focused on the municipality of Basel. Section 8 analyses the heterogeneous effects of 30 km/h zones. Section 9 concludes.

2 Institutional context

The first regulation on 30 km/h limit zones in Switzerland was introduced by the Federal Government in 1989. As a result, several zones of this type were implemented in the 1990s. The current regulatory framework was instituted in 2001, and requires that any proposal for a 30 km/h zone must be complemented by a report underlining desired goals and motivation for speed reduction, characteristics of the zone, and potential positive and negative consequences.

There are limitations on which areas can be designed as 30 km/h limit zones. In particular, only secondary roads can be part of these zones. As consequence, main urban traffic lanes or highways are unaffected by the disposition. Entrances to the 30 km/h zones must be clearly visible through appropriate vertical and horizontal road signs. It is possible, but not compulsory, to install within the zone speed limiters such as speed bumps.

The decision of introducing a 30 km/h zone is a political decision taken at the municipal level, but in some circumstances also the approval of the cantonal government is needed. Because a series of infrastructures such as signals or speed bumps need to be built, the local government must approve the funding needed for the actual implementation. The decisional process can also be triggered in a decentralized way, by petition of groups of local residents that are included in the motivation for the funding approval. In various instances, especially in large municipalities, multiple 30 km/h zones are approved at once and then they are gradually implemented with timing that might vary due to technical and infrastructural reasons. There is no uniform criteria for the decision of building a 30 km/h zone, as the process responds to specific local needs. Some of the recurring motivations in favor of the implementation are decreasing traffic noise, improving road safety, or the presence of a specific infrastructure, such as a school, whereas the most common arguments against the introduction are the implementation costs and the vehicle speed reduction.

3 Data

For the analysis of the effects of the 30 km/h speed limits on accident severity, we combine several sources of data. Our main dataset on road accidents in Switzerland is integrated with data on the road network, on neighborhood characteristics, road traffic, municipality characteristics and, for specific areas, geographic information of the location of 30 km/h zones. By doing so, we fulfill two goals: first, we are able to focus on the subsample of accidents occurred in roads that are eligible to become a 30 km/h zone; second, we are able to control for several factors that are linked to the introduction of the speed limits and the severity of the accidents. Below we describe each data source separately.

Accident data Our vehicle accident data come from the Swiss Federal Roads Office (ASTRA). We have data on all vehicle accidents occurred in Switzerland from 1995 to 2016. Each accident has information at the accident level (e.g. road speed limit, location of the accident, road conditions, number of people involved, number of people injured, accident cause, accident type), at the vehicle/pedestrian level (e.g. type of vehicle, driver type, alcohol test results), and at the individual level (e.g. gender, age, type of injury, driving experience). In particular, the ASTRA database contains information on the geographic coordinates of each accident.

Before 2011, only some cantons had gathered information on the geographical coordinates for all their road accidents, and some information about accident characteristics was collected only in part or with a lower degree of detail. For all those reasons in the first part of the analysis, focused on the whole Swiss territory, we use the most complete data from 2011 to 2016, while for the second part we use data from 1995 to 2016 from the municipality of Basel, which has accident geographic coordinates available also before 2011.

Road data Because the ASTRA database contains the exact geographic coordinates of each accident, we are able to identify the exact road where the accident took place. To do so, we use the swissTLM3D 2017 road network data, a large scale topographic model of Switzerland provided by the Swiss Federal Office of Topography (Swisstopo). This dataset contains spatial vector data on the entire Swiss road network, and each road is categorized according to its characteristics. The combination of the two databases allows to select only accidents occurred in secondary, municipal roads within built-up areas, and to control for other road characteristics. Within this group, we consider only accidents occurred in roads with width between 2.81 and 10.20 meters, as it is rare that 30 km/h limits are adopted in roads with tighter or larger width.

Accident location data Through the geographic coordinates of the accident we are able to construct additional information about the characteristics of the place where the accident took place. We use the swissTLM3D 2017 data to measure the distance of each accident to locations that might be correlated with the decision of having a 30 km/h speed limit. In particular, we measure the distance to the closest location for each of the following: religious buildings, leisure locations such as zoos or museums, parks, sport locations, education buildings such as school and universities, forest areas.[3] We also construct measures of the number of buildings and public transport stops in a radius of 100, 250, 500 and 1000 meters from the accident location.

We also consider the type of area where the accident took place. Using geodata from the Conference of Cantonal Services for Geoinformation (KKGEO), we measure the distance of each accident from the closest residential, working, mixed, central, and public area.[4]

Traffic estimate data Our accident dataset contains a categorical variable for the traffic level at the time of the accident. We complement this information with an estimate of the average daily and nightly traffic level for the road where the accident occurred. The estimates come from the 2011 SonBASE traffic engineering model based on actual traffic traffic monitor data. [5] While the estimates we use are not actual measurements of the average traffic for each Swiss road, they allow us to further differentiate roads that might appear similar based on other characteristics, such as width or proximity to certain types of areas.

Municipality data Finally, we also collect baseline characteristics of the municipality where the accident took place, such as population, population density, median altitude, road density, average

[3]According to the swissTLM3D 2017 guidelines, the location of educational buildings and parks might be incomplete. Therefore we merge the swissTLM3D geographic information with data from Openstreetmap, an open source spatial database of buildings and locations of interest. If a location labeled as educational or park area in either database, we consider it for the purpose of distance calculation. The swissTLM3D data is complete for what concerns the other types of locations taken into account.

[4]We use a distance measure, instead of assigning each accident to a specific area type, because in the KKGEO data roads are not considered part of any area, and because some roads lie in between two different types of areas.

[5]We thank the Federal Office of the Environment and Arendt Consulting for sharing the data with us.

taxable income for the federal income tax.[6]

Data on 30 km/h zones The ASTRA database contains information on the road speed limit in place at the time of the accident. However, it does not provide data on when the 30 km/h limit was introduced, or whether a 30 km/h limit was going to be introduced on that road in the future. To get this information, we would need to rely on geodata on the location and the timing of implementation of 30 km/h zones in Switzerland and rely on the geographic coordinates of the accident to assign an accident to a control group (30 km/h limits were never in place) or to a treatment group (30 km/h has been in place from a certain point in time). This approach is not applicable for the whole Switzerland, because many cantons do have complete geographic coordinates of accidents only from 2011, and because geodata on the location of 30 km/h zones is available only for specific areas.

Instead, we gather comprehensive geodata about 30 km/h zones for the municipality of Basel, in the canton of Basel Stadt. The data includes information on the location of 30 km/h zones and their date of introduction up to 2018 from the cantonal geoportal of Basel Stadt. The city of Basel is the only large Swiss city for which both information on 30 km/h zones location and the geographic coordinates of the accidents are available between 1995 and 2016 and for which most of the 30 km/h zones were introduced within that period.

Variables of interest Our outcome of interest is accident severity, which we measure through an indicator on whether an accident has at least one person injured (light injuries, severe injuries or death), and an indicator on whether an accident has at least one person deceased or with serious injuries. An important reason to focus on accident severity is that in Switzerland total intangible vehicle accident damages due to injuries are one order of magnitude higher than material costs such as property damage (Niemann et al., 2015, p. 63). That means that the marginal benefits of avoiding injuries from an accident would bring higher benefits than completely preventing an

[6]The data from average taxable income is for 2005 and comes from the Federal Office of Finances, while the rest of the data is for 2017 and comes from the Federal Statistical Office.

accident with no injuries.

4 Summary statistics for the whole Switzerland

Between 2011 and 2016 in Switzerland there were 321'536 accidents involving vehicles. Of those, 64.38% occurred in built-up areas, and 36.64% in secondary roads. For comparison, accidents occurred in highways - typically studied in the past literature - represent only 13.29% of all accidents. Secondary roads have a higher share (32.75%) of accidents with at least one person injured then highways (23.94%), but lower than primary roads (42.08%). We observe a similar pattern for the share of accidents with at least one serious injury: 8.45% for secondary roads, 3.06% for highways and 9.09% for primary roads. We do not observe differences in accident severity between roads in built-up and non built-up areas.

Our sample of interest considers only accidents in secondary, communal 30 km/h or 50 km/h roads in built-up areas, occurred in a road with width between 2.81 and 10.20 meters. Within that group, the share of accidents with injuries is 29.46% (6.99% for serious injuries), and the average share of people injured per accident is 17.84% (4.35% for serious injuries).

Focusing our attention to the differences between accident occurred in 30 km/h roads versus accidents occurred in 50 km/h roads, in Table 1 we compare accident severity between the two cases. In Panel A, with data at the accident level, we compare accidents resulting in injuries, accidents resulting in at least serious injuries (including death), and the share of people involved with any injuries or with at least serious injuries. In Panel B, we use data at the level of the person involved in the accident, comparing the occurrence of injuries of any types, and severe injuries or death.[7] Overall, we observe a higher frequency of injuries for roads with less stringent speed limits. That applies also for injures classified as severe (including deaths).

In Appendix B we compare accidents occurred in 50 km/h and 30 km/h roads based on their main characteristics. Among the most notable differences, accidents in 30 km/h roads are more

[7] In Panel B we exclude individuals, for the vast majority involved in hit and run accidents, for which information on the presence and type of injury was not available.

Table 1: Summary statistics for accident severity, 2011-2016

	Panel A: Accident level statistics			
Variable	**50 km/h**	**30 km/h**	**T-Test**	**Total**
Accidents with injuries	0.329	0.214	*** (29.27)	0.295
Accidents with serious injuries	0.079	0.049	*** (13.56)	0.070
Share injured	0.198	0.133	*** (24.12)	0.178
Share seriously injured	0.049	0.031	*** (11.45)	0.044
N	44120	18748	62868	62868
	Panel B: Individual level statistics			
Variable	**50 km/h**	**30 km/h**	**T-Test**	**Total**
Any injury	0.218	0.185	*** (10.63)	0.210
Any serious injury	0.048	0.040	*** (4.95)	0.046
N	74928	23207	98135	98135

likely to be parking accidents, hit and run or collision accidents, to involve distractions from phones, people or electronic equipment, and to occur in straight lanes and parking lots. They have a higher share of individuals involved who are adults, they are more likely to occur in roads close to schools, mixed or residential zones, and with higher building density. Finally, they occur in municipalities with higher population and population density.

Conversely, accidents in 50 km/h roads are more likely to occur due to people not following driving codes or driving under influence, and they involve more often cars and motorcycles. We observe similarities between accidents in 30 and 50 km/h roads in terms of road conditions, road layout, weather conditions and luminosity.[8]

5 Identification and baseline empirical strategy

Identification The goal of this paper is to evaluate the effect of the introduction of 30 km/h zones, including both lower speed limits and specific structures such as speed bumps, on accident severity. The best possible setting for the identification of the effect of the lower limits is a situation

[8]This arguably occurs because atmospheric conditions influence whole parts of the whole road network, rather than specific roads or zones.

in which 30 km/h limits are simply assigned randomly over different roads. This is not necessarily how the 30 km/h zones have been introduced in Switzerland. In particular there are factors at the municipality and at the local level, related to accident severity, that can influence the introduction of 30 km/h zones. For instance, municipalities with greater population and density, or with more financial resources, might be able to implement the limits earlier and more often.[9] At the local level, city administrators might decide to prioritize residential areas rather than work areas (or vice versa), or areas close to structures drawing high levels of traffic such as schools or religious buildings. If the factors influencing the implementation of 30 km/h limits are correlated with higher accident severity, we are facing a potential endogeneity problem.

We try to address this identification issue in two ways: first, by controlling for a large number of covariates representing accident and location characterstics. Second, by exploiting the quasi-experimental variation in the timing of introduction of 30 km/h zones to control for time-invariant unobservable characteristcs linked to accident severity and the implementation of the speed limits. While the first approach is applicable to the whole Swiss sample, the second strategy is possible only in a context where we know the location and the date of implementation of the zones. However, such information is not uniformly available for the whole country.

For these reasons, our empirical analysis is composed by two parts. In the first part, we use a baseline OLS model to analyse the effect of 30 km/h zones for the whole Switzerland. In the second part, we focus on the municipality of Basel, about which we have information on the location and the date of introduction of 30 km/h limits, and use a difference in differences model to validate the results of the first part.

In the baseline strategy used for the first part of the analysis we compare the severity of accidents occurred in 30 km/h roads versus accident occurred in 50 km/h roads between 2011 and 2016. We rely on the large amount of information we have on each accident and the area where the accident occurred to take into account factors that might be correlated with accident severity and 30 km/h adoption. In practice, we control for the following groups of covariates: Accident-level

[9]For instance, the city of Zürich has introduced the first 30 km/h zones in the 1980's. Typically smaller municipalities have done so much later.

characteristics.[10] Vehicle/driver-level characteristics.[11] Person-level characteristics.[12] Accident location/road characteristics.[13] Municipality characteristics.[14] The ability to control for specific characteristics of the accident (e.g. frontal accident vs parking accident) and characteristics of the location of the accident (e.g. road width, traffic level, distance from residential area or school) allows to attenuate concerns about omitted variable bias.

6 Swiss-wide results

We use the following baseline specification to measure the impact of 30 km/h speed limits on accident severity:

$$y_{icmt} = \alpha + \beta 30kmh_i + \gamma X_i + \delta_c + \eta_t + \epsilon_{icmt} \tag{1}$$

Where y_{icmt} is the variable of interest (dummy for accident with at least one injury, dummy for accident with at least one serious injury) for accident i occurred in canton c, municipality m and year t. Variable $30kmh_{it}$ has value 1 if the speed limit of the road where the accident took place was reported to be 30 km/h instead of 50 km/h. X_i is a set of controls for the characteristics of the accident, the characteristics of the vehicles involved, the characteristics of the individuals involved, and the characteristics of the place and the municipality where the accident took place.

[10] Number of persons involved, number of vehicles/pedestrians involved, month, year, day of the week, accident type, accident cause, traffic level at the moment of the accident, type of location, road priority type, road conditions, road layout, presence of level crossing, weather conditions, traffic signals, light conditions, illumination, visibility, type of vehicles involved, hit and run accident.

[11] Trailer, vehicle(s) without working headlights, trip purpose, poor route knowledge, suspected alcohol/medicine/drugs abuse, alcohol test performed, blood test performed, positive at alcohol/medicine/drug test, foreign driving license, third party vehicle, company vehicle, professional driver. At the accident level analysis, these variables are expressed in categorical variables equal to 1 if there is at least one vehicle/driver with that characteristic and 0 otherwise.

[12] Share of women involved, share of children (0-16) involved, share of seniors (65+) involved, share of people with seatbelts or helmets.

[13] Average estimate of 2011 road-specific daily traffic (and traffic squared), average estimate of 2011 road-specific nightly traffic (and traffic squared), road width category, indicator for trail roads, distance from closest religious building, distance from closest educational building, distance from closest leisure structure, distance from closest public building, distance from closest sport structure, distance from closest wood area, number of buildings within 250m

[14] Population, population density, median altitude, road density, average 2005 taxable income

Finally, δ_c and η_t represent canton and year fixed effects respectively.

We estimate our model using ordinary least squares, with standard errors clustered at the municipality level. To control for unobserved time-invariant and time-variant factors at the cantonal and municipality level, we estimate Equation 1 using five specifications with different types of fixed effects: 1. Canton fixed effects without controls 2. Canton fixed effects with controls 3. Canton-year fixed effects 4. Municipality fixed effects 5. Municipality-year fixed effects.

Baseline specification (2) relies on the assumption that, conditional on accident and road characteristics, there are no unobserved factors correlated with accident severity and the speed limits in place at the time of the accident. Specifications (4) and (5), which include municipality and municipality-year fixed effects respectively and compare accidents within the same municipality, partially relaxes this assumption, requiring no unobserved factors at the accident and/or road level correlated with speed limits, but not at the municipality level.

Specifications (4) and (5) allow also to control for factors such as different policy priorities of municipal governments or availability of funding for the implementation of 30 km/h zones. Identification concerns might still arise if the propensity of adopting lower speed limits in certain areas rather than others within a municipality is driven by unobserved factors correlated with accident severity. These concerns are in part addressed by the large number of observable accident and road characteristics included in the analysis.

Baseline OLS results Table 2 show the results of regressions based on the baseline specification introduced in Equation 1. Column (1) shows results with only canton and year fixed effects and indicators for the number of vehicles and persons involved in the accident as controls, while columns (2) to (5) show the results for the four different specifications with different types of fixed effects and the full set of controls. We show results for the two dependent variable of interests: Panel A uses as dependent variable the indicator on whether an accident reported at least one injury of any kind (light injury, serious injury, death). Panel B uses the indicator on whether an accident reported at least one serious injury or death.

Results show that adopting a 30 km/h limit has a significant, negative effect on accident severity. The effect on the probability of any type of injury is robust for all specifications, including the specifications with municipality and municipality-year fixed effects, and similar in magnitude for columns (2)-(5) which include the full set of covariates. The effect on the probability of serious injuries is negative as well, but weakly or not significant when including municipality and municipality-year fixed effects. Considering that the unconditional probability of injuries from accidents under a 50 km/h limit is 0.329, and the unconditional probability of serious injuries is 0.079, the magnitude of the coefficient suggests a meaningful impact of 30 km/h speed limits on accident severity.

Table 2: Baseline OLS results

	Panel A: Accidents with any injury				
	(1)	(2)	(3)	(4)	(5)
30 km/h	-0.052***	-0.021***	-0.021***	-0.018***	-0.018***
	(0.009)	(0.003)	(0.003)	(0.004)	(0.004)
N	62868	61027	61027	61027	61027
	Panel B: Accidents with serious injuries				
	(1)	(2)	(3)	(4)	(5)
30 km/h	-0.019***	-0.010***	-0.009***	-0.005*	-0.003
	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
N	62868	61027	61027	61027	61027
Controls	No	Yes	Yes	Yes	Yes
Canton FE	Yes	Yes	No	No	No
Canton-Year FE	No	No	Yes	No	No
Municipality FE	No	No	No	Yes	No
Municipality-Year FE	No	No	No	No	Yes

Results from specifications (1)-(5) for accidents occurred in Switzerland between 2011 and 2016. In Panel A the dependent variable is an indicator on whether an accident involved any type of injury or deaths. In Panel B the dependent variable is an indicator on whether an accident involved serious injuries or deaths. Coefficient $30km/h$ identifies the change in injury probability due to the switch from 50 km/h speed limits to 30 km/h. Standard errors are clustered at the municipality level.

As observed in the summary statistics section, accidents in 30 km/h zones are more likely to be parking accidents, or "hit and run" accidents. Parking accidents arguably occur when a vehicle is not anymore on the move, and thus can be considered a totally different accident type.[15] In hit

[15]For instance, the probability of injuries in a parking accident in a 50 km/h road is only 6.96%. This is by far the

and run accidents it is possible that part of the information collected is incomplete - for instance the identity of the individual involved or the accident cause. In Table C.1 of Appendix C we repeat our baseline analysis excluding parking and hit and run accidents. Results show that the effect of 30 km/h on the probability of any injuries is larger in magnitude then the results found in Table 2. For the probability of serious injuries, results are similar to those using all accidents, although the coefficient are only significant for specifications (2) and (3) with canton and canton-year fixed effects.

An alternative way to construct our dependent variables is using the share of individuals with any injuries or with serious injuries. In Table C.2 of Appendix C we report results using those dependent variables under the same set of specifications, and in Table C.3 we report the marginal effects of a probit model using model 1. The coefficients are similar to those found in Table 2.

Results at the individual level In the main analysis, we use vehicle accidents as the unit of observation. As an alternative way to measure the impact of 30 km/h zones, we repeat the analysis using as unit of observations the individuals involved in the accident. That allows to use as dependent variable the outcome of the accident for each individual.

We use a similar model as in Equation 1.[16] The dependent variable measures whether an individual got any type of injury during the accident (light, serious, or death) or whether the individual got at least a serious injury.[17] Results on Table 3 are similar to what found for the baseline model at the accident level in Table 2. In Appendix C we show similar results by discarding hit and run and parking accidents (Table C.4), and using a probit model (Table C.5).

Information on the severity of injuries at the individual level allows also to employ an ordered probit approach, in which we order accident outcomes for each individual involved by their sever-

lowest amount among all types of accidents, followed by "loss of control" accidents with a probability of 28.65%.

[16]We include the position of the individual in the vehicle (driver, front passenger, back passenger, pedestrian), and the type of vehicle the individual was in. Vehicle and passenger characteristics, previously expressed as shares, now they are expressed as dummy variables. We do not include anymore the number of individuals involved, as the analysis now refers to a specific individual.

[17]For about 11.54% of the individuals in the sample, the accident outcome is unknown. We drop those individuals from the sample. Almost all of them are involved in hit and run accidents. There is no meaningful difference in our estimates when we include these observations assuming no injuries.

Table 3: Baseline OLS results, individuals

	Panel A: Any injury				
	(1)	(2)	(3)	(4)	(5)
30 km/h	-0.031***	-0.020***	-0.020***	-0.016***	-0.015***
	(0.006)	(0.002)	(0.002)	(0.003)	(0.003)
N	98135	97554	97554	97554	97554
	Panel B: At least serious injuries				
	(1)	(2)	(3)	(4)	(5)
30 km/h	-0.009***	-0.008***	-0.008***	-0.004***	-0.003*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
N	98135	97554	97554	97554	97554
Controls	No	Yes	Yes	Yes	Yes
Canton FE	Yes	Yes	No	No	No
Canton-Year FE	No	No	Yes	No	No
Municipality FE	No	No	No	Yes	No
Municipality-Year FE	No	No	No	No	Yes

Results from specifications (1)-(5) for individuals involved in accidents occurred in Switzerland between 2011 and 2016. In Panel A the dependent variable is an indicator on whether an individual involved in an accident sustained any type of injury or died. In Panel B the dependent variable is an indicator on whether an individual involved in an accident sustained a severe injury or died. Coefficient $30km/h$ identifies the change in injury probability due to the switch from 50 km/h speed limits to 30 km/h. Standard errors are clustered at the municipality level.

ity: no injury, light injury, serious injury, death. Using an ordered probit allows to estimate the effect of 30 km/h zones for each accident outcome. This approach is slightly different, but still linked, to the regular OLS approach in which we look at whether an accident outcome reaches at least a certain level of severity. Given possible incidental parameter issues and computational issues due to the presence of large set of fixed effects, we limit our estimates to models with canton or municipality fixed effects. Results show again an effect of 30 km/h zones in reducing all types of injuries. The overall effect is lower in magnitude then the OLS estimates, but the effect on serious injuries is similar.

Overall, these results suggest that switching from a 50 km/h speed limit to a 30 km/h regime has a meaningful effect in reducing accident severity. In particular, our baseline linear probability model estimates with controls and canton fixed effects shows that on average under 30 km/h limits in Switzerland an accident has 2.1% reduced probability to cause injuries of any kind, and 1.0% reduced probability to cause at least serious injuries. Similary, an individual involved in an accident has on average a 2% lower probability to sustain an injury of any type and a 0.8% lower probability to sustain at least a serious injury.

Table 4: Ordered probit results

	Coefficients		
	(1)	(2)	(3)
30 km/h	-0.109***	-0.138***	-0.106***
	(0.020)	(0.016)	(0.018)
	Marginal effects		
	(1)	(2)	(3)
No injuries	0.031***	0.020***	0.015***
	(0.006)	(0.002)	(0.003)
Light injury	-0.020***	-0.012***	-0.009***
	(0.004)	(0.001)	(0.002)
Serious injury	-0.010***	-0.007***	-0.005***
	(0.002)	(0.001)	(0.001)
Death	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
N	98112	97531	97531
Controls	No	Yes	Yes
Canton FE	Yes	Yes	No
Municipality FE	No	No	Yes

Results from ordered probit estimation for individuals involved in accidents occurred in Switzerland between 2011 and 2016. The dependent variable is a integer between 1 and 4 depending on the consequences of the accident, from no injuries to death. Panel A shows the coefficient estimates, while Panel B displays the related average marginal effects. Coefficient $30km/h$ identifies the change in injury probability due to the switch from 50 km/h speed limits to 30 km/h. Standard errors are clustered at the municipality level.

7 Difference in differences estimation: Basel city

The results from our baseline model using data for the whole Switzerland suggests that switching from a 50 km/h limit to a 30 km/h limit contributes to reduce accident severity. However, we cannot exclude the possibility that 30 km/h zone assignment is endogenous due to unobserved factors linked to accident severity. For instance, lower speed limits might have been applied selectively to roads with the highest rates of serious accidents. In the Swiss-wide analysis we try to address these issues by focusing on accidents occurred on similar roads (municipal, secondary, in built up areas, and within certain width range) and controlling for several characteristics of the accident and its location. However, endogeneity problems might still persist.

These issues also arise due to limitations of our data: because the ASTRA database provides information on speed limits only at the time the accident took place, but does not document past or future changes, it is not possible to assign each accident to a treatment or control group and perform a difference in differences model which would address some of these concerns. Thus, to reinforce the reliability of our results, we run an additional analysis using more detailed data from the city of Basel.

Data and summary statistics from Basel We gathered comprehensive geodata on the location of 30 km/h zones, their name and their date of introduction up to 2018 from the cantonal geoportal of Basel Stadt. Figure 1 illustrates the timing of introduction of the 30 km/h limits in Basel. The zones have been introduced gradually, in particular between 1996 and 2004 and after the 2010s. This gap occurred because the construction of the 30 km/h zones starting from 2012 needed a revision of the road hierarchy and an approval from the cantonal Grand Council. Because zones can vary in size, their number might not necessarily coincide with road surface or vehicle circulation. To provide another metric for the timing of the 30 km/h roll-out we display also for all zones introduced in a given year the number of accidents occurred there in 1995 - i.e. before the speed limits took place. The number of accidents roughly matches the number of zones created.

We can use the geographic information on the speed limit implementation to clearly distinguish

Figure 1

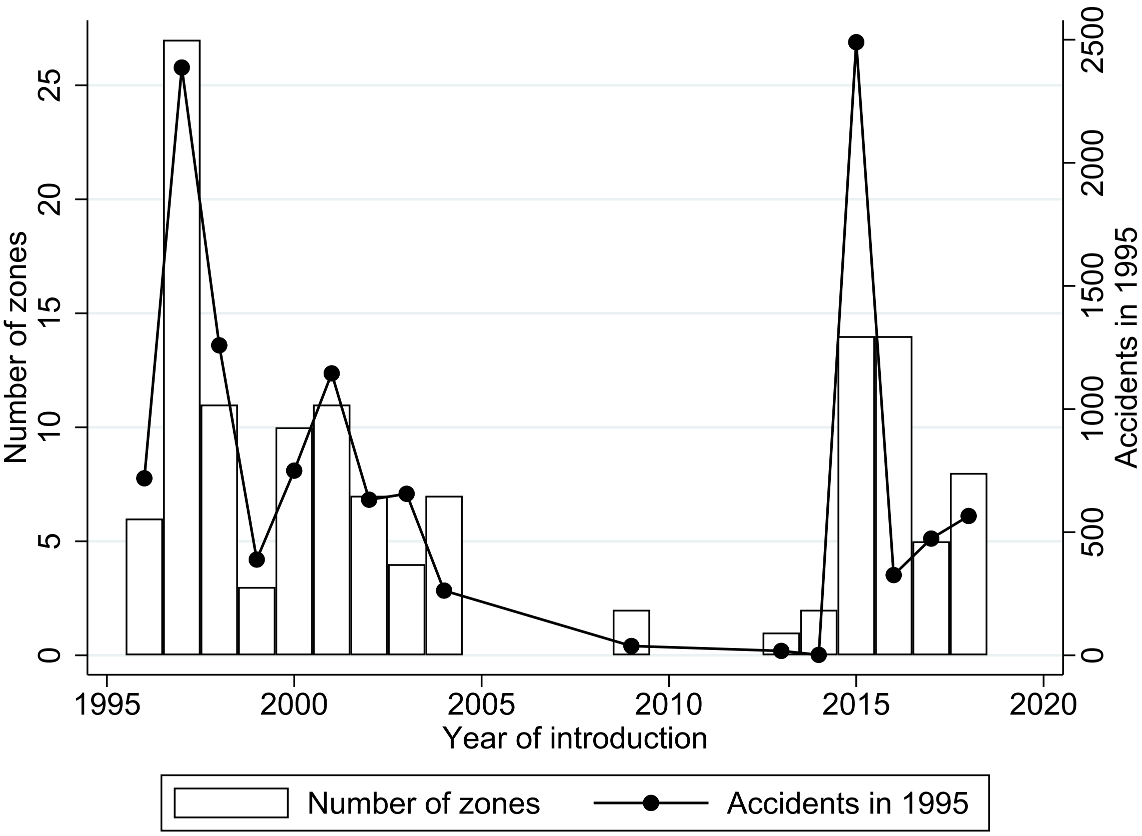


Illustration of accidents and 30 km/h zones installation in Basel. The bars represent the number of zones installed each year in Basel. The line represent the corresponding number of total accidents for those zones in year 1995 (where no 30 km/h limit was yet implemented).

between 'control group' accidents (in roads that always kept a 50 km/h limit) and 'treatment group' accidents (in roads that switched to a 30 km/h limit). It is then possible to perform a difference in differences strategy for the city of Basel, using the longer series of accident data from 1995 to 2016. This strategy allows to control for unobserved time-invariant factors related to accident severity and 30 km/h assignment.

The use of the longer 1995-2016 data instead of the 2011-2016 data allows to observe the severity of accidents in the treatment group before the switch to a 30 km/h speed limit. This imposes also some limitations: while all accidents in Basel in the ASTRA database have correct geographic coordinates information, a few variables used in the Swiss-wide analysis, such as accident cause, have been only partially collected before 2011.[18] Table A.1 in Appendix A describes which variables were only partially collected before 2011.

We illustrate the evolution of accident severity and accident numbers in Basel city in Figure 2. The left hand graph compares the share of accidents with injuries occurred in the following three types of zones: 1. Control zones, always under a 50 km/h limit (Control); 2. Treatment zones under a 50 km/h limit (Treatment pre); 3. Treatment zones under a 30 km/h limit (Treatment post).[19] Accidents occurred in 50 km/h limit roads (Control and Treatment pre), regardless whether they belong to a treatment or control zone, have a very similar evolution in injury probability. Those two groups experienced an increase of share of accidents with injures. On the other hand, the share of accidents with injuries remained stable for zones with a 30 km/h limit.

The right hand graph shows instead the evolution in the number of accidents between control zones that remained with a 50 km/h limit and treated zones.[20] We observe that both treated and control zones experienced a sharp reduction in the number of accidents over time.[21] Overall, the graphs suggest that road safety greatly improved over time regardless the speed limit adopted, but the adoption of tighter limits is associated to a further reduction in accident severity.

Empirical strategy The availability of the location and the year of introduction of the 30 km/h speed limits for each zone allows to use a difference in differences strategy, using accidents occurred in roads that were never subject to such limits as control group. Our basic specification has thus the following form:

$$y_{it} = \alpha + \beta 30kmhpost_{it} + \gamma 30kmh_i + \delta X_i + \eta_t + \epsilon_{it} \tag{2}$$

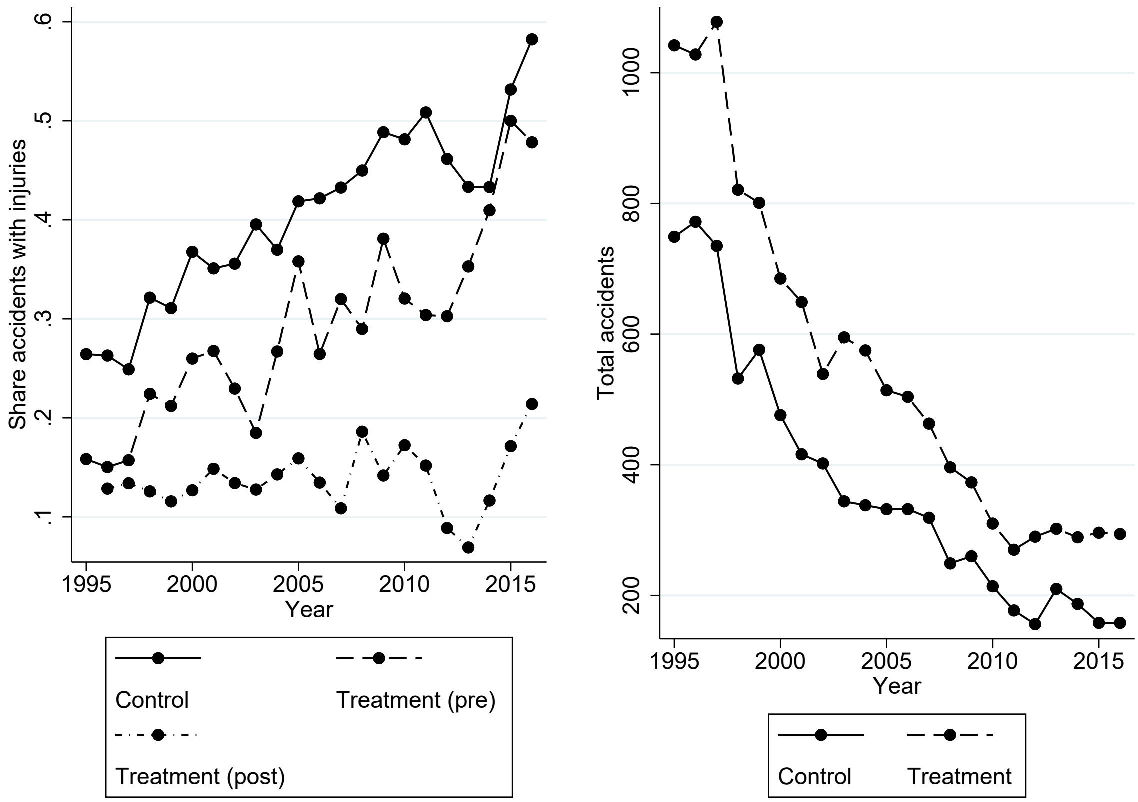
[18]For the reason, while in the Swiss-wide analysis we are able to distinguish accidents occurred in municipality roads, in the Basel analysis we are not. We are still able to select only secondary roads in built-up areas with width between 2.81 and 10.20 meters.

[19]This implies that treatment zones under a 50 km/h limit are switching to a 30 km/h limit over time.

[20]Thus the treated group in this graph includes both accidents occurred under a 50 km/h and a 30 km/h limit.

[21]Studying the effects of 30 km/h limit on accident probability goes beyond the scope of the paper. However, the gap in number of accidents between treated and control zones seems to tighten slightly over time, hinting at an additional effect of the stricter speed limits.

Figure 2: Accidents in Basel, 1995-2016



Left panel: evolution of the share of accidents with injuries over time. The solid line represents accidents occurred in control zones that always maintained a 50 km/h limit; the dashed line represents accidents occurred in treatment zones still under a 50 km/h limit; the dash-dotted line shows accidents occurred in treatment zones under a 30 km/h limit. Right panel: evolution of total accidents over time. The solid line represents accidents occurred in control zones; the dashed line represents accident occurred in treatment zones.

Where $30kmh_i$ is a dummy for accidents in the treated group i.e. accidents happening within an area designed to be a 30 km/h zone, and $30kmhpost_{it}$ is a dummy for accident i happening in a zone and a year where the 30 km/h limit was in place. As for baseline specification 1, X_i represents a set of controls and η_t is a set of year fixed effects. Coefficient γ identifies the unobservable time-invariant factors of an accident occurring in a designated 30 km/h zone influencing accident severity. Our coefficient of interest is β, which identifies the effect of 30 km/h zones on accident severity. As in the specifications described in the previous section, the dependent variable y_{it}

represents either whether an accident caused at least light injuries, or whether an accident caused at least serious injuries.

To control for unobservable differences in accident severity between different 30 km/h zones, we expand the baseline difference in differences Equation by adding zone-specific fixed effects:

$$y_{izt} = \alpha + \beta 30kmhpost_{izt} + \delta X_{iz} + \eta_t + \theta_z + \epsilon_{izt} \quad (3)$$

Where θ_z represent a set of fixed effects for each zone z.[22]

The indicators $30kmh_i$ and $30kmhpost_{it}$ are not derived from the ASTRA accident report, but from the Basel geodata showing the exact location of the speed limit zones, and their year of introduction. For some observations we observe discrepancies in the treatment indicator between the ASTRA data and the Basel geodata: only one set of data indicates that a specific accident occurred in a zone with a 30 km/h speed limit in place. This can happen for multiple reasons, for instance because the accident occurred in the same years the limits were put in place but before their introduction, or due to imprecise geolocation of the zone or the accident. Therefore, in the main analysis we use only accidents for which both treatment indicators coincide.[23]

The identification assumption for our difference in differences strategy is the presence of a common trend in accident severity between the treatment and the control group. In other words, we assume that the timing of the introduction of the 30 km/h zones is not related to unobservable factors linked to accident severity. We believe this is a reasonable assumption as many unrelated factors can accelerate or slow the actual implementation of 30 km/h limits. In fact, the implementation of a 30 km/h zone is not decided individually. Instead, a group of zones is planned and approved.[24] Delays in implementation might depend on political and administrative reasons, or on

[22] Because a zone is created only following the implementation of speed limits, all accidents belonging to the control group are considered as part of a single zone.

[23] In particular, we observe a small share of cases where only the ASTRA data indicates the presence of the 30 km/h limits (1.64% of the sample) and a larger share where only the Basel geodata indicates the presence of the limits (9.58% of the sample).

[24] The 30 km/h zones adopted from 1996 and 2009 were the result of three decisions by the cantonal Grand Council in 1994, 1995 and 1997. To allow the implementation of additional zones, it was necessary a revision of the road network hierarchy, done in 2010, and another Grand Council decision.

technical reasons.[25] Furthermore, the process of introducing the speed limits in specific parts of the city is often triggered in a decentralized way by petitions and requests by groups of citizens or associations sent years earlier.[26] Given that all those factors do not have a clear connection with accident severity, we have reason to believe that our main identification assumption is likely to be valid.

To test the robustness of the common trend assumption, we perform a standard parallel trend test. We modify Equation 2 and include time-to-treatment effects of the introduction of 30 km/h zones, by interacting the $30kmhpost_{it}$ with indicators for the distance in years from the treatment $DistTr_j$, with ($j = -10, -9, ... + 9, +10$).[27] We then estimate the following equation:

$$y_{it} = \alpha + \sum_j \xi_j 30kmh_i * DistTr_j + \gamma 30kmh_i + \delta X_i + \eta_t + \epsilon_{it} \tag{4}$$

In which ξ_j is the effect of 30 km/h zones in year j from the introduction of the 30 km/h limit. The rejection of a null hypothesis of coefficient estimate equal to zero in the pre-treatment period would be in line with our main identification assumption of no common trends.

Basel difference in differences results Figure 3 shows the results of the parallel trend test as in Equation 4. We observe no significant difference in the probability of injuries between accidents in treatment 30 km/h zones before the treatment and control accidents. When the 30 km/h limit is introduced, we observe a clear decrease in accident severity over time, especially after some years from the implementation of the speed limits. Results using the probability of serious injuries show again common pre-treatment trends, but no clear effect after the implementation of the limits.

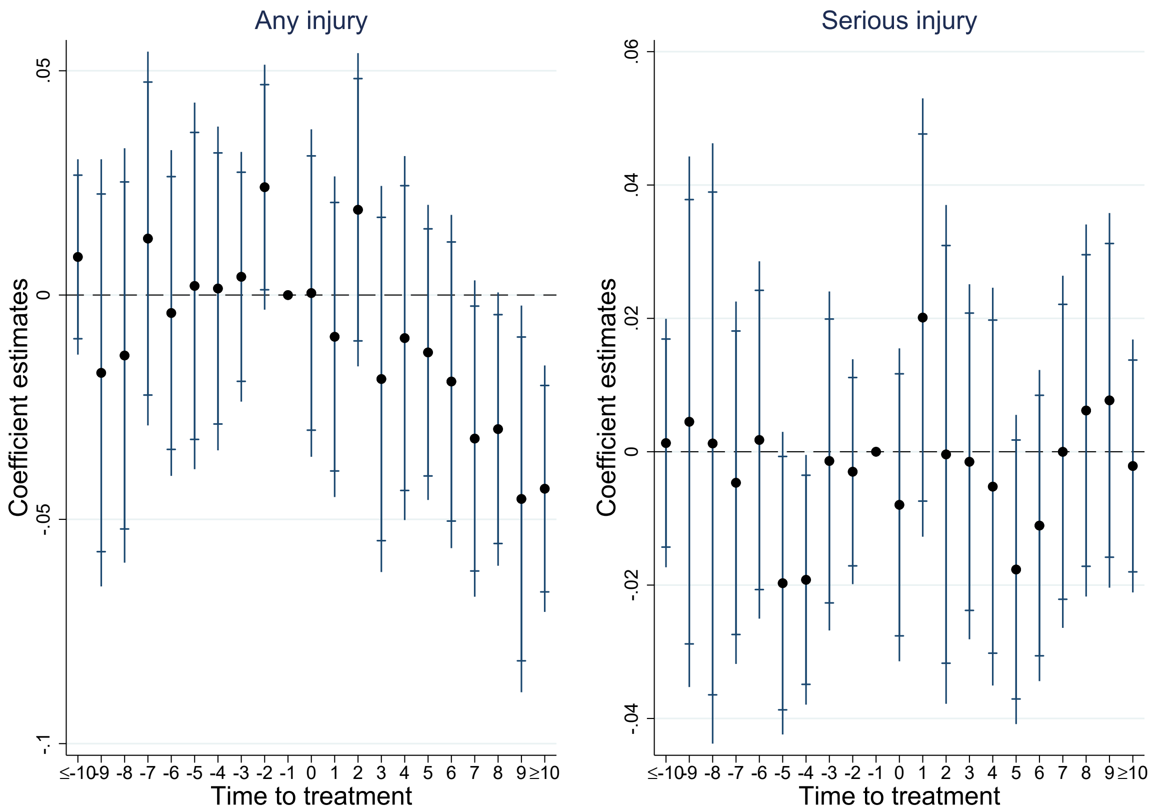
To compare the difference in differences approach with the one used in the Swiss-wide analysis, Table 5 shows two sets of results. In columns (1) and (2) we report the estimates using the same

[25]In the website of the Department for Mobility of Basel Stadt, it is mentioned that delays in the implementation of the speed limits can occur in case of structural or urban design issues (Kanton Basel-Stadt, 2020)

[26]For instance, in a 2012 request for funding to the cantonal Grand Council for the introduction of new 30 km/h zones, the Basel Stadt cantonal government mentioned nine separate petitions by group of citizens of Basel to introduce 30 km/h limits in various parts of the city (Regierungsrat des Kantons Basel-Stadt, 2012). Many of these petitions were submitted several years earlier.

[27]The treatment starts in period 0, and period -1 is the omitted indicator. We aggregate in an unique indicator all the accidents with time to treatment ≤ -10, and we do the same for accidents with time to treatment $\geq +10$.

Figure 3: Parallel trend test, Basel, 1995-2016



Results from the parallel trend test (Equation 4). The horizontal axis shows the distance in years from the year of introduction of a 30 km/h zone (time 0). Each coefficient represents the change in the probability that an accident has at least one person injured. Time period -1 is the omitted coefficient. Clustered standard errors by zone. The bars represent 90% and 95% confidence intervals.

baseline strategy as in Equation 1 that we employed for the whole Switzerland. Column (1) uses only basic controls such as the year, the number of vehicles involved, and the number of persons involved, while column (2) uses the whole set of controls. Columns (3)-(5) report the results from the difference in differences approach. In column (3) we use only a basic control, in column (4) we use the full set of controls as in Equation 2, and in column (5) we include fixed effects for each 30 km/h zone as in Equation 3.

Our estimates show a negative effect of the introduction of 30 km/h zones on the probability of an accident with injuries occurring, but no effect in terms of accidents with severe injuries once we include the full set of controls. Including individual 30 km/h zone fixed effect does not meaningfully change the results. The coefficients obtained with the baseline model are very close to those obtained with the difference in differences model, thus providing evidence of the validity of the baseline OLS methodology as in Equation 1. The magnitude of the coefficients for the effect on any type of injury in Panel A is also remarkably similar to the magnitude of the coefficient reported for the Swiss-wide analysis in Table 2. As shown in Table 1, the overall probability of injuries in an accident under a 50 km/h limit in Switzerland is about 32.9%, so a reduction of 2.7 percentage points represents a substantial effect of 30 km/h zones in reducing the risk of accident injuries.

In the results of Table 5 we exclude observations where there are discrepancies in the speed limits in place in the ASTRA database and in the cantonal geodata i.e. where at the time of the accident one dataset indicates a 30 km/h limit and the other a 50 km/h limit. In Table 6 we repeat the analysis including all observations, and consider only the speed limits of the Basel Stadt cantonal geodata. Results show virtually no difference from the results in Table 5. Our results for the parallel trend test are also very similar when using all observations (Figure D.1 of Appendix D

One element of concern could be that the distinction between treated and control zones is not clearly defined: roads that are currently subject to 50 km/h might switch to 30 km/h in the future, and while we consider changes in the speed limits up to 2018, we might miss future changes. To check whether the treatment assignment criteria represents a problem for our result, we perform an additional robustness check. Because Figure 1 shows that almost no 30 km/h zones were introduced between 2005 and 2012 (only a couple of zones in 2009), we can make a clear distinction between 30 km/h zones implemented before and after 2012.[28]

We repeat our analysis using only data from 1996 to 2012, and we treat accidents occurred in zones that would have adopted 30 km/h limits later than 2012 as belonging to the control group. In other words, we perform our empirical strategy as if we observed accidents and the introduction of 30 km/h zones only up to 2012. Results from this exercise are shown in Table 7, and again display

[28]This is further justified by the fact that the two groups of zones were implemented following different authorizations from the cantonal Grand Council.

no substantial difference from the main results. In Table D.1 of Appendix D we also show results obtained by dropping accidents occurred in zones that switched to a 30 km/h limit after 2013, and in Figure D.2 of Appendix D we do the same for the parallel trend test graph. The results confirm the validity of our estimates.

As done during the Swiss-wide analysis, we check the robustness of our results using data at the individual level as well. On Table 8 we show the coefficients for our difference in differences

Table 5: OLS and difference in differences, Basel 1995-2016

	Panel A: Accidents with any injury				
	OLS		Difference in Differences		
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.084***	-0.035***	-0.086***	-0.027***	-0.035**
	(0.016)	(0.009)	(0.018)	(0.008)	(0.013)
30 km/h			0.004	-0.020***	
			(0.009)	(0.007)	
N	17939	16997	17939	16997	16997
Controls	No	Yes	No	Yes	Yes
Zone FE	No	No	No	No	Yes
	Panel B: Accidents with serious injuries				
	OLS		Difference in Differences		
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.021***	-0.005	-0.017**	0.002	-0.000
	(0.008)	(0.005)	(0.008)	(0.005)	(0.007)
30 km/h			-0.007	-0.017***	
			(0.005)	(0.004)	
N	17939	16997	17939	16997	16997
Controls	No	Yes	No	Yes	Yes
Zone FE	No	No	No	No	Yes

Results using accident data in the municipality of Basel from 1995 to 2016. We include only accidents for which speed limit provided is the same in the ASTRA database and in the Basel Stadt geodata. Columns (1) and (2) show results using the baseline OLS model 1. Columns from (3) to (5) show results using the difference in differences approach as in Equation 2 and Equation 3. Coefficient *30 km/h * Post* identifies the effect of the implementation of a 30 km/h zone (treatment) on the dependent variable. Coefficient *30 km/h* represents the time-invariant differences from accidents in treated and control zones. Columns (1) and (3) include only indicators of year, number of persons and vehicles involved as controls. Columns (2), (3) and (4) include also accident and location characteristics. Clustered standard errors by zone in parenthesis.

model using as dependent variable an indicator for an individual with any type of injury (Panel A), and using an indicator for an individual with a serious injury or worse (Panel B). The results show a statistically significant reduction in the probability of accident injuries of any type, but not on at least serious injuries when including our set of controls.

Our preferred methodological approach shown so far is a standard difference in differences strategy, in which we compare the accidents occurred in "treated" roads with accidents occurred

Table 6: OLS and difference in differences, Basel 1995-2016, full sample

	Panel A: Accidents with any injury				
	OLS		Difference in Differences		
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.075***	-0.034***	-0.076***	-0.025***	-0.034***
	(0.012)	(0.007)	(0.015)	(0.006)	(0.011)
30 km/h			0.001	-0.021***	
			(0.009)	(0.007)	
N	20206	19165	20206	19165	19165
Controls	No	Yes	No	Yes	Yes
Zone FE	No	No	No	No	Yes
	Panel B: Accidents with serious injuries				
	OLS		Difference in Differences		
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.021***	-0.008**	-0.017**	-0.001	-0.005
	(0.007)	(0.004)	(0.006)	(0.004)	(0.006)
30 km/h			-0.009*	-0.019***	
			(0.005)	(0.004)	
N	20206	19165	20206	19165	19165
Controls	No	Yes	No	Yes	Yes
Zone FE	No	No	No	No	Yes

Results using accident data in the municipality of Basel from 1995 to 2016. We include all accidents available, using speed limit information from the Basel Stadt geodata. Columns (1) and (2) show results using the baseline OLS model 1. Columns from (3) to (5) show results using the difference in differences approach as in Equation 2 and Equation 3. Coefficient *30 km/h * Post* identifies the effect of the implementation of a 30 km/h zone (treatment) on the dependent variable. Coefficient *30 km/h* represents the time-invariant differences from accidents in treated and control zones. Columns (1) and (3) include only indicators of year, number of persons and vehicles involved as controls. Columns (2), (3) and (4) include also accident and location characteristics. Clustered standard errors by zone in parenthesis.

in "control" roads. The illustrative evidence in Figure 2 and the parallel trend test in Figure 3 both suggest that in this setting the parallel trend assumption is valid. As an alternative empirical strategy to further validate our findings, we adopt an event study methodology using only accidents occurred in locations designated to be 30 km/h zones, and we exploit the variation in the timing of introduction of the zones to compare accidents occurred in zones already under a 30 km/h limit

Table 7: OLS and difference in differences, Basel 1995-2013

	Panel A: Accidents with any injury				
	OLS		Difference in Differences		
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.071***	-0.031***	-0.080***	-0.027***	-0.031***
	(0.010)	(0.005)	(0.013)	(0.009)	(0.009)
30 km/h			0.011	-0.006	
			(0.010)	(0.008)	
N	16111	15368	16111	15368	15368
Controls	No	Yes	No	Yes	Yes
Zone FE	No	No	No	No	Yes
	Panel B: Accidents with serious injuries				
	OLS		Difference in Differences		
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.019***	-0.006*	-0.019***	-0.001	-0.004
	(0.005)	(0.003)	(0.007)	(0.005)	(0.004)
30 km/h			-0.000	-0.007	
			(0.006)	(0.006)	
N	16111	15368	16111	15368	15368
Controls	No	Yes	No	Yes	Yes
Zone FE	No	No	No	No	Yes

Results using accident data in the municipality of Basel from 1995 to 2013. We include only accidents for which speed limit provided is the same in the ASTRA database and in the Basel Stadt geodata. Accidents occurred in roads that switched to 30 km/h after 2013 are considered as part of the control group (*30 km/h* = 0) Columns (1) and (2) show results using the baseline OLS model 1. Columns from (3) to (5) show results using the difference in differences approach as in Equation 2 and Equation 3. Coefficient *30 km/h * Post* identifies the effect of the implementation of a 30 km/h zone (treatment) on the dependent variable. Coefficient *30 km/h* represents the time-invariant differences from accidents in treated and control zones. Columns (1) and (3) include only indicators of year, number of persons and vehicles involved as controls. Columns (2), (3) and (4) include also accident and location characteristics. Clustered standard errors by zone in parenthesis.

with accidents occurred in zones that did not yet switched to a 30 km/h limit.[29] Table D.2 of Appendix D, shows again a negative effect of 30 km/h on the probability of an accident resulting in injuries of any kind, but no effects on the probability of an accident resulting in serious injuries or death.

Table 8: OLS and difference in differences, individual level, Basel 1995-2016

	Panel A: Individual with any injury				
	OLS		Difference in Differences		
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.041***	-0.029***	-0.045***	-0.020***	-0.016*
	(0.008)	(0.008)	(0.012)	(0.007)	(0.009)
30 km/h			0.006	-0.018***	
			(0.009)	(0.003)	
N	28196	27573	28196	27573	27573
Controls	No	Yes	No	Yes	Yes
Zone FE	No	No	No	No	Yes
	Panel B: Individual with serious injuries				
	OLS		Difference in Differences		
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.005	0.000	-0.004	0.005	0.004
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)
30 km/h			-0.001	-0.010***	
			(0.004)	(0.002)	
N	28196	27573	28196	27573	27573
Controls	No	Yes	No	Yes	Yes
Zone FE	No	No	No	No	Yes

Results using accident data in the municipality of Basel from 1995 to 2016, at the individual level. We include only accidents for which speed limit provided is the same in the ASTRA database and in the Basel Stadt geodata. Columns (1) and (2) show results using the baseline OLS model 1. Columns from (3) to (5) show results using the difference in differences approach as in Equation 2 and Equation 3. Coefficient *30 km/h * Post* identifies the effect of the implementation of a 30 km/h zone (treatment) on the dependent variable. Coefficient *30 km/h* represents the time-invariant differences from accidents in treated and control zones. Columns (1) and (3) include only indicators of year, number of persons and vehicles involved as controls. Columns (2), (3) and (4) include also accident and location characteristics. Clustered standard errors by zone in parenthesis.

[29] Of course this approach does not allow to take into account time invariant unobservable characteristics of the 30 km/h zones i.e. fixed effects for 30 km/h zones.

8 Heterogeneity

Overall, our results suggest that reducing speed limit contributes to reducing accident severity, and in particular that an accident results in injuries of any type. An important aspect of our analysis is to understand in which situations the introduction of 30 km/h limits is best suited to reduce the probability of injuries due to an accident. To do so, we perform our analysis both with our Swiss-wide baseline methodology and with our difference in differences model focused on Basel using subsets of data based on accident, road and zone characteristics. We then look whether we observe heterogeneous effects for both approaches. Below we show some selected findings, while we report the full results of our analysis in the tables contained in Appendix E.

In terms of typology of accident, we find that 30 km/h zones are particularly effective in reducing accident severity for accidents occurred between vehicles in the same lane, or accidents occurred when entering or exiting a road (Table 9). Similarly, we observe a higher effectiveness of 30 km/h for accidents occurred at road turns. There is little or no evidence of an effect of lower speed limits for other types of accidents. We find a very small effect for parking accidents, which even under 50 km/h limits had very low rates of injuries. Notably, we find no effect on accident severity for pedestrian hits, which have a very high rate of injuries. An explanation is that even being hit at lower speed is not sufficient to avoid some health consequences.[30]

The effect of 30 km/h zones is also strong in case of accident involving cars, and even stronger for accidents with motorbikes (Table 10). However, no effect is found for accidents involving bikes or pedestrians. Again, it seems that lower speed limits help in reducing accident severity for certain high injury risk situations, but only up to a certain point. When a very vulnerable party is involved (such as pedestrians or cyclists), then a 30 km/h speed can still cause injuries. This is confirmed also by the findings of Table 11, based on the effect by the type of individuals involved in an accident: we find no effect in case of accidents involving children and little or no effect when safety belts or helmets were not used.

[30] Another explanation could be that accidents involving pedestrians which do not cause injuries are not reported to the police.

In Appendix E we report other relevant heterogeneities. For instance, we detect the presence of different effects based on certain road characteristics: wider roads and roads with higher average estimated traffic benefit more from the introduction of tighter speed limits. This might be simply linked to the fact that 30 km/h are more effective in case of accidents between two vehicles, instead of vehicle collisions involving only one vehicle. We also find high effectiveness for roads closer to working areas. On the other hand, we observe no heterogeneity based on building or public transport stop density.

Finally, road characteristics matter as well for the effectiveness of 30 km/h limits: we report higher reduction in accident severity in roads with some sort of priority rule (e.g. stop sign, priority to the right), roads with a slope, and humid, wet, snowy or icy roads. This might signal that the lower speed limits have a strongest effect in more dangerous situations due to the characteristics of the road. On the other hand, we find no clear difference in terms of weather condition, luminosity or street illumination.

Overall, the contribution of 30 km/h hour limits in reducing accident injuries is particularly strong for certain circumstances that present a higher risk than normal, such as accidents when entering or exiting a road or involving motorbikes. However, lower speed limits are not effective for situations that at a glance look extremely dangerous: accidents involving pedestrians, bikes, children, or people wearing no helmet or safety belts. This suggests that in order to protect these vulnerable categories a set of different policies might be needed, and that lowering speed limits must be part of a more comprehensive road safety strategy.

Table 9: Heterogeneity: Accident Type

	Loss of control	Same lane	Enter/exit road	Parking	Pedestrian hit	Crossing road
	Panel A: OLS Switzerland, 2011-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.014***	-0.042***	-0.040***	-0.005***	0.010	-0.017
	(0.005)	(0.013)	(0.010)	(0.002)	(0.011)	(0.021)
N	20156	5052	9266	13852	4016	3605
Share injuries	0.2748	0.2890	0.4620	0.0420	0.9329	0.5241
	Panel B: Diff-in-Diff Basel, 1995-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	0.003	-0.181***	-0.066**	-0.004*	0.026	-0.032
	(0.007)	(0.065)	(0.031)	(0.002)	(0.035)	(0.026)
30 km/h	-0.030***	0.005	-0.040**	-0.001	-0.019	-0.003
	(0.009)	(0.030)	(0.019)	(0.002)	(0.025)	(0.014)
N	5803	1432	1692	2314	1025	2470
Share injuries	0.1005	0.3530	0.5242	0.0320	0.9481	0.4078

Heterogeneous effects results by accident type. Each column shows the results using a different subset of data. Column (1): accidents due to loss of control. Column (2): accidents occurred in a single lane. Column (3): accidents occurred when entering or exiting a road. Column (4): parking accidents. Column (5): accidents involving pedestrians. Column (6): accidents occurred when crossing an intersection. Panel A shows the OLS results using data for the whole Switzerland from 2011 to 2016, similarly to column (2) of Table 2. Panel B shows the difference in differences results using the data for the municipality of Basel from 1995 to 2016, similarly to column (3) of Table 5. In both panels, the dependent variable is an indicator on whether the accident resulted in injuries of any type. All specifications include the full set of controls. For each subset, the baseline share of accidents with injuries occurred in 50 km/h roads is reported at the bottom of each panel.

Table 10: Heterogeneity: Vehicle involved

	Car	Motorbike	Bike/Pedestrian	Heavy	Other
	OLS Switzerland, 2011-2016				
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.024***	-0.049**	0.003	-0.028***	-0.006*
	(0.004)	(0.019)	(0.007)	(0.008)	(0.003)
N	42696	5470	11601	7527	10284
Share injuries	0.3184	0.7798	0.8961	0.2431	0.0860
	Diff-in-Diff Basel, 1995-2016				
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.036***	-0.071*	0.017	0.019	-0.012**
	(0.011)	(0.039)	(0.020)	(0.024)	(0.006)
30 km/h	-0.022***	-0.012	-0.015	-0.003	-0.001
	(0.007)	(0.018)	(0.012)	(0.017)	(0.006)
N	10621	1448	2968	1673	5500
Share injuries	0.3594	0.7789	0.8915	0.2789	0.0599

Heterogeneous effects results by type of vehicles involved. Each column shows the results using a different subset of data. Column (1): accidents involving passenger cars. Column (2): accidents involving passenger motorbikes or motorcycles. Column (3): accidents involving bikes or pedestrians. Column (4): accidents involving trucks or other heavy duty vehicles. Column (5): accidents involving other types of vehicles. Panel A shows the OLS results using data for the whole Switzerland from 2011 to 2016, similarly to column (2) of Table 2. Panel B shows the difference in differences results using the data for the municipality of Basel from 1995 to 2016, similarly to column (3) of Table 5. In both panels, the dependent variable is an indicator on whether the accident resulted in injuries of any type. All specifications include the full set of controls. For each subset, the baseline share of accidents with injuries occurred in 50 km/h roads is reported at the bottom of each panel.

Table 11: Heterogeneity: Safety

	Collision accident		**Any belt/helmet**		**Any child involved**	
	No	Yes	No	Yes	No	Yes
	OLS Switzerland, 2011-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.027***	-0.009***	-0.009***	-0.025***	-0.023***	-0.018
	(0.006)	(0.003)	(0.003)	(0.004)	(0.004)	(0.012)
N	34814	26213	17440	43587	45706	5999
Share injuries	0.4560	0.1269	0.2341	0.3610	0.3411	0.6433
	Diff-in-Diff Basel, 1995-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.021**	-0.002	-0.005	-0.030***	-0.033***	0.004
	(0.009)	(0.008)	(0.005)	(0.011)	(0.010)	(0.038)
30 km/h	-0.019***	-0.033***	-0.022***	-0.019***	-0.026***	-0.030
	(0.006)	(0.012)	(0.007)	(0.006)	(0.005)	(0.042)
N	12752	4245	6549	10448	10917	1091
Share injuries	0.3563	0.0895	0.1514	0.3793	0.3736	0.6599

Heterogeneous effects results by selected characteristics. Each column shows the results using a different subset of data. Column (1): accidents not involving collision. Column (2): collision accidents. Column (3): accidents with no person involved wearing helmets or safety belts. Column (4): accidents with some person involved wearing helmets or safety belts. Column (5): accidents with no children involved. Column (6): accidents with at least one child involved. Panel A shows the OLS results using data for the whole Switzerland from 2011 to 2016, similarly to column (2) of Table 2. Panel B shows the difference in differences results using the data for the municipality of Basel from 1995 to 2016, similarly to column (3) of Table 5. In both panels, the dependent variable is an indicator on whether the accident resulted in injuries of any type. All specifications include the full set of controls. For each subset, the baseline share of accidents with injuries occurred in 50 km/h roads is reported at the bottom of each panel.

9 Concluding remarks

The introduction of 30 km/h limits in urban areas has been remarkably commonplace for several countries in the last couple of decades. Yet, their potential benefits in mitigating vehicle externalites has been less explored compared to speed limits in highways and extra-urban roads. In this paper, we analyse the impact of these lower speed limits in Switzerland on one of these externalities, namely the probability that an accident causes injuries to one or more individuals involved.

Using a comprehensive dataset on vehicle accidents from 1995 to 2016, we perform two complementary approaches: a baseline Swiss-wide analysis from 2011-2016, and a difference in differences approach using data from 1995 to 2016 in the municipality of Basel. Results from both strategies show that the introduction of 30 km/h zones has contributed to reduce accident severity, and has the potential to provide substantial benefits.

In general, our findings suggest that, in order to maximize the benefits from accident severity mitigation, installation of 30 km/h zones should be prioritized for areas with high number of vehicle accidents, and with accidents involving disproportionally specific categories or circumstances - such as accidents with motorbikes, accidents occurring in a single lane, when entering or exiting a road - or roads with certain characteristics - such as wider and with above-median traffic. On the other hand, implementation of 30 km/h zone cannot, by itself, reduce accident severity for certain types of accidents involving highest risk categories such as pedestrians or children, and other complementary road safety policies might be necessary.

An important consideration is that often 30 km/h zones imply the introduction of ancillary measures to enforce such limits, such as speed bumps or modification of roadside parking spaces. In our analysis we are not able to separate the effect of the imposition of lower speed limits from the implementation of these supplementary measures. It is thus possible that the effect on accident severity depends in part also on the specific way the 30 km/h zones are built.

In this paper we are estimating part of the benefits from the introduction of 30 km/h limits, without comparing with the related costs. The goal is to provide a reliable estimate that can be used in a broader cost-benefit analysis that includes costs and the effect on other externalities such as noise, pollution, and accident frequency. As mentioned in the introduction, the average cost per person due to light injuries from traffic accident is about 15,277 CHF, and about 405,708 CHF in case of serious injuries (Niemann et al., 2015, p. 63). The monetary benefits from the reduction in accident severity depend of course on the specific situation of the zone when the 30 km/h limits are imposed - roads experiencing a larger number of accidents and injuries are going to benefit more from the imposition of lower limits. On this point, a ruling by the Federal Court in 2018 allowed in principle the imposition of 30 km/h limits not only within secondary roads, but also within more traffic-oriented roads in built-up areas (Bundesgericht, 2018). It is thus possible that in the future 30 km/m limits will be applied to the group of roads that has statistically a higher risk of traffic accidents and related injuries. Further research would be needed to establish whether the imposition of 30 km/h limits in primary roads would cause similar decline in accident severity as for secondary roads.

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Appendix

A Variables used

Table A.1: Variables

Accident level		Vehicle level	
Variable	**Collected before 2011**	**Variable**	**Collected before 2011**
Date and time	Yes	Hit and run	Yes
Municipality	Yes	Main responsible	From 2003
Canton	Yes	Vehicle type	Yes
Accident type	Yes	Trailer	Yes
Accident cause	Partially	Daylights condition	Yes
Geographic coordinates	Partially	Vehicle ownership	Yes
Economic damages	Yes	Driver type	Yes
Built-up area	Yes	Type of distraction	Yes
Number of vehicles	Yes	Trip purpose	Partially
Number of persons	Yes	Route knowledge	Partially
Persons injured/deceased	Yes	Permit type	Less details
Road type	Yes		
Road category	From 2001		
Traffic conditions	From 2003		
Speed limit	Yes		
Zone 30 / 20 sign	Partially		
Accident location type	Yes		
Priority signals	Yes		
Road condition	Yes		
Road layout	Less details		
Weather	Less details		
Traffic rule type	Partially		
Light conditions	Yes		
Illumination conditions	Yes		
Gender	Yes		
Age	Yes		
Injury type	Yes		
Belt / Helmet used	Yes		

B Summary statistics on accidents

Table B.1: Summary statistics and T-test

Variable	50 km/h	30 km/h	T-Test	Total
Hour, day and season				
Weekends	0.235	0.236	(-0.07)	0.235
Morning (6am-12pm)	0.345	0.340	(1.25)	0.343
Afternoon (1pm-6pm)	0.412	0.403	* (2.18)	0.409
Evening (7pm-5am)	0.224	0.221	(1.05)	0.223
Fri-Sat 7pm-5am	0.097	0.090	** (3.03)	0.095
Sun-Thu 7pm-5am	0.127	0.131	(-1.35)	0.128
Autumn	0.254	0.265	** (-2.71)	0.258
Winter	0.227	0.216	** (2.89)	0.223
Spring	0.254	0.255	(-0.18)	0.254
Summer	0.265	0.264	(0.14)	0.265
Accident type				
Loss of control	0.327	0.327	(0.07)	0.327
Same lane	0.097	0.044	*** (22.17)	0.081
Enter/Exit road	0.176	0.083	*** (30.37)	0.148
Parking accident	0.183	0.373	*** (-52.24)	0.240
Pedestrian hit	0.070	0.049	*** (9.81)	0.064
Crossing road	0.061	0.051	*** (4.73)	0.058
Other types	0.085	0.072	*** (5.68)	0.081
Accident cause				
Driver condition or distraction	0.311	0.286	*** (6.38)	0.304
Not following code	0.514	0.405	*** (25.05)	0.481
Other causes	0.175	0.309	*** (-37.87)	0.215
Traffic level				
Low	0.658	0.768	*** (-27.45)	0.691
Normal	0.260	0.144	*** (32.15)	0.225
Other	0.082	0.088	* (-2.57)	0.084
Accident location				
Straight lane	0.466	0.599	*** (-30.69)	0.505
Turn	0.116	0.075	*** (15.12)	0.104
Parking lot	0.059	0.100	*** (-18.18)	0.071
Intersection	0.127	0.094	*** (11.85)	0.117
Entrance	0.193	0.117	*** (23.34)	0.170
Other	0.039	0.015	*** (15.65)	0.032

Table B.2: Summary statistics and T-test

Variable	50 km/h	30 km/h	T-Test	Total
Road priority				
Any priority rule	0.236	0.137	*** (28.15)	0.206
Road conditions				
Humid/Wet/Snow/Icy	0.232	0.186	*** (12.72)	0.218
Road layout				
Any slope	0.294	0.283	** (2.73)	0.291
Weather conditions				
Good/Cloudy	0.847	0.816	*** (9.61)	0.838
Luminosity				
Dark	0.280	0.260	*** (5.32)	0.274
Illumination				
None	0.206	0.150	*** (16.60)	0.189
Vehicles involved				
Car involved	0.724	0.590	*** (33.31)	0.684
Motorbike involved	0.103	0.050	*** (21.50)	0.088
Bycicle involved	0.124	0.111	*** (4.44)	0.120
Pedestrian involved	0.077	0.056	*** (9.50)	0.071
Heavy vehicle involved	0.127	0.106	*** (7.33)	0.121
Other vehicle involved	0.149	0.279	*** (-38.81)	0.188
Estimate vehicles day	2285.766	1142.180	*** (38.81)	1944.735
Estimate vehicles night	172.778	86.499	*** (37.99)	147.049

Table B.3: Summary statistics and T-test

Variable	50 km/h	30 km/h	T-Test	Total
Vehicle characteristics				
Hit an run	0.278	0.460	*** (-45.23)	0.332
Any trailer	0.031	0.020	*** (7.42)	0.028
Any no daylights	0.085	0.093	** (-3.01)	0.087
Any distraction	0.280	0.395	*** (-28.54)	0.314
Purpose: work	0.230	0.152	*** (22.30)	0.207
Purpose: shopping	0.639	0.527	*** (26.49)	0.605
Purpose: goods	0.100	0.085	*** (5.89)	0.096
Any poor route knowledge	0.133	0.110	*** (8.08)	0.126
Any alcohol suspect	0.161	0.119	*** (13.61)	0.148
Any medicines suspect	0.014	0.013	(0.89)	0.014
Any drugs suspect	0.020	0.014	*** (5.31)	0.018
Any alcohol test	0.283	0.198	*** (22.42)	0.257
Any alcohol blood test	0.075	0.051	*** (10.78)	0.067
Any medicine positive test	0.004	0.003	(1.28)	0.004
Any drugs positive test	0.008	0.006	** (3.00)	0.007
Any foreign permit	0.206	0.291	*** (-23.17)	0.231
Any not vehicle owner	0.311	0.241	*** (17.75)	0.290
Any company vehicle	0.210	0.160	*** (14.44)	0.195
Any professional driver	0.119	0.090	*** (10.75)	0.110
Collision	0.386	0.576	*** (-44.65)	0.442
Individual characteristics				
Share women	0.322	0.331	* (-2.45)	0.324
Share children	0.058	0.054	* (2.19)	0.057
Share adults	0.782	0.762	*** (6.00)	0.777
Share seniors	0.142	0.166	*** (-8.16)	0.148
Share belt	0.660	0.644	*** (3.95)	0.656
Share helmet	0.096	0.068	*** (11.94)	0.088
Share airbag on	0.022	0.014	*** (6.19)	0.020
Share infant seat	0.006	0.006	(0.07)	0.006

Table B.4: Summary statistics and T-test

Variable	50 km/h	30 km/h	T-Test	Total
Road characteristics				
Road width 6m	0.261	0.219	*** (11.24)	0.249
Road width 4m	0.543	0.658	*** (-26.94)	0.578
Road width 3m	0.095	0.077	*** (7.17)	0.089
Road width 8m	0.101	0.045	*** (22.89)	0.084
Trail road	0.138	0.091	*** (16.28)	0.124
Zone characteristics				
Church within 100m	0.073	0.091	*** (-7.96)	0.078
Leisure within 100m	0.047	0.047	(-0.35)	0.047
Park within 100m	0.176	0.208	*** (-9.38)	0.185
Education within 100m	0.203	0.303	*** (-27.36)	0.233
Sport within 100m	0.096	0.136	*** (-14.97)	0.108
Woods within 100m	0.143	0.111	*** (10.75)	0.134
Central zone within 100m	0.325	0.248	*** (19.34)	0.302
Mixed zone within 100m	0.474	0.531	*** (-13.17)	0.491
Public zone within 100m	0.418	0.455	*** (-8.49)	0.429
Residential zone within 100m	0.639	0.778	*** (-34.50)	0.680
Work zone within 100m	0.247	0.107	*** (40.46)	0.205
Low building density	0.290	0.163	*** (33.86)	0.252
Medium building density	0.385	0.377	(1.86)	0.383
High building density	0.325	0.460	*** (-32.38)	0.366
Municipality characteristics				
Population	69267.104	144353.741	*** (-67.82)	91635.737
Population density	21.957	31.163	*** (-40.50)	24.699
Median altitude	561.243	516.043	*** (17.90)	547.778
Taxable revenue 2005	73.016	74.185	*** (-7.74)	73.364
Road density	0.086	0.104	*** (-38.34)	0.091

C Robustness checks

Table C.1: OLS results, whole Switzerland, no hit and run or parking accidents

	Panel A: Accidents with injuries				
	(1)	(2)	(3)	(4)	(5)
30 km/h	-0.034***	-0.032***	-0.032***	-0.028***	-0.026***
	(0.010)	(0.006)	(0.006)	(0.007)	(0.008)
N	28602	28394	28394	28394	28394
	Panel B: Accidents with serious injuries				
	(1)	(2)	(3)	(4)	(5)
30 km/h	-0.008	-0.011***	-0.011***	-0.004	-0.001
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
N	28602	28394	28394	28394	28394
Controls	No	Yes	Yes	Yes	Yes
Canton FE	Yes	Yes	Yes	Yes	Yes
Municipality FE	No	No	No	Yes	No
Canton-Year FE	No	No	Yes	No	No
Municipality-Year FE	No	No	No	No	Yes

Table C.2: OLS results, whole Switzerland, accident share

	Panel A: Share people with injuries				
	(1)	(2)	(3)	(4)	(5)
30 km/h	-0.046***	-0.017***	-0.017***	-0.014***	-0.018***
	(0.006)	(0.002)	(0.002)	(0.002)	(0.004)
N	62868	61027	61027	61027	61027
	Panel B: Share people with serious injuries				
	(1)	(2)	(3)	(4)	(5)
30 km/h	-0.016***	-0.008***	-0.007***	-0.004***	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
N	62868	61027	61027	61027	61027
Controls	No	Yes	Yes	Yes	Yes
Canton FE	Yes	Yes	Yes	Yes	Yes
Municipality FE	No	No	No	Yes	No
Canton-Year FE	No	No	Yes	No	No
Municipality-Year FE	No	No	No	No	Yes

Table C.3: Probit results, accident level

	Marginal effects		
	(1)	(2)	(3)
30 km/h	-0.059***	-0.020***	-0.016***
	(0.011)	(0.004)	(0.004)
N	62861	61020	60030
Controls	No	Yes	Yes
Canton FE	Yes	Yes	No
Municipality FE	No	No	Yes

Table C.4: OLS results, individuals, no hit and run or parking accidents

	Panel A: Accidents with injuries				
	(1)	(2)	(3)	(4)	(5)
30 km/h	-0.028***	-0.036***	-0.037***	-0.031***	-0.031***
	(0.010)	(0.007)	(0.007)	(0.008)	(0.008)
N	80007	79528	79528	79528	79528
	Panel B: Accidents with serious injuries				
	(1)	(2)	(3)	(4)	(5)
30 km/h	-0.009*	-0.013***	-0.013***	-0.005	-0.003
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
N	80007	79528	79528	79528	79528
Controls	No	Yes	Yes	Yes	Yes
Canton FE	Yes	Yes	Yes	Yes	Yes
Municipality FE	No	No	No	Yes	No
Canton-Year FE	No	No	Yes	No	No
Municipality-Year FE	No	No	No	No	Yes

Table C.5: Probit results, individual level

	Marginal effects		
	(1)	(2)	(3)
30 km/h	-0.055***	-0.029***	-0.023***
	(0.011)	(0.005)	(0.006)
N	110909	108811	107163
Controls	No	Yes	Yes
Canton FE	Yes	Yes	No
Municipality FE	No	No	Yes

Table C.6: Ordered probit results, no hit and run or parking accidents

	Coefficients		
	(1)	(2)	(3)
30 km/h	-0.052***	-0.142***	-0.109***
	(0.019)	(0.017)	(0.020)
	Marginal effects		
	(1)	(2)	(3)
No injuries	0.016**	0.023***	0.017***
	(0.006)	(0.003)	(0.003)
Light injury	-0.010**	-0.014***	-0.010***
	(0.004)	(0.002)	(0.002)
Serious injury	-0.005**	-0.009***	-0.007***
	(0.002)	(0.001)	(0.001)
Death	-0.000**	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
N	79854	79376	79376
Controls	No	Yes	Yes
Canton FE	Yes	Yes	No
Municipality FE	No	No	Yes

D Robustness checks for Basel difference in differences model

Table D.1: OLS and difference in differences, Basel 1995-2016, Zones before 2013

	Panel A: Accidents with any injury				
	OLS		Difference in Differences		
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.090***	-0.044***	-0.104***	-0.040***	-0.044***
	(0.015)	(0.006)	(0.019)	(0.010)	(0.010)
30 km/h			0.017	-0.006	
			(0.010)	(0.010)	
N	14179	13357	14179	13357	13357
Controls	No	Yes	No	Yes	Yes
Zone FE	No	No	No	No	Yes
	Panel B: Accidents with serious injuries				
	OLS		Difference in Differences		
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.026***	-0.010***	-0.027***	-0.003	-0.005
	(0.006)	(0.004)	(0.008)	(0.005)	(0.005)
30 km/h			0.001	-0.011	
			(0.006)	(0.007)	
N	14179	13357	14179	13357	13357
Controls	No	Yes	No	Yes	Yes
Zone FE	No	No	No	No	Yes

Figure D.1: Parallel trend test, Basel, 1995-2016, Full Sample

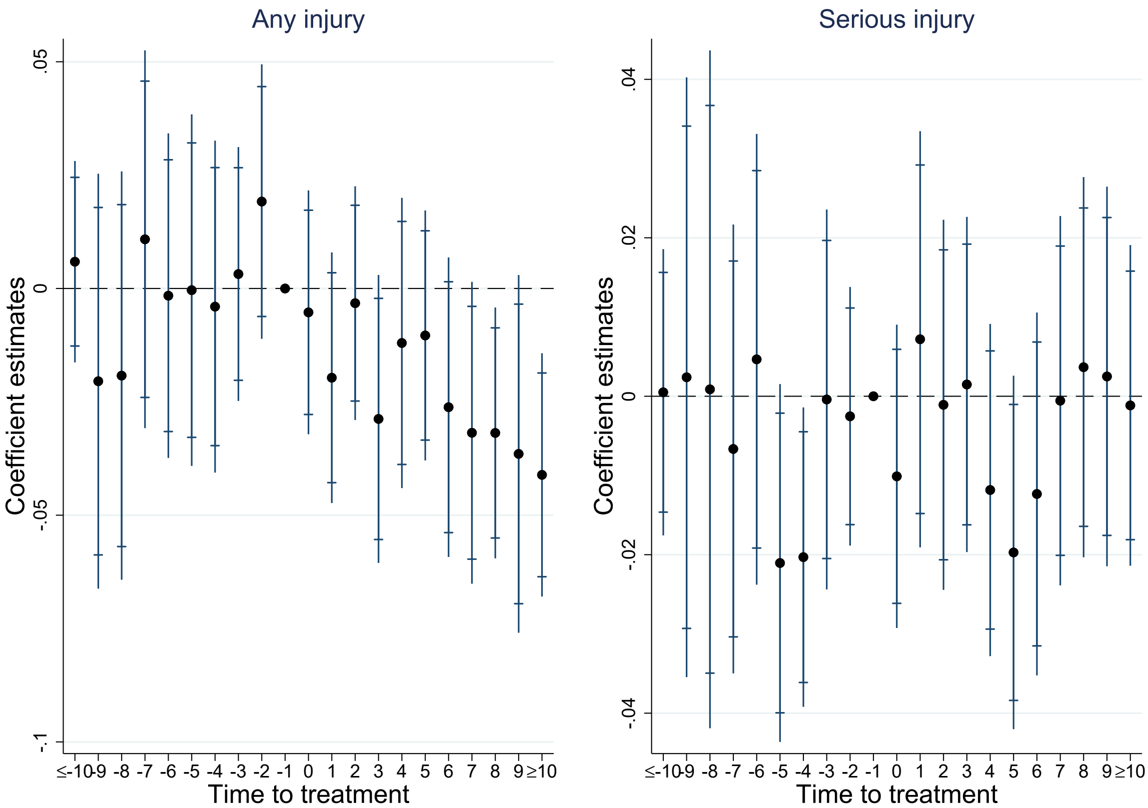
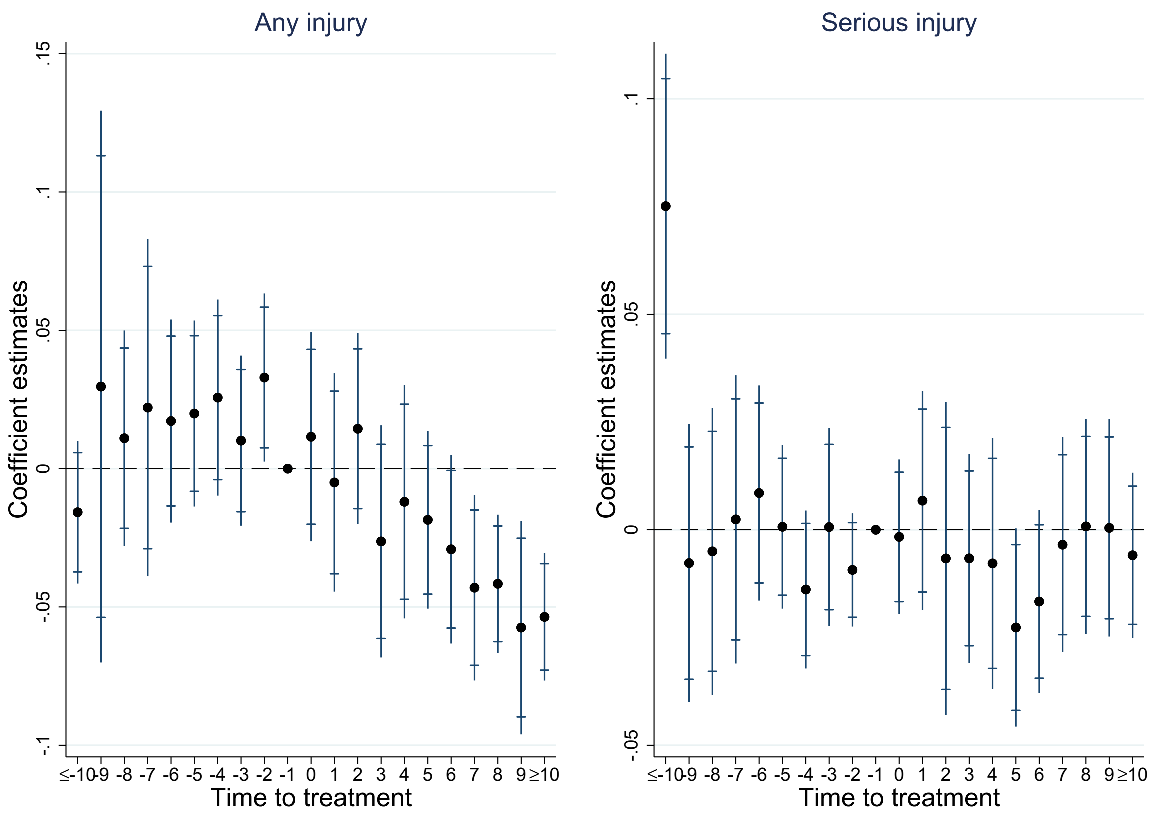


Table D.2: OLS results, Basel 1995-2016, pre-treatment accidents as control group

	Panel A: Accidents with any injury	
	(1)	(2)
30 km/h * Post	-0.058***	-0.015*
	(0.012)	(0.008)
N	9961	9284
Controls	No	Yes
	Panel B: Accidents with serious injuries	
	(1)	(2)
30 km/h * Post	-0.007	0.005
	(0.006)	(0.006)
N	9961	9284
Controls	No	Yes

Figure D.2: Parallel trend test, Basel, 1995-2016, Zones before 2013



E Heterogeneity results

Table E.1: Heterogeneity: Time and day

	Day of week		**Hour of day**		
	Mon-Fri	Sat-Sun	6am-12am	1pm-6pm	7pm-5am
	OLS Switzerland, 2011-2016				
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.018***	-0.031***	-0.022***	-0.017***	-0.025***
	(0.004)	(0.006)	(0.004)	(0.005)	(0.005)
N	46661	14366	21464	25595	13968
Share injuries	0.3404	0.2924	0.3413	0.3648	0.2723
	Diff-in-Diff Basel, 1995-2016				
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.023**	-0.044***	-0.015	-0.035***	-0.028**
	(0.009)	(0.011)	(0.012)	(0.012)	(0.013)
30 km/h	-0.025***	0.000	-0.015**	-0.022**	-0.015
	(0.006)	(0.013)	(0.007)	(0.011)	(0.010)
N	13072	3925	5605	7095	4297
Share injuries	0.3153	0.2571	0.3315	0.3260	0.2332

Table E.2: Heterogeneity: Evenings and months

	Evenings (7pm-5am)		**Months**			
	Fri-Sat	Sun-Thu	Sep-Nov	Dec-Feb	Mar-May	Jun-Aug
	OLS Switzerland, 2011-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.031***	-0.022***	-0.012**	-0.021***	-0.027***	-0.021***
	(0.007)	(0.007)	(0.005)	(0.006)	(0.006)	(0.006)
N	5940	8028	15768	13564	15487	16208
Share injuries	0.2653	0.2777	0.3424	0.2631	0.3318	0.3701
	Diff-in-Diff Basel, 1995-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.036*	-0.026	-0.013	-0.049***	-0.033***	-0.016
	(0.019)	(0.017)	(0.015)	(0.011)	(0.010)	(0.015)
30 km/h	0.023	-0.035***	-0.028**	-0.009	-0.017**	-0.023*
	(0.016)	(0.011)	(0.013)	(0.010)	(0.008)	(0.013)
N	1631	2666	4549	3866	4385	4197
Share injuries	0.2160	0.2439	0.3136	0.2746	0.3024	0.3144

Table E.3: Heterogeneity: Accident Type

	Loss of control	Same lane	Enter/exit road	Parking	Pedestrian hit	Crossing road
	OLS Switzerland, 2011-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.014***	-0.042***	-0.040***	-0.005***	0.010	-0.017
	(0.005)	(0.013)	(0.010)	(0.002)	(0.011)	(0.021)
N	20156	5052	9266	13852	4016	3605
Share injuries	0.2748	0.2890	0.4620	0.0420	0.9329	0.5241
	Diff-in-Diff Basel, 1995-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	0.003	-0.181***	-0.066**	-0.004*	0.026	-0.032
	(0.007)	(0.065)	(0.031)	(0.002)	(0.035)	(0.026)
30 km/h	-0.030***	0.005	-0.040**	-0.001	-0.019	-0.003
	(0.009)	(0.030)	(0.019)	(0.002)	(0.025)	(0.014)
N	5803	1432	1692	2314	1025	2470
Share injuries	0.1005	0.3530	0.5242	0.0320	0.9481	0.4078

Table E.4: Heterogeneity: Accident cause

	Driver influence	Rules non-compliance	Other cause
	OLS Switzerland, 2011-2016		
	(1)	(2)	(3)
30 km/h * Post	-0.017***	-0.027***	-0.003
	(0.006)	(0.005)	(0.003)
N	18984	30051	11992
Share injuries	0.3262	0.3834	0.1748

Information about accident cause is incomplete before 2011. Thus, this variable is not used in the Basel difference in differences model with data from 1995 to 2016.

Table E.5: Heterogeneity: Accident place

	Straight lane	Turn	Parking lot	Intersection	Entrance
	OLS Switzerland, 2011-2016				
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.019***	-0.027***	-0.006	-0.044***	-0.016**
	(0.004)	(0.010)	(0.005)	(0.011)	(0.008)
N	31008	6393	3919	7282	10441
Share injuries	0.3073	0.3342	0.0490	0.4497	0.3700
	Diff-in-Diff Basel, 1995-2016				
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.027***	-0.078**	0.011**	-0.011	0.001
	(0.010)	(0.039)	(0.005)	(0.021)	(0.026)
30 km/h	-0.014	-0.042	-0.015***	-0.018	-0.052***
	(0.013)	(0.028)	(0.005)	(0.011)	(0.020)
N	9308	623	1359	3498	1403
Share injuries	0.2602	0.3253	0.0190	0.4142	0.4009

Table E.6: Heterogeneity: Road characteristics

	Priority		Road conditions		Road slope	
	No	Yes	Dry/Other	Wet/Snow/Icy	No	Yes
	OLS Switzerland, 2011-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.017***	-0.035***	-0.019***	-0.025***	-0.019***	-0.024***
	(0.003)	(0.010)	(0.004)	(0.007)	(0.004)	(0.005)
N	48167	12860	47601	13426	43069	17958
Share injuries	0.2707	0.5184	0.3365	0.3045	0.3167	0.3589
	Diff-in-Diff Basel, 1995-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.016*	-0.030*	-0.020**	-0.058***	-0.026***	-0.048**
	(0.009)	(0.016)	(0.009)	(0.017)	(0.009)	(0.022)
30 km/h	-0.022*	-0.017**	-0.031***	0.037**	-0.017**	-0.039**
	(0.013)	(0.008)	(0.007)	(0.014)	(0.008)	(0.015)
N	11076	5921	13896	3101	15251	1746
Share injuries	0.2014	0.4643	0.2901	0.3494	0.2921	0.3822

Table E.7: Heterogeneity: Weather and illumination

	Weather		**Luminosity**		**Street illumination**	
	Good/Cloudy	Rain/Snowfall	Day/Unknown	Dawn/Dusk/Night	Any	None
	OLS Switzerland, 2011-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.020***	-0.023***	-0.019***	-0.026***	-0.017***	-0.035***
	(0.004)	(0.007)	(0.004)	(0.005)	(0.004)	(0.006)
N	51837	9190	44033	16994	49374	11653
Share injuries	0.3419	0.2580	0.3414	0.2975	0.3300	0.3254
	Diff-in-Diff Basel, 1995-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.027***	-0.022***	-0.027***	-0.027**	-0.025**	-0.016
	(0.010)	(0.007)	(0.009)	(0.011)	(0.010)	(0.012)
30 km/h	-0.030***	0.015	-0.023**	-0.014*	-0.024***	-0.017*
	(0.007)	(0.009)	(0.009)	(0.008)	(0.007)	(0.010)
N	12308	4689	11647	5350	9747	7250
Share injuries	0.3487	0.1629	0.3210	0.2605	0.3114	0.2916

Table E.8: Heterogeneity: Vehicle involved

	Car	Motorbike	Bike/Pedestrian	Heavy	Other
	OLS Switzerland, 2011-2016				
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.024***	-0.049**	0.003	-0.028***	-0.006*
	(0.004)	(0.019)	(0.007)	(0.008)	(0.003)
N	42696	5470	11601	7527	10284
Share injuries	0.3184	0.7798	0.8961	0.2431	0.0860
	Diff-in-Diff Basel, 1995-2016				
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.036***	-0.071*	0.017	0.019	-0.012**
	(0.011)	(0.039)	(0.020)	(0.024)	(0.006)
30 km/h	-0.022***	-0.012	-0.015	-0.003	-0.001
	(0.007)	(0.018)	(0.012)	(0.017)	(0.006)
N	10621	1448	2968	1673	5500
Share injuries	0.3594	0.7789	0.8915	0.2789	0.0599

Table E.9: Heterogeneity: Road traffic estimate

	Day traffic		**Night traffic**	
	Below median	Above median	Below median	Above median
	OLS Switzerland, 2011-2016			
	(1)	(2)	(3)	(4)
30 km/h * Post	-0.013***	-0.028***	-0.013***	-0.028***
	(0.004)	(0.005)	(0.004)	(0.005)
N	29561	31466	31020	30007
Share injuries	0.2808	0.3680	0.2824	0.3706
	Diff-in-Diff Basel, 1995-2016			
	(1)	(2)	(3)	(4)
30 km/h * Post	-0.015	-0.045***	-0.013	-0.037***
	(0.010)	(0.013)	(0.010)	(0.011)
30 km/h	-0.025***	-0.015**	-0.018**	-0.019***
	(0.008)	(0.006)	(0.008)	(0.006)
N	7692	9305	7714	9283
Share injuries	0.2257	0.3461	0.2275	0.3475

Table E.10: Heterogeneity: Driver intoxicated

	Suspected intoxication		**Alcohol blood test**	
	No	Yes	No	Yes
	OLS Switzerland, 2011-2016			
	(1)	(2)	(3)	(4)
30 km/h * Post	-0.018***	-0.033***	-0.020***	-0.019
	(0.003)	(0.010)	(0.003)	(0.012)
N	51065	9962	56806	4221
Share injuries	0.3133	0.4054	0.3250	0.3803
	Diff-in-Diff Basel, 1995-2016			
	(1)	(2)	(3)	(4)
30 km/h * Post	-0.026***	-0.044	-0.028***	-0.036
	(0.008)	(0.037)	(0.008)	(0.028)
30 km/h	-0.017**	-0.045	-0.017**	-0.016
	(0.007)	(0.029)	(0.007)	(0.026)
N	15853	1144	16152	845
Share injuries	0.3002	0.3256	0.3002	0.3256

Table E.11: Heterogeneity: Driver and car ownership

	Car ownership			Professional driver	
	Not owner	Company	Other	No	Yes
	OLS Switzerland, 2011-2016				
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.014**	-0.043***	-0.016***	-0.018***	-0.038***
	(0.006)	(0.007)	(0.004)	(0.003)	(0.009)
N	15985	12181	32861	54107	6920
Share injuries	0.3238	0.2967	0.3449	0.2644	0.3378
	Diff-in-Diff Basel, 1995-2016				
	(1)	(2)	(3)	(4)	(5)
30 km/h * Post	-0.032	-0.023	-0.020**	-0.024***	-0.055
	(0.024)	(0.021)	(0.008)	(0.009)	(0.038)
30 km/h	-0.027*	-0.042***	-0.014*	-0.019**	-0.031
	(0.016)	(0.010)	(0.008)	(0.008)	(0.024)
N	3556	3359	10082	15872	1125
Share injuries	0.3636	0.3168	0.2711	0.3775	0.2959

Table E.12: Heterogeneity: Collision accident and safety measures

	Collision accident		**Belt/Helmet**	
	No	Yes	No	Yes
	OLS Switzerland, 2011-2016			
	(1)	(2)	(3)	(4)
30 km/h * Post	-0.027***	-0.009***	-0.009***	-0.025***
	(0.006)	(0.003)	(0.003)	(0.004)
N	34814	26213	17440	43587
Share injuries	0.4560	0.1269	0.2341	0.3610

	Diff-in-Diff Basel, 1995-2016			
	(1)	(2)	(3)	(4)
30 km/h * Post	-0.021**	-0.002	-0.005	-0.030***
	(0.009)	(0.008)	(0.005)	(0.011)
30 km/h	-0.019***	-0.033***	-0.022***	-0.019***
	(0.006)	(0.012)	(0.007)	(0.006)
N	12752	4245	6549	10448
Share injuries	0.3563	0.0895	0.1514	0.3793

Table E.13: Heterogeneity: Individuals involved

	Women		**Children**		**Senior**	
	None	Any	None	Any	None	Any
	OLS Switzerland, 2011-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.018***	-0.029***	-0.023***	-0.018	-0.025***	-0.020**
	(0.004)	(0.006)	(0.004)	(0.012)	(0.004)	(0.008)
N	25848	25913	45706	5999	40042	11663
Share injuries	0.3233	0.4285	0.3411	0.6433	0.3682	0.4081
	Diff-in-Diff Basel, 1995-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.022**	-0.035**	-0.033***	0.004	-0.019	-0.063***
	(0.011)	(0.016)	(0.010)	(0.038)	(0.012)	(0.017)
30 km/h	-0.027***	-0.021**	-0.026***	-0.030	-0.030***	-0.014
	(0.008)	(0.009)	(0.005)	(0.042)	(0.007)	(0.017)
N	6120	5894	10917	1091	9947	2061
Share injuries	0.3086	0.4935	0.3736	0.6599	0.3840	0.4745

Table E.14: Heterogeneity: Road width

	3m	4m	6m	8m
	OLS Switzerland, 2011-2016			
	(1)	(2)	(3)	(4)
30 km/h * Post	-0.015	-0.018***	-0.021***	-0.042***
	(0.011)	(0.004)	(0.005)	(0.013)
N	5416	35165	15257	5189
Share injuries	0.3414	0.3069	0.3536	0.3733

	Diff-in-Diff Basel, 1995-2016			
	(1)	(2)	(3)	(4)
30 km/h * Post	-0.014	-0.021*	-0.029**	-0.052***
	(0.037)	(0.012)	(0.013)	(0.014)
30 km/h	-0.005	-0.051***	-0.001	-0.016
	(0.021)	(0.013)	(0.009)	(0.009)
N	602	6360	5616	4419
Share injuries	0.3200	0.2671	0.3112	0.3266

Table E.15: Heterogeneity: Distance from points of interest

	Church		**Leisure**		**Sport**	
	$\leq$100m	>100m	$\leq$100m	>100m	$\leq$100m	>100m
	OLS Switzerland, 2011-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.011	-0.021***	-0.030**	-0.021***	-0.015**	-0.022***
	(0.009)	(0.004)	(0.014)	(0.004)	(0.008)	(0.004)
N	4807	56220	2829	58198	6592	54435
Share injuries	0.3337	0.3287	0.3392	0.3286	0.3458	0.3273
	Diff-in-Diff Basel, 1995-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.048*	-0.025***	-0.073***	-0.024***	-0.071***	-0.025***
	(0.025)	(0.008)	(0.021)	(0.008)	(0.025)	(0.008)
30 km/h	0.017	-0.024***	0.008	-0.022***	0.042	-0.020***
	(0.013)	(0.008)	(0.022)	(0.006)	(0.031)	(0.007)
N	1846	15151	1107	15890	837	16160
Share injuries	0.3524	0.2956	0.3245	0.3002	0.3184	0.3011

Table E.16: Heterogeneity: Distance from points of interest

	Education		**Park**		**Woods**	
	$\leq$100m	>100m	$\leq$100m	>100m	$\leq$100m	>100m
	OLS Switzerland, 2011-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.023***	-0.019***	-0.018**	-0.021***	-0.029***	-0.019***
	(0.005)	(0.004)	(0.007)	(0.004)	(0.008)	(0.004)
N	14292	46735	11390	49637	8157	52870
Share injuries	0.3339	0.3278	0.3445	0.3258	0.3095	0.3323
	Diff-in-Diff Basel, 1995-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.027*	-0.025***	-0.021*	-0.031***	-0.164**	-0.026***
	(0.016)	(0.009)	(0.012)	(0.009)	(0.069)	(0.008)
30 km/h	-0.018**	-0.020***	-0.040***	-0.010	-0.050	-0.021***
	(0.008)	(0.007)	(0.007)	(0.010)	(0.079)	(0.007)
N	3804	13193	5339	11658	261	16736
Share injuries	0.2930	0.3045	0.3255	0.2896	0.3169	0.3016

Table E.17: Heterogeneity: Distance from building zone

	Central		**Residential**		**Working**	
	$\leq$100m	$>$100m	$\leq$100m	$>$100m	$\leq$100m	$>$100m
	OLS Switzerland, 2011-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.018***	-0.022***	-0.019***	-0.019***	-0.042***	-0.017***
	(0.006)	(0.003)	(0.004)	(0.006)	(0.008)	(0.003)
N	18634	42393	41348	19679	12526	48501
Share injuries	0.3394	0.3241	0.3330	0.3222	0.3239	0.3308
	Diff-in-Diff Basel, 1995-2016					
	(1)	(2)	(3)	(4)	(5)	(6)
30 km/h * Post	-0.024	-0.026***	-0.026**	-0.029***	-0.044**	-0.026***
	(0.016)	(0.009)	(0.010)	(0.009)	(0.019)	(0.009)
30 km/h	-0.017	-0.021*	-0.007	-0.032***	0.011	-0.021***
	(0.010)	(0.011)	(0.010)	(0.007)	(0.009)	(0.007)
N	4094	12903	9229	7768	1821	15176
Share injuries	0.2957	0.3043	0.3011	0.3028	0.2788	0.3052

Table E.18: Heterogeneity: Distance from building zone

	Mixed		**Public**	
	$\leq$100m	$>$100m	$\leq$100m	$>$100m
	OLS Switzerland, 2011-2016			
	(1)	(2)	(3)	(4)
30 km/h * Post	-0.015***	-0.024***	-0.016***	-0.025***
	(0.004)	(0.004)	(0.004)	(0.004)
N	29895	31132	26193	34834
Share injuries	0.3268	0.3312	0.3396	0.3215
	Diff-in-Diff Basel, 1995-2016			
	(1)	(2)	(3)	(4)
30 km/h * Post	-0.025***	-0.026*	-0.039***	-0.020**
	(0.008)	(0.013)	(0.010)	(0.010)
30 km/h	-0.023***	-0.017	-0.002	-0.032***
	(0.007)	(0.011)	(0.009)	(0.008)
N	12631	4366	6824	10173
Share injuries	0.3146	0.2688	0.2966	0.3059

Table E.19: Heterogeneity: Density public transport stops

	Radius 100m		**Radius 250m**		**Radius 500m**		**Radius 1000m**	
	Low	High	Low	High	Low	High	Low	High
	OLS Switzerland, 2011-2016							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
30 km/h * Post	-0.018***	-0.025***	-0.021***	-0.018***	-0.019***	-0.021***	-0.016***	-0.023***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)
N	38080	22947	39678	21349	31338	29689	30875	30152
Share injuries	0.3138	0.3514	0.3317	0.3241	0.3265	0.3322	0.3197	0.3406
	Diff-in-Diff Basel, 1995-2016							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
30 km/h * Post	-0.024**	-0.030***	-0.036***	-0.022**	-0.024***	-0.030**	-0.026**	-0.031***
	(0.012)	(0.011)	(0.011)	(0.009)	(0.008)	(0.012)	(0.010)	(0.010)
30 km/h	-0.011	-0.029***	-0.009	-0.036***	-0.016*	-0.022***	-0.022**	-0.013*
	(0.009)	(0.007)	(0.009)	(0.009)	(0.008)	(0.007)	(0.010)	(0.007)
N	8821	8176	9132	7865	8406	8591	8255	8742
Share injuries	0.2513	0.3480	0.3026	0.3013	0.3060	0.2979	0.2921	0.3113

Table E.20: Heterogeneity: Density buildings

	Radius 100m		**Radius 250m**		**Radius 500m**		**Radius 1000m**	
	Low	High	Low	High	Low	High	Low	High
	OLS Switzerland, 2011-2016							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
30 km/h * Post	-0.025***	-0.017***	-0.026***	-0.015***	-0.022***	-0.020***	-0.020***	-0.019***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)
N	30482	30545	30374	30653	30475	30552	30152	30875
Share injuries	0.3413	0.3142	0.3390	0.3171	0.3303	0.3277	0.3317	0.3259
	Diff-in-Diff Basel, 1995-2016							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
30 km/h * Post	-0.023***	-0.027**	-0.027***	-0.031***	-0.025***	-0.036**	-0.027***	-0.027**
	(0.007)	(0.012)	(0.010)	(0.009)	(0.008)	(0.014)	(0.008)	(0.013)
30 km/h	-0.038***	-0.003	-0.024**	-0.013	-0.028***	-0.014	-0.020***	-0.019*
	(0.007)	(0.009)	(0.011)	(0.008)	(0.007)	(0.011)	(0.007)	(0.009)
N	9128	7869	8630	8367	8808	8189	8477	8520
Share injuries	0.3047	0.2985	0.2993	0.3050	0.2996	0.3047	0.3052	0.2986

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