Exploring the road safety impacts of public transport: a case study of Melbourne

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Abstract

This paper explores the impacts of travel to work by public transport on road safety at a macroscopic level using a case study of Melbourne. Random effect negative binomial regression is employed to model crashes at the statistical area level 2 (SA2). Results indicate that using public transport (i.e. train, tram, and bus) for travelling to work tends to reduce severe as well as total crashes, highlighting the great potential of public transport as a road safety solution. Safety issues related to cycling, walking, and motorcycling to work are also discussed.

Background

In 2018, there were approximately 1,150 road deaths in Australia and many more serious injuries, costing Australia around 1.7% of its GDP (BITRE, 2007, 2019). The current national road safety strategy's goal is unlikely to be met by 2020, despite significant investments on road safety. Overall, public transport is a relatively safe travel mode compared to private vehicle, in terms of fatality rates per trip and per passenger kilometre (Savage, 2013). Therefore, mode shift from private vehicle to public transport is now considered to be a potential means of improving road safety (Litman, 2016). This however is largely ignored in current Australian transport policies, road safety action plans, and the Safe System vision (ATC, 2011; TIC, 2016). Furthermore, little research has investigated how public transport travel contributes to road safety at a macroscopic level, which often showed mixed effects (Moeinaddini et al., 2015; Dong et al., 2016; Wang et al., 2017). This paper therefore aims to explore the impacts of travel to work by public transport on road safety at a macroscopic level using a case study of Melbourne.

Method

Random effect negative binomial regression is employed to model crash frequencies at the statistical area level 2 (SA2) in Melbourne, to account for spatial heterogeneity (Truong et al., 2016). Three models are developed for total crashes and severe (fatal and serious injury) crashes respectively. Population is used as the key exposure variables. Explanatory variables are selected based on a review of literature, including journey to work mode share (e.g. train, tram, bus, walk, bicycle, motorcycle, and car), transport network (e.g. intersections and public transport stops/stations), sociodemographic (e.g. income and age group), and land use characteristics (e.g. land use mix). Data are obtained from the 2016 ABS census and Victoria's open data directory, which are then aggregated into SA2 zones using ArcGIS. The modelling is conducted using NLOGIT.

Results

Modelling results are presented in Table 1. Results indicate that a higher proportion of travel to work by train is associated with fewer total crashes and severe crashes ($p<0.001$). Similarly, the proportions of travel to work by bus/tram are negatively associated with both total crashes and severe crashes ($p<0.01$). However, higher proportions of cycling/walking to work are associated with more total crashes and severe crashes ($p<0.001$). A higher proportion of motorcycling to work is also associated with more total crashes and severe crashes ($p<0.01$). Results also confirm expected effects of exposure and explanatory variables (e.g. population, the proportion of young people, number of signalized intersections, and public transport stops/stations).

Table 1 Results of random effect negative binomial regression for the frequency of total crashes and severe crashes

Variable	Total crashes		Severe crashes	
	Estimate	Std. Error	Estimate	Std. Error
Log of population	0.283 ***	0.03	0.352 ***	0.024
Proportion of people aged 0-14	-2.440 ***	0.394	-3.269 ***	0.318
Number of signalised intersections	0.015 ***	0.002	0.014 ***	0.001
Number of public transport stops/stations	0.005 ***	0.001	0.003 ***	0.000
Proportion of roads with a speed limit>100 km/h	10.262 ***	2.313	14.006 ***	1.556
Proportion of industrial area	1.026 ***	0.155	1.086 ***	0.099
Land use mix - entropy measure	-0.255 *	0.102	-0.408 ***	0.073
Proportion of commuting by train	-1.364 ***	0.255	-2.220 ***	0.179
Proportion of commuting by tram	-1.986 **	0.61	-3.857 ***	0.391
Proportion of commuting by bus	-3.315 ***	0.947	-4.687 ***	0.673
Proportion of commuting by cycling	3.816 ***	1.153	3.919 ***	0.694
Proportion of commuting by walking	2.765 ***	0.467	3.450 ***	0.292
Proportion of commuting by motorbike	30.724 **	10.095	31.609 ***	7.194
Intercept	2.236 ***	0.285	0.756 **	0.239
Standard deviation of parameter distribution	0.272 ***	0.016	0.393 ***	0.011
Dispersion parameter	15.970 ***	1.467	107.023 ***	30.291
Log likelihood	-1619.946		-1271.703	
Log likelihood (intercept only)	-1784.972		-1400.975	

Note: * p<0.05; ** p<0.01; *** p<0.001; all models were significant at p<0.001

Conclusions

Overall, it is evident that using public transport for travelling to work tends to reduce severe as well as total crashes, which highlights the great potential of public transport as a road safety solution. Road safety issues related to pedestrians, cyclists, and motorcyclists are also evident as crashes tend to increase with walking, cycling, and motorcycling to work.

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