ERSA 2017 Conference

Title: CO2 emission profiles for mobility behavior in Austria

Author: Julia Janke

Mobility is essential for high quality of life in modern times because it enables people to access labor markets, goods and services and enjoy recreational activities. However, transport is a major contributor to local and global environmental pollution. Hence, major efforts are required to achieve the EU climate goal of 80% CO_2 emission reduction by 2050. The transport sector is of special interest in Austria because it is a major contributor to the nationally generated greenhouse gas emission with a share of a about one quarter of GHG generated in Austria. In addition, it has been reported that on average every fourth way in Austria is related to work. Hence the provision of sustainable mobility solutions is essential for prosperity and a low carbon society.

This paper aims to assess drivers of transport-related CO_2 emissions based on an Austrian household survey and is driven by the following research questions: Which mobility-related CO_2 emission patterns can be observed in Austria? To which extent are mobility-related CO_2 emissions driven by household characteristics and structural factors?

Different factors affect the choice for low carbon transport modes on a household level. Economic activity, income, land use and socio-demographics are well approved variables driving travel behavior (Circella et al., 2016). Spatial pattern affects travel behavior and can be described by urban function and form. Urban function includes functional aspects of land use such as residence, education or employment (Wergles, 2012). Several studies have shown the impact of density and, land-use mix on travel behavior (cf. van Wee and Handy, 2016; Buehler, 2011; Ewing and Cervero, 2010; Meurs and Haaijer, 2001; Salon et al., 2012; Stead, 2001). For instance, for some countries and cities we observe that with increasing population density the share of private motorized transport decreases in the modal split (Grubler et al., 2012). Among others (Hickman and Banister, 2007; Newman and Kenworthy, 1988), Knoflacher et al. (2006) highlighted that population density per area of built land correlated with reduced energy consumption for transport. Moreover, personal attitudes, preferences and lifestyle are getting more and more in the focus of travel behavior research (Circella et al., 2016). In this context, intergenerational differences in travel behavior can be observed. For instance, younger generations, also called “Millennials”, show different mobility behavior than the previous “generation X” since they tend to drive less with cars, use information and communication technologies more often and perform multiple tasks while commuting (Circella et al., 2016). In addition, a life-orientated approach puts emphasis on the dynamic perspective of travel behavior by analyzing travel behavior along the life time of an individual and occurring life events (Fatmi and Habib, 2016; Holz-Rau and Scheiner, 2015)

Connecting travel behavior research with CO_2 emission footprints for mobility is important to provide evidence-based understanding and more effective policies to reduce environmental burden of the current transportation system. Western countries face high air pollution in urban environment, demographic change and dispersion of economic activity which challenge the provision of public

transport and hence low-carbon transport modes. Therefore, this research paper aims to contribute to a better understanding how preferences, socioeconomic characteristics and urban structure affect transport-related CO_2 emissions.

Our analysis is based on a representative (web-based) Austrian household survey (1449 observations) which has been conducted in February 2013 for the EU FP7 project DEFINE (Development of an Evaluation Framework for the Introduction of Electromobility) (Hanappi and Mayr, 2013). The survey provides information on typical mobility behavior such as trips to work, most often travelled trips and annual car usage. We developed two indicators to assess CO_2 emission profiles for Austrian households. The first indicator describes CO_2 emissions for trips that are travelled most often and is based on the trip distance and energy intensity of the chosen transport mode. Means of transport include non-motorized transport modes such as walking and cycling, motorized private transport (car, motorcycle) as well as public transport (bus, train, underground and tram). The second indicator illustrates CO2 emissions for annual car usage based on annually driven kilometers and vehicle characteristics (e.g. fuel economy). Multivariate analyses permitted to test the effects of socioeconomic characteristics, behavior and preferences of households on CO_2 emissions. In addition, another focus of analysis laid on the effect of agglomeration size on mobility and CO_2 emission pattern. Based on a heckman selection model with maximum likelihood estimation, we first model the selection equation which estimates the probability of positive CO_2 emissions (Heckman, 1976; Wooldridge, 2009). The second equation then estimates the level of positive CO_2 emissions for the main trip. Thereby, we suppose that persons do not randomly choose whether to cycle or to walk on their main trip. Relating to the CO_2 emission indicator for annual car usage, 108 persons are not included into the OLS regression analysis since they do not have a driver license or only drive very rarely.
Statistics of the survey indicate that the share of walking as main transport mode for a trip decreases sharply after the trip distance exceeds one kilometer. In addition, the use of underground and tram services remains relatively constant up to 10 kilometers of travelled trip distance and then decreases. Already for main trip distances of above one kilometer on average over 50% of the interviewed persons use private transport modes.

Our results show that the size of a city, work status and educational degree are important factors in determining transport-related CO_2 emissions. Employment and rising income contributes positively to CO_2 emissions generated by traveling the main trip. Persons with tertiary educational attainment in comparison to persons with primary educational attainment have a lower chance to use motorized transport modes for the main trip. In general, persons living in rural areas have a higher CO_2 emission profile than people in urban areas because typical trips are longer. In general, persons living in larger cities tend to have lower CO_2 emissions because availability and actual use of low carbon transport modes (public transport, walking, cycling) become more common.
Relating to annually driven kilometers, gender adds explanatory power since men drive more often and over larger distances. Also, educational status becomes relevant as higher educated people tend to travel by car more often. Likewise, employment adds CO_2 emissions in comparison to persons who are unemployed, on maternity leave or pensioner. With increasing age, persons tend to drive less often with

their car. However, small and slightly significant interaction effects between age and income indicate that with increasing income and age, persons drive more often. One explanation maybe that persons may move to less accessible areas with increasing income and age. In comparison to persons living in rural areas, persons in intermediately and densely populated areas have lower CO_2 emissions for annual car usage. Moreover, a positive environmental attitude does not directly affect CO_2 emissions generated by mobility for both indicators.

To conclude, long-term spatial planning should include enterprises and the private sector in the development of sustainable mobility concepts since the majority of persons indicated that their main trip is related to work. Next to household-specific drivers, external factors such as population size, availability of infrastructure and public services shape significantly CO_2 emission profiles of households. This paper contributes to the understanding on the interrelationship between both socioeconomic and structural drivers of mobility patterns which is necessary to drive behavioral change. A combined analysis of socioeconomic and spatial patterns informs urban and regional policies for effective low carbon mobility solutions.