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Do fewer people mean fewer cars? Population decline and car ownership in Germany

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ABSTRACT

Drawing on household data from Germany, this study econometrically analyzes the determinants of automobile ownership, focusing specifically on the extent to which decreases in family size translate into changes in the number of cars at the national level. Beyond modeling several variables over which policy makers have direct leverage, including the proximity of public transit, fuel prices and land use density, the analysis uses the estimated coefficients from a multinomial logit model to simulate car ownership rates under alternative scenarios pertaining to demographic change and other socio-economic variables. Our baseline scenario predicts continued increases in the number of cars despite decreases in population, a trend that is attributed to continued increases in household income.

1. Introduction

In Germany, as elsewhere in the industrialized world, the demand for automobiles has grown substantially in the last decades. Between 1995 and 2009, the car ownership rate increased by roughly 32%, from 417 to 551 cars per 1000 inhabitants (EEA, 2012). At the same time, the share of carless households in the country has been markedly decreasing, from 38% in 1976 to 19% in 2002 (Buehler and Kunert, 2008, p. 9). Understanding the determinants of these trends has emerged as a major priority within the scientific and policy arenas given the range of externalities associated with the automobile, including air and noise pollution as well as congestion, accidents, and land use considerations.

The incidence of car ownership in Germany is of particular interest for several reasons. First, as Europe's largest car market, the country is a major source of transport emissions, accounting for some 19% of the EU-15 total in 2005 (EEA, 2008). Moreover, the German government has for many years pursued policies that combine high fuel taxes with land use planning measures to reduce automobile dependency (BBR, 1993). Perhaps most significantly, like in many other countries of Europe, major socio-demographic changes are currently underway in Germany that could dramatically affect future automobile ownership. Between 2000 and 2010, for example, the birth rate decreased some 10.7%, from 9.3 to 8.3 births/1000 population, having already decreased 18.4% over the preceding decade (STABUA, 2010). By 2050, Germany's population is projected to shrink by roughly 16% (STABUA, 2006), a trend that will be paralleled by an increasingly older age structure of the German population and an increase in the number of single person households. While several studies have suggested that these changes will have profound consequences for transport demand in Germany (e.g. Limbourg, 2004; Just, 2004; Zumkeller

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et al., 2004), the anticipated impacts are largely speculative, and there have been few attempts to quantify how the underlying variables affect automobile ownership at the household level.

Drawing on travel survey data, the present study aims to address this issue by exploring the implications of household-level socio-demographic changes for car ownership at the national level. The analysis proceeds in two steps. We begin by estimating a multinomial logit model of the determinants of car ownership. The model specification includes a rich array of explanatory variables, many of which, such as fuel prices and the accessibility of public transit, have immediate relevance for policy but have rarely been parameterized using household level data. Following validation of the model by comparing the in-sample predictions with national car-ownership figures, the second step uses the model coefficients to simulate car-ownership levels under alternative scenarios about the future trajectory of key explanatory variables. We are particularly interested in the effects of demographic change, and to this end draw on population projections published by Germany's Federal Statistical Office.

Our baseline scenario, which assumes decreases in the overall population coupled with increases in the number of one-person households, the share of the elderly, income, and fuel prices, indicates that the increase in car ownership will continue despite population decline, albeit at a slightly abbreviated pace relative to recent years. Nevertheless, this result is found to be strongly dependent on assumed increases in income. Alternative scenarios reveal rather limited scope for reducing the number of cars through increases in land use density. We also uncover evidence for a negative association of public transit service with the proclivity to own a car. Taken together, these results can be used to assess the country's future infrastructure needs and how these needs may be altered by public policy.

The remainder of the paper is organized as follows. Section 2 anchors the present analysis in the larger literature on car ownership, focusing primarily on those studies that use household data to parameterize the determinants of car ownership levels. Section 3 describes the econometric model employed, while Section 4 presents the assembly of data sources used in the analysis as well as the hypothesized effects of the modeled variables. The coefficient estimates are described in Section 5, followed by a simulation exercise demonstrating alternative trajectories of future car ownership levels in Section 6. The final section concludes.

2. Literature review

Much of the contemporary empirical work on automobile ownership has been influenced by Train's (Train, 1986) seminal book covering the theory and econometrics of qualitative choice models and applying these to the question of automobile demand. This volume is of particular relevance to the development of disaggregate models of the individual decisions underpinning car ownership, as distinguished from aggregate models based on market-level data. An excellent overview of both approaches is provided by de Jong et al. (2004), who compare different empirical methodologies including aggregate time series models, aggregate car market models, static disaggregate car ownership models, and dynamic car transaction models. A more recent review is provided by de Jong and Kitamura (2009), who specifically cover disaggregate vehicle ownership models, the focus of the current study.

As Train (1986, p. 3) notes, studies using disaggregate data offer unique insights not only because they capture the determinants of individual behavior that give rise to aggregate outcomes, but also because they typically contain greater variation in each modeled factor than in aggregate data, making more precise estimation of the underlying parameters possible. Among the more recent articles that use household data to model car ownership, Whelan (2007), undertakes a detailed analysis of income and demographic structure, finding both factors to be important predictors of the number of cars owned. Other issues covered in this research include the role of employment status (Raphael and Rice, 2002; Matas et al., 2009), the costs of car acquisition and motoring (Dargay, 2002), and the influence of car-sharing (Prettenthaler and Steininger, 1999). A relatively smaller body of work has addressed the impact of urban form and preferences thereof on household mobility in general (Eluru et al., 2009) and specifically on car ownership. Studies in this vein using North American data include Potoglou's (Potoglou, 2008) analysis of the effect of neighborhood characteristics on the type of vehicle owned, and Bento et al.'s (2005) investigation of city shape, the supply of public transit, and other aspects of urban spatial structure.

International evidence on the effect of urban form beyond the North American context has also emerged. Zegras (2010) and Zegras and Hannan (2011), for example, provide relevant evidence in rapidly urbanizing Latin America, focusing on urban design and public transport accessibility in Santiago de Chile. Using data from China, Wu et al. (1999) apply the concept of *symbolic utility* to investigate the role of psychological and sociological factors in the early stages of motorization, while Li et al. (2010) study different dimensions of urban form on car ownership in 36 Chinese megacities. Karlaftis and Golias (2002), who analyze the role of urban traffic parameters such as speed and parking availability in Athens, Greece, is one of the few studies of the link between urban form and car ownership in a European context.

While Germany is, by most accounts, a highly car-enthusiastic country – indeed, it is the only country in the European Union in which car sales over the past five years have not been declining – there is relatively little research on the determinants of car ownership in Germany. Frondel and Vance (2009) estimate a joint model of car ownership on German data, but their analysis simplifies the ownership decision to a binary outcome and focuses primarily on vehicle mileage. Buehler et al. (2009) undertake a descriptive analysis that, among other issues, compares car ownership levels in the US and Germany and the public policies that give rise to observed differences. They point to higher land use densities and a more extensive public transportation system as being among the key factors that have contributed to lower car dependency relative to the US. The