Transport Reviews, Vol. 32, No. 5, 541–567, September 2012

Routledge
Taylor & Francis Group

Demand for Public Transport in Germany and the USA: An Analysis of Rider Characteristics

RALPH BUEHLER* AND JOHN PUCHER**

**School of Public and International Affairs, Virginia Tech, Alexandria, VA, USA; **Bloustein School of Planning and Public Policy, Rutgers University, New Brunswick, NJ, USA*

(*Received 23 March 2012; revised 12 June 2012; accepted 26 June 2012*)

ABSTRACT *This paper first provides a brief review of trends in public transport demand from 1980 to 2010 in 16 countries in Europe, North America, and Australia. The focus, however, is on a detailed analysis of public transport demand in Germany and the USA, using uniquely comparable national travel surveys from 2001/2002 and 2008/2009 for both countries. Public transport has been far more successful in Germany than in the USA, with much greater growth in overall passenger volumes and trips per capita. Even controlling for differences between the countries in demographics, socio-economics, and land use, logistic regressions show that Germans are five times as likely as Americans to use public transport. Moreover, public transport in Germany attracts a much broader cross-section of society and for a greater diversity of trip purposes. The success of German public transport is due to a coordinated package of mutually supportive policies that include the following: (1) more and better service, (2) attractive fares and convenient ticketing, (3) full multimodal and regional integration, (4) high taxes and restrictions on car use, and (5) land-use policies that promote compact, mixed-use developments. It is the integrated package of complementary policies that explains why public transport in Germany can compete so well with the private car, even among affluent households. Conversely, it is the lack of complementary policies that explains the continuing struggle of public transport in the USA.*

Introduction

For many decades, public transport has been struggling to compete with the automobile. Around the world, the rates of car ownership have been increasing as incomes rise and cars become more affordable. The continuing decentralization of cities into suburban and exurban areas has generated land-use patterns and trips that are difficult for public transport systems to serve. Especially during the decades immediately following the Second World War, demand for public transport declined, first in North America but then in Western Europe as well (Cervero, 1998; Downs, 2004; Dunn, 1981, 1998; Pacione, 2009; TRB, 2001; Webster & Bly, 1981, 1982; Yago, 1984).

Since the 1960s and 1970s, however, the number of annual public transport passengers in North America and Western Europe has generally been increasing. Although there is much variation among countries, the market share of public transport has stabilized in most countries (European Commission, 2011; ITF,

Correspondence Address: Ralph Buehler, School of Public and International Affairs, Virginia Tech, Alexandria Center, 1021 Prince Street, Suite 200, Alexandria, VA 22314, USA. Email: ralphbu@vt.edu; ralph. buehler@gmail.com

0144-1647 print/1464-5327 Online/12/050541-27

http://dx.doi.org/10.1080/01441647.2012.707695

2011). It is encouraging that public transport has succeeded in raising overall passenger levels and maintaining its market share in spite of rising incomes and car ownership and extensive, car-oriented suburban sprawl.

This paper first provides a brief review of international trends in public transport demand from 1980 to 2010, documenting the differences among countries. It then focuses on a detailed analysis of public transport demand in Germany and the USA, using uniquely comparable national travel surveys from 2001/2002 and 2008/2009 for both countries. The questions of particular interest are as follows:

(1) Who rides public transport (disaggregated by gender, age, employment status, income, car ownership, city size, population density, and urban versus rural location)?
(2) What trip purposes does public transport serve (trips to work, school, shopping, recreation, and visiting friends and family)?
(3) How do rider characteristics and trip purposes differ between Germany and the USA, and how have they changed over time?

As this paper demonstrates, Germany has been much more successful than the USA at raising public transport use, both on a per capita basis and as a market share of total urban travel. We conclude the paper with an examination of the public policies in Germany that have contributed to the impressive success of public transport and draw lessons that might be useful for other countries.

International Overview of Public Transport Demand

As shown in Figure 1, per capita levels of public transport use vary by roughly 10:1, ranging from 237 trips per year in Switzerland to only 24 trips per year in the USA. It may seem surprising that the Netherlands has the second lowest number of trips per capita (51), but that is due to the extraordinary importance of cycling, which accounted for 26% of all trips by the Dutch in 2008, the highest bike share of any European country (Pucher & Buehler, 2010, 2012). It is noteworthy that Canada has more than twice the level of public transport use in the USA, probably due to more compact settlement patterns, lower car ownership, higher fuel prices, and earlier public ownership, operation, and financing of public transport systems (Filion, Bunting, McSpurren, & Tse, 2004; Grant, 2002; Miron, 2003; TRB, 2001). All of the European countries shown in Figure 1 have much higher public transport use than that in the USA, but even within Europe, there are large differences. Studies suggest that the greater demand for public transport in Europe is due to higher density cities, much higher taxes on fuel and car purchases, less (and more expensive) car parking, and a wide range of restrictions on car use in cities. In addition, European cities generally offer more and better public transport services than the USA (Cervero, 1998; Mees, 2010; Newman & Kenworthy, 1999; Pucher & Kurth, 1996; TRB, 2001; Vuchic, 1999).

An alternative indicator of public transport demand is the mode share of public transport as a percentage of trips by all means of travel. Figure 2 shows trends in mode share over the past three decades for ten countries. Similar to the per capita trip numbers shown in Figure 1, Switzerland also has the highest share of trips by public transport ($>$20%), roughly two to three times higher than that in the other European countries (5–11%) but ten times as high as that in the USA ($<$2%). The mode share of public transport has been fairly stable in all the countries.

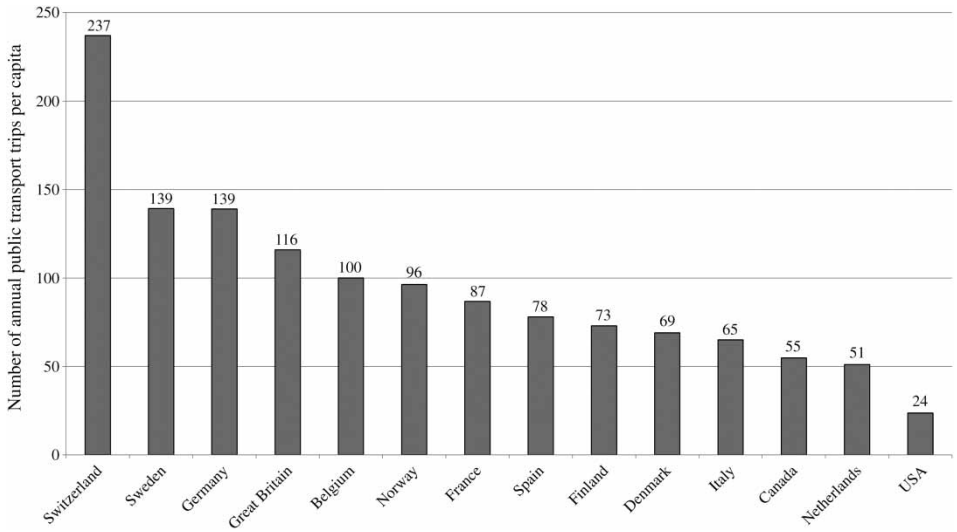

Figure 1. Number of annual public transport trips per capita in Europe and North America, 2005–2010.

Note: Due to differences in survey design, trip definitions, and timing, travel survey results among countries are not entirely comparable.

Sources: APTA, 2012; BFS, 2011; BMVBS, 1991–2012; CBS, 2011; DfT, 2011; DMT, 2010; ITF, 2011; SIKA, 2007; SOeS, 2010; TOI, 2011; USDOT, 2010; WSP, 2006.

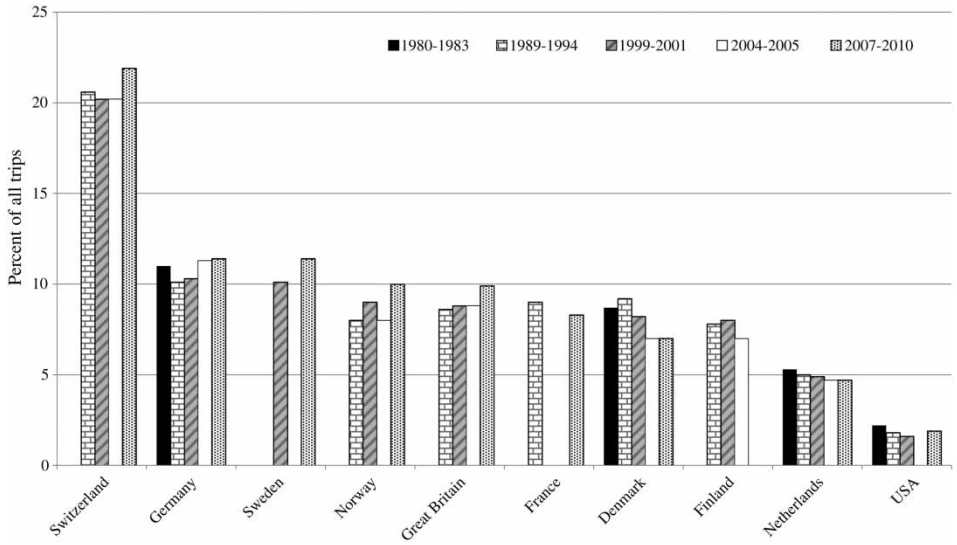

Figure 2. Percentage of trips by public transport (all trip purposes).

Notes: Due to differences in survey design, trip definitions, and timing, travel survey results among countries are not entirely comparable. Data for the German survey in 1980 are for West Germany only. Data for German surveys from 1993 to 2010 are for the re-unified Germany. Survey data were collected for the following specific years in each country: Switzerland (1990, 2000, 2005, 2010); Germany (1980, 1993, 2000, 2005, 2010); Sweden (1999, 2007); Norway (1992, 2001, 2005, 2009); Great Britain (1989, 2000, 2005, 2010); France (1994, 2008); Denmark (1981, 1992, 2005, 2009); Finland (1992, 1999, 2005); Netherlands (1990, 2000, 2005, 2010), and USA (1982, 1990, 2001, 2009).

Sources: APTA, 2012; BFS, 2011; BMVBS, 1991–2010; CBS, 2011; DfT, 2011; DMT, 2010; ITF, 2011; SIKA, 2007; SOeS, 2010; TOI, 2011; USDOT, 2010; WSP, 2006.

It increased slightly in Switzerland, Germany, Sweden, Norway, and the UK and decreased slightly in France, Denmark, Finland, and the Netherlands. These aggregate national statistics mask variation within countries. For example, public transport use rose considerably in London but declined in many other British metropolitan areas (DfT, 2010).

Whereas Figure 2 shows mode share for all trip purposes combined, Figure 3 only reports mode share for the trip to work. Because Ireland, Canada, and Australia do not have national travel surveys, the only information available on mode shares is from their censuses, which report the share of workers using public transport as their main means of travel for the journey to work. For comparison, mode shares of workers in Germany and the USA are also shown.

The largest increase in public transport mode share for work commuters was in Germany, rising from about 13% in 1993 to 16% in 2008. The censuses for Canada and Australia report slight increases in public transport mode share over the past two decades, while mode share declined in Ireland. There has been almost no change in the share of American workers commuting by public transport, remaining about 5%, a third as high as the share in Germany.

It is beyond the scope of this paper to analyse in depth the many possible reasons for the variation among the countries included in Figures 1–3. These three exhibits are mainly intended as an overview to provide the international context for the detailed analysis of public transport demand trends and patterns in Germany and the USA, which is the focus of this paper.

Long-Term Trends in Public Transport Demand in Germany and the USA

Public transport use plummeted in the USA after the Second World War from 16.4 billion trips in 1945 to only 4.7 billion in 1973 (Figure 4). The loss of 13.7 billion passengers reduced overall demand by almost three-fourths. The initial decline

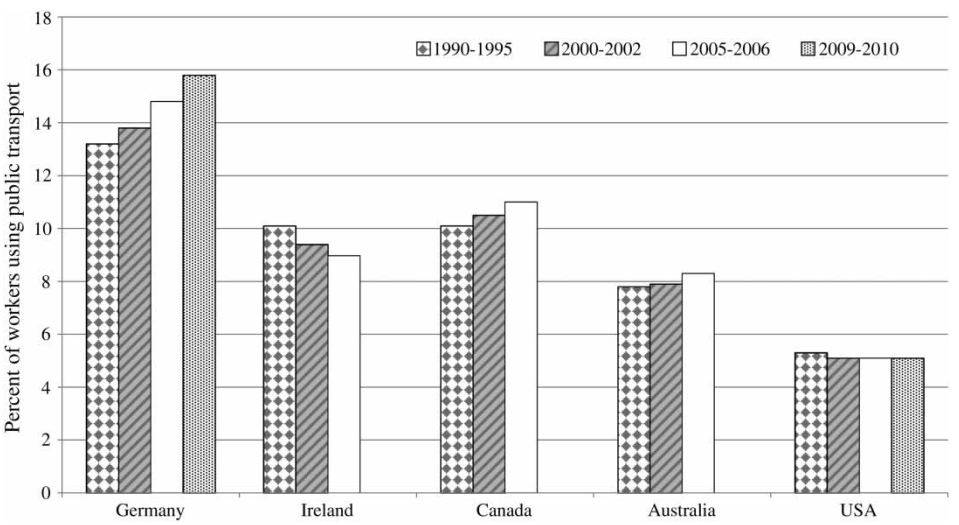

Figure 3. Percentage of workers using public transport as main means of transport to work.
Notes: Due to differences in survey design, trip definitions, and timing, travel survey results among countries are not entirely comparable. Survey data were collected for the following specific years in each country: Germany (1993, 2000, 2005, 2010); Ireland (1991, 2002, 2006); Canada (1996, 2001, 2006), Australia (1991, 2001, 2006); and USA (1990, 2000, 2005, 2010).
Sources: ABS, 2011; BMVBS, 1991–2012; CSO, 2010; StatCan, 1996-2010; USDOT, 2000–2012.

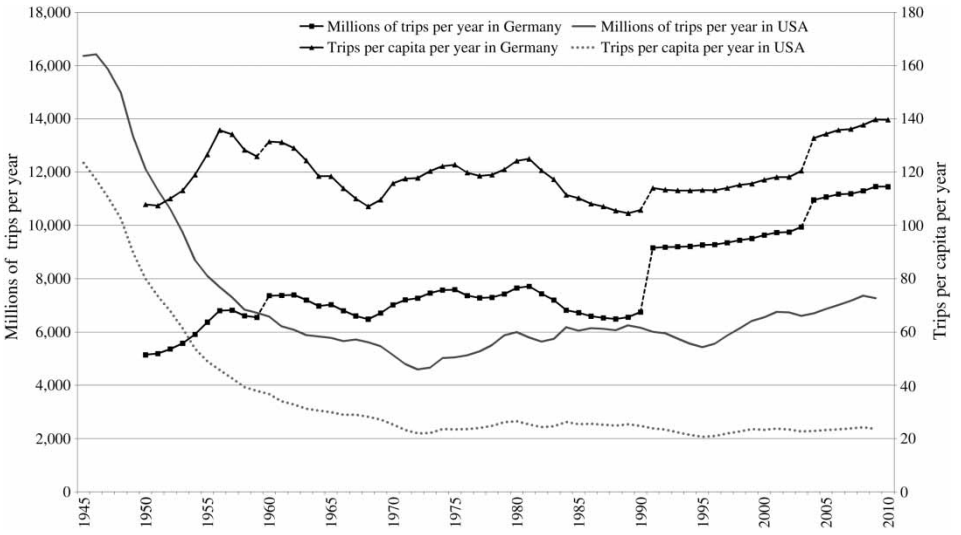

Figure 4. Trend in total public transport trips and trips per capita in Germany and the USA, 1945–2010.

Notes: Data from 1950 to 1990 are for West Germany only. West German data from 1950 to 1960 exclude West Berlin and the Saarland. German data from 1991 to 2010 are for the re-unified Germany, including the former East Germany. The strong increase in Germany between 2003 and 2004 is a statistical artifact due to a change in data collection methodology. Public transport trips as shown in this graphic are defined from origin to destination; thus, a trip involving transfers between public transport lines or modes is counted as one trip (technically designated as a linked trip). Since 1970 official data for the USA report unlinked trips, with transfers counted as additional trips. This study converted the unlinked trips to linked trips in order to ensure comparability with Germany, using a methodology explained in Polzin and Chu (2003).

Source: APTA, 2012; BMVBS, 1991–2012.

was due to the ending of wartime fuel and tire rationing and the resumption of car production, which had been interrupted by the use of factories to construct military vehicles. Throughout the 1950s and 1960s, however, rapidly rising per capita income and car ownership—as well as the resulting proliferation of car-oriented suburban sprawl—undermined public transport demand (Altshuler, Womack, & Pucher, 1979; Yago, 1984). The lack of public financing led to rising fares, deteriorating service, and widespread bankruptcies of public transport firms throughout the country. Streetcar services were almost completely terminated and only partially replaced by bus services. By 1970, most public transport services in the USA were poorly maintained, undependable, and uncoordinated (Altshuler et al., 1979; Dunn, 1981; Yago, 1984).

During the 1970s, however, there was dramatic growth in federal government support for public transport, including both capital and operating subsidies. State and local government support also increased, with an almost complete transition to public ownership, management, and financing by the end of the 1970s (Pucher, Markstedt, & Hirschman, 1983). There was a turnaround in public transport demand in the mid-1970s, thanks to the considerable expansion and improvement of public transport services enabled by government funding. Although there have been many ups and downs, the general trend since 1973 has been upward. The biggest increase was from 1973 to 1980 (from 4.7 to 6.0 million passengers) when

the infusion of government funding was most dramatic. Since 1980, growth has been modest but steady, rising to 7.2 billion passengers by 2010 (APTA, 2012). In general, short-term declines in passengers have been due to recessions, while short-term spurts in demand have been due to economic booms or sharp rises in fuel prices.

Overall, it was a considerable accomplishment turning around the dramatic fall in public transport demand between 1945 and 1973. The total number of passengers rose by 57% between 1973 and 2010. Nevertheless, demand for public transport barely kept pace with overall population growth, with only a slight increase in trips per capita (from 22 in 1973 to 24 in 2010). This is consistent with the roughly constant mode share of public transport shown for the USA in Figures 2 and 3. Moreover, the revival of public transport in the USA required an enormous infusion of subsidy funds. Including all levels of government and both capital and operating subsidies, total financial assistance between 1975 and 2010 exceeded $830 billion in inflation-adjusted, constant 2010 dollars, averaging more than $23 billion per year (APTA, 2012; USDOT, 2012a).

There are no statistics available for Germany for the years immediately after the Second World War. From 1950 to 1956, however, public transport demand rose sharply (Figure 4). Much of the public transport infrastructure had been destroyed during the war, but by the early 1950s, most of the infrastructure was restored or at least repaired enough so that it was again usable (Baron, 1995). In the 1950s, the West German economy began its strong recovery, with increasing employment and more trips to work. Because car ownership was still low (80 cars per 1000 population), most travel was by public transport, walking, and cycling (BMVBS, 1991–2012). Moreover, after the Second World War, over 6 million ethnic Germans from Poland, Czechoslovakia, and other Soviet-occupied countries in Eastern Europe fled to West Germany (Baron, 1995). Crowded urban areas, increasing employment, and low car ownership levels contributed to rising demand for public transport in West Germany in the 1950s (Yago, 1984).

Eventually, however, the economic recovery in West Germany led to steady increases in per capita income, rising car ownership, and declining demand for public transport (Baron, 1995; Dunn, 1981; Yago, 1984). Overall, the total number of public transport passengers in West Germany fell by only 1% between 1956 and 1968, but trips per capita fell from 136 to 107, a 21% decline. During the same period, motorization almost tripled, reaching 230 cars per 1000 population in 1968 (BMVBS, 1991–2012). Moreover, in response to crowded housing in cities, the federal government subsidized the construction of single-family houses at the urban fringe (Baron, 1995; BMVBS, 2008; Yago, 1984).

Public transport operators were not able to serve new low-density suburban locations. At the same time, the federal government subsidized reconstruction and expansion of the federal highway network, and most cities widened urban roads, built new arterial highways, and constructed parking garages in their city centres (Koeberlein, 1997). Faced with increasing competition from the automobile and decreasing demand for public transport, West German public transport systems reduced or cut services, replaced trolley services with buses, and raised fares (Baron, 1995; Schmucki, 2001; Yago, 1984).

Between 1968 and 1982, public transport demand increased from 6.4 to 7.7 billion passengers per year and from 107 to 125 annual trips per capita. This increase is partially explained by the two oil price shocks of the 1970s. Over the same period, public transport services were expanded and improved, thanks to federal government subsidies for capital investments in local public transport.

As in the USA, during the 1980s, governments in West Germany decreased their subsidies for public transport. By 1989, the year before German reunification, public transport demand had fallen by about 15% to 6.5 billion annual passengers or 105 trips per capita. Data shown in Figure 4 from 1991 onwards are for the reunified Germany and show a steady increase from 9.2 billion passengers in 1991 to 11.5 billion in 2010. Per capita ridership increased from 114 to 139 trips per person per year. The increase in ridership in the 1990s was concentrated in the former West Germany. Between 1990 and 2000, public transport demand in the cities of former East Germany fell from 24% to 12% of trips (Broeg & Erl, 2003). Moreover, motorization more than doubled in the former East Germany from 237 to 499 cars per 1000 inhabitants (BMVBS, 1991–2012). In contrast, public transport demand in the former West Germany increased by 20% during the 1990s—offsetting the steep decline in the former East Germany. Since the early 2000s, public transport demand has been increasing throughout Germany.

Rising public transport demand in Germany since 1990 is partly explained by a doubling in the gasoline (petrol) tax from $0.41 per litre in 1990 to $0.88 per litre in 2010. Moreover, public transport systems have greatly improved their services through regional coordination of ticketing and timetables, new vehicles, real-time information at stations and on vehicles, and discounted monthly, semester, and annual tickets. Recent policies of German public transport agencies and governments are discussed in more detail later in this paper. The next sections focus on a detailed comparison of public transport demand in Germany and the USA in 2001/2002 and 2008/2009.

Similarity of German and American Travel Surveys in 2001/2002 and 2008/2009

International comparative studies of travel behaviour typically are hampered by inconsistencies among country surveys in their timing, variable definitions, and survey methodology (Bassett, Pucher, Buehler, Thompson, & Crouter, 2008; Buehler, Pucher, Merom, & Bauman, 2011; Kunert, Kloas, & Kuhfeld, 2002; Pucher, Buehler, Merom, & Bauman, 2011). In contrast, the Mobility in Germany (MiD) surveys of 2002 and 2008 are almost entirely comparable with the 2001 and 2009 National Household Travel Surveys (NHTS) in the USA. They are similar in their design and timing in almost every respect and thus offer a unique opportunity to compare public transport demand in two countries. Although the two countries' survey names differ by 1 year, their data collection periods are almost identical. Indeed, both surveys would be more accurately designated by their actual survey periods of 2001/2002 and 2008/2009.

Table 1 compares the MiD survey and NHTS along many dimensions. For both years, each country's surveys used almost identical data collection methods and included virtually the same variables. The surveys are so similar because German researchers used the 2001 NHTS as a model for their 2002 MiD survey. In fact, because of changes in methodology starting with the 2001 NHTS, and copied by the 2002 MiD, the NHTS and MiD survey are more comparable to each other than to any earlier surveys within their respective countries. The data collection period was 14 months for all four surveys. After being contacted by phone and agreeing to participate, all US households completed a computer-assisted telephone interview (CATI). Most German households also completed the survey using CATI; only 17% of households completed the survey online or on paper.

Table 1. Comparability of German and US travel surveys 2001/2002 and 2008/2009

	MiD 2001/2002 and 2008/2009 (Germany)		NHTS 2001/2002 and 2008/2009 (USA)	
Collection rhythm	Kontinuierliche Verkehrserhebung (KONTIV) '76, '82, '89; MID '02, '08		Nationwide Personal Transportation Survey '69, '77, '83, '90, '95; NHTS '01, '09	
Survey period	14 months		14 months	
	11/2001–12/2002	02/2008–04/2009	03/2001–04/2002	03/2008–04/2009
Sample size				
Households	25, 848 (2002)	25, 922 (2008)	69, 817 (2001)	150, 147 (2009)
Individuals	61, 729 (2002)	60, 713 (2008)	162, 758 (2001)	304, 184 (2009)
Survey method	CATI (95% in 2002 and 83% of households in 2008)		CATI (100% in 2001 and 2009)	
Target population	Civilian population			
Eligibility of household members	Adults and all children in 2002 and 2008		Adults and all children in 2001; adults and children aged 5 years and older in 2009	
Sampling technique	Stratified random sample			
Data collection period per respondent	1-day travel diary for randomly assigned travel day			
Response rates (% of households)	42% (2002)	21% (2008)	41% (2001)	20% (2009)
Inclusion criterion for households	At least 50% of household members responding		At least 50% of household members over 18 years old responding	
Weights	Selection reciprocal, non-response, household size, weekday, month, regional characteristics; trimming of large weights			
Data level	Household, person, trip, car			
Representative	For nation and individual states		For nation and individual census regions	
Definition of trips	From one address to another			

Sources: Infas and DLR, 2010; DIW, 2004; Kunert et al., 2002; USDOT, 2010.

All household members recorded their travel in a 1-day travel diary during a randomly assigned day. The diary helped respondents report their travel day activities in a subsequent phone interview. All surveys included adults and children as target population. Travel information for children aged <15 years was collected through proxy interviews with parents.

Recent Trends in Public Transport Demand in Germany and the USA

As discussed above, the two most recent national travel surveys in Germany and the USA are almost entirely comparable. Moreover, the two countries are similar

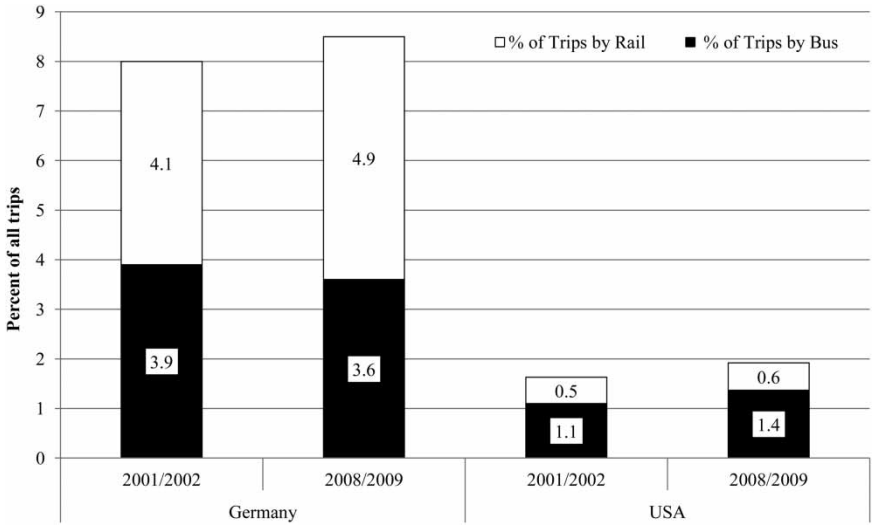

Figure 5. Percentage share of trips by rail and bus in Germany and the USA, 2008/2009.
Note: Rail includes light rail/streetcar, suburban/regional rail, and metro/subway.
Source: Authors' calculations based on NHTS and MiD.

in many ways that enable meaningful comparisons of public transport demand (International Monetary Fund, 2008; Wentzel & Wentzel, 2000). Both Germany and the USA are affluent countries with market economies and federal systems of democratic government. Both countries have vast roadway systems, high rates of car ownership, and roughly the same proportion of licensed drivers (BMVBS, 1991–2012; IRF, 2007; USDOT, 1990–2012). Just as in the USA, most suburban development in Germany occurred after the Second World War during a period of rapid motorization (Baron, 1995; BMVBS, 2000; Jackson, 1985). In spite of these similarities, there are significant differences between the two countries in public transport demand.

Differences Between Bus and Rail

In 2008/2009, both bus and rail accounted for a higher share of trips in Germany than in the USA (Figure 5). The bus share of trips in Germany was 2.6 times greater (3.6% versus 1.4%) and the rail share of trips was 8.2 times greater (4.9% versus 0.6%). Buses accounted for the vast majority (70%) of public transport trips in the USA, compared with only 42% in Germany. During the last decade, the percentage of trips by bus in Germany decreased from 3.9% to 3.6% of trips, while demand for rail travel (suburban rail, metro, light rail, and streetcars) increased from 4.1% to 4.9% of trips. Shifting demand from bus to rail in Germany may be partially explained by changes in public transport supply. Between 2000 and 2010, vehicle kilometres of bus service in Germany declined by 11%, while vehicle kilometres of rail service increased by 10% (Destatis, 2012; VDV, 2001–2008, 2011).

From 2001/2002 to 2008/2009, the NHTS indicate a slightly larger percentage point increase in mode share for bus than for rail in the USA (+0.3% versus +0.1%). Adjusting for the higher initial mode share for bus, however, the percentage growth rate in mode share was roughly the same (+25%) for bus and rail.

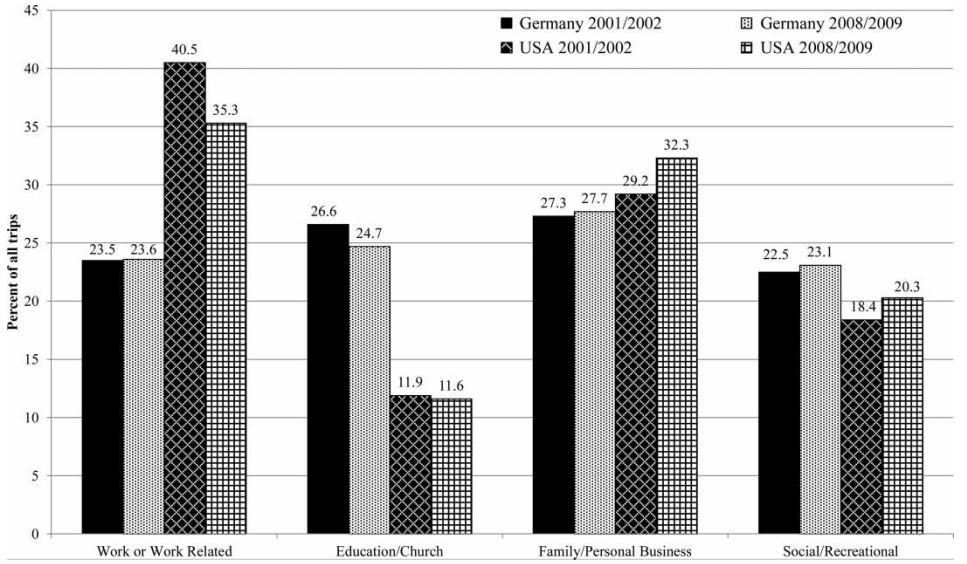

Figure 6. Main purpose of public transport trips in Germany and the USA, 2001/2002 and 2008/2009.
Note: The category 'family and personal business' includes trips for shopping, doctor's visits, daycare, dog walking and other animal care, transporting someone else, using professional services, and attending family events.
Source: Authors' calculations based on NHTS and MiD.

During the same time period, vehicle kilometres of service increased at similar rates for bus (+15%) and rail (+18%) (APTA, 2012).

Trip Purpose

During both the survey periods, work and work-related trips accounted for a much higher share of public transport trips in the USA than in Germany (40.5% versus 23.5% in 2001/2002 and 35.3% versus 23.6% in 2008/2009) (Figure 6). Compared with Germany, public transport use in the USA is more concentrated during the peak hours, dominated by commuter travel from the suburbs to central cities in the morning and from central cities back to the suburbs in the evening.

Nevertheless, the share of public transport trips for work declined in the USA between the two survey periods (from 40.5% to 35.3%), while the share of work trips in Germany remained stable (23.5% versus 23.6%). Over the past three decades, both countries have experienced an overall decline in the relative importance of work trips for urban travel. In the USA, the share of work trips (for all modes of transport combined) fell from 20% in 1983 to 16% in 2008/2009 (USDOT, 2011). In Germany, the work share of all trips fell from 21% in 1982 to 14% in 2008/2009 (Infas & DLR, 2010). The continued decline in work trips over the last decade in the USA may be partly due to the economic recession in the USA during the survey period in 2008/2009. The worldwide recession affected Germany to a lesser degree than the USA, which may help explain Germany's stable share of work trips by public transport between 2001/2002 and 2008/2009.

In 2001/2002 and 2008/2009, education accounted for twice as high a share of public transport trips in Germany as in the USA: 26.6% versus 11.9% in 2001/2002 and 24.7% versus 11.6% in 2008/2009. In the USA, most school systems

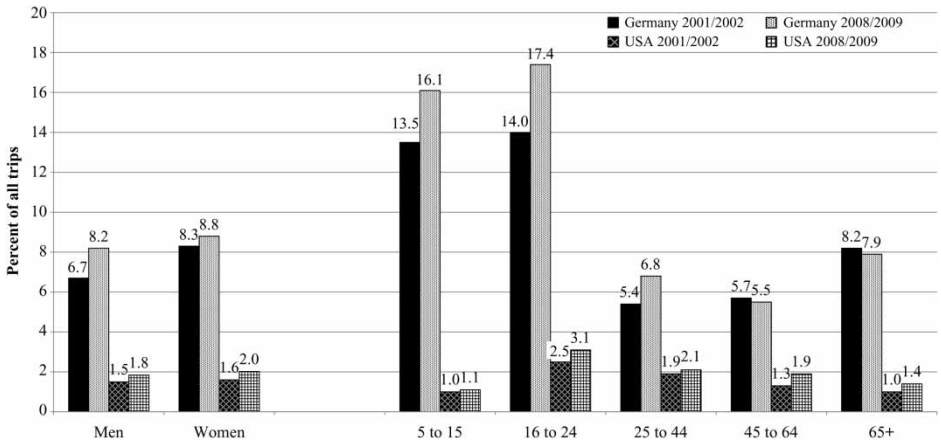

Figure 7. Percentage share of trips by public transport in Germany and the USA by gender and age group, 2001/2002 and 2008/2009.

Source: Authors' calculations based on NHTS and MiD.

provide their own fleets of school buses; indeed, for the country as a whole, there were five times more school buses than public buses in 2010 (USDOT, 2012b). In a few large American cities, school children also ride public transport, but in most of the USA, separate school bus systems are the norm, especially in the suburbs. In contrast, German children generally ride public transport (or walk or bike) for their trips to and from school. The lack of American school children's experience with public transport probably discourages their use of public transport later in life as well. By comparison, many German children learn how to use public transport on their daily trips to school, thus facilitating their use of public transport as adults.

Nevertheless, the share of public transport trips for education declined in Germany from 26.6% to 24.7%. This decline is probably due to the falling share of children in the rapidly ageing German population (Buehler & Nobis, 2010; Destatis, 2010). The combined share of family/personal business and social/recreational trips rose in both countries, from 49.8% to 50.8% in Germany and from 47.6% to 52.6% in the USA.

Differences in Rider Age and Gender

In both Germany and the USA, women use public transport more than men (Figure 7). Between the two survey periods, however, there was a considerable increase in men's use of public transport in Germany (from 6.7% to 8.2% of trips), while the increase among women was much smaller (from 8.3% to 8.8%). The increase in public transport use in the USA was roughly the same for men and women, but for both genders, the share of trips by public transport was less than a fourth as high as in Germany.

As shown in Figure 7, public transport use is much higher in Germany than in the USA for all age groups. The difference between the countries ranges from a low of about 3:1 for the age category 25–44 years up to a high of 15:1 for the age category 5–15 years. The extremely large gap in public transport use between German and American children (5–15 years) is almost certainly due to

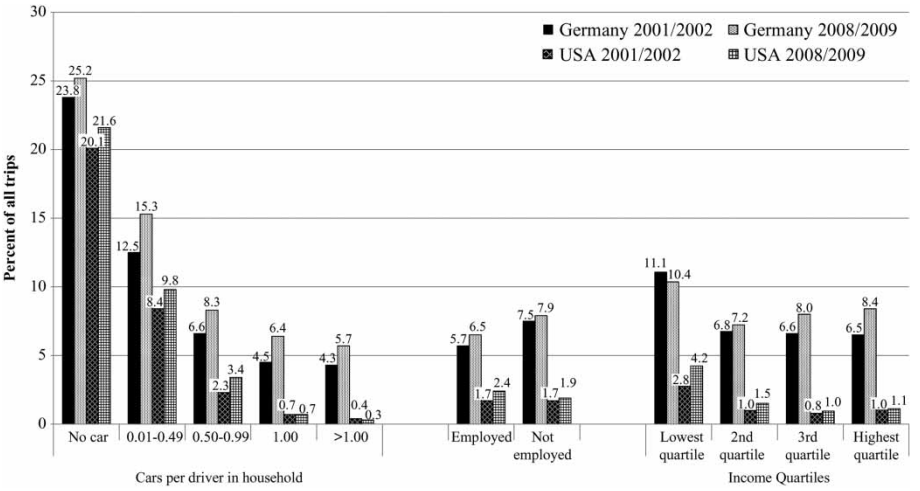

Figure 8. Percentage share of trips by public transport in Germany and the USA by car access, employment status, and income quartile, 2001/2002 and 2008/2009.
Source: Authors' calculations based on NHTS and MiD.

the much greater use of public transport for the trip to school in Germany compared with the use of special school buses in the USA. At the other end of the age spectrum, it is notable that elderly Germans are far more likely to use public transport than elderly Americans (7.9% versus 1.4% of trips). In 2008/2009, the share of licensed drivers among the elderly was almost identical in Germany (76%) and the USA (78%) (BMVBS, 2010; USDOT, 2010). The German elderly, however, have less access to a car: 0.5 cars per licensed driver in households with elderly members compared with 0.9 in the USA (Buehler & Nobis, 2010).

Car Ownership and Economic Status of Riders

Germans use public transport for a higher share of trips than Americans in all categories of car ownership, employment status, and income displayed in Figure 8. In 2008/2009, households without cars had the highest shares of trips by public transport in both countries (25.2% and 21.6%). Individuals in households without cars are often "captive" public transport riders—at least for trips beyond distances that are easily covered by bicycle and foot. Having a car at all makes a dramatic difference in household travel behaviour in both countries. Having additional cars per licensed driver makes less and less difference in rates of public transport use as the total number of cars per driver increases.

Whereas public transport use is similar for households without cars, public transport use in Germany is much higher than that in the USA for households with cars. Compared with the USA, Germans in households with more cars than drivers made 20 times as high a share of their trips by public transport in 2008/2009 (5.7% versus 0.3%). Between 2001/2002 and 2008/2009, the share of trips by public transport in households with more cars than licensed drivers increased significantly in Germany, but remained stable in the USA. The increasing appeal of public transport in Germany for persons with easy access to a car

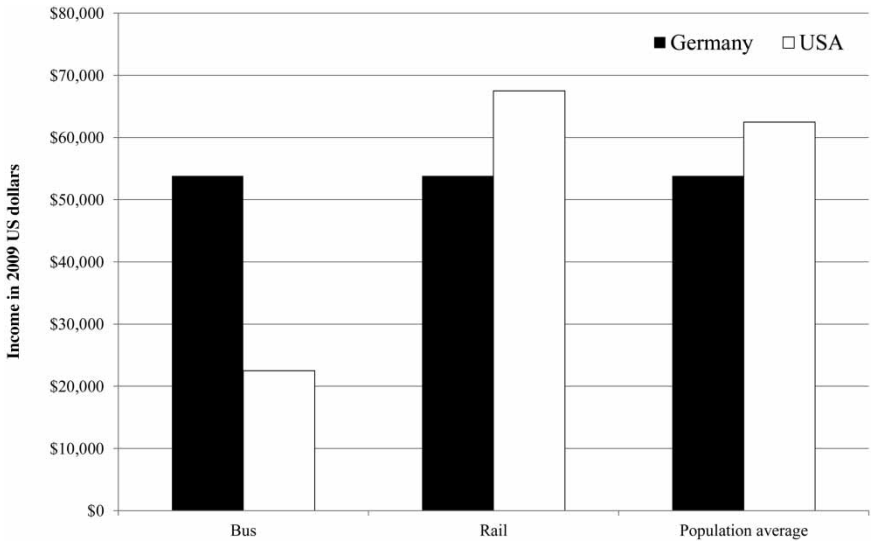

Figure 9. Median annual family income for bus and rail passengers, compared to population average, in Germany and the USA, 2008/2009 (in 2009 US dollars).
Source: Authors' calculations based on NHTS and MiD.

may be explained by the rising cost of driving as well as improved public transport service—as discussed further below.

In 2001/2002, Americans used public transport for 1.7% of trips regardless of their employment status (Figure 8). By 2008/2009, however, Americans with jobs used public transport for 2.4% of their trips compared with 1.9% of persons without paid employment (including children, university students, stay-at-home parents, retirees, and the unemployed). In contrast, public transport ridership in Germany was higher both in 2001/2002 and in 2008/2009 for persons who were not employed.

In both Germany and the USA, the poorest income quartile used public transport much more than other income groups. Low-income persons are less likely to own a car and thus have fewer travel options. In 2001/2002, public transport use for the second, third, and highest income quartiles was almost identical within each country, but about six times greater in Germany than in the USA (about 1.0% in the USA versus 6.5% in Germany).

Between the two survey periods, the share of public transport trips for the two highest income quartiles rose only slightly in the USA, but increased significantly in Germany (from 6.6% to 8.0% and from 6.5% to 8.4%). In 2008/2009, public transport's share of trips in the two highest income quartiles was eight times greater in Germany than in the USA. Even more strikingly, Germans in the highest income quartile rode public transport at twice the rate of Americans in the lowest income quartile (8.4% versus 4.2%).

In 2008/2009, bus and rail passengers in Germany had the same median income as each other and the national average—reflecting public transport's appeal to all income groups (Figure 9). In the USA, rail passengers had the highest incomes of any modal user group and considerably higher than national average income. In sharp contrast, bus passengers had incomes that were only a third of national average income. Spatial segregation of poorer households in inner cities and weal-

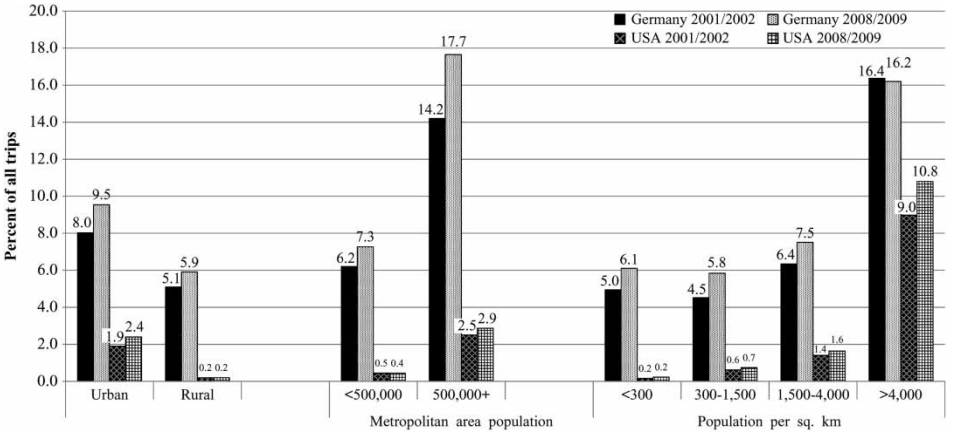

Figure 10. Percentage share of trips by public transport in Germany and the USA by urban versus rural household location, metropolitan area size, and population density, 2001/2002 and 2008/2009.
Source: Authors' calculations based on NHTS and MiD.

thier households in the suburbs may help explain the discrepancy in incomes between rail and bus in the USA (Bullard, 2004; Schaeffer & Sclar, 1980). Commuter rail services typically run from high-income suburbs into downtown business districts with lucrative jobs. Poorer neighbourhoods are usually served by slower, more crowded, and less attractive bus service. Moreover, buses in the USA are stigmatized as the travel option of last resort, used mainly by poor people and ethnic minorities (Altshuler et al., 1979; Bullard, 2004).

Given the much higher income of rail transit users in the USA, it is not surprising that the median incomes of transit riders overall are much higher in cities with extensive rail systems. For example, the US Census Bureau (2012) reports median household incomes of work commuters by mode of travel. Over the period 2006–10 (5-year running average), the ratio of transit rider incomes to car driver incomes was highest for cities such as Boston (0.90), New York (0.83), Washington (0.93), Chicago (0.97), and San Francisco (0.88), all of which have extensive metro and suburban rail systems. By comparison, the transit rider/car driver income ratio was much lower in cities without extensive rail systems, such as Dallas (0.60), Houston (0.62), Kansas City (0.56), and Phoenix (0.52).

Impacts of Urban versus Rural Location, City Size, and Population Density

In both countries, public transport accounts for a higher share of trips in urbanized areas, large metropolitan regions, and high population densities (Figure 10). Between the two survey periods, public transport use in Germany increased significantly in both urban and rural areas, in both small and large metropolitan regions, and for most of the population density categories displayed in Figure 10. In the USA, by comparison, rising trip shares for public transport were limited to urban areas, large metropolitan regions, and high population densities. Moreover, during both the survey periods, public transport was more concentrated in urban areas, large metropolitan regions, and high densities in the USA than in Germany.

In 2008/2009, public transport use was 20 times higher in urban areas than in rural areas in the USA. Urban–rural differences were far smaller in Germany.

For example, public transport's mode share was only 60% higher in urban areas than in rural areas in 2008/2009. Public transport's share of trips in rural areas was 30 times higher in Germany than in the USA (5.9% versus 0.2%). Indeed, Germans living in rural areas rode public transport at twice the rate of Americans living in urbanized areas. In both countries, public transport use was higher in large metropolitan areas. The largest difference between the countries was for small metropolitan areas: Germans used public transport at 18 times the rate of Americans in 2008/2009 (7.3% versus 0.4%). Even for large metropolitan areas, the discrepancy between the countries was large, five times higher in Germany than in the USA (17.7% versus 2.9%).

In both countries, public transport's share of trips increases as population density rises. The discrepancy in public transport mode shares between the countries declines with increasing population density from 30:1 in the lowest population density category to only 1.6:1 in the highest density category. Between the two survey periods, public transport use stagnated in the highest density category in Germany but increased significantly in the lower population density categories (+1.1%, +1.3%, and +1.1%). In the USA, the highest population density had the greatest percentage point increase in public transport mode share (from 9.0% to 10.8%). Increases at lower population densities in the USA were small (<0.2%).

Regional variation in public transport use is much greater in the USA than in Germany. For example, in 2008/2009, the transit share of all trips was 5.1% in the Northeast Census Region, 2.0% in the West, 1.2% in the Midwest, and only 1.0% in the South (USDOT, 2010). Compared with this 5:1 difference among the four census regions of the USA, the transit share of trips among German states (excluding special city-states such as Berlin and Hamburg) ranged from 8.9% in Hessen to 6.3% in Lower Saxony, which is a ratio of only 1.4:1 (BMVBS, 2010).

Logistic Regression Analysis of Public Transport Use

The bivariate analysis described above presents relationships between public transport use and individual explanatory variables, one at a time. Table 2 compares two logistic regression models—one for each country—estimating the likelihood of riding public transport while controlling for other variables. Explanatory variables in the multiple regression analysis include almost all of the demographic, socio-economic, and land-use variables introduced in Figures 7, 8, and 10. Multi-collinearity prevented the inclusion of both automobile ownership and income in the same equation. Thus, the models in Table 2 include only automobile ownership because the most important impact of income on travel behaviour is through car ownership (Dargay & Gately, 1999; Giuliano & Dargay, 2005).

Within each country, adjusted odds ratios (AORs) represent the population subgroup's likelihood of riding public transport relative to a specific reference group assigned the base value 1.00. Controlling for other explanatory factors, AORs show that men in the USA are 1.07 times as likely as women to ride public transport. In Germany, by comparison, the likelihood of riding public transport is not significantly different between men and women. In both countries, the likelihood of riding public transport is highest for the 16–24 age group and declines with age.

In the USA, employed individuals are 1.41 times as likely to ride public transport as persons unemployed or not in the workforce, whereas there is no statisti-

Table 2. Relative likelihood of riding public transport for population subgroups, 2008/2009

	Used public transport	
	Adj. odds ratio[a,b]	
	USA	Germany
Gender		
Female	1.00	1.00
Male	1.07*	0.95
Age group		
16–24	1.00	1.00
25–44	0.50**	0.19**
45–64	0.44**	0.18**
65+	0.19**	0.13**
Employment		
Not in workforce or unemployed	1.00	1.00
Employed	1.41**	0.99
Number of cars in household		
No vehicles	1.00	1.00
One car	0.10**	0.26**
Two cars	0.03**	0.16**
Three or more cars	0.02**	0.11**
Population per square kilometre		
<300	1.00	1.00
300<1500	1.98**	0.95
1500<4000	3.66**	1.19**
4000+	12.88**	1.89**
Metropolitan area population		
Outside of metro	1.00	1.00
<500 000	1.05	1.20**
500 000+	2.27**	2.10**
Day of the week		
Weekday	1.00	1.00
Weekend	0.44**	0.50**
Observations[b]	229 124	42 965

Source: Calculated by the authors based on NHTS 2008/2009 Version 2.0 and MiD 2008/2009.
[a]Relative likelihoods were calculated using logistic regressions, which control for the influence of other variables.
[b]Excludes persons younger than 16 years.
*$P < 0.05$.
**$P < 0.01$.

cally significant difference for employment status in Germany. Differences between households with and without cars are much larger for the USA than for Germany. For example, American households without cars are 50 times more likely to use public transport than households with three or more cars; German households without cars are only ten times as likely to use public transport as those with three or more cars.

Similarly, density has a larger impact in the USA than in Germany. Americans living in areas with 4000 or more persons per square kilometer are 13 times as likely to ride public transport as Americans living in areas with fewer than 300 persons per square kilometre. By comparison, Germans living at high densities are only twice as likely to ride public transport as Germans living at low popu-

lation densities. Both Americans and Germans living in metropolitan areas with more than 500 000 inhabitants are roughly twice as likely to ride public transport as their fellow countrymen living outside of metropolitan areas (AORs 2.22 and 2.14). Finally, Americans as well as Germans are much less likely to ride public transport on weekends than on weekdays (AORs 0.42 and 0.52).

Controlling for gender, age, employment, car ownership, population density, metropolitan area size, and day of the week, logistic regressions (not shown in Table 2) on a pooled USA–Germany data set indicate that Germans, compared with Americans, are five times more likely to ride public transport (AOR 5.12, 95% CI 4.81–5.46). As discussed in the following section, Germany has implemented a wide range of measures that help explain Germany's much greater and faster growing public transport use compared with the USA. We discuss some of the key policies that encourage public transport in Germany and suggest possible lessons for the USA.

Comparison of Public Transport Policies in Germany and the USA

As discussed in Buehler and Pucher (2011), public transport agencies in Germany have been more successful at increasing productivity, reducing costs, and improving financial efficiency. In 2010, for example, the total operating and capital subsidy per passenger trip was less than half as much in Germany as in the USA ($1.82 versus $5.09) (APTA, 2012; VDV, 2011). Passenger revenues in Germany covered 77% of public transport operating costs compared with only 33% in the USA (APTA, 2012; VDV, 2011).

In contrast to the productivity and cost analysis of the earlier paper, we focus here on measures to increase public transport use. Of course, higher productivity and lower costs enable the provision of more services at lower fares, thus encouraging more riders. But there are many strategies specifically designed to increase demand. Such measures fall into the three general categories of (1) expanded and improved service; (2) attractive fares and convenient ticketing; and (3) regional and multimodal coordination of services and fares. In addition, there are important complementary policies that can encourage public transport use, especially those restricting car use or increasing its price. Similarly, land-use policies can either promote or inhibit public transport demand. Table 3 provides a detailed comparison of policies in Germany and the USA. In the following discussion, we focus on the successful German policies, which help explain the much higher and faster growing levels of public transport use in Germany than in the USA.

Expanded and Improved Service

There is about three times more public transport service in Germany than in the USA: 59 versus 20 vehicle kilometres of service per year per inhabitant in 2009. Moreover, 88% of Germans live within 1 km of a public transport stop, compared with only 43% of Americans (Buehler, 2009). Since the mid-1990s, most public transport systems in Germany have modernized their vehicles and improved the comfort, convenience, and reliability of their services. Schedules and routes are integrated across public transport operators and modes, providing quick and easy connections for passengers.

Table 3. Summary of policy differences between the USA and Germany

	USA	Germany
Public transport ownership and finance		
Government subsidies	• Most firms privately owned and operated until 1960s; almost all firms publicly owned since 1970s • Sharp rise in federal subsidies during 1970s, but declining federal share of total government subsidies from 1980 (52%) to 2009 (25%) • Steady growth in state and local subsidies from 1970 to 2009, more than offsetting declining share of federal subsidies since 1980	• Public ownership and operation of firms since 1920s • In 1991, EU-mandated open competition for provision of all public transport services, including foreign operators • Federal subsidies for capital investments since mid-1960s • Cross-subsidies from municipal water and energy utilities • Devolution of suburban rail finance from federal to state level
Public transport service		
Quantity of service	• 20 vehicle kilometres of service per capita per year: regional rail and metro: 6 km; bus and light rail: 14 km	• 59 vehicle kilometres of service per capita per year: regional rail and metro: 28 km; bus and light rail: 31 km
Quality of service	• Many systems have modernized their vehicles and stations • Little coordination of services and ticketing across modes and operators	• All systems have modernized their vehicles and stations offering low-floor boarding and comfortable seating • Full coordination of schedules and routes across modes and operators
Traffic priority	• Some cities have dedicated bus lanes or high occupancy vehicle lanes that can be used by buses • Over 20 cities have bus rapid transit (BRT), with varying degrees of separate right of way and traffic priority	• Many cities have special bus lanes and traffic signal priority for buses • Many cities operate express bus services that are similar to BRT in the USA
User information	• Fragmented, incomplete, and often undependable information • Real-time information rare even on trains, almost never on buses (except BRT) • Bus stops usually lack timetables, maps, and route information	• Convenient online information about regional, state-wide, and even national routes, timetables, and fares • Real-time information at most rail stops, some bus stops, and on-board most trains and buses • All bus stops provide schedules and route information
Fares and ticketing		
Discounts	• Public transport commuter tax benefits • Slightly discounted monthly tickets for regular commuters • Discounts for off-peak travel provided by some systems	• Tax benefit based on daily commute distance • Discounts for children, university students, and seniors • Deeply discounted monthly tickets available to all groups • Entrance tickets for large events include free public transport
Region-wide fare integration	• Fares and ticketing are rarely integrated across operators and jurisdictions	• Urban areas have regional public transport authorities that fully integrate fares and ticketing across operators and jurisdictions • State-wide coordination of schedules, fares, and tickets

(Continued.)

Table 3. Continued

	USA	Germany
Regional and intermodal coordination		
Regional integration	• Regional transport planning authorities in most cities, but with much less coordination and integration of services than in Germany	• Full coordination of operation and financing of public transport through regional public transport authorities since late 1960s
Multimodal coordination	• Limited integration of bus and rail • Bike racks on 75% of buses; bike parking at many rail stations • Park and ride lots in suburbs at rail stations and key bus stops • Inconvenient walking and cycling access to bus and rail stops	• Convenient transfers between bus and rail • Extensive, high-quality bicycle parking at rail stops • Park and ride facilities for cars at suburban rail stations • Bike and car rental programmes run by public transport firms
Pricing and restrictions of car ownership, use, and parking		
Sales tax for new car purchase	• State sales taxes for new car purchases range from 0% to 8.25%, with an average of 4.9%	• 19% in all states
Driver licensing and cost	• Easy and cheap driver training and licensing, costing about $100 in most states	• Strict and expensive driver training and licensing, costing over $2000 per license
Price of gasoline	• In 2011: $0.91 per litre (15% of price is tax)	• In 2011: $2.09 per litre (61% of price is tax)
Road revenues and expenditures	• Road user taxes and fees account for 60% of roadway expenditures by all levels of government	• Roadway user taxes and fees are 2.5 times higher than roadway expenditures by all levels of government
Traffic calming and speed limits in cities	• Few cities have any traffic-calmed neighbourhoods • Speed limits on most city streets range from 35 to 45 mph (56–72 km/h)	• Most residential streets are traffic-calmed at 30 km/h or less, with speeds reduced to 7 km/h on some residential streets • General speed limit of 50 km/h (33 mph) in cities
Road supply and car restrictions	• High-speed motorways and arterials criss-cross cities and suburbs • A few cities have pedestrian malls, but not extensive zones	• High-speed motorways rarely penetrate into city centres • Extensive car-free zones in centres of most city centres
Parking supply and cost	• Municipal zoning codes require high levels of minimum parking • 95% of all car parking is free of charge • Free parking is provided by most firms for their employees and customers; cheap and convenient on-street parking in most cities	• Most cities have reduced car parking in downtowns and increased parking fees since the 1960s • German cities have only 39% as many parking spaces per job than US cities
Land-use policies		
Coordination with public transport	• No coordination of public transport with land use, except for some TOD focused around rail stations	• Strict land-use controls limit low-density sprawl and encourage compact development around public transport stops
Land-use planning process	• No federal land-use planning at all • Very limited state land-use planning • Metropolitan planning organizations can propose land-use plans, but have no power to enforce plans • Fragmented, uncoordinated, and often conflicting land-use planning by local jurisdictions	• Federal, state, regional, and local land-use plans backed by power of law • Coordination of land-use plans among levels of government and across jurisdictions • Integration of land-use, transport, and environmental planning at all levels of government

Sources: APTA, 2006, 2008a, 2008b, 2012; Baron, 1995; Buehler, 2009; Buehler et al., 2009; FTA, 2012; Hass-Klau, 1993; Hirt, 2007; IEA, 2012; Koeberlein, 1997; Newman and Kenworthy, 1999; Pucher, 1995a, 1995b; Pucher and Buehler, 2008; Schmidt and Buehler, 2007; Schmucki, 2001; Shoup, 2005; TRB, 2001; USDOT, 1990–2012, 2000–2012; Van de Velde, 2003; VDV, 2003, 2008, 2011; Vuchic, 1999; Wachs et al., 1992; Wiegandt, 2004; Yago, 1984.

Real-time information about actual arrival and departure times is available at most suburban rail, metro, and light rail stations as well as on board trains and buses. Express bus services and dedicated bus-only lanes improve the speed and reliability of bus services. In many cities, signal priority for light rail and buses triggers a green light when they approach intersections, making public transport service faster and more dependable. In Freiburg, for example, traffic signals give priority to light rail over cars at all but two intersections in the city (Hildebrandt, 2009). Integrated multimodal websites allow searches across operators, public transport modes, and regions, providing up-to-date information on schedules, routes, and fares as well as walking, cycling, and driving access to public transport stops.

Integrated and Attractive Fares

Most regional public transport authorities in Germany offer integrated daily, weekly, monthly, semester, and annual tickets, which allow passengers to use one ticket for the entire trip, regardless of the number of transfers and public transport modes used during the trip. Over the last two decades, German public transport agencies expanded their programmes of deeply discounted tickets for school children, seniors, and university students. Most universities cooperate with public transport agencies to offer inexpensive semester tickets for students at a fraction of the cost of regular monthly tickets. Similarly, many firms negotiate directly with public transport systems to finance deeply discounted monthly tickets for their employees. For Germany, on average, public transport systems offer regular monthly tickets that cost about 60% less per trip than single-trip fares (VDV, 2011). Annual tickets offer an additional discount ranging from 10% to 25%, often by charging for only 10 months and offering the other 2 months of the year for free. Both monthly and annual tickets are especially useful for attracting and keeping long-term public transport users.

Customer-tailored fare policy in many German cities makes it economical and convenient to use public transport on a daily basis, increasing its competitiveness with the private car (VDV, 2001–2008, 2011). During the last two decades, German public transport has expanded the share of passengers using weekly, monthly, or annual tickets from 60% in 1992 to 76% in 2010 (VDV, 2001–2008, 2011). In cities such as Hannover and Freiburg, monthly and annual tickets also include other transport services, such as reduced rates for taxis, car-sharing services, rental cars, and discounts for long-distance rail travel (Hildebrandt, 2009). Moreover, virtually all German states now offer state-wide public transport tickets for groups of up to five travellers. Group tickets cost €30 ($39) per day and permit use of all regional and local public transport services in the entire state on weekends, holidays, and during off-peak periods (Paetzold, 2008). Tickets for large events, such as professional soccer games and music concerts, often include free public transport access to such events.

In addition to conventional paper tickets, many public transport systems now offer smart cards with electronic chips that enable convenient re-charging and multiple uses. Moreover, in an increasing number of cities, fully electronic tickets can be purchased via mobile phone, eliminating the need to wait in line at ticket booths or vending machines. Passengers simply show the screen of their mobile phone when asked for their ticket, similar to the web-based ticketing on many airlines (VDV, 2008).

Regional and Intermodal Coordination

German public transport services are enhanced by the full coordination of routes, schedules, and fares within metropolitan regions (Bundesregierung, 1999; Pucher & Kurth, 1996). Starting in the 1960s, German cities created regional public transport organizations that fully integrate all aspects of public transport operations and ticketing. Transfers between bus and rail are usually facilitated by coordinated schedules that minimize waiting time and by placement of bus stops within or directly adjacent to rail stations to minimize walking distance required for transfers. Between 1991 and 2010, metropolitan areas with public transport authorities, such as Berlin, Freiburg, Hamburg, Munich, Rhein-Main, and Stuttgart, reported increases of at least 20% in passenger volumes (BMVBS, 1991–2012).

Extensive, safe, and convenient walking and cycling networks in German cities facilitate public transport use. Most public transport riders in Germany reach public transport stops by foot or bicycle (BMVBS, 2010). Since the 1970s, most German cities have improved conditions for cycling and walking by traffic calming nearly all neighbourhood streets to 30 km/h or less, establishing car-free zones in their centres, and expanding networks of separate bike paths and lanes (Pucher & Buehler, 2008, 2012). For example, even large cities such as Berlin and Munich have traffic calmed over 75% of their road networks (City of Berlin, 2010; City of Munich, 2012). Most German cities provide safe and convenient sidewalks, crosswalks, bike lanes, and cycle tracks leading to bus and rail stops, whereas walking and cycling to public transport stops in American cities are often difficult as well as dangerous due to poor design or the lack of facilities.

German public transport systems allow bikes on trains and provide extensive bike parking facilities at rail stations. In fact, there are more parking spaces at suburban rail and metro stations in the Munich region than in the entire USA (45 000 versus 38 000) (APTA, 2009; City of Munich, 2012). American public transport systems, however, do a better job integrating buses with cycling. In the USA, 75% of buses have bike racks, usually mounted on the front of the bus and accommodating two bikes. No German buses have bike racks.

Pricing and Restrictions of Car Ownership, Use, and Parking

Transport, taxation, and land-use policies at all levels of government make German public transport more competitive with the automobile. Federal taxation policies increase the cost of driving. For example, from 1999 to 2003, the federal government increased the gasoline (petrol) tax by €0.03 ($0.04) per litre each year to a total of €0.15 ($0.22) over 5 years (BMF, 2005). In 2010, the share of taxes in the price of gasoline was four times higher in Germany than in the USA (60% versus 15%) (IEA, 2012). Sales taxes on new vehicle purchases were four times higher in Germany than in the USA (BMF, 2008; USDOT, 2001). Moreover, the USA heavily subsidizes road transport. In the USA, road user taxes and fees account for only 60% of roadway expenditures by all levels of government (Buehler et al., 2009; USDOT, 1990–2012). In sharp contrast, German road users pay taxes and fees that are 2.5 times higher than government roadway expenditures, yielding an important source of net tax revenues that can be used to finance other sectors (BMVBS, 1991–2012; USDOT, 1990–2012).

There are many more restrictions on car use and parking in Germany than in the USA. Not only is the supply of roads per capita much less in German cities than in American cities, but motorways are also mostly restricted to the outskirts of German cities and rarely penetrate city centres. By comparison, most American cities and suburbs are criss-crossed with extensive networks of high-speed motorways and wide arterials (Bratzel, 1995, 1999). Most German cities have reduced car parking supply and increased its cost, whereas most American cities continue to focus their redevelopment plans on increased provision of low-cost or free parking for cars (Shoup, 2005).

Traffic calming of residential neighbourhoods predominates in German cities, while it is rare in American cities and generally restricted to speed humps on a few isolated streets and not systematic. Almost all German cities feature extensive car-free pedestrian zones in their city centres (Hass-Klau, 1993). Only a few American cities have any car-free streets (usually pedestrian malls) and never an entire network of connecting streets that form a comprehensive car-free zone. In short, there are many more restrictions on car use in German cities, making it less convenient as well as more expensive than in American cities. This makes public transport far more attractive relative to the private car in Germany than in the USA.

Land-Use Policies

German land-use laws and regulations encourage dense and mixed-use settlements, which facilitate public transport use (Hirt, 2007; Schmidt & Buehler, 2007; Wiegandt, 2004). In the USA, local government land-use plans usually require single-use zoning and discourage mixed use. Higher population density and mixed land uses in Germany facilitate short trip distances between public transport stops and trip origins and destinations. Many German cities specifically plan neighbourhood town centres that enable easy walking and cycling access to shopping and other daily needs. German federal law mandates coordination of land-use planning among municipalities, regions, and states as well as among jurisdictions at the same level of government (Fuerst & Scholles, 2003). German planning law also requires the integration of land-use plans with transport, water, energy, and environmental plans. With the exception of some recent transit-oriented developments (TODs), land-use planning in the USA is generally fragmented, inconsistent, and conflicting across local jurisdictions and rarely integrated with transport plans (Burchell, Lowenstein, Dolphin, & Galley, 2002; Levine, 2006).

Challenges for Public Transport in Germany

In spite of its relative success compared with the American public transport, German public transport faces several challenges. Over the coming decade, most urban rail systems that were built in the 1960s and 1970s will have to be renovated. There is still no dedicated funding source for this work because local, state, and federal governments have been quarrelling about how much each should pay. Cost cutting by public transport systems over the past two decades has succeeded in reducing subsidy requirements but has taken a toll on labour by reducing wages and increasing work hours and the range of job responsibilities (Buehler & Pucher, 2011). As a consequence, the last 5 years have been marred by an increasing number of short-term labour strikes for higher salaries and benefits, which have disrupted service and irritated customers in many German cities.

Moreover, because of a reduction of the labour force and cut-backs in maintenance expenditures, some German cities have experienced disruptions in service because vehicles broke down or were preemptively removed from service due to defects that were discovered. To make matters worse, crime has been increasing on public transport systems. In recent years, for example, there have been highly publicized assaults on passengers waiting at rail stations. Graffiti and vandalism of rail cars and buses have also become problems.

Suburbanization also presents a challenge. Although most German cities are much more compact than American cities, there is a trend towards decentralization of businesses, big-box retailers at the urban fringe, and more suburban housing developments (Mueller & Rohr, 2005). This type of settlement pattern makes it increasingly difficult for German public transport to compete with the car in the suburbs. Demographic shifts also present a challenge: the ageing of the German population will further reduce the number of children and young adults riding public transport (Buehler & Nobis, 2010).

German public transport will have to deal with all of these issues: funding shortages, maintenance problems, labour disputes, service disruptions, suburbanization, and an older population.

Conclusion and Lessons for the USA

Over the past four decades, public transport has been far more successful in Germany than in the USA, with much greater growth in overall passenger volumes and in trips per capita. Even controlling for differences between the countries in demographics, socio-economics, and land use, logistic regressions show that Germans are five times as likely as Americans to make a trip by public transport. In both countries, public transport use declines with increasing car ownership, rising incomes, and decreasing population densities. However, compared with that in the USA, public transport in Germany attracts a much broader cross-section of society and for a greater diversity of trip purposes. Most American public transport passengers are either work commuters in large, older cities or low-income captive riders without cars.

The success of German public transport is due to a coordinated package of mutually supportive policies that include the following: (1) more and better service, (2) attractive fares and convenient ticketing, (3) full multimodal and regional integration, (4) high taxes and restrictions on car use, and (5) land-use policies that promote compact, mixed-use developments and densities high enough to support public transport. It is the integrated package of complementary policies that explains why public transport in Germany can compete so well with the private car, even among affluent households. Conversely, it is the lack of complementary policies that explains the continuing struggle of public transport in the USA.

Over the last two decades, public transport agencies in both countries have improved the quality and quantity of public transport service. As shown in this paper, however, Germany is far ahead of the USA, offering more and better service, more attractive fares and ticketing, and superior multimodal and regional coordination. The most important difference between the two countries, however, is that local, state, and federal governments in the USA have failed to restrict car use in cities, raise the cost of driving, and improve land-use policies. Indeed, all levels of government in the USA have subsidized

roadways, car use, and parking. Due to political opposition from motorist groups, the US federal government and many state governments have not increased the gasoline (petrol) tax for almost 20 years—in spite of large deficits in state and federal highway trust funds. Local government zoning ordinances usually require private developers and firms to supply large amounts of car parking, segregate residential from commercial land uses, and often ban high-density development of any kind. Free parking remains a tax-free fringe benefit for most employees and a tax-deductible expense for firms for both state and federal taxes.

Even $830 billion in government subsidies since 1975 have not succeeded in raising public transport's mode share in the USA, which remains at less than 2% of all trips. Without the necessary policies to restrict car use and make it more expensive, American public transport is doomed to remain a marginal means of transport, used mainly by those who have no other choice.

References

Australian Bureau of Statistics. (2011). *Census of population and housing, journey to work files*. Canberra: Author.

Altshuler, A., Womack, J.P., & Pucher, J. (1979). *The urban transportation system: Politics and policy innovation*. Cambridge, MA: MIT Press.

American Public Transportation Association. (2006). *Annual report 2006: Growth investment forward*. Washington, DC: Author.

American Public Transportation Association. (2008a). *2008 public transportation fare database*. Washington, DC: Author.

American Public Transportation Association. (2008b). *It pays to ride public transportation*. Washington, DC: Author.

American Public Transportation Association. (2009). *2008 transit infrastructure database*. Washington, DC: Author.

American Public Transportation Association. (2012). *Public transportation factbook 2011*. Washington, DC: Author.

Baron, P. (1995). Transportation in Germany: A historical overview. *Transportation Research Part A: Policy and Practice*, *29*(1), 9–20.

Bassett, D., Pucher, J., Buehler, R., Thompson, D., & Crouter, S. (2008). Walking, cycling, and obesity rates in Europe, North America and Australia. *Journal of Physical Activity and Health*, *5*(6), 795–814.

BFS. (2011). *Mobility and transport 2010*. Bern: Bundesamt fuer Statistik/Swiss Federal Office for Statistics.

Bundesministerien der Finanzen – German Federal Ministry of Finance. (2005). *Die Mineraloelsteuer* [Petroleum taxes]. Berlin: Author.

Bundesministerien der Finanzen – German Federal Ministry of Finance. (2008). *Mehrwertsteuer* [Value added tax]. Berlin: Author.

BMVBS. (1991–2012). *Verkehr in Zahlen* [German transport in figures]. Berlin: German Federal Ministry of Transportation and Urban Development.

BMVBS. (2000). *Urban development and urban policy in Germany*. Bonn: German Federal Ministry of Transportation and Urban Development, Bundesamt fuer Bauwesen und Raumordnung.

BMVBS. (2008). *Rueckblick: Staedtebau und Stadtentwicklung im Wandel* [Changes in urban planning and development]. Bonn: German Federal Ministry of Transportation and Urban Development, BBR.

BMVBS. (2010). *Mobilitaet in Deutschland 2008/2009*. Bonn: German Federal Ministry of Transportation.

Bratzel, S. (1995). *Extreme der Mobilität. Entwicklung und Folgen der Verkehrspolitik in Los Angeles*. Basel: Birkhäuser Verlag.

Bratzel, S. (1999). Conditions of success in sustainable urban transport policy—policy change in "relatively successful" European cities. *Transport Reviews*, *19*(2), 177–190.

Broeg, W., & Erl, E. (2003). *Verkehrsmittelwahl in Deutschland: Neue und Alte Bundeslaender* [Transportation mode choice in East and West Germany]. Socialdata: Munich.

Buehler, R. (2009). Promoting public transportation: A comparison of passengers and policies in Germany and the US. *Transportation Research Record: Journal of the Transportation Research Board of the National Academies of Science, 2110,* 60–68.
Buehler, R., & Nobis, C. (2010). Travel behavior in ageing societies: A comparison of Germany and the United States. *Transportation Research Record: Journal of the Transportation Research Board, 2182,* 62–70.
Buehler, R., & Pucher, J. (2011). Making public transport financially sustainable. *Transport Policy, 18*(1), 126–138.
Buehler, R., Pucher, J., & Kunert, U. (2009). *Making transportation sustainable: Insights from Germany.* Washington, DC: The Brookings Institution.
Buehler, R., Pucher, R., Merom, D., & Bauman, A. (2011). Active travel in Germany and the USA: Contributions of daily walking and cycling to physical activity. *American Journal of Preventive Medicine, 40*(9), 241–250.
Bullard, R.D. (2004). *Highway robbery.* Cambridge, MA: South End Press.
Bundesregierung. (1999). *Bericht der Bundesregierung ueber den Oeffentlichen Nahverkehr in Deutschland nach Vollendung der Deutschen Einheit*. Berlin: German Federal Government.
Burchell, R., Lowenstein, G., Dolphin, W.R., & Galley, C. (2002). *Costs of sprawl 2000, TCRP report 74*. Washington, DC: Transportation Research Board, National Academy Press.
CBS. (2011). *Transport statistics*. Amsterdam: Statistics Netherlands.
Cervero, R. (1998). *The transit metropolis. A global inquiry.* Washington, DC: Island Press.
City of Berlin. (2010). *Cycling and walking in Berlin*. Berlin: Senatsverwaltung fuer Stadtentwicklung.
City of Munich. (2012). *Bicycling and walking in Munich*. Munich: Author.
CSO. (2010). *Travel to work, school, and college*. Dublin: Central Statistics Office.
Dargay, J., & Gately, D. (1999). Income's effect on vehicle ownership, worldwide: 1960–2015. *Transportation and Research, Part A, 33*(2), 101–138.
Destatis. (2010). *Genesis Online Database. Bevölkerung, Erwerbstätige, Erwerbslose, Erwerbspersonen, Nichterwerbspersonen: Deutschland, Jahre, Altersgruppen*. Wiesbaden: German Statistical Office.
Destatis. (2012). *Personenverkehr mit Bussen und Bahnen*. Wiesbaden: Destatis, German Federal Office for Statistics.
Department for Transport. (2010). *National travel survey.* London: Author.
Department for Transport. (2011). *National travel statistics*. London: Author.
DMT. (2010). *Danish national travel surveys*. Copenhagen: Danish Institute of Transport Research.
Downs, A. (2004). *Still stuck in traffic*. Washington, DC: Brookings Institution Press.
Dunn, J. (1981). *Miles to go: European and American transportation policies*. Cambridge, MA: MIT Press.
Dunn, J. (1998). *Driving forces: The automobile, its enemies, and the politics of mobility.* Washington, DC: Brookings Institution Press.
European Commission. (2011). *Transport in figures. Statistical pocketbook 2011*. Brussels: European Commission, Directorate General for Energy and Transport.
Filion, P., Bunting, T., McSpurren, K., & Tse, A. (2004). Canada–US metropolitan density patterns: Zonal convergence and divergence. *Urban Geography, 25*(1), 42–65.
FTA. (2012). *National transit database (NTD).* Washington, DC: U.S. Department of Transportation, Federal Transit Administration.
Fuerst, D., & Scholles, F. (2003). *Landes- und Regionalplanung Teil 1: Verwaltungswissenschaftliche Grundlagen. Institut fuer Landesplanung und Raumforschung*. Hannover: University of Hannover.
Giuliano, G., & Dargay, J. (2005). Car ownership, travel and land use: A comparison of the US and Great Britain. *Transportation Research Part A, 40,* 106–124.
Grant, J. (2002). Mixed use in theory and practice: Canadian experience with implementing a planning principle. *Journal of the American Planning Association, 68*(1), 71–85.
Hass-Klau, C. (1993). *The pedestrian and city traffic*. New York: Belhaven Press.
Hildebrandt, A. (2009). *Transit supply in Freiburg*. Freiburg: Freiburger Verkehrs AG, Presse und Oeffentlichkeitsarbeit.
Hirt, S. (2007). The devil is in the definitions. Contrasting American and German approaches to zoning. *Journal of the American Planning Association, 73*(4), 436–450.
Institute of Transport Economics. (2011). *Norwegian travel survey key results*. Oslo: Author.
International Energy Agency. (2012). *Energy prices and taxes*. New York: Author.
Infas and DLR. (2010). *Mobilität in Deutschland 2008. Endbericht*. Bonn: German Federal Ministry of Transport.
International Monetary Fund. (2008). *World economic outlook database*. Washington, DC: Author.
International Road Federation. (2007). *World road statistics*. Brussels: Author.

ITF. (2011). *Transport for society: International demand for public transport*. Paris: OECD/International Transportation Forum.
Jackson, K.T. (1985). *The crabgrass frontier. The suburbanization of the United States*. Oxford: Oxford University Press.
Koeberlein, C. (1997). *Kompendium der Verkehrspolitik* [Compendium of transport policies]. Munich: Oldenbourg Wissenschaftsverlag.
Kunert, U., Kloas, J., & Kuhfeld, H. (2002). Design characteristics of national travel surveys. International comparison for 10 countries. *Transportation Research Record, 1804,* 107–116.
Levine, J. (2006). *Zoned out. Regulation, markets and choices in transportation and metropolitan land-use*. Washington, DC: Resources for the Future.
Mees, P. (2010). *Transport for Suburbia: Beyond the automobile age*. New York City, NY: Earthscan.
Miron, J. (2003). *Urban sprawl in Canada and America: Just how dissimilar?* Toronto: Department of Geography, University of Toronto.
Mueller, W., & Rohr-Zaecker, R. (2005). Amerikanisierung der Peripherie in Deutschland? In K. Barke & G. Herfert (Eds.), *Suburbanisierung in Deutschland* (pp. 27–39). Opladen, Leske und Budrich.
Newman, P., & Kenworthy, J. (1999). *Sustainability and cities*. Washington, DC: Island Press.
Pacione, M. (2009). *Urban geography: A global perspective*. London: Routledge.
Paetzold, J. (2008). *VDV Landesgruppen Erfahrungsaustausch Baden-Wuerttemberg*. Stuttgart: VDV.
Polzin, S., & Chu, X. (2003). *NHTS early findings on public transportation travel trends*. Washington, DC: FHWA.
Pucher, J. (1995a). Urban passenger transport in the United States and Europe: A comparative analysis of public policies. Part 1. Travel behavior, urban development and automobile use. *Transport Reviews*, *15*(2), 99–117.
Pucher, J. (1995b). Urban passenger transport in the United States and Europe: A comparative analysis of public policies. Part 2. Public transport, overall comparisons and recommendations. *Transport Reviews*, *15*(3), 211–227.
Pucher, J., & Buehler, R. (2008). Making cycling irresistible: Lessons from the Netherlands, Denmark, and Germany. *Transport Reviews*, *28*(1), 495–528.
Pucher, J., & Buehler, R. (2010). Walking and cycling for healthy cities. *Built Environment*, *36*(4), 391–414.
Pucher, J., & Buehler, R. (2012). *City cycling*. Cambridge, MA: MIT Press.
Pucher, J., Buehler, R., Merom, D., & Bauman, A. (2011). Walking and cycling in the United States, 2001–2009: Evidence from the NHTS. *American Journal of Public Health*, *101*(S1), S310–S317.
Pucher, J., & Kurth, C. (1996). Verkehrsverbund: The success of regional public transport in Germany, Austria and Switzerland. *Transport Policy*, *2*(4), 279–291.
Pucher, J., Markstedt, A., & Hirschman, I. (1983). Impacts of subsidies on the costs of urban public transport. *Journal of Transport Economics and Policy*, *17*(2), 155–176.
Schaeffer, K.H., & Sclar, E. (1980). *Access for all: Transportation and urban growth*. New York City, NY: Columbia University Press.
Schmidt, S., & Buehler, R. (2007). The planning process in the US and Germany: A comparative analysis. *International Planning Studies*, *12*(1), 55–75.
Schmucki, B. (2001). *Der Traum vom Verkehrsfluss: Städtische Verkehrsplanung seit 1945 im deutsch-deutschen Vergleich*. Munich: Campus/Deutsches Museum Muenchen.
Shoup, D. (2005). *The high cost of free parking*. Chicago, IL: APA Planners Press.
SIKA. (2007). *SIKA statistics: The national travel survey.* Östersund: Swedish Institute for Transport and Communications Analysis.
SOeS. (2010). *Enquête nationale transports et déplacements (ENTD) 2008*. France: Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer (Meeddm), Service de l'observation et des statistiques (SOeS) LaDefense.
StatCan. (1996–2010). *Where Canadians work and how they get there*. Ottawa: Statistics Canada.
TRB. (2001). *Making transit work: Insight from Western Europe, Canada and the United States*. Washington, DC: Transportation Research Board, National Research Council, National Academy Press.
US Census Bureau. (2012). *American community survey 2006–2010*. Washington, DC: Author.
USDOT. (1990–2012). *Highway statistics*. Washington, DC: US Department of Transportation, Federal Highway Administration.
USDOT. (2000–2012). *Transportation statistics*. Washington, DC: US Department of Transportation, Federal Highway Administration.
USDOT. (2001). *Summary of state motor vehicle registration fee schedules*. Washington, DC: US Department of Transportation, Federal Highway Administration.

USDOT. (2010). *National Household Travel Survey 2008/2009*. Washington, DC: US Department of Transportation, Federal Highway Administration.
USDOT. (2011). *Summary of travel trends: 2009 National Household Travel Survey*. Washington, DC: US Department of Transportation, Federal Highway Administration.
USDOT. (2012a). *FY 2010 statistical summary*. Washington, DC: US Department of Transportation, Federal Transit Administration.
USDOT. (2012b). *Bus registrations, table MV 10*. Washington, DC: US Department of Transportation, Federal Transit Administration.
Van de Velde, D.M. (2003). Regulation and competition in the European land passenger industry: Some recent evolutions. In *8th Conference on Competition and Ownership in Land Passenger Transport*, Rio de Janeiro. Retrieved from http://www.thredbo.itls.usyd.edu.au/downloads/thredbo8_papers/thredbo8-plenary-van_de_Velde.pdf
Verband Deutscher Verkehrsunternehmen. (2001–2008). *VDV Statistik*. Cologne: Author.
Verband Deutscher Verkehrsunternehmen. (2003). *Jahresbericht 2002/2003*. Cologne: Author.
Verband Deutscher Verkehrsunternehmen. (2008). *VDV Jahresbericht 2007/2008*. Cologne: Author.
Verband Deutscher Verkehrsunternehmen. (2011). *VDV Statistik 2010*. Berlin: Author.
Vuchic, V. (1999). *Transportation for livable cities*. New Brunswick, NJ: Center for Urban Policy Research (CUPR).
Wachs, M., Crawford, M., Wirka, S., & Rikala, T. (1992). *The car and the city: The automobile, the built environment, and daily urban life*. Ann Arbor: University of Michigan Press.
Webster, F.V., & Bly, P.H. (1981). The demand for public transport. Part I. The changing environment in which public transport operates. *Transport Reviews*, *1*(4), 323–351.
Webster, F.V., & Bly, P.H. (1982). The demand for public transport. Part II. Supply and demand factors of public transport. *Transport Reviews*, *2*(1), 23–46.
Wentzel, B., & Wentzel, D. (2000). *Wirtschaftlicher Systemvergleich Deutschland/USA*. Stuttgart: Lucius & Lucius Verlagsgesellschaft.
Wiegandt, C. (2004). Mixed land use in Germany: Chances, benefits and constraints. In *Conference paper: International Planning Symposium on Incentives, Regulations and Plans—the role of states and nation-states in smart growth*. College Park, MD: Planning National Center for Smart Growth Research and Education, University of Maryland.
WSP. (2006). *Finnish national travel survey*. Helsinki: WSP Finland.
Yago, G. (1984). *The decline of transit: Urban transportation in German and US cities, 1900–1970*. New York, NY: Cambridge University Press.