

Regional Coordination in Public Transportation: Lessons from Germany, Austria, and Switzerland



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<p>16. Abstract: This report analyzes history, demand, supply, organizational structure, and policies of regional coordination of public transport in large metropolitan regions in Germany, Switzerland, Austria, and the U.S. with a focus on the time period between 1990 and 2012. The goal is to distill lessons for regional coordination of public transport in countries with federal systems of government and high levels of car ownership. The first part of the report focuses on case studies of regional public transport associations (called <i>Verkehrsverbände</i> or in this report <i>VBs</i>) in Berlin, Hamburg, and Munich, the three largest cities in Germany, as well as Zurich and Vienna, the largest city in Switzerland and Austria respectively. The second part of the report provides an overview of regional coordination of public transport in the San Francisco Bay Area and the Washington National Capital regions.</p> <p>The report finds that between 1990 and 2012, the five VBs successfully attracted more riders and increased revenues—both in total and per capita. VBs involve collaboration among governments, among public transport providers, and between governments and public transport agencies. The original creation of VBs often involved one stakeholder taking the lead in enticing other stakeholders to participate—often at the (monetary) expense of the ‘lead’ stakeholder who absorbed potential financial risk for other collaborators. Moreover, the creation of VBs often occurred during a time of major transport infrastructure investment. In general, VBs are small agencies with between 30 and 150 employees that focus on an easy to use, convenient, and customer oriented public transport system (“One Network, One Timetable, One Ticket”). Typical main tasks of VBs are (1) ticketing, including steeply discounted monthly, annual and tickets for special groups (e.g. students), (2) marketing, branding and consistent messaging, (3) customer information and service, (4) drawing up and overseeing service contracts with public transport agencies, (5) quality control and tracking of quality standards, (6) planning of coordinated public transport services, and (7) coordination and distribution of fare revenue.</p>		

<p>Compared to the VBs, regional public transport in the San Francisco Bay Area and Washington National Capital region is more fragmented between operators and jurisdictions, offers less transit service with smaller geographic coverage, and has much lower farebox recovery ratios and total per capita demand. Regional transit coordination in the US systems is largely focused around capital investments and long-range transportation planning, with metropolitan planning organizations playing a critical role in facilitating collaboration between public agencies, transit providers, and other stakeholders.</p>		
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GLOSSARY and Key Translations

BVG – Berliner Verkehrsbetriebe (Largest Public Transport Provider in Berlin)

CNB – Center for Public Transport Berlin

DB – Deutsche Bahn (German Railways)

GA – Generalabonnement (Annual public transport ticket in Switzerland)

GDP – Gross Domestic Product

HHA – Hamburger Hochbahn (Largest Public Transport Provider in Hamburg)

HVV – Hamburger Verkehrsverbund (Hamburg Public Transport Association)

Kanton – Swiss State

Land – State in Austria or Germany

MVG – Münchner Verkehrsgesellschaft (Largest Public Transport Provider in Munich)

MVV – Münchner Verkehrs und Tarifverbund (Munich Public Transport Association)

ÖBB – Österreichische Bundesbahnen (Austrian Federal Railways)

Place Kilometer – measure of supply combining seating and standing area on vehicles

Public transport, public transportation, public transit, transit – the terms are used interchangeably in this report

S-Bahn – Regional rail

SBB – Schweizerische Bundesbahn (Swiss Federal Railways)

SFR – Swiss Francs

Transport, transportation – the terms are used interchangeably in this report

U-Bahn – Metrorail, subway

VB – Verkehrsverbund (German for regional public transport association)

VBB – Verkehrsverbund Berlin Brandenburg (Berlin Public Transport Association)

VBZ – Verkehrsbetriebe Zürich

VDV – German Public Transport Association

VOR – Verkehrsverbund Ost Region (Vienna Public Transport Association)

WL – Wiener Linien (Largest Public Transport Provider in Vienna)

ZVV – Zürcher Verkehrsverbund (Zurich Public Transport Association)

1 Part 1: Regional Coordination of Public Transport in Germany, Austria, and Switzerland

1.1 Introduction

The first part of this report analyzes history, demand, supply, organizational structure, and public transport policies of regional public transport associations (called *Verkehrsverbund* (singular) or *Verkehrsverbände* (plural); here after VB for short) in Berlin, Hamburg, and Munich, the three largest cities in Germany, as well as Zurich and Vienna, the largest city in Switzerland and Austria respectively. Analysis of and potential lessons from public transport in those countries are relevant for urban regions in the United States, Canada, and Australia, because Germany, Switzerland, and Austria are wealthy western democracies with federal systems of government, where transport policy and funding are determined by an interplay of federal, state, and local levels of government. Moreover, the three countries have high levels of car ownership, together represent over 100 million inhabitants, and they have been at the forefront of regional coordination of public transport in Europe. The report includes three German cities, because it is by far the largest country among the three and it is home to a strong and politically influential car industry—accounting for 20% of the country’s GDP—thus potentially providing lessons more applicable to car-dependent countries like the US, Canada, or Australia.

The case studies focus on trends in VBs in large metropolitan regions (1.5 to 5.9 million inhabitants in VB service areas). Large metropolitan regions are home to significant and growing shares of population who are exposed to many transport related problems, such as traffic congestion, air pollution, or poor traffic safety. Attracting more passengers to public transport can help combat these externalities. Because urban regions stretch across boundaries of service areas of public transport companies and jurisdictions, provision of integrated public transport in metropolitan regions requires coordination among governments, among public transport agencies, and between governments and public transport agencies.

The goal of this part of the report is to distill lessons for regional coordination of public transport in countries with federal systems of government and high levels of car ownership. The analysis proceeds as follows. The next section introduces the research methods used for data collection. Then, key characteristics of the VBs are introduced. Prior to a detailed analysis of trends in demand, supply, financial efficiency and history of the VBs, a section provides a short background about public transport planning and financing in each country. This section also describes the history of each VB, focusing on the roles of and arrangements between governments and public transport agencies in the creation and development of the VB. The next section consists of an in-depth analysis of trends in demand, supply, and financial efficiency of the VBs between 1990 and 2012. The final section provides lessons for regional coordination of public transport.

1.2 Methods

The analysis relied on information from various types of documents including peer-reviewed academic publications, professional reports by consulting companies, reports by national public transport associations, VB and public transport agency annual reports, statistical publications, and presentations by public transport agency or VB staff. Data for the case study analysis was obtained through in-person and telephone interviews, e-mail exchanges, site visits, online searches, archival research, as well as academic and professional literature searches in German or English language. Interviewees included representatives from public transport agencies, VBs,

national public transport associations, as well as local, state, and federal governments. Some American readers may assume that standardized information about public transport operators in Germany, Austria, and Switzerland may be available from a central database at the national level, as in the US national transit database. However, such databases do not exist at the federal level in those countries and data had to be requested and collected directly from each public transport agency and VB.

2 Overview of VBs in Germany, Austria, and Switzerland

Table 1 provides an overview of the VBs analyzed in this report, including information about year founded, population size, geographic area, population density, motorization levels, and gross domestic product (GDP) per capita. Hamburg's HVV is the oldest among the case study VBs and was Germany's first VB when founded in 1965. Since then the vast majority of German cities has followed HVV's example and founded a VB together with adjacent jurisdictions. Munich's MVV dates back to 1972 and was inspired by HVV's successes in the 1960s. The foundation of Vienna's VOR was also inspired by HVV. Founded in 1984, VOR was Austria's first VB and served as a model for Austria, where the federal government now mandates all states have state-wide VBs. Founded in 1990, the Zurich region has Switzerland's most tightly coordinated VB (ZVV). Berlin has the youngest VB among the case studies founded in 1999—roughly a decade after the fall of socialism in East Germany that divided the city into two parts and separated West Berlin from its surroundings.

Name 'Verkehrs- verbund'	Name Core City	Year 'Verkehrs- verbund' Founded	Residents 'Service Area' (in million)	Residents 'Core City Area' (in million)	Share of Population in City vs. Region	Land Area Service Area km ²	Land Area City km ²	Share of Land Area City vs. Region	Population Density		Motorization			GDP Per Capita (in \$ using PPP)
									Service Area	Core City	City (Cars per 1,000)	Suburbs (Cars per 1,000)	Ratio Suburb vs City Motorization Rate	
MVV	Munich	1972	2.8	1.4	0.5	5,471	311	0.06	508	4,502	475	796	1.7	\$60,084
HVV	Hamburg	1965	3.4	1.7	0.5	8,616	755	0.09	389	2,291	404	590	1.5	\$52,555
VOR	Vienna	1984	2.8	1.8	0.6	8,841	415	0.05	322	4,241	394	960	2.4	\$45,600
VBB	Berlin	1999	5.9	3.4	0.6	30,374	892	0.03	193	3,778	324	542	1.7	\$29,864
ZVV	Zurich	1990	1.5	0.4	0.3	1,839	88	0.05	811	4,432	368	583	1.6	\$77,000

Table 1. Overview of Key Characteristics of VB Service Areas (Source: own calculations by the authors based on data collected directly from each VB)

Berlin's VBB covers the largest land area and comprises the largest population among the case study VBs, including the City of Berlin and the entire State of Brandenburg that surrounds the City of Berlin. The VBs in Munich and Vienna serve about 2.8 million residents each, while HVV serves 3.4 million people. Even though Zurich is Switzerland's largest city, Zurich's ZVV is the smallest VB with about 1.5 million inhabitants.

The cities of Munich, Hamburg, Berlin, and Vienna account for between 50 and 62% of the population in their respective VB area, while the City of Zurich only accounts for 26% of the population of the ZVV area. Central cities make up about 3 to 9% of the land area served by the VB—indicating large suburban service areas. In all VBs population density, measured as number of inhabitants divided by land area, is much greater in the main city than in the entire service area that often includes suburban and even rural areas. City population densities in Table 1 can also be expressed as population by settled land area—excluding parks, forests, nature preserves, or agricultural land. This method yields much higher population densities (than just dividing by

total land area) ranging from Vienna (8,500 people per km²) to Hamburg (2,300). Munich (6,000), Zurich (6,900), and Berlin (5,400) are in between.

In all VBs motorization rates are lower in cities than in suburbs. The difference is greatest in the Vienna VB region, where car ownership in the suburbs is 2.4 times greater than in the city itself. In all other VB areas, suburban motorization rates are between 50 to 70% greater than in cities. Among cities, Munich has the highest motorization rate (475 cars per 1,000 inhabitants), followed by Hamburg (404), Vienna (394), and Zurich (368). Berlin has the lowest motorization rate with only 324 cars per 1,000 inhabitants. Berlin's low motorization rate may be related to its relative poverty compared to the other cities in terms of GDP per capita. However, Zurich's high GDP and comparatively low motorization rate indicate, that wealth alone does not determine car ownership rates.

2.1 Public Transport Supply and Demand Indicators for Case Study VBs

Table 2 provides an initial overview of public transport supply and demand indicators for each VB area for the year 2012. Berlin has the largest network of U-Bahn (metrorail) routes (146km), followed by Hamburg (117km), Munich (100km), and Vienna (79km). Zurich is the only city without a U-Bahn, because Zurich voters rejected proposals for underground public transport service twice (in 1959 and 1973). The City of Berlin also has the longest system of tramway routes, mainly located in the formerly socialist eastern part of the city, where many tramway lines were preserved and not torn out as in West Berlin. Hamburg is the only city without a tramway network, because the city tore out its tramway tracks and abandoned its tramway service in 1978. Vienna, Zurich, and Munich, all have large tramway networks.

VB Name	City	SUPPLY INDICATORS						DEMAND INDICATORS					
		Route km of Service				Place Kilometers PT Service (Billion)	Place Kilometers PT Service per Capita	PT Trips Per Year (million)	PT Trips Per Capita	% All Trips by Public Transport			
		U-Bahn	Tramway	S-Bahn	Regional Rail					City	Inner City	Outside of Center	Suburbs
MVV	Munich	100	109	530	n.a.	36	13,067	662	241	21	51	18	10
HVV	Hamburg	117	n.a.	239	683	36	10,450	717	211	18	19	17	18
VOR	Vienna	79	222	603	1236	44	15,420	979	318	39	44	38	9
VBB	Berlin	146	300	556	3251	53	9,150	1,321	225	27	29	26	12
ZVV	Zurich	n.a.	119	1254	n.a.	25	17,939	605	434	32	n.a.	n.a.	n.a.

Table 2. Overview of Key Aggregate Supply and Demand Indicators for VBs (Source: own calculations by the authors based on data collected directly from each VB)

All VBs have significant S-Bahn and regional rail networks. Table 2 shows route kilometers of S-Bahn and regional rail systems. Data are somewhat incomparable because in many regions S-Bahn and regional rail share tracks and are operated by the same company—mainly by the national rail agency in each country (DB, SBB, and ÖBB respectively). In the Berlin and Hamburg regions the S-Bahn has its proper tracks and receives power through a third rail. Regional rail in the two cities is powered from overhead wires. In Munich, Zurich, and Vienna regions, the S-Bahn runs (at least partially) on the same tracks as regional rail. The exact share of regional rail networks and services that are classified as S-Bahn (vs. regional rail) influence system sizes listed in Table 2. For example, in the Zürich region virtually all regional rail is reported as 'S-Bahn' service.

Data on route kilometers presented above hide information about the level of actual service provided. One measure of total supply of public transport is place kilometers of public transport service in the VB region—considering available seating and standing space on vehicles. In 2012, VBB (53 billion) and VOR (44 billion) had the greatest supply of place

kilometers of public transport service per year, followed by MVV and HVV (36 billion each), as well as Zurich (25 billion). Adjusting for VB service area population, ZVV (18,000 annual place kilometers per capita), VOR (15,500), and MVV (13,000) provide greater levels of service per capita than HVV (10,500) and VBB (9,000).

Table 2 assesses public transport demand using two indicators: (1) annual public transport trips per capita as well as (2) share of all trips made by public transport. Annual public transport trips per inhabitant is the only available measure for public transport demand at the VB level. ZVV (434 annual public transport trips per capita) and VOR (318) have considerably higher demand than the German VBs in Munich (241), Berlin (225), and Hamburg (211). Mode share of public transport trips compares public transport demand relative to other modes of transport. Statistics are only available for sub-sections of the VB regions. Residents of the cities of Vienna and Zurich make the highest shares of trips by public transport (39%)—followed by residents of Berlin (27%), Munich (23%), and Hamburg (18%).

Available data suggest that in all cities the public transport share of trips is highest in the city center and lowest in the suburbs. Hamburg has the least variation in public transport share of trips between city center and suburbs, while public transport usage is much lower in the suburbs than the city center in Berlin, Munich, and Vienna. In fact, of all case study regions Vienna displays the lowest public transport share of trips in its suburbs and the highest usage in the city center—9% vs. 44% of trips.

Table 3 provides an overview of the stakeholders directly collaborating in each VB. In each VB, state, counties, cities, and public transport operators cooperate to plan, finance, and/or operate public transport. States are either involved, because all public transport in the state is part of the VB (e.g. State of Brandenburg in VBB, or Kanton Zurich in ZVV) or to facilitate public transport coordination in areas around a large city with significant transport and economic impact for the state (e.g. state of Bavaria in MVV, or the states of Niederösterreich and Burgenland in VOR). In addition the cities of Vienna, Hamburg, and Berlin serve in two administrative roles in their respective countries—as city and state.

Name	City	Collaborators in Verbund (#)			
		States	Counties/Local Governments	Large Cities	PT Operators
MVV	Munich	1	8	1	55
HVV	Hamburg	3	7	1	30
VOR	Vienna	3	-	1	41
VBB	Berlin	2	14	5	42
ZVV	Zurich	1	168	1	51

Note: Hamburg, Berlin and Vienna are each classified as a state and a city at the same time.

Table 3. Overview of Governments and Public Transport Agencies Collaborating in VBs
(Source: own calculations by the authors based on data collected directly from each VB)

ZVV has the largest number of collaborating local governments—representing Switzerland’s fine-grained system of local government with many independent small jurisdictions. While most VBs rely on coordinated service among many public transport operators (between 30 and 55), most of these operators are small companies, providing suburban

or rural bus service. Public transport service in each region is dominated by one or a few large operators—often the main public transport agency in each city and the regional rail/S-Bahn provider(s) (e.g. BVG and S-Bahn in Berlin; Wiener Linien and S-Bahn in Vienna; or MVG and S-Bahn in Munich). The exact role and responsibilities of governments and public transport agencies in planning, financing, and operating public transport varies between VBs and is explored later in this report.

3 Public Transport in Germany, Switzerland, and Austria: History and Development of Case Study VBs

3.1 Public Transport and Regional Coordination in Germany¹

3.1.1 Funding Public Transport in Germany

Public transport in Germany is funded by federal, state, and local governments. The mix of funding sources and lack of a federal database for public transport makes Germany's accounting for capital and operating expenses confusing. The following provides a general overview based on data available for the year 2008—estimating that about €28 billion were spent on public transport operation and capital investments that year.

The largest share of funding comes from farebox revenue paid by public transport users (estimated to be €9.0 billion in 2008). In addition to farebox revenue, German public transport operators receive reimbursements from governments for transporting school students, individuals in professional training, and people with disabilities (~€2.2 billion in 2008). Typically, these transfers are not considered subsidies, because public transport operators are reimbursed for service provided to those groups. In addition, public transport services are exempt from value added tax (19% in Germany). Moreover, many German municipalities use deficits of municipally owned public transport agencies to lower the tax rates paid on profits generated by other city-owned services, such as water, or electricity utilities. The estimated value of these tax advantages was about €2.8 billion in 2008. The federal government provides a share of the federal gas tax to state governments dedicated to operating statewide regional rail (~€3 billion per year). Municipal governments fund public transport operations with about €3.0 billion per year. In addition, the federal government provides €1.9 billion per year in matching funds for capital investments in public transport (other than regional rail). The federal government also

¹ Sources: Buehler, R., & Pucher, J. 2011. Making public transport financially sustainable. *Transport Policy*, 18(1), 126-138.

Girnau, G. 2003. Restrukturierungs-Modelle deutscher Nahverkehrsunternehmen: Voraussetzungen, Massnahmen, Ergebnisse. In VDV (Ed.), *Restrukturierung der OEPNV Unternehmen fuer den Wettbewerbsmarkt: Zwischenbilanz und Dokumentation*. Cologne: Verband Deutscher Verkehrsunternehmen.

Barth, S. 2013. Regionalisierungsgesetz des Bundes und ÖPNV-Gesetze der Länder. In: Baumeister, H. (ed.) 2013. *Recht des ÖPNV*. Volume 2. DVV Media, Hamburg, Germany. Pp. 235-432.

Weiss, H. J. 2003. Doppelrolle der Kommunen im ÖPNV. *Internationales Verkehrswesen*, Vol. 7+8 (Juli/Aug.), pp. 338-342.

Bormann, R., Bracher, T., Dümmler, O., Dünbier, L., Haag, M., Holzapfel, H., Kunst, F., Mietzsch, O., Mirbach, J., Mossakowski, H., Ubbelohde, J.H., Werner, J., and Zoubek, H. 2010. *Neuordnung der Finanzierung des Öffentlichen Personennahverkehrs: Bündelung, Subsidiarität und Anreize für ein zukunftsfähiges Angebot*. Friedrich-Ebert-Stiftung, Bonn, Germany.

VDV. 1990-2015. *VDV Statistik*. Cologne: VDV.

invests in the national (intercity) rail network, which is partially used by regional rail (€0.4 billion).

The German public transport association (VDV) provides a different data source on financing of public transport—limited to public transport only. The database includes information about VDV member organization only—including most of Germany’s municipal public transport agencies, but excluding regional rail and S-Bahn services provided by German railways (DB). In 2012, total operating costs for VDV public transport agencies was €2.3 billion. VDV public transport operators collected 9.6 billion in farebox revenue and funds for transporting school children, individuals in professional training, and people with disabilities. This represents a cost-recovery ratio of about 78% for operating costs. According to time series data of VDV, cost recovery of public transport operations increased from 59% in 1990 to 78% in 2012. The main reason for greater cost recovery was faster increases in revenues compared to costs. For example between 1996 and 2012, average cost per passenger increased by 10% (from 141 to 155 cents), while average revenue per passenger increased by 26% (96 to 121 cents).

3.1.2 Current Organization of Public Transport in Germany

The 1990s brought several significant legislative changes to the organization of public transport in Germany—affecting all case study regions in Germany (Hamburg, Munich, and Berlin).

First, German Railways (DB) was transformed from an administrative unit of the federal government to a private company owned by the German federal government. As part of this process, responsibilities for funding and planning of regional rail public transport remained with the government, but operations of regional rail were transferred to a new federally owned company (DB Regio).

Second, the federal government handed the responsibility for planning and funding of regional rail services to the states. In response, virtually all states passed state public transport laws to regulate organization, planning, and funding of rail public transport (with the exception of the city state Hamburg).

Third, a new federal law stipulates that cities and counties are responsible for planning and funding local public transport (other than regional rail). In practice, most cities (and some counties) combine two roles: (1) as funding and planning agency for public transport, and (2) as owner of public transport agencies that operate public transport service. Virtually, all large public transport agencies in German cities are owned by the city itself.

Fourth, state public transport laws created a new framework for public transport in each state. Each state law designates funding and planning responsibility for public transport within the state. In most states either state or regional associations of counties and cities are responsible for planning and funding of regional rail services. Moreover, in most states, counties and cities or regional associations of counties and cities are responsible for planning and funding bus, tramway, and U-Bahn services.

Fifth, since the 1990s German federal law distinguishes between public transport services that are subsidized and those that are for profit. This was prompted by EU regulations that called for more competition between operators if public transport service was subsidized. The exact meaning of the law and its consequences remained unclear and subject of long lasting court cases in Germany. However, in the late 1990s and early 2000s German public transport companies believed that all public transport services that are subsidized may eventually be subject to mandatory public calls for tender (calls for proposal) requiring public transport companies to compete for the right to provide subsidized service. This led to strong increases in financial efficiency among German public transport agencies in preparation for potential competition.

Revised EU regulations in 2009 and a corresponding German law in 2012 clarified that public transport agencies that can provide specified services without subsidies have priority over agencies that are subsidized. However, municipalities can subsidize public transport and designate a public transport provider without a call for tender, if there are no other public transport agencies that can provide the desired service without subsidies. In virtually all large cities, city owned public transport agencies provide public transport service as specified by the local jurisdiction. Most competitive tendering has occurred for regional bus and rail services.

3.1.3 Hamburg—Public Transport Innovator Facing Adverse Circumstances²

3.1.3.1 The Beginnings—Early Negotiations to Create Germany’s First Regional Transit Association

Founded in 1965, the Hamburger Verkehrsverbund (HVV) was Germany’s first regional public transport association. Prior to collaboration between operators in the HVV, traversing the City of Hamburg by public transport required up to 7 separate public transport tickets from different providers—all using their own rules for ticketing.

The Hamburger Hochbahn (HHA), a public transport provider owned by the City of Hamburg and the area’s largest public transport agency, developed a blueprint for regional collaboration in 1960 and initiated negotiations to found the HVV. In the early 1960s Hamburg experienced skyrocketing motorization and car use. HAA believed that cooperation with other public transport companies could help fight competition from the automobile, declining ridership, shrinking revenues, and increasing operating costs. Negotiations with other public transport agencies were difficult. For example, Germany’s federal railway company DB owned Hamburg’s S-Bahn (regional rail) system alongside similar regional rail services in other cities. As a national company DB was not keen on changing its business model for just one city and participating in a regional transport authority in Hamburg. DB agreed to join HVV once the City of Hamburg guaranteed payment of subsidies for the S-Bahn, promised to pay for new S-Bahn extensions, and gave DB considerable control within the newly founded HVV.

HVV also included bus operators from the two states adjacent to the City of Hamburg. HVV guaranteed bus operator’s revenues for several years after joining the regional transport association—limiting the business risk of joining HVV for bus operators. Bus operators in turn agreed to reorganize some of their bus routes to function as feeder services to regional rail lines. Participating HVV public transport agencies agreed to distribute joint farebox revenues according to the amount of service provided by each operator.

3.1.3.2 Other Public Transport Planning Goals

Public transport agencies, particularly HHA, participated in the HVV with the goal to improve future revenue flows and achieving cost efficiency. City planners and politicians saw the HVV as part of a larger strategy to combat problems of car use in the city, like air pollution and traffic congestion. They planned to build or extend rapid rail lines connecting the city to the region, forming development axis with compact land uses. Suburban Park & Ride facilities at rapid rail stations were an integral to this concept. At the same time car parking was restricted in the city

² Sources: HVV. 1995-2014. *Annual Reports*. HVV, Hamburg, Germany.
HVV. 1995-2014. *HVV Facts and Figures*. HVV, Hamburg, Germany.
HVV. 2015. *Presentation: HVV—Guidance Organization for Local Public Transport*. HVV, Hamburg, Germany.
Krause, R. 2009. *The HVV from 1965 Until Today*, HVV, Hamburg. 347 pages.

center. The goal was to shift car trips—between the suburbs and the city center—to public transport, especially during peak commute hours. In addition, new (off-street) rapid rail lines and new bus lines were to replace on-road tramways, so that tramway tracks could be torn out to provide more space for cars. Hamburg first reduced tramway service, from 19 lines in 1955 to 7 in 1972, and then eliminated its tramway system entirely in 1978.

3.1.3.3 Initial Success and Innovations in Ticketing and Customer Service

HVV was an innovator in many areas. First, HVV introduced single and monthly tickets for the entire region and integrated timetables across operators. The number of annual passengers increased by 10% between 1967 and 1972 and the number of monthly tickets sold more than doubled—in spite of an economic recession. By 1977, 60% of trips were made by passengers with monthly or annual tickets. Annual passes for high school and university students increased from 20,000 in 1970 to 140,000 in 1978. Second, HVV was first in Germany to develop special tickets for seniors, weekend tickets, special off-peak tickets, and to offer cash-free annual ticket directly debited to bank accounts. Third, HVV developed new bus services like limited-stop rapid lines and night buses. Fourth, as early as the 1970s, HVV guaranteed connections between bus and rail—using communication technology to make busses wait for delayed trains. Fifth, HVV focused its communications around the customer—replacing the previously held engineering/operations focus of communications of many public transport providers. Last, HVV focused on quality with customer friendly bus stops, more comfortable trains, and better and real time customer information.

3.1.3.4 Battling with Economic Crisis and Shrinking Population

In spite of its many innovations and initial success, during the 1970s and 1980s public transport companies of the HVV struggled with the repercussions of an economic recession in the Hamburg region, population decline in the City of Hamburg (from 1.9 million in 1960 to 1.6 million in 1989), and suburbanization of residents and businesses. Moreover, lofty plans for compact, mixed use development along rapid rail axis were undermined by low-density car-oriented sprawl between the axis and the lack of funding to build many of those regional rapid rail lines.

During the early 1970s HVV had to increase ticket prices significantly to cover its costs: 21% price increase in 1971, 7% in 1973, and 18% in 1974 and 1975. But even those aggressive increases in ticket prices could not keep up with increases in cost, which were 30% in 1972/1973 alone due to inflation and more and better benefits, shorter work hours, and more vacation for workers. Starting in 1975 passenger numbers in the HVV declined. Hamburg's public transport companies now received operating subsidies from the city. As a result, the influence of politicians on the HVV increased, demanding better service at lower cost. Starting in the 1980s, Hamburg's public transport system was also plagued by crime and vandalism on its trains and at stations.

In 1989 annual ridership was only 1.5% higher than in 1967 (416 vs 410 million passengers per year). However, Hamburg had fared better than most other public transport systems in Germany. Between 1960 and 1989 public transport ridership in Germany declined from 7.4 to 6.6 billion passengers per year (-11%) and public transport trips per capita shrank from 131 to 105 (-20%).

3.1.3.5 Renaissance and Restructuring in the 1990s

Since 1990, the City of Hamburg has been gaining population again from 1.59 million inhabitants in 1990 to 1.75 in 2014 (+10%). Public transport ridership has increased from 167 to 211 passengers per capita per year (+26%). The actual number of annual passengers increased from 416 to 729 million (+75%), but two extensions of the HVV service area, in 2002 and 2004, render absolute ridership numbers incomparable over time.

In 1990, Hamburg's city government passed a new pro-transit initiative aimed at improving public transport service, while restricting car use, including measures such as bus priority at traffic signals, bus only lanes, more Park & Ride, and reduced car travel speeds in neighborhoods. New suburban bus lines were opened establishing fast bus connections between rail axes in the suburbs—connecting traditionally car dependent areas to reliable and fast public transport service.

Invisible to most HVV customers, the mid 1990s also brought a major reform of HVV's administrative structure—from an association of public transport operators (e.g. HHA, S-Bahn) to an association of jurisdictions including the City of Hamburg, its two neighboring states (Niedersachsen and Schleswig Holstein), and 6 counties in those states. There were several reasons for this organizational restructuring.

First, the City of Hamburg had subsidized public transport in adjacent counties in its neighboring states and wanted those states to chip in.

Second, in the 1990s, the German federal government handed funding and other responsibilities for rail public transport to the states. Hamburg's two neighboring states passed state-wide public transport laws governing public transport provision and finance.

Third, the political influence of local governments on HVV decisions had grown since 1967 due to increasing subsidies for public transport. In the new administrative structure, a supervisory board from the nine participating jurisdictions sets the framework for public transport provision and finance. HVV guides public transport planning, provides marketing and customer relations, distributes fare revenues, and assures quality standards are met. Public transport agencies provide transit service according to a contract with HVV (based on standards set by the jurisdictions). Moreover, public transport agencies are involved in HVV decisions due to their role on the advisory board, their input in transport planning, and their fulfillment of specific HVV tasks. In the new HVV, public transport subsidies (beyond farebox revenue distributed by HVV) are paid directly to the public transport provider by the jurisdiction where the deficit occurs.

Since the 1990s, public transport service in Hamburg has focused on safety, cleanliness, and improved service. The new service initiative has included a modernized vehicle fleet and refurbished stations. HVV's regular citizen survey indicates success with the average grade for public transport service on a scale from 1 (very good) to 6 (poor) increasing from 2.96 to 2.52 between 1998 and 2014. In 2014, HVV received its best grades for comfort, reliability, seamless connections, and overall company image. Citizens gave the lowest grades for perceived high fares and crowding on vehicles. In addition, Hamburg introduced a variable length flexible ticket valid between one and 8 weeks, new company tickets purchased for employees directly by employers, and negotiated with universities to include a city-wide public transport ticket in student fees. Over the last 20 years HVV has increased its productivity, but fares also increased by about 3 to 4% per year. Compared to other case study cities, HVV receives very little support from municipalities that are hesitant to implement car-restrictive policies.

3.1.4 Munich—Joint Creation of U-Bahn, S-Bahn, and MVV³

3.1.4.1 *The Beginnings*

Founded in 1972, the Munich Verkehrsverbund (MVV) is Germany's second oldest regional public transport association—following Hamburg's HVV founded in 1965. Unlike Hamburg, Munich neither had legacy U- nor S-Bahn systems running through the city. Both, U- and S-Bahn systems started operations in the early 1970s—together with the MVV.

Until then, the city was served by trolleys and buses, while regional rail—whose 379km of track eventually became part of the S-Bahn network—arrived at two terminus stations (Haupt- and Ostbahnhof) without a rail connection within the city. Similar to Hamburg, Munich experienced rapid motorization in the 1950s and 1960s. As a response city planners wanted to build tunnels for the city's tramway system to free-up space for automobiles on roadways and to speed-up the trams (from about 9km/h on the road to over 20km/h in tunnels). The main tramway tunnel was to run underneath the city center between Munich's two main terminus stations for regional rail. At the same time German Federal Railways (DB), operator of Munich's regional rail lines, had competing plans for construction of tunnels underneath the city center as part of a city wide regional rail system to be named S-Bahn. City and DB could not agree on who would get to build and operate service in the tunnel.

In 1963, Munich's city council decided to build a U-Bahn—abandoning its initial idea of tunneling the tramway system. At the same time the federal government—owner of DB—tentatively agreed to pay 2/3 of the cost of an S-Bahn in Munich. This paved the way for DB to construct its S-Bahn tunnels connecting the two terminus stations. In 1965 construction for the U-Bahn began and Germany's federal government officially decided to build and finance Munich's S-Bahn—owned and operated by DB. In addition, in 1966 Munich was chosen as host for the Olympic Games in 1972—giving added urgency to the expansion and construction of U- and S-Bahn systems. In 1968, a commission was formed to prepare the creation of a regional transport authority—the MVV. Construction of new S-Bahn tracks and upgrades to existing regional rail infrastructure began in 1967. MVV was formed in 1971 (with the City of Munich and DB as shareholders) and assumed operations in 1972. In 1971, the first U-Bahn line was opened and in April 1972 the first new S-Bahn train connected the two main terminus stations—passing a stretch of 4km of new rails underneath Munich's city center.

3.1.4.2 *Initial Success and System Expansion and Improvement*

Assuming operations right before the Olympic Games in 1972, the MVV, the U-Bahn, and the S-Bahn were an instantaneous success. Demand remained high, even after the Games had ended. In 1972, MVV reported about 163 annual public transport trips per capita. This number increased to 200 by 1980 and reach 241 in 2013. Total annual ridership grew from 360 million passengers per year in 1973 to 670 million in 2013.

Since the early 1970s, MVV's public transport service has been improved and expanded. The first 12km of U-Bahn tracks (line U6) opened in 1971, followed by the U3 (3.6km) in 1972.

³ Sources: Cervero, R. 1998. *The transit metropolis. A global inquiry*. Washington D.C: Island Press.

MVV. 2012. *40 Years of MVV*. MVV, Munich, Germany.

MVV. 1990-2014. *Verbundbericht/Report*. MVV, Munich, Germany.

MVV. 2014. *Website*. MVV, Munich, Germany.

Switzer, A., Bertolini, L., and J. Grin. 2015. „Understanding transitions in the regional transport and land-use system: Munich 1945-2013,” in: *Town Planning Review*, 86, No. 6, pp. 699-723.

Since then U-Bahn network has grown to 95km with only about 2 minutes between trains during rush hour in the city center. In contrast to the newly built U-Bahn, the S-Bahn inherited 379km of track from Munich's regional rail network. Stations and tracks have been upgraded and new lines were added (e.g. to Munich's new airport in 1992) reaching 442km network length in 2012. S-Bahn trains depart for the city center every 10 minutes during peak times with 2 minute headways between trains at the busiest stations in the city center.

As in many other cities, starting in the early 1970s Munich's 125km long tramway system was destined to be abandoned. For many, the new underground U-Bahn was a replacement of the tramway. However, citizen protests encouraged a turn-around in the city council that in the 1980s first decided to keep the tramway and then in the 1990s voted to upgrade the tramway system. In 1997, the first line was re-opened and others have followed since. In addition to upgraded vehicles and timetables, tramway service was sped-up through own rights-of-way and priority green-lights at all traffic signals at intersections. In 2012, the tramway network was 79km long—up from 71km in 2000.

Like the tramway, Munich's bus fleet was modernized and service was upgraded including rapid bus lines with partially separated rights of way and signal priority at more than half of all intersections (in 2014). In 1972, there 304km of bus lines in city. In 2012, there were 456km of bus and metro bus lines in the City of Munich.

3.1.4.3 MVV's Role and Organizational Structure

Founding members of the MVV in 1971 were the owners of the major public transport companies: the City of Munich, as owner of Munich's tram, bus, and U-Bahn operator MVG, and DB, as owner of the S-Bahn. The State of Bavaria and representatives from counties surrounding Munich provided input via an advisory board. Like Hamburg's HVV, MVV was reorganized in 1996—transforming from an association of public transport companies to an association of jurisdictions with public transport funding and planning authority.

As in Hamburg, changes in German federal law triggered this re-organization of MVV. The federal government abandoned its role in funding and planning regional rail and S-Bahn services, by handing that responsibility and corresponding funding to the states. In response, German states passed their own public transport law—building a new framework for public transport in each state. This framework designates funding and planning responsibility for public transport. In most states counties and cities are responsible for planning and funding bus, tramway, and U-Bahn services, while either state or regional associations of jurisdictions are responsible for regional rail and S-Bahn services.

As a result of this change, DB was longer responsible for funding and planning any public transport in Munich and left the MVV. The State of Bavaria, now responsible for planning and funding regional rail (and the S-Bahn), and eight counties surrounding Munich, responsible for planning bus public transport in their area, joined the City of Munich as members of the MVV board. The City of Munich's role on the board changed from representing MVG, the city-owned public transport operator, to representing city interests in planning and funding public transport. MVG, S-Bahn, regional rail, and regional bus operators provide the service planned and funded by the jurisdictions (in collaboration through MVV). Operators also provide input into planning and collaborate within MVV—in areas such as marketing, distribution of fare revenue, and customer information.

In fact, MVV's traditional main responsibilities have been the distribution of fare revenue across operators, marketing, transport research, coordinating timetables, as well as creating and

improving the regional fare system. Since 1971 MVV has followed its motto “1 Network, 1 Timetable, 1 Ticket.”

MVV was a pioneer in using new technologies to provide customer information about its timetable. In 1984, MVV timetables were available on teletext to all TV users in Germany. In 1995/1996, they published their searchable timetables on disk/CD for everyone to install on their PCs. In 1998, MVV launched its website with searchable timetables. Since 2002, MVV information is available for mobile devices and since 2005 information on the occupancy rates of Park and Ride facilities is available online.

MVV also provided many innovations in ticketing with the goal to create fares that are simple to understand, fair for all groups and users, and covering operating costs. In 1972, MVV introduced electronic ticket machines—requiring passengers to purchase tickets themselves without the help of a sales person. In 1986, MVV offered an annual ticket for the first time at the cost of 10.5 months for 12 months of public transport use. The price was further reduced to 9.5 months in 1988 (if the annual fare was paid all at once up-front). In 2010, MVV sold 250,000 monthly or annual tickets.

While MVV’s tickets were successful, over time MVV’s fare system had become too complicated—offering a plethora of special tickets. The ticketing system was reformed and streamlined twice: in 1989 and again 1999. For example, the reforms reduced the number of travel zones from 141 zones to 16 rings around the city center and all weekly, monthly, and annual tickets were integrated in a system called Isarcard—named after the main river traversing Munich.

3.1.5 Berlin-Brandenburg: Providing Seamless Public Transport Service across the Former Border between West and East Germany⁴

The Verkehrsverbund Berlin-Brandenburg (VBB) is the youngest VB analyzed in this study. It was founded in 1996 and integrated public transport service assumed operations in 1999. VBB is also the largest VB analyzed in this study and one of the largest in Europe, comprising the entire state of Brandenburg and the City of Berlin (which is also considered a federal state under German law) serving a total of roughly 6 million inhabitants. Regional coordination of public transport in the Berlin and Brandenburg region was first mentioned in the 1990 treaty of reunification between West and East German governments. Prior to German reunification, the City of West Berlin was an island within socialist East Germany. The Berlin wall inhibited free passenger movement across the border. Between 1961 and 1989, there was neither regular unhindered public transport service between West and East Berlin nor between West Berlin and its suburbs in East Germany. East Berlin was the capital of East Germany and connected to its hinterlands by public transport service.

A detailed discussion of the history of the complicated public transport in East and West Berlin is beyond the scope of this report, but the political division between East and West Berlin had left its traces in the public transport system and influenced public transport service and investments after reunification in 1990. Key elements include:

⁴ Sources: Franz, H.W. *Birth of VBB*. In: *Nahverkehrs-praxis – Ausgabe 1/2-2007*, pp. 40-42

Stein, A. and Runge, D. 2014. *Financing Public Transport in Germany*. Part C: Case Study Berlin. Berlin KCW.

Kalender, U. 2014. *History of Transport Planning in Berlin*. Cologne: FGSV.

VBB. 2000-2015. *VBB Annual Reports*. Berlin: VBB.

First, similar to other West German cities, West Berlin abandoned its streetcar system in 1967 and expanded its subway system—freeing roadway space for automobiles and buses. Even though East Berlin had plans to cut streetcar service and expand subway service as well, East Berlin left its trolley system largely intact and even expanded it with ‘express’ routes with dedicated rights of way (after it became clear that large subway expansion was not financially feasible in the East). As a result today accessibility and travel speeds by public transport are uneven between West and East Berlin—with faster subway travel in West Berlin and slower light rail travel in the East.

Second, subway trains from West Berlin (lines U6 and U8) traversed East Berlin underground without stopping at (closed) stations in East Berlin. After reunification, these ‘ghost stations’ were quickly reopened to reconnect the subway network and some subway lines were extended in East Berlin.

Third, until the mid-1980s the West Berlin portion of the S-Bahn was operated by the national East German railway agency—resulting in a boycott by many West Berlin residents who did not want to support the East German government with ticket revenue. With the start of the boycott on 17 August 1961 daily S-Bahn ridership fell from 500,000 to 35,000. In response, bus services were expanded in West Berlin and some U-Bahn extensions paralleled existing (but little used) S-Bahn lines. While S-Bahn usage in West Berlin was low, the S-Bahn and regional service was important in East Berlin—because of the comparatively small U-Bahn network and slow trolley service.

Fourth, motorization rates had been lower in East Germany than in Berlin. After reunification motorization rates skyrocketed in East Berlin and in particular in Berlin’s suburbs in Brandenburg.

Fifth, since 1990 the Berlin region has experienced suburbanization and increasing car dependence in those suburbs. Land use had been strictly controlled prior to 1990. West Berliners could not move into East Germany across the wall. In East Berlin, housing construction was mainly focused on residential high rises at the urban fringe, connected to the city by public transport.

Sixth, in contrast to other case study cities, the city of Berlin lost population between 1990 and 2000. Since then population levels have stabilized and then slightly increased to 3.45 million. The state of Brandenburg has also lost population from 2.45 million in 1991 to 2.35 million in 2014. Population trends varied within Brandenburg, with the areas immediately adjacent to Berlin gaining population and remote areas of the state losing population.

Last, as a result of political division, at reunification in 1990, Berlin and Brandenburg had a disjointed public transport system and rail and roadway connections had to be rebuilt and/or reconnected within the city and between the city and its hinterlands.

The German federal government helped finance key public transport infrastructure upgrading, reconstruction, and new construction (e.g. new main train station, new routing of rail tracks through the center of Berlin with connections to Brandenburg, S-Bahn refurbishment and expansion, a new north-south rail tunnel). For example, between 1992 and 2002, the length of the S-Bahn network increased by 27% (200km to 255km) and the number of stations grew from 97 to 130. Similarly, the regional rail network increased from 100km in 1992 to 156km in 2002. However, these statistics do not capture the many improvements in quality of service for all public transport modes and better connectivity of the formerly separated U-Bahn, S-Bahn, regional rail, and bus systems. In any case, today regional rail services, bus services, and the S-Bahn traverse the former border within Berlin and connect the City of Berlin with its

Brandenburg suburbs. These connections are facilitated by VBB—the regional public transport association.

3.1.5.1 VBB's Role and Organizational Structure

It took 9 years from German unification to the start of integrated VBB operations in 1999. Organizationally, the board of VBB comprises representatives from 14 counties in Brandenburg (one each), 4 independent cities in Brandenburg (one each), as well as the City of Berlin and the State of Brandenburg (4 each). Ownership of VBB is also shared between municipalities and cities in Brandenburg (33%), the City of Berlin, and the State of Brandenburg (33%) each. Moreover there are 42 public transport agencies providing service in the VBB area. The main responsibilities for VBB are coordination of fares, planning for regional bus and rail transport, coordination of timetables, distribution of farebox revenues, travel surveys, controlling of quality standards of public transport, customer information, and promotion and branding of regional public transport.

VBB's monthly ticket can be used by multiple people during the day. In the evening (after 20:00), on weekends, and during holidays, one monthly ticket allows travel for two adults and three children. Because of its size, VBB offers monthly tickets for various sub-networks, e.g. just the city of Berlin or just for Potsdam. VBB significantly increased the price for its tickets. Between 1999 and 2014 the price for a single ticket increased by 30% and monthly tickets increased by 54%. Over the longer period between 1991 and 2013 prices increased by 69% (single ticket) and 117% (monthly ticket). In 2013, 77% of public transport trips were made by individuals with monthly (14%) or annual tickets (63%). VBB also offers special tickets for poorer individuals, such as the 'Mobilitätsticket Brandenburg' with a 50% savings compared to a regular monthly ticket. This ticket is subsidized by the state of Brandenburg and Brandenburg counties, where ticket holders reside. In addition VBB offers steeply reduced tickets for students.

The states of Berlin and Brandenburg jointly finance operations for regional rail and S-Bahn services. As all other German states, both states receive funds from the federal government for operation of regional rail. The State of Berlin additionally finances operations of the U-Bahn, trolleys, and buses in Berlin—mainly operated by BVG, the main public transport supplier in Berlin. The State of Brandenburg also finances bus number 618 (a bus route important for the entire state). In addition, the state of Brandenburg supplies its counties and cities with funds for student transport, as well as subsidies for tickets for poor individuals. Local bus operations are funded by the counties.

In the VBB region, the States of Berlin and Brandenburg have the main responsibility for planning and financing public transport. This includes the development of strategic and operational public transport plans (via VBB). These plans include standards for public transport, such as reliability, punctuality, or accessibility (e.g. in Berlin 80% of population should be within 300m or public transport; 96% within 500m). Since 2008, an organization called 'Center for Public Transport Berlin' (CNB) helps the City of Berlin in developing these plans and contracting with BVG. The contract between the city and BVG include a bonus and malus system—enticing BVG to deliver its service according to the standards defined in the contract. The City of Berlin on the other hand is responsible for transport infrastructure and its good state of repair allowing efficient transit service. Service quality is assessed using objective operations data and customer surveys. VBB cooperates with CNB, and VBB is still responsible for overall marketing of public transport in the region, coordination between Brandenburg and Berlin, ticketing, and revenue sharing.

3.2 Public Transport and Regional Coordination in Austria⁵

3.2.1 Financing and Planning for Public Transport in Austria

As in Germany, operation of public transport in Austria is financed by a mix of federal, state, and local sources. The federal government pays for operations of a ‘base level’ of regional rail services (~€70 million per year). This base level is defined in Austria’s latest federal financing law as regional rail service provided in the year 2000—just prior to passage of the law. States and jurisdiction fund additional or higher quality regional rail service themselves.

In contrast to Germany, the Austrian federal government and state governments also subsidize VBs with about €70 million and €80 million respectively. To entice local public transport operators to join VBs, in the 1990s, federal and state governments guaranteed the revenue level achieved prior to joining the VB. If company revenues were lower after joining the VB, the public transport agency was reimbursed. In turn, companies could not keep any revenue increases, which had to be transferred to the VB. This system did not provide incentives to increase revenue and increase ridership. Since 2000, this practice has changed and public transport companies enter into 5 year contracts with VBs—quantifying revenue and public transport service levels.

In addition the federal government supports jurisdictions that issue calls for tender (calls for proposals) for public transport service provision (~€7million), helps fund semester tickets for university students (~€75million), and pays for transport to and from school for school children through high school and those in vocational training (~€90 million). Transport for school children is the most important funding source for local public transport in rural areas. Since 1996, transport for school children and university students are part of the responsibility of VBs—giving them access to federal subsidies. For example, since 2012 Vienna and the two surrounding states use this funding to offer a ‘youth ticket’ for school children valid on all public transport in the entire area of the three states for only €60 a year. An alternative ticket for €20 a year is only valid between home and school and only on school days. Semester tickets for university students typically cost 40% less than regular monthly tickets. This difference is subsidized by local and federal governments.

There are no exact Euro amounts available at the national level for state and local government funds spent on operation of public transport. In general local and/or state governments pay for operations of tramway, bus, and U-Bahn services as well as for regional rail service beyond the ‘base level of service’ supplied by the federal government. State and local shares are indirectly paid through federal government transfers, because in Austria, the federal government collects most of the significant taxes, such as value added tax, gasoline tax, or income tax. Tax revenue is redistributed to states and local jurisdictions based on population size and other criteria identified in regularly re-negotiated contracts between the different levels of government. For example, states receive roughly 5% of federal gasoline tax revenues for public transport. There are also some local tax sources dedicated for public transport, such as the

⁵ Sources: Novy, M. 2009. Überblick über die Verbundlandschaft in Österreich. In: *Verkehrsverbände*, VDV, Köln, Germany
Amtmann, Brezina, Deußner, Ebner, Emberger, Faber, Höfler, Klementsitz, Lung, Mösl, Müller, Novy, Rauh, Rollinger, Schmidt, Spanner, Sticklberger, Weinzinger, Wolf, Zipfel. 2012. *Handbuch Öffentlicher Verkehr*. Österreichische Verkehrswissenschaftliche Gesellschaft. Vienna, Austria. Pp. 186-204.
VOR. 2012. *Public Transport Authority Eastern Region*. VOR, Vienna, Austria.
VOR. 2000-2012. *Annual Report*. VOR, Vienna, Austria.

City of Vienna's special public transport tax on large employers who pay roughly €100 per employee per year producing revenue of €70 million per year to finance the U-Bahn.

There are no nationwide data available on capital funding for public transport for Austria. The federal government typically pays for intercity rail lines for freight and passenger rail. Some of those intercity rail lines are also used by regional rail. In addition the federal government also pays up to 80% for new regional rail lines and 50% for subway lines in Vienna, the only city with a U-Bahn. Moreover, the federal government provides some matching funds for rail stations and park and ride spaces along regional rail lines—with states and municipalities covering the remainder.

More details about VBs in Austria are described below in a case study about VOR—Austria's first and largest VB. The case of VOR can illustrate some general traits of VBs in Austria. However, it is Austria's most urban VB and in many ways is different from VBs in other states.

3.2.2 Austria's First Public Transport Association: VOR in Vienna

3.2.2.1 The Beginnings

Founded in 1984, VOR was Austria's first regional public transport association and served as a model for all of Austria. By 1997, all states had founded state-wide public transport associations. Vienna's local public transport providers cooperated long before the official formation of VOR in 1984. As early as in the 1960s, tickets for some S-Bahn lines were valid on busses and tramways from Wiener Linien (WL)—Vienna's city-owned public transport agency. Similarly, WL tickets were valid on local buses serving areas of the City of Vienna not served by WL.

Similar to Munich, in the late 1950s and 1960s Vienna decided to build its S-Bahn and U-Bahn networks. Vienna's S-Bahn was built, owned, and operated by Austrian federal railways (ÖBB). The first S-Bahn lines opened in the 1960s. The decision to build a U-Bahn was more controversial, because (like in Munich) Vienna City officials long favored the tunneling of the tramway system or a monorail system, but in the late 1960s decided to build a U-Bahn. The Austrian federal government provided 50% of construction costs for the U-Bahn and it has been operated by WL. The first new U-Bahn line opened in 1976.

A study commissioned by the City of Vienna in the early 1970s recommended a VB for the Vienna region modeled after Hamburg's successful HVV. In 1974, the City of Vienna, the two neighboring states (Niederösterreich and Burgenland) and the Austrian federal government formed a commission to create a VB. The main area of disagreement was about funding for the new VB—especially the contentious question if all participants of the new VB would be jointly responsible for servicing the existing financial debts of S-Bahn and WL. In 1983, it was decided that old debts would remain within each public transport agency and that the federal government (50%) and states (30% Vienna, 15% Niederösterreich, and 5% Burgenland) would be jointly responsible to cover costs of public transport coordination and potential loss of revenue for some providers due to participation in a unified single ticket.

In 1984, the VOR launched including the entire City of Vienna and S-Bahn lines—with an integrated timetable and an annual ticket for all public transport modes within the city and the S-Bahn. In 1988, other smaller suburban rail lines and regional buses were fully integrated into VOR as well—including an annual ticket and timetable for the entire system. To entice public transport agencies to participate, VOR guaranteed existing revenue levels prior to joining VOR—thus removing the risk of participation for public transport agencies. Today VOR

comprises the City of Vienna and surrounding areas in Niederösterreich and Burgenland, often limited to areas adjacent to suburban rail lines. Areas of Niederösterreich and Burgenland that are farther away from Vienna are served by another VB called VVNB. Starting in 2016, VOR and VVNB will be amalgamated into one agency (called VOR) comprising all of Vienna, Niederösterreich, and Burgenland.

3.2.2.2 Increasing Ridership, System Expansion, and More Public Transport Service

Assuming operations in 1984, right after completion of the first construction phase of the U-Bahn network, VOR was an initial success. Ridership increased from 565 million in 1984 to 716 million in 2000 and over 900 million in 2012. Even adjusting for population growth, ridership per capita increased from 255 trips per person per year in 1984 to 281 in 2000 to 318 in 2012.

Ridership growth was facilitated by increasing public transport supply expanding from 20 billion place kilometers of public transport service in 1985 to 41 billion in 2012. Most of this growth in passengers and service can be attributed to the U-Bahn, which was extended from 41km of tracks in 1990 to 75km in 2012. WL also increased the service frequency for the U-Bahn, so that between 1990 and 2012, place kilometers of U-Bahn service almost doubled from about 6 billion to almost 12 billion per year. In addition S-Bahn service was expanded, increasing place kilometers of service by over 50% between 2000 and 2012 alone.

Even though Vienna still has one of the most extensive streetcar networks (172km of track) in Western Europe, level of service and track length shrunk between 1990 and 2012. Place kilometers of tramway service shrank from about 5 billion in 1990 to 4 billion in 2012—mainly due to elimination of tramway lines that paralleled newly opened U-Bahn lines in the 1990s. By contrast, bus service was expanded in Vienna and surroundings—increasing from 2.9 to 4.2 billion place kilometers of service.

3.2.2.3 Current Operations of VOR and Responsibilities

Since the year 2000, main tasks of VBs in Austria are prescribed by federal law. VBs coordinate ticketing, work with jurisdictions to plan for public transport, develop marketing ideas and materials, design and implement customer information, provide contracting expertise for public transport services, and distribute fare revenues across operators. The same law prohibits the federal government from being a partner in a VB. Thus the Austrian federal government left the VOR in the early 2000s. The new VOR included the City of Vienna (44%) as well as the states of Niederösterreich (44%) and Burgenland (12%). However, the Austrian federal government maintained its 50% funding role—even after giving up its influence on the board of VOR.

The Austrian federal government provides funding to create and maintain state-wide (or regional) public transport associations. In 2005, the Austrian federal government supported VBs with about €70 million per year to partially offset fare revenue losses due region-wide coordinated tickets and student tickets. This represents about 40% of the total of €150 million spent in Austria on lost revenue per year. Lost revenue due to a unified ticket typically occurs in suburban or rural areas for long-distance suburban public transport providers, whose passenger ride longer distances than public transport riders in central cities.

In the Vienna region, VOR coordinates public transport between three regional jurisdictions (Vienna, Burgenland, and Niederösterreich), who form VOR's board and 41 local public transport operators—with WL and the S-Bahn accounting for the vast majority of place kilometers of service and passengers. Regional collaboration of VOR includes a unified fare system, marketing, customer information, organizing calls for tender for regional bus lines, quality control, service contracts for regional rail (for service that's above the base service

provided by ÖBB), research about customer demand, public transport planning in coordination with jurisdictions and transit agencies, and distribution of fare revenues between public transport operators.

Fares in VOR are based on distance as measured by zones. The central zone consists of the City of Vienna. VOR offers weekly, monthly, student, semester, and senior tickets. In 2012, the Vienna government dropped the price for an annual ticket for the central zone (covering the entire City of Vienna) from €449 to €365 per person per year. The new €365 ticket increased the sales of annual tickets by almost 75% from 372,000 in 2011 to 650,000 in 2014. Moreover, since 2012, seniors only pay €24 per year for a ticket covering the City of Vienna. An annual ticket for school students is €60 for the entire VOR region and areas beyond in the two surrounding states.

3.3 Public Transport and Regional Coordination in Switzerland

3.3.1 Financing and Planning for Public Transport in Switzerland⁶

As in Germany and Austria, public transport in Switzerland is financed by a mix of federal, state, and local sources. Unlike financing statistics for Germany and Austria, it is not possible to obtain national level financing information for local and regional passenger public transport only. Swiss statistics on public transport comprise national intercity rail as well as public expenditures for freight rail. Government sources for public transport infrastructure and operation account for roughly 50% of its cost (~8.1 billion SFR of 16.8 billion SFR in 2014). The other 50% originate from farebox revenue (5.9bn SFR) and other sources such as advertisement (1.7bn SFR) and revenue from freight transport (1.2bn SFR). About half of all public spending on public transport is for infrastructure and the other 50% is for operations. Overall, federal sources account for 70% of public transport expenditures (mainly infrastructure and federal railways), followed by states (20%) and local sources (10%).

In general, the Swiss federal government finances infrastructure and operations of intercity rail, as well as large infrastructure projects of regional significance. Together with the states, the federal government also helps finance infrastructure and covers operating deficits for regional public transport service. The federal share depends on tax revenue per capita for each state—with the federal government paying for a larger share of expenditures in poorer states. States and local jurisdictions jointly finance infrastructure and operations for local public transport. There are no federal subsidies for local public transport—other than payment for large regionally significant infrastructure projects, such as expansion of light rail systems or railway stations where the federal government covers roughly 40% of the cost. Government revenue sources for public transport include federal, state, and local general funds, as well as earmarked amounts from federal gas tax and roadway tolling revenue.

Switzerland is internationally renowned for its high quality and highly integrated public transport services. Historically, this reputation is based on the integration of national and regional rail and bus services. Since the 1850s, an increasing number of Swiss regional and

⁶ Sources: LITRA. 2015. Public Transport Finance for Infrastructure. Bern, CH: LITRA (Informationsdienst Oeffentlicher Verkehr).

LITRA. 2015. Public Transport Finance for Operations. Bern, CH: LITRA (Informationsdienst Oeffentlicher Verkehr)

VOEV. 2015. Facts and Arguments in Favor of Public Transport. Bern, CH: Verband öffentlicher Verkehr.

Vollmer, P. 2009. Only few understand how it works: Financing public transport in Switzerland. In: Regional Schiene, No. 7, 2009. Accessible online at: http://www.regionale-schienen.at/0_thema_200907.asp?mid=23

national rail companies have cooperated integrating ticketing for individual trips—charging pre-negotiated prices per distance traveled (a system called ‘Direkter Verkehr’). Since the late 1890s an increasing number of Swiss rail operators have also participated in offering an annual ticket valid on vehicles of each participating company—eventually comprising virtually all regional and national rail services in Switzerland (Generalabonnement—GA)—excluding local public transport in cities, but including many intercity and regional bus services (e.g. Postbus).

However, in spite of these efforts of national coordination, public transport in Switzerland faced increasing competition in the 1960s and 1970s due to skyrocketing car ownership and use. In response, in 1982, the Swiss national rail provider SBB introduced its nationwide ‘puls timetable’ coordinating arrivals and departures of intercity trains with regional trains and buses. In addition, in 1990, local public transport systems became part of the GA—with the ticket now covering virtually all urban, regional, and intercity public transport in Switzerland.

As in most other cities in Western Europe, Swiss cities and towns experienced skyrocketing car ownership and use after WWII. At the same time public transport usage declined. During this time many cities abandoned their trolley systems to make space on roadways for more automobiles. By the early 1980s only Zurich, Bern, Geneva, and Basel still had trolley systems. In most cities, public transport usage declined until the early 1980s. Since the early 1980s, however, public transport ridership has increased again. Several factors contributed to this change. The oil crises of the 1970s and environmental pollution dampened public enthusiasm for the car.

In 1978, the city state of Basel—the Swiss city with the lowest car ownership rate—and its adjoining state (Kanton Basel Landschaft) were first to offer monthly and annual tickets for local light rail services valid in both states. In 1987, the city of Basel and four adjoining states were again first in Switzerland to introduce a regionally coordinated monthly and annual ticket valid for all public transport in the entire region. The ticket approved by voters in each state included a 1/3 subsidy of the ticket price paid by the state of residence of the annual ticket holder. This effectively cut the cost of an annual public transport pass for the region by half. The number of customers with an annual pass increased from roughly 0.8 million in 1985 to 1.9 million in 2003. Today most Swiss cities and regions coordinate their ticketing similar to the Basel model that first emerged in the mid-1980s—reaching about 90% of the Swiss population.

3.3.2 Zurich’s ZVV—Switzerland’s First ‘Real’ VB and a Special Case in a Country Known for Its Public Transport System⁷

Zurich’s regional public transport association (ZVV) was founded in 1990. Following the Swiss tradition of grassroots politics, ZVV was approved by 75% of voters in the state of Zurich in 1988 and comprises the City of Zurich, 168 municipalities in the state of Zurich and 15

⁷ Sources: ZVV. 2015. Kennzahlen und Statistiken. Zurich: ZVV. Accessible online at:

<http://www.zvv.ch/zvv/de/ueber-uns/zuercher-verkehrsverbund/kennzahlen-und-statistiken.html>

Bruehweiler, D., W. Schurter, G. Rey, and Th. Weiss. 2015. 25 Jahre Zuercher S-Bahn. In: Eisenbahn Revue, No. 6, pp.283-293.

Vollmer, P. and H. K. Schiesser. 2009. The emergence and significance of fare alliances in Switzerland. In: VDV. 2009. Transport Alliances. Cologne, VDV. Pp. 283-293.

Henes, B. 2009. The special status of the Zurich Verkehrsverbund. In: VDV. 2009. Transport Alliances. Cologne, VDV. Pp. 293-301.

Cervero, R. 1999. Creating First Class Transit with Transit-First Policies: Zurich, Switzerland. In: Transit Metropolis. New York: Island Press. Pp.299-318.

Mees, P. 2009. The Zurich Model. In: Transport for Suburbia. New York: Earthscan. Pp. 129-146.

jurisdictions from other geographically adjoining states. ZVV is Switzerland's first and largest true VB including regional cooperation in the areas of ticketing (as in most other Swiss city regions), as well as strategic planning, marketing, operations, and funding of public transport.

The launch of ZVV was accompanied by the opening of the Zurich S-Bahn—a regional rail service financed by the state of Zurich and the federal government. The S-Bahn largely runs along existing rail rights of way in the Zurich region, but has included significant investments (up to 1 billion Swiss Francs) in upgraded and new stations as well as additional track capacity—importantly a new S-Bahn line, underground tunnels, and an underground station beneath Zurich's central railway station. The decision to build the Zurich S-Bahn was approved by the state's citizens in 1981 with a 2/3 majority. The vote was a major turn-around in public opinion mainly attributed to increasing traffic congestion and environmental pollution. Previously, Zurich voters had rejected an underground light rail system (1962; 61% No) as well as a proposed subway and S-Bahn network (1973; 57% No). Instead of the U- and S-Bahn network, voters boosted general public transport in Zurich narrowly endorsing a 'public transport first' policy (51% Yes) with the goal to enhance the quality, speed, and reliability of existing public transport service—essentially separating trolley and bus right of ways from other traffic and giving priority green lights for trolley's and busses at most intersections.

ZVV's tight integration of public transport planning and financing is unique in Switzerland. ZVV contracts with its member public transport companies to provide public transport service at a pre-negotiated price, volume, and quality. Public transport service and timetables are planned by local public transport providers who jointly develop an integrated regional timetable of public transport services (within the financial limits set by ZVV and the jurisdictions that help finance ZVV). Regional coordination of planning for public transport service is led by eight large public transport companies. Each of the eight large companies is responsible for leading public transport service planning in a specific geographic market/sub-region in ZVV. The other 43 public transport agencies are typically small companies that only provide service in one of the eight markets/sub-regions. ZVV is responsible for strategic marketing, financing, and transport planning (i.e. infrastructure planning, long-term strategic planning for public transport supply).

Farebox revenue collected by the public transport providers goes to the ZVV, as do (subsidy) payments from federal, state, and local governments. Local government subsidies paid to ZVV depend on level of public transport service (number of public transport departures) and wealth of the local jurisdiction—measured as local tax revenue collected per inhabitant. ZVV is also responsible for planning, financing, and overseeing public transport infrastructure investments. As of 2015, ZVV covered roughly 60% of annual operating and capital expenditures from farebox revenue.

3.4 Comparison of Recent Trends in Public Transport Demand, Supply, Finance and Ticketing in VBs in Hamburg, Munich, Berlin, Vienna, and Zurich between 1990 and 2012

3.4.1 Trend in Public Transport Demand 1990 to 2012

Tables 4a and 4b provide trends in public transport demand between 1990 and 2012 for the 5 VBs—both as total passenger trips per year and as passenger trips per capita—adjusting for changes in service area and population. All VBs have increased the number of annual passengers. HVV and ZVV had the strongest percent increases (+64% and 57%), followed by VOR and MVV (+44% and 31%). Data for VBB are only available since 1995, 4 years before

VBB was founded, and show a 22% increase in annual passengers between 1995 and 2012. Adjusting for population growth (and expansion of service areas), all VBs saw increases in public transport trips per capita. Zurich had the strongest increase in passengers per capita (+35%), followed by HVV and VOR (+24% and +22%). MVV saw an increase of 11% of passenger trips per capita. VBB is the only VB that lost population and its increase of 28% in passengers per capita is partially related to a decline in population in the state of Brandenburg—reducing the overall population serviced by VBB.

	1990	1995	2000	2005	2010	2014	Change '90-'14
HVV (Hamburg)	436	423	489	567	676	738	1.69
MVV (Munich)	507	529	547	581	633	680	1.34
VOR (Vienna)	680	755	784	805	908	1027	1.51
VBB (Berlin)	n.a.	1085	1061	1227	1260	1365	1.26
ZVV (Zurich)	384	407	449	528	582	620	1.61

Table 4.a. Trend in Public Transportation Passengers per Year, 1990 -2014 (in million)
(Source: own calculations by the authors based on data collected directly from each VB)

	1990	1995	2000	2005	2010	2014	Change '90-'14
HVV (Hamburg)	169	182	185	179	199	219	1.30
MVV (Munich)	216	222	224	226	234	241	1.12
VOR (Vienna)	286	278	281	272	324	367	1.28
VBB (Berlin)	n.a.	173	177	211	214	231	1.34
ZVV (Zurich)	321	337	371	412	423	442	1.38

Table 4.b. Trend in Public Transportation Passengers per Person per Year, 1990 -2014
(Source: own calculations by the authors based on data collected directly from each VB)

3.4.2 Trend in Public Transport Supply 1990 to 2012

Tables 5a and 5b summarize trends in public transport supply and public transport supply per capita—again adjusting for changes in population over time. With the exception of the VBB, all VBs have expanded their public transport supply, measured as annual place kilometers of service. HVV and MVV increased their supply by almost 86 and 88%, while ZVV and VOR saw growth of about 75%. VBB witnessed a slight decline in place kilometers of service, since 2000—the first year of available supply data for VBB. Adjusting for population in the VB area, Munich (+59%), Zurich (+50%), Vienna (+46%), and Hamburg (+36%) increased their supply per capita significantly. VBBs supply has been stable.

	1990	1995	2000	2005	2012	Change '90-'12
HVV (Hamburg)	19	22	23	35	36	1.86
MVV (Munich)	19	25	29	34	36	1.88
VOR (Vienna)	25	30	32	34	44	1.74
VBB (Berlin)	n.a.	n.a.	54	54	53	0.99
ZVV (Zurich)	14	16	20	23	25	1.75

Table 5.a. Trend in Public Transportation Passengers per Year, 1990 -2014 (in million)
(Source: own calculations by the authors based on data collected directly from each VB)

	1990	1995	2000	2005	2012	Change '90-'12
HVV (Hamburg)	7,680	8,528	8,750	10,547	10,450	1.36
MVV (Munich)	8,234	10,348	11,948	13,015	13,067	1.59
VOR (Vienna)	10,588	12,049	12,490	12,615	15,420	1.46
VBB (Berlin)	n.a.	n.a.	9,041	9,040	9,150	1.01
ZVV (Zurich)	11,984	13,385	16,369	17,593	17,939	1.50

Table 5.b. Trend in Public Transportation Passengers per Person per Year, 1990 -2014
(Source: own calculations by the authors based on data collected directly from each VB)

3.4.2.1 Trend in Supply by Mode 1990 to 2012

Aggregate supply trends above hide variability in supply trends by mode of public transport. However, data availability and comparability by mode was more limited than for aggregate trends in supply. Tables 6a and 6b present available supply indicators for U-Bahn, S-Bahn, bus, and tramways. Table 6a shows that Hamburg (+47%), Munich (+59%), and Vienna (+92%) greatly expanded their supply of place kilometers of U-Bahn service. Vienna and Munich's strong increases are related to expansions of their comparatively new U-Bahn systems that started operations in the 1970s. Table 6b shows that since 1992 their U-Bahn networks were extended by 67% (Munich) and 82% (Vienna). Hamburg's U-Bahn dates back to before WWII, but was its network was also extended and service was increased.

Trend in Public Transportation Place Kilometers of U-Bahn Service per Year, 1990 -2012 (in million)

	1990	2000	2012	Change '90-'12
HVV (Hamburg)	5345	6192	7853	1.47
MVV (Munich)	5749	7697	9132	1.59
VOR (Vienna)	6169	7748	11837	1.92
VBB (Berlin)	n.a.	n.a.	n.a.	n.a.
ZVV (Zurich)	n.a.	n.a.	n.a.	n.a.

Trend in Public Transportation Place Kilometers of S-Bahn Service per Year, 1990 -2012 (in million)

	1990	2000	2012	Change '90-'12
HVV (Hamburg)	9545	10130	11583	1.21
MVV (Munich)	9006	16741	21167	2.35
VOR (Vienna)	n.a.	14265	22483	n.a.
VBB (Berlin)	n.a.	31	33	n.a.
ZVV (Zurich)	10327	15543	20275	1.96

million train kilometers for berlin

Trend in Public Transportation Place Kilometers of Trolley Service per Year, 1990 -2012 (in million)

	1990	2000	2012	Change '90-'12
HVV (Hamburg)	n.a.	n.a.	n.a.	n.a.
MVV (Munich)	1432	1226	1290	0.90
VOR (Vienna)	5556	4231	4120	0.74
VBB (Berlin)	n.a.	n.a.	n.a.	n.a.
ZVV (Zurich)	2998	2864	3195	1.07

Trend in Public Transportation Place Kilometers of Bus Service per Year, 1990 -2012 (in million)

	1990	2000	2012	Change '90-'12
HVV (Hamburg)	5793	5425	8836	1.53
MVV (Munich)	3117	3548	4708	1.51
VOR (Vienna)	2872	4074	4209	1.47
VBB (Berlin)	n.a.	n.a.	n.a.	n.a.
ZVV (Zurich)	1410	1513	1790	1.27

Table 6.a. Trend in Place Kilometers of Public Transport Service by Mode, 1990-2012

(Source: own calculations by the authors based on data collected directly from each VB)

Between 1990 and 2012, place kilometers of tramway service declined in Vienna (-26%) and Munich (-10%), but increased slightly in Zurich (+9%) (see table 6a). In all three cities, tramway service declined between 1990 and 2000. Since 2000, service in Munich (+5%) and Zurich (+11%) increased and only decline slightly in Vienna (-3%). The decline in Vienna is mainly related to elimination of tramway lines that ran parallel to newly opened U-Bahn lines—while tramway service was actually expanded and upgraded elsewhere in the city. There is no information about place kilometers of tramway service in Berlin. However, table 6b shows an increase in kilometers of tramway network length in Berlin (+7%) between 1990 and 2012.

Trend in Km of U-Bahn Networks, 1990 -2012

	1990	2000	2012	Change '90-'12
HVV (Hamburg)	90	101	104	1.16
MVV (Munich)	57	85	95	1.67
VOR (Vienna)	41	63	74.8	1.82
VBB (Berlin)	134	144	146	1.09
ZVV (Zurich)	n.a	n.a	n.a	n.a

Trend in Route Km of S-Bahn Networks, 1990 -2012

	1990	2000	2012
HVV (Hamburg)	212	212	239
MVV (Munich)	489	517	530
VOR (Vienna)	n.a.	533	603
VBB (Berlin)	256	322	327
ZVV (Zurich)	908	1097	1254

Trend in Route Km of Streetcar Networks, 1990 -2012

	1990	2000	2012
HVV (Hamburg)	n.a.	n.a.	n.a.
MVV (Munich)	114	98	109
VOR (Vienna)	248	233	222
VBB (Berlin)*	178	188	191
ZVV (Zurich)	117	109	119

*track length

Table 6.b. Trends in Route Kilometers and Network Length of Public Transport (Source: own calculations by the authors based on data collected directly from each VB)

Available data indicate that HVV, VOR, MVV, and ZVV greatly increased S-Bahn service. ZVV and MVV's S-Bahns saw large increases in place kilometers of service (+96% and +135%). Supply data for Berlin's S-Bahn were only available as train kilometers of service and suggest a slight increase in level of service between 2000 and 2012 (+5%). Increases in route kilometers of S-Bahn networks in Table 6b confirm trends in S-Bahn supply identified in Table 6a. All VBs also increased their bus service, mainly in areas outside of the central city, but also along special express bus routes within the cities.

3.4.3 Revenue, Ticket Prices, Cost Recovery, and Customer Satisfaction

Tables 7a and 7b show that all VBs have increased their revenues between 1990 and 2012. Revenue for ZVV is given in Swiss Francs (SFR), because of large exchange rate fluctuations of SFR, which would distort revenue trends if presented in Euros or US Dollars⁸. Hamburg, Munich and Zurich increased their revenues more than twofold, while Vienna saw an increase of 75% only. Data for Berlin's VBB show an increase of 56% between 2000 and 2012. Adjusting for increases in the number of passengers shows smaller increases in revenue per passenger from 22% (VOR) to 92% (ZVV). Again data for Berlin in Table 7b are only available for the time between 2000 and 2012. Longer time trend data for revenue per passenger exist when comparing VBB data after 2000 to data for the City of Berlin only (prior to 2000). Those data show an increase in revenue per passenger of 63% between 1990 and 2012.

Table 7b also demonstrates that VOR has much lower revenue per passenger (€0.57) than the other systems: MVV (€1.10), HVV (€1.00), ZVV (€1.00), and VBB (€0.85). While VOR already had the lowest revenue per passenger in 1990 (€0.47), the difference compared to other systems has increased from 11% to 28% less revenue per passenger in 1990 to 34% to 49% less

⁸ Exchange rates of the Swiss Franc relative to US dollars appreciated significantly from SFR1.50 per \$US to roughly 0.90 SFR per \$US in 2012.

revenue per passenger in 2012. Changes in fare policy discussed below help explain these trends.

	1990	1995	2000	2005	2012	Change '90-'12
HVV (Hamburg)	280	336	359	473	692	2.48
MVV (Munich)	283	405	423	523	727	2.57
VOR (Vienna)	317	367	415	465	558	1.76
VBB (Berlin)	n.a.	n.a.	700	889	1095	1.56
ZVV (Zurich) (in SFR)	140	191	187	250	325	2.32

Table 7.a. Trend in Revenue (in million Euros/SFR), 1990 -2012 (Source: own calculations by the authors based on data collected directly from each VB)

	1990	1995	2000	2005	2012	Change '90-'12
HVV (Hamburg)	0.64	0.70	0.73	0.86	1.00	1.56
MVV (Munich)	0.56	0.77	0.77	0.94	1.10	1.96
VOR (Vienna)	0.47	0.49	0.53	0.58	0.57	1.22
VBB (Berlin)	n.a.	n.a.	0.72	0.72	0.85	1.19
ZVV (Zurich) (in SFR)	0.52	0.69	0.65	0.81	1.00	1.92

Table 7.b. Trend in Revenue per Passenger, 1990 -2012 (Source: own calculations by the authors based on data collected directly from each VB)

Table 8 compares the price of single, monthly, and annual public transport tickets for the main city of each VB⁹. VBs also offer steeply discounted tickets for special groups such as seniors, students, or the unemployed. The ticket prices compared in Table 8 are for adults not qualifying for special discounts, such as semester or senior tickets. In 2012, VOR had the cheapest single, monthly, and annual tickets. In all cities, monthly tickets provide significant discounts compared to single tickets. In Zurich, a monthly ticket costs as much as 19 single tickets, compared to 26 and 27 single tickets for the price of a monthly ticket in Hamburg, Vienna, and Munich, as well as 31 single tickets per price of a monthly ticket in Berlin.

In all cities annual tickets represent further discounts compared to monthly tickets. Prices for annual tickets shown here are paid monthly. There are additional smaller discounts for a lump-sum onetime payment for annual tickets, compared to monthly installments directly deducted from bank accounts (e.g. €365 vs €375 in Vienna). In Vienna, an annual ticket only costs as much as 8 monthly tickets, compared to 9 and 10 months in the other cities. In any case, passengers with annual tickets only pay for 8 to 10 months, but get to ride for an entire year.

⁹ Note: all VBs also offer different kinds of tickets for sub-areas of their networks. Data presented here are for the main city of each VB.

	Price Single Ticket	Price Monthly Ticket	Price Annual Ticket	# Single Tickets per Price Monthly Ticket	# Single Tickets per Price Annual Ticket	# Monthly Tickets per Price Annual Ticket
	2012	2012	2012	2012	2012	2012
HVV (Hamburg)	2.8	75.6	726	27	264	10
MVV (Munich)	2.5	64.2	642	26	257	10
VOR (Vienna)	1.8	48.2	375	27	208	8
VBB (Berlin)	2.4	74.0	740	31	308	10
ZVV (Zurich) (in SFR)	3.6	70.0	630	19	175	9

Table 8. Comparison of Price of Single, Monthly, and Annual Public Transport Tickets for the Main City of Each VB (Source: own calculations by the authors based on data collected directly from each VB)

Table 9 shows trends in the price of monthly and single tickets for the central zone/main city of each VB. The price for monthly tickets increased between 50% (VOR) and 110% (VBB), while the cost of single tickets grew by 60% to 80%. Both in 1990 and 2012, VOR had the cheapest monthly ticket and HVV had the most expensive ticket. VBB had the strongest increases in monthly ticket prices between 1990 and 2012. However, the data are not fully comparable, because the service area included in a ticket for the City of Berlin increased in the 1990s (expansion from Tarifgebiet A to AB). In both years, ZVV had the most expensive single ticket.

Importantly, in all countries, the cost of gasoline increased at a faster rate than the price for public transport tickets. According to International Energy Agency data, the cost of a liter of gasoline (RON 95) increased from \$0.80 to \$2.16 in Germany, \$0.71 to \$1.98 in Switzerland, and from \$0.81 to \$2.07 in Austria (in international dollars using purchasing power parities).

	Monthly Ticket			Single Ticket		
	1990	2012	Change	1990	2012	Change
HVV (Hamburg)	43.0	75.6	<u>1.8</u>	1.6	2.8	<u>1.7</u>
MVV (Munich)	36.7	64.2	<u>1.7</u>	1.4	2.5	<u>1.8</u>
VOR (Vienna)	33.2	48.2	<u>1.5</u>	1.2	1.8	<u>1.6</u>
VBB (Berlin)	35.8	74.0	<u>2.1</u>	1.5	2.4	<u>1.6</u>
ZVV (Zurich) (in SFR)	41.6	70.0	<u>1.7</u>	2.0	3.6	<u>1.8</u>

Table 9. Trend in Cost for Monthly and Single Public Transport Tickets for the Main City of Each VB (Source: own calculations by the authors based on data collected directly from each VB)

Differences in ticket prices between VBs are also reflected in cost recovery ratios for operation of public transport service. Not all VBs report this statistic and cost recovery ratios are not always publicly accessible. Available data indicate the following cost recovery ratios for public transport operation for the year 2012: HVV 72%, MVV 80%, ZVV 63%, VOR 55%, and VBB 74%. Thus, the German systems seem to have higher cost-recovery ratios than ZVV and VOR. Available Trend data suggest strong improvements in operating cost recovery ratios since

1990 for Hamburg (58% to 72%) and Munich (62% to 80%). Vienna's operating cost recovery ratio only increased slightly from 53% to 55%. VORs low cost recovery ratio and small increase over time is partially explained by Vienna's comparatively low fares, small fare increases over time, and the new cheap €65 annual ticket introduced in 2012 (discussed in the Vienna case study)¹⁰.

Another indicator for public transport performance is customer satisfaction. In 2014, HVV, MVV, VOR, and VBB conducted customer satisfaction surveys indicating that customers in Vienna were most satisfied: 99% of respondents rating the system positively. MVV and HVV came in second with 87% and 86% positive ratings. VBB customers were most critical with only 68% positive ratings. The European Union's Eurobarometer surveys of cities shows similar trends with improved customer satisfaction for all systems between 2011 and 2015. In this rating Zurich is leading with 95% (2011) and 97% (2015) positive ratings, followed by Vienna (88% and 95%), Hamburg (88% in both years), and Munich (85% and 86%). Berlin had the lowest shares of satisfied customers again, but with strong improvements: 76% positive ratings in 2011 and 84% in 2015.

In terms of average travel speed, Reported average speeds for S-Bahn services are comparable for all case study cities (either 39 or 40km/h). Similarly, there is little variability in average speeds for buses ranging from 18 to 19km/h. Reported U-Bahn speeds range from 31km/h in Berlin to 36km/h in Munich with Hamburg and Vienna in-between at 33km/h. Streetcar service is slightly faster in Munich and Berlin (19km/h) than in Vienna and Zurich (15km/h and 16km/h).

3.5 Summary for European Case Studies

While there are many differences between countries and VBs, several joint characteristics of VBs emerged:

First, between 1990 and 2012, the five VBs analyzed here were all successful in attracting more riders and increasing revenues. Total and per-capita ridership increased between 34-69% and 12-38% respectively. Farebox revenue collected from passengers grew overall between 76%-157% and per passenger between 22-96%. Higher fares and more riders help explain the increases in revenue. Customer satisfaction was high and increasing in most VB areas, based on the standardized Eurobarometer survey and individual surveys by each VB—with positive ratings of over 85% of respondents (with the exception of VBB).

Second, VBs focus on the customer experience of riding public transport. The slogan of Munich's MVV summarizes this very well: "One Network, One Timetable, One Ticket." The goal is to create a seamless transport network for the customer with convenient connections using just one ticket throughout the service area. Customers do not have to bother with different

¹⁰ Data on public transport productivity per employee are not available on the VB level and not readily supplied by individual public transport companies. Some data could be culled from annual reports and other publicly accessible financial documents for Munich's MVG, Zurich's VBZ, Vienna's Wiener Linien, Berlin's BVG, and Hamburg's Hochbahn. Data presented here are 'good faith back-of-the-envelope' based on these numbers and not necessarily reliable nor comparable. The systems reported cost recovery ratios ranging from 100% (MVG), 97% (BVG), 90% (Hochbahn) to 66% (VBZ) and 55% (Wiener Linien). Based on available revenue statistics, estimated operating costs per passenger were calculated to be SFR1.51 (VBZ), €1.09 (Hochbahn), €0.98 (Wiener Linien), €0.82 (MVG), and €0.76 (BVG). Two other efficiency indicators compare number of employees to annual passengers and revenue. Annual passengers per 1,000 employees ranged from 177 (MVG) and 133 (VBZ), 105 (Wiener Linien), 89 (Hochbahn), and 73 (BVG). Annual revenue per 1,000 employees ranged from 145 (MVG), 131 (VBZ), 88 (Hochbahn), 56 (Wiener Linien), and 54 (BVG).

timetables, disjointed physical locations of stations and stops, multiple tickets, different fare structures, or worry about timing of connections between modes and operators. Operators coordinate timetables and cooperate to assure connections between modes of transport in case of delays. All this work is invisible to customers and happens on the side of public transport suppliers who coordinate to provide public transport service with the customer in mind. Often VBs use the same branding for all vehicles in the VB—even for different operators.

Third, all VBs combine collaboration among governments, among public transport providers, and between governments and public transport agencies. In all VBs collaboration among jurisdictions is at the core of regional coordination of public transport. Municipalities, states, and regions are responsible for funding and planning local public transport. Their collaboration in planning and funding is crucial and typically entices or forces collaboration among public transport operators. Historically, Hamburg's and Munich's VBs consisted of collaboration among public transport operators (or public owners of operators), but their organizational models changed in the 1990s towards VBs made up of governments. These governments use their financial and planning powers to coordinate public transport.

Fourth, the original creation of VBs often involved one stakeholder taking the lead in enticing other stakeholders to participate—often at the (monetary) expense of the 'lead' stakeholder who absorbed the potential financial risk for other collaborators. For example, to win-over the S-Bahn to join HVV in the 1960s, the City of Hamburg agreed to help cover operating subsidies of the S-Bahn and promised help in financing capital projects. In addition, the City of Hamburg guaranteed revenues for suburban bus operators in order to convince them to join HVV. Similarly, in Vienna VOR and the federal government guaranteed revenues for small public transport agencies joining in the 1990s.

Fifth, in all cities the creation of VBs occurred during the time of major infrastructure investments (or plans for such investments). For example, in Vienna, the second phase of the U-Bahn construction was underway when VOR was founded. In Munich, new S- and U-Bahn networks were built at the time MVV was created. In Zurich the S-Bahn was constructed along with voter approval for the creation of ZVV, and in Berlin important infrastructure connections to and from West Berlin were built when or just before VBB assumed operations.

Sixth, the creation of VBs occurred from both sides: bottom-up and top-down. Austria is the only country with federal government financial help and federal mandates to create VBs. Even before the federal mandate to create VBs in each state, the Austrian federal government was involved providing major funding for VOR in Vienna—Austria's first VB. In Germany's first VB in Hamburg, the City and its public transport agency were leading the charge with the goal to compete more effectively against skyrocketing car ownership and use. Following Swiss tradition, in Zurich a public referendum sponsored the state-wide VB. In Berlin, regional transport coordination was first mentioned in the German reunification treaty between West and East German national governments and then negotiated between Berlin and Brandenburg's state governments. Lastly, in Munich local government and a federal agency (DB) came together to collaborate.

Seventh, compared to large public transport providers with many employees, VBs are small agencies with between 30 and 150 employees. VBs often rely on external government staff and experts in public transport agencies to provide input and expertise for public transport planning. In some VBs, such as Hamburg, different public transport agencies are explicitly responsible for implementing specific tasks for the VB, such as developing marketing strategies

and materials. ZVV's large public transport operators take the lead in public transport planning and coordination for sub-markets in the VB region.

Eight, main tasks of VBs are (1) ticketing, including monthly, annual and tickets for special groups (e.g. students), (2) marketing, branding and consistent messaging, (3) customer information and service, (4) drawing up and overseeing service contracts with public transport agencies, (5) quality control and tracking of quality standards set in transport service contracts with public transport providers, (6) planning of coordinated public transport services, (7) coordination and distribution of fare revenue, and in some cases (8) external consulting services.

Ninth, distribution of fare revenues among operators is handled differently in each VB. In some VBs all revenue goes to the VB and transport operators receive funding for their operation directly from local jurisdictions, based on service contracts between the jurisdiction and the public transport operator. In others, farebox revenue is distributed among public transport agencies using a combination of public transport supply and demand measures to calculate the share. Originally, several VBs only relied on measures of public transport supply to distribute revenues. However, over time VBs found that using demand measures provides an added incentive for public transport providers to increase ridership. For similar reasons, fare revenue guarantees for operators who joined a VB (which were common in Austria in the 1990s for example) were replaced with renewable (5 year) contracts that specify levels of service, quality of service, and funding.

Tenth, many VBs are responsible for controlling of public service contracts between jurisdictions and public transport providers. VBs collect information on customer satisfaction and technical service performance (on-time arrival, etc.). In some contracts (e.g. VBB and HVV) public transport providers can receive bonus payments for good performance and achievement of goals in the service contracts, as well as 'malus' payment deductions for under or non-achievement of items stipulated in the contracts. VBs play a crucial role in collecting data about service performance from customer and technical perspectives.

Eleventh, VBs proved to be innovators in many areas, particularly in ticketing. In particular, steeply discounted annual and monthly tickets have been successful at enticing residents to ride public transport. A large share of trips in each VB is made by passengers with annual or monthly tickets. Annual tickets typically provide a discount of 15 to 25% compared to monthly tickets (pay for 9 or 10 months and ride for a full year). All providers offer customers the option to pay in monthly installments for annual tickets (direct deposit from bank account). VBs also offer additional steeply discounted tickets for special populations, such as the unemployed, students, or retirees.

Twelfth, complementary government policies and plans are important to improve public transport. These include land-use policies to keep densities high enough for efficient public transport provision, dedication of rights of way and priority green lights at intersections for buses and light rail, as well as policies that make car use less attractive and more costly (such as parking restrictions or fees). In addition, between 1990 and 2012, the price per liter of gasoline more than doubled in each country. This was a result of national level tax increases, as well as an overall spike in global petroleum prices. These sharp increases in the cost of driving were greater than fare increases for public transport between 1990 and 2012 (between 50 and 110%).

4 Part 2: Regional Coordination of Public Transport in the United States

4.1 Methods

Similar to the case studies for the European systems, the analysis for the U.S. also relied on information from various types of documents including peer-reviewed academic publications, professional reports by consulting companies, reports by the national public transport association (APTA), and public transport agency annual reports, statistical publications, and presentations by public transport agency or staff. Data for the case study analysis was obtained through in-person and telephone interviews, e-mail exchanges, site visits, online searches, and archival research. Interviewees included representatives from public transport agencies, regional organizations, national public transport associations, as well as local, state, and federal governments. Public transport system data were culled from the National Transit Database (NTD).

5 Overview of United States Case Study Regions¹¹

Table 10 provides an overview of the two US case study regions analyzed in this report, including information about population size, geographic area, population density, and gross domestic product (GDP) per capita. The service area and number of residents served by transit in the Washington National Capital Region is significantly greater than in the San Francisco Bay Area. The service area of the Washington National Capital Region (2,128 km²) is 2.52 times larger than the San Francisco Bay Area (843 km²) providing service to 40% more residents (4.59 million vs. 3.28 million). The size of the core city of Washington, D.C. (158 km²) is 30% percent larger than the core city of San Francisco (121 km²), however, the number of residents within San Francisco (805,235) is 34% greater than Washington, D.C. (601,723). This difference is reflected in the 74-80% greater population densities of the San Francisco Bay Area with 1,735 more people per square km in the service area and 2,828 more people per square km in the core city area. The share of population and land in the core area versus the service area is double the size for the San Francisco Bay Area (.25 and .14) when compared to Washington National Capital Region (.13 and .07). Finally, the gross domestic product per capita in 2010 for the Washington National Capital Region (\$75,473) and the San Francisco Bay Area (\$75,080) are similar.

Region	Residents 'Service Area' (in million)	Residents 'Core City Area' (in million)	Share of Population in City vs. Region	Land Area Service Area km ²	Land Area City km ²	Share of Land Area City vs. Region	Population Density		GDP Per Capita (in \$ using PPP)
							Service Area	Core City	
Washington, D.C.	4.59	0.60	0.13	2,128	158	0.07	2,156	3,806	\$75,473
San Francisco, CA	3.28	0.81	0.25	843	121	0.14	3,891	6,633	\$75,080

Table 10. Overview of Key Characteristics of US Transit Service Areas (Source: own calculations by the authors based on data collected from the National Transit Database and US Census Bureau)

¹¹ Bureau of Economic Analysis. 2015. *Per capita real GDP by metropolitan area*. Washington, DC.
 U.S. Census Bureau. 2015. *QuickFacts: San Francisco County, California*. Suitland, MD.
 U.S. Census Bureau. 2015. *QuickFacts: Washington city, District of Columbia*. Suitland, MD.
 U.S. Department of Transportation, Federal Transit Administration. 2014. *National Transit Database*. Charlottesville, VA.

5.1 Public Transport Supply and Demand Indicators for US Case Study Regions

Table 11 below provides an initial overview of public transport supply and demand indicators for the two US case study regions for the year 2012. The Metrorail system in Washington National Capital Region and the Bay Area Rapid Transit system in the San Francisco Bay Area have similar subway networks with 170 km and 168 km of track each. These systems were founded within ten years of each other (1966 and 1957) and have followed similar construction and expansion patterns. The San Francisco Bay Area has 89 km of tramway operated by SFMTA while the Washington National Capital Region currently has zero. There are plans for a DC Streetcar system, however revenue service has been delayed. The commuter rail network is 80% larger in the Washington National Capital Region with service to West Virginia, Virginia, and Maryland. Overall, the Bay Area offers 31.4% more seat km of public transport service and 82.2% more seat km of public transport service per capita.

Region	SUPPLY INDICATORS					DEMAND	
	Route km of Service			Seat Kilometers PT Service (Billion)	Seat Kilometers PT Service per Capita	PT Trips Per Year (million)	PT Trips Per Capita
	Subway	Tramway	Commuter Rail				
Washington, D.C.	170	0	452	35	7,665	344	75
San Francisco, CA	168	89	254	46	13,964	304	93

Table 11. Overview of Key Aggregate Supply and Demand Indicators for US Transit Service Areas (Source: own calculations by the authors based on data collected from the National Transit Database and US Census Bureau)

Table 11 also examines the demand for public transport. The number of public transport trips per year in the Washington National Capital Region was 13.3% higher than in San Francisco Bay Area with four million more trips. However, when considering the number of public transport trips per capita, there were 18 more trips per inhabitant per year in the San Francisco Bay Area.

Each US region involves a large number of stakeholders in the regional coordination process. Table 12 below shows the number of coordinating agencies, public transport operators, and the number of states, counties, and cities involved. These stakeholders, with many different funding sources and obligations, collaborate on planning and funding public transport. While the San Francisco Bay Area is entirely within one state, there are numerous city and county operated transit agencies. The Washington National Capital Region includes two states, the District of Columbia, and several coordinating agencies in each state. More information on the relationships between these stakeholders is provided in the following sections.

Region	Collaborators in Transit Service Area (#)				
	States	Counties	Cities	Coordinating Agencies	PT Operators
Washington, D.C.	3	10	6	5	14
San Francisco, CA	1	9	101	3	23

Table 12. Overview of Governments and Public Transport Agencies Collaborating in US Transit Service Areas (Source: own calculations by the authors)

5.2 Financing and Organization of Public Transport in the United States¹²

Public transport in the United States is funded by a combination of federal, state, and local governments. The exact mix of public transport funding varies by state and locality. A 2008 survey of state funding for transportation, for example, found that in total states provided \$12.3 billion for transit per year while the federal government contribution totaled \$13.1 billion. Six states accounted for over three-quarter of the state funding (\$9.5 billion) and these same states also received almost half of the total federal funding¹³ (AASHTO 2010).

State and federal funding is largely derived from federal and state gasoline tax revenues, whereas local governments use a variety of methods ranging from sales tax or property tax funding to bonds, special assessment districts, and in some cases employer tax or contributions. A majority of states have restrictions or constitutional prohibitions on using state collected gasoline tax revenues to fund public transportation. The last time Congress raised the federal gasoline tax rate was 1993 and it has since remained unchanged at 18.4 cents per gallon. Federal funding is primarily limited to funding transit capital investments including maintenance, whereas transit operations are primarily funded through local resources (APTA, 2015a).

Federal transit programs are authorized in legislation by Congress with funding appropriated annually. In December 2015, a new federal transportation bill was signed into law. The Fixing America’s Surface Transportation (FAST) Act, is a five-year authorization for surface transportation programs, fully funded through September 2020. The total authorized funding for Federal Transit Administration (FTA) programs increases to \$61 billion over the life of the bill. This represents a 17.74 percent increase by FY 2020 over current levels. The

¹²Sources: US Department of Transportation, Bureau of Transportation Statistics (2010). “Survey of State Funding for Public Transportation, Final Report.” AASHTO Standing Committee on Public Transportation: Washington, DC APTA (2009). “Challenges of State and Local Funding Constraints on Transit Systems: Effects on Service, Fares, Employment and Ridership). APTA: Washington, DC.

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Washington State Department of Transportation (2009). “Transit Farebox Recovery and US and International Transit Subsidization: Synthesis.” WSDOT: Olympia, WA.

¹³ The six states with greatest funding support and transit usage are California, New York, Massachusetts, Pennsylvania, New Jersey and Maryland.

legislation also authorizes certain highway program funds for transit, bicycle and pedestrian projects (23 CFR 450.206 and 49 CFR 450.306). These funds are largely distributed through formulas established by Congress that take into account ridership, system size and age, and population size. An important exception is the discretionary federal Capital Investment Grant program used to support funding for locally-planned, implemented, and operated transit "guideway" capital investments (often referred to as "New Starts") such as light rail, commuter rail, bus rapid transit and subway system lines or extensions. The FAST Act replaces the previous federal surface transportation, MAP-21, ("Moving Ahead for Progress in the 21st Century Act," Public Law 112-141) which authorized a number of significant reforms including a new federal safety oversight role of transit systems, new asset management reporting requirements, and a new focus on performance measurement by metropolitan planning organizations, transit agencies and state departments of transportation. MAP-21 also consolidated a number of smaller highway and transit programs, including those funding disabled, elderly and low-income transit service.

The American Public Transportation Association (APTA) provides annual analysis of the National Transit Database (NTD)—a federally required database of self-reported information by transit providers on service levels, ridership, system conditions, revenues and costs. Total transit funding from all sources in 2013 was roughly \$63.74 billion with federal funding accounting for 18.6 percent (APTA, 2015a). Farebox revenues and other local directly generated funds such as advertising, debt financing and bond proceeds are the two largest sources of public transit funding with passenger fares providing 28.4% of total funding in 2013 and 35.9% of funding specifically to support transit operations. For capital investment needs, the federal government provided over 65% of funding in 2013, whereas localities provided almost 20% and states only 12.7%. Most transit systems in the United States have farebox recovery ratios between 25 and 35%.

State transportation funding in the United States has primarily focused on funding highway projects. Among the few exceptions to this trend are states included in the case studies for this paper. California, Virginia, Maryland and Washington DC are notable in the amount of funding they provide for transit capital and operations. Local funding sources remain an important source of transit revenue, and most of the increase in transit funding that has occurred recently has come in the form of higher sales taxes or bond measures approved by local voters, many as special ballots.

5.2.1 Organization of Public Transport in the United States

Federal government regulations and funding plays an important role in the planning and operations of public transportation at the state, regional and local levels. The Intermodal Surface Transportation Efficiency Act (ISTEA) was passed by Congress in 1991 and marked a notable change from past transportation policy. Among the key distinctions from past authorizations, ISTEA created a clear link between transportation and air quality with the newly created CMAQ program and new planning provisions that empowered metropolitan areas to plan and prioritize investments that achieved environmental goals.

All states and metropolitan areas are federally required to undertake a long-range comprehensive transportation planning process and to develop a fiscally-constrained plan that identifies projects to be funded. Transit agency representation is now required to be part of this process, with MAP-21 formally requiring MPOs to include representatives from transit agencies among its voting members. Additional provisions require transit riders to be part of the MPO

process. The Federal government reviews these documents, but authority is ceded to the state DOTs for approval.

Transit agencies themselves are ultimately responsible for identifying their funding needs and priorities. Federal law does not dictate how transit agencies are to be funded or structured, or that regional transit service be coordinated beyond inclusion in the long range planning process. As a result there are a variety of ways this is done. Some transit agencies are divisions of local city government, whereas in other instances the transit agency is a distinct and separate local government unit or it can be a regional authority. In a few instances, such as Maryland and Massachusetts, the state serves as the transit agency with responsibility for its operations, capital investments and planning. In many instances, there are a number of providers operating in one region each with its own service area, funding source, and operational mandate. While the MPO can facilitate regional coordination, its coordination role is limited given that its focus is on planning for new capital investments and the bulk of transit funding goes directly to transit agencies not through the MPO.

The federal government requires transit agencies (receiving federal dollars) to report a variety of data. MPOs, DOTs and transit agencies are now required to establish and track performance standards related to safety, infrastructure condition, congestion reduction, environmental sustainability and system reliability (MAP 21 §1203; 23 USC 150(b)). These new requirements are still in the process of being implemented, and the Federal Transit Administration has not yet completed its rule making. However, it is already apparent that localities and states will be required to give more priority to safety and system condition. Regions like Washington, DC and the San Francisco Bay Area which are served by “legacy” transit systems (i.e. heavy rail subway systems) face increasing funding challenges to address critical maintenance needs while also meeting public demand for improved and new service. States maintain the authority to establish state safety provisions and funding, in partnership with local transit agencies, however, FTA now plays a federal safety oversight role for public transit such as bus and light rail, while the Federal Railroad Administration has oversight of commuter rail safety. These dynamics are playing out in real time in the Washington DC region where a series of high profile accidents have plagued the Washington Metro rail system and the federal government is being asked to play a direct safety enforcement role.

Finally, most transit systems are publicly provided in the United States with the exception of employer van pools or shuttles, and some suburban express bus service. Service and funding are not dependent upon system performance or customer satisfaction. This may change somewhat as a result of new federal performance goals but their implementation will still largely be a local responsibility.

5.2.2 The San Francisco Bay Area¹⁴

5.2.2.1 Overview

The region's public transportation system is a patchwork of more than 20 operators spread across nine counties and 101 municipalities. The major transit service providers in the region are Alameda-Contra Costa Transit District (AC Transit) (est. 1956), Bay Area Rapid Transit District (BART) (est. 1957), San Francisco Municipal Transportation Agency (SFMTA Muni) (est. 1912), Peninsula Corridor Joint Powers Board (CalTrain), and the Santa Clara Valley Transportation Authority (VTA) (est. 1972). Additional transit service is provided locally by cities, counties, and various Joint Power Authorities.¹⁵

The Metropolitan Transportation Commission (MTC) was established in 1970 and is the Metropolitan Planning Organization (MPO) in the region. MTC is responsible for long-term transportation planning, financing, and coordinating for the City of San Francisco as well as the counties of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano and Sonoma County. The MTC also operates the Bay Area Toll Authority (BATA) and the Service Authority for Freeways and Expressways (SAFE). Under California law, MTC receives direct federal transportation funds. This is unique from other MPOs around the country where federal funds flow first to state transportation agencies. The Association of Bay Area Governments, established 1961, is also involved with regional planning.

5.2.2.2 The Beginnings

The earliest forms of public transport in the Bay Area were rail and streetcar service beginning in the early 1900's. CalTrain service was originally provided by private railroad companies until declining revenues led to public subsidies and later public control. In 1988, the Peninsula Corridor Joint Powers Board was formed between San Francisco, San Mateo and Santa Clara counties in order to take over the CalTrain service. The track right-of-way was later

¹⁴ Sources for this case study:

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¹⁵ This includes Altamont Commuter Express (ACE) (est. 1997), Central Contra Costa Transit Authority (County Connection) (est. 1980), Fairfield/Suisun Transit System (FAST) (est. 1990), Golden Gate Bridge, Highway & Transportation District (Golden Gate Transit) (est. 1972), Livermore-Amador Valley Transit Authority (WHEELS) (est. 1985), Marin County Transit District (Marin Transit) (est. 1964), Petaluma Transit (est. 1976), Rio Vista Delta Breeze (est. 1980), San Mateo County Transit District (SamTrans) (est. 1976), Santa Rosa Transit Division (Santa Rosa CityBus) (est. 1956), Solano County Transit (SolTrans) (est. 2010), Sonoma County Transit (est. 1971), Eastern Contra Costa Transit Authority (Tri Delta Transit) (est. 1977), Union City Transit (est. 1974), Vacaville City Coach, Napa County Transportation and Planning Agency (VINE) (est. 2000), and Western Contra Costa Transit Authority (WestCAT) (est. 1977)

purchased in 1991 from the Southern Pacific Transportation Company. Similarly, the San Francisco Municipal Railway, one of the first publicly owned transit companies in the United States, was created in 1909 and began operating streetcar service in 1912. The acquisition of United Railroads in 1944 and several other operators in 1951 contributed to the growth of the system.

The Bay Area Rapid Transit (BART) Commission was created in 1951 by the California state legislature with the task of studying long range transportation needs for the Bay Area. In 1957, the San Francisco Bay Area Rapid Transit District was established with Alameda, Contra Costa, Marin, San Francisco and San Mateo Counties and taxing powers in order to fund the system. Marin County and San Mateo County left BART prior to approval of the system due to the high costs. The system plan was approved by member jurisdictions in 1962 and construction began in 1964. The system opened in 1972 with 28 miles of track and was fully constructed in 1974 when the Transbay tube opened. The BART system was expanded in 1991 and in 2009 with service to San Francisco International Airport and Fremont financed through a combination of funds from MTC, BART, regional bridge tools, state funds, and more.

Many public transport agencies were approved by local voters. Voters in Alameda County and Contra Costa County approved the Alameda-Contra Costa Transit District in 1964, supported the issue of bonds to purchase the privately operated Key Systems bus lines in 1956 which led to the purchase of 250 additional buses and a significant expansion of service scope and frequency. AC Transit was given the power to plan, construct, and operate transit facilities including control over rates, service levels, and lines. Similarly, Marin County Transit District was approved by voters in 1964.

In 1971, the Mills-Alquist-Deddeh Act (SB 325) better known as the Transit Development Act (TDA) was passed by the California State Legislature. TDA created a statewide ¼ cent general sales tax in 1972 which feeds into a Local Transportation Fund (LTF). The TDA also created the State Transportation Fund in 1980 which is funded through diesel fuel taxes. TDA funds can be used for a variety of public transport services and bicycle and pedestrian infrastructure. Many locally provided public transport agencies including Union City Transit, SamTrans, Petaluma Transit, Tri Delta Transit, WestCAT, Rio Vista Delta Breeze, and County Connection were established in the decade following the passage of the Transit Development Act.

5.2.2.3 Regional Transit Funding & Planning

As the federally-designated MPO and state-designated regional transportation planning agency, the MTC creates a critical venue for long-range transportation planning and coordination across regions and geographies. MTC's role is largely limited to capital planning as it manages federal funds, Bay Area Toll Authority revenues, and TDA Local Transportation Fund revenues. In this role, MTC uses federal funding and planning requirements associated with developing the long-range transportation plan to bring together transit operators with other regional stakeholders. For example, MTC received a 2014 TIGER grant for a San Francisco Bay Area Core Capacity Transit Study to evaluate and prioritize short-, medium- and long-term transit investments, and strategies to address existing and forecasted transit capacity constraints in the core of the region. This study brought BART, SF Muni, AC Transit, CalTrain, and the Water Emergency Transportation Authority together. The emphasis is largely on capital planning, and the regional goals to increase transit ridership and better coordinate transportation and land use. Without formal requirements to coordinate service and operations, however, deeper coordination

on fares, customer information, and service are limited. Further, the separate revenue sources further challenge deeper coordination.

Historically in the Bay Area, each transit agency develops and submits its own plan that identifies its priority projects to MTC for inclusion into the long-range transportation plan. MTC ranks projects to include in the long-range plan, and fund in the TIP (Transportation Improvement Program). Local governments that are able to fund their own projects without the regional process, or that have a greater match can circumvent this process. The result is that transit service and expansion may not truly be fitting regional needs, but rather reflect regional ability to fund.

The Transportation 2030 Plan, Regional Transit Expansion Program, Transit Connectivity Study, and Core Capacity Study are good examples of the role MTC plays in coordination. Transportation 2030 is the regional transportation plan for the Bay Area and the Regional Transit Expansion Program is a supplement which ranked and evaluated future rail and bus projects. Financial and performance criteria including the commitment of local funding, cost-effectiveness, system connectivity, and project readiness are among the criteria projects are ranked upon. The Transit Connectivity Study examined how wayfinding, schedules, and other aspects of transit could be improved.

Transit operations are primarily funded through a combination of property taxes, sales taxes, and farebox revenue. Local funding of transit means that each jurisdiction worries that its interests will not be served if there were just one regional transit agency. The different eligibility requirements that come with different revenues are often a challenge, with local sales tax measures only able to fund local service, or only funding capital costs and not operations. Agencies offer different fare and discount systems which makes a single shared fare card system challenging. The Clipper Card (for details see below) is a first step, which MTC, is heralding in the region but still only works on a few systems each of which has a separate fare.

Regional monetary incentives are an emerging tool to incentivize coordination. The Transit Sustainability Project is a transit performance initiative which examined the costs and complexity of different public transport operators and made recommendations aimed at controlling costs and improving customer service. The project includes a goal of reducing operating costs by 5 percent. Operators that meet these objectives or who improve ridership or productivity through other means can receive money. The North Judah light rail line, operated by SFMTA, received \$3.7 million, and Muni is funding bus stop consolidation and route modification to reduce wait times and number of stops on key trunk lines.

Although MTC does not provide operational funding and is not involved with service decisions, MTC does help with fare coordination. The MTC created the Partnership Technical Advisory Committee to assist in coordination between operators, including expansion of a coordinated fare--with limited success, however. Transit service and operations between the two dozen agencies do not have a formal coordinated timetable. The BART - AC Transit Interagency Liaison Committee was established in order to encourage communication and coordination between the two agencies. With AC Transit service feeding into BART stations, this coordination could affect a large number of transfers. However, most carriers in the region are in competition with each other over revenues and ridership leading to a lack of communication. This lack of communication extends to uncoordinated changes in service.

5.2.2.4 Passes and Fares

One of the biggest problems associated with regional coordination in the Bay Area is fare coordination. Due to the large number of agencies and local funding, fares lack coordination.

Taking the bus to a BART station requires the payment of two separate fares. MTC helped launch the Translink Card, which aimed to facilitate the coordination of fares across providers in 1993—with little success due in part to technical problems. This was later replaced by the Clipper Card, a contactless farecard, which has operated mainly as an electronic payment storage card. The card can store and pay for service separately but experiments with discounts across operators have been repealed due to revenue loss. For example, the BART Plus pass offered unlimited local bus service in conjunction with BART fares for an additional \$26-28 per half month period but was discontinued as sales of the more expensive monthly AC Transit pass declined. Furthermore, BART has high farebox recovery rate and charges a distance based fare while bus operators have significantly lower farebox recovery rates and charge a flat fare. The Clipper Card can be used on 17 systems with many agencies offering separate daily, weekly, and monthly passes while offering discounts for seniors, students, and the disabled.

The number of agencies and differing fare structures in the region makes station planning and interagency cooperation difficult. Currently, the system requires riders to go through multiple turnstiles for different operators using the same card rather than one turnstile that could process fares for different systems. The platforms are also on different levels with station design often reinforcing these different systems rather than allowing for multiple providers to stop at a single platform. Even when agencies agree to coordinate, there is no standard for coordinating services requiring separate memorandum of understandings (MOU) even for the same tasks at different stations.

5.2.2.5 Customer Service

MTC, California Highway Patrol, and California Department of Transportation operate 511, a phone and web based transportation information service that provides transit information to customers. This service features schedules, fares, maps, agency profiles, alerts, advisories, and a trip planner. Real time arrivals and departures are also available for 10 operators. Beyond 511, marketing and customer service is provided individually by agencies.

Unlike other US regions, the Bay Area region lacks coordinated public transport maps and signage that allow riders to navigate across systems. A recent third party assessment of the region's transit coordination found, among other things, that multiple timetables, service maps, and disparate fare combinations challenge the ability of potential and existing riders to fully utilize the regional system.

5.2.3 Washington National Capital Region¹⁶

5.2.3.1 Overview

Regional coordination of public transport across the Washington National Capital Region involves three states, ten counties, six cities, five multijurisdictional coordinating agencies, and 14 public transport operators. The District of Columbia, a quasi-state, is bordered by the state of Maryland to the north and east and the state of Virginia to the south and west. The major public transport agency in the region is the Washington Metropolitan Area Transit Authority (WMATA) which is an interstate compact agency providing service to the District of Columbia, Montgomery County and Prince George’s County in Maryland, and the cities of Alexandria, Falls Church, and Fairfax and the counties of Arlington, Fairfax, and Loudoun in Virginia. WMATA was created in 1966 to plan, develop, finance, and operate a comprehensive mass transit system for the metropolitan area.

		Board Membership				
		Cities	Counties	State	Federal	Other
Agency	PRTC	Fredericksburg (1), Manassas (1), Manassas Park (1)	Prince William (6), Stafford (2), Spotsylvania (2)	Virginia General Assembly (3), Virginia Department of Rail and Public Transportation (1)		
	NVTC	Fairfax (1), Falls Church (1), Alexandria (2)	Fairfax (5), Loudoun (1), Arlington (3)	Secretary of Transportation Designee (1), General Assembly Members (6)		
	WMATA			Maryland (2), Virginia (2), Council of the District of Columbia (2)	Administrator of General Services (2)	
	WSTC		Montgomery County Executive Delegate (2), Prince George’s County Executive Delegate (2)	Governor Appointed member from Montgomery County (1), Governor Appointed member from Prince George’s County (1)		Ex officio member (1)
	NVTA	Alexandria (1), Fairfax (1), Falls Church (1), Manassas (1), Manassas Park (1)	Arlington (1), Fairfax (1), Loudoun (1), Prince William (1)	Members of the House of Delegates (2), Member of Senate (1), Citizens appointed by the Governor (2), Director of the Virginia Department of Rail and Public Transportation (1), Commonwealth Transportation Commissioner (1)		NVTA selected chief elected officer (1)

Table 13. Board Membership of Washington National Capital Region Transit Agencies
(Source: based on data collected directly from transit agencies)

Public transit coordination and financial management for jurisdictions in Virginia is primarily handled by the Northern Virginia Transportation Commission (NVTC) (est. 1964) and

¹⁶ Maryland Transit Administration. *History of the MARC Train*. Baltimore, MD.

Northern Virginia Transportation Commission. 2014. *Celebrating 50 Years of Transit Innovation*. Arlington, VA.

Taube, R. 2008. *Chronology of the Virginia Railway Express: 1964 to Present*. Alexandria, VA.

Washington Area Metropolitan Transit Authority. 2011. *FY2012 Preliminary Subsidy Calculation*. Washington, D.C.

Washington Area Metropolitan Transit Authority. 2014. *Gaining Momentum: FY2015 Approved Budget*. Washington, D.C.

Washington Area Metropolitan Transit Authority. 2009. *Metro History*. Washington, D.C.

Washington Area Metropolitan Transit Authority. 1997. *Report of the Regional Mobility Panel on the Current and Future Bus Transportation Needs for the Washington Region*. Washington, D.C.

Washington Area Metropolitan Transit Authority. 2015. *Tariff of the Washington Metropolitan Area Transit Authority on Metro Operations within the Washington Metropolitan Area*. Washington, D.C.

the Potomac & Rappahannock Transportation Commission (PRTC) (est. 1986). In Maryland, transit coordination is done primarily by the Washington Suburban Transit Commission (WSTC) (est. 1965) which administers the Washington Suburban Transit District (WSTD) with the Maryland Department of Transportation. NVTC, WSTC, the Council of the District of Columbia, and the Administrator of General Services on behalf of the federal government each elect two members to the WMATA Board. The National Capital Region Transportation Planning Board (TPB) (est. 1965) is the Metropolitan Planning Organization (MPO) for the Washington, D.C. area. The TPB is housed within the Metropolitan Washington Council of Governments (MWCOG) (est. 1957) and is responsible for long range transportation planning (including public transport) in the region, ensuring compliance with federal laws, and providing a forum for policy and coordination. The Northern Virginia Transportation Authority (est. 2002) is also involved in long-range transportation planning for several jurisdictions in Virginia.

5.2.3.2 The Beginnings

A 1954 joint-commission between Virginia, Maryland, and Washington, DC first studied the need for a passenger transport system in metropolitan Washington. The National Capital Transportation Agency (est. 1960) drafted the first proposal for an underground metrorail system until the agency was replaced by WMATA in 1966. In early 1968, the WMATA Board, consisting of 8 voting and 8 alternate directors appointed equally by Virginia, Maryland, Washington DC and the federal government, approved a 97.2-mile regional metrorail plan which was extended to 103-miles in 1984. Construction of the system began in 1968 and the system officially opened in March of 1976 with service within Washington, D.C. from Rhode Island Avenue to Farragut North. NVTC, WSTC, and District of Columbia Government coordinated with WMATA to plan and implement the entire Metro System plan.

Construction of the Metrorail system continued and the full 103-mile 83 station system was completely open in 2001. The popularity of the Metrorail system led to extended service hours. Hours were first extended from 8:00 PM to midnight on weekdays in 1978 and then Saturdays from 8:00 AM to midnight. Sunday service would be added the following year from 10:00 AM to 6:00 PM.

Originally WMATA only provided rail service but in 1973, it purchased D.C. Transit, Inc, WV&M Coach Co., AB&W Transit Co., and WMA Transit Co. in order to create the regional Metrobus system. The acquisition of these companies was seen as a necessary step in order to provide reliable and coordinated service to and from metro stations throughout the region. The creation of the Metrobus system included the coordination of rates across previously separate carriers, the elimination of transfer charges, and the branding of buses with red, white, and blue. NVTC had until this point coordinated transit fares, service levels, and routes only in Virginia but reached an agreement with WMATA that guaranteed NVTC's participation in determining these characteristics for the broader system. This partnership resulted in a new bus fare structure which lowered off-peak fares.

5.2.3.3 Commuter Rail

Local commuter rail service in Maryland was provided by private railroad companies until 1974. Since then the State of Maryland first provided subsidies for vehicles and operating deficits and then finally assumed operations. The Maryland Rail Commuter (MARC) Service currently connects the District of Columbia with Martinsburg, West Virginia and Perryville, Maryland and is operated by CSX and Amtrak. In the early 1980s, NVTC and PRTC collaborated to establish the Virginia-based commuter rail service known as the Virginia

Railway Express (VRE). VRE service began in 1992 with two lines running from Manassas and Fredericksburg to Union Station on CSX track.

5.2.3.4 Regional Bus

The Metrobus system has faced many problems throughout its early tenure including uncoordinated service due partially to an outdated cost allocation formula based on the difference between revenues and costs attributed to each jurisdiction. As a result of this formula, fare simplification and service changes disproportionately affected the revenues and costs allocated to each individual jurisdiction leading to the prioritization of local revenue impacts over benefits to the regional transit system. Additionally, Metrobus has a competitive disadvantage compared to local providers due to the higher average wage rates, wage progression, and benefits associated with the larger size of the Metrobus organization. Subsequently, Metrobus service declined from 99% of bus service miles in 1977 to only 74% of bus service miles by 1996. Locally provided bus service includes Montgomery County's Ride-On Bus (est. 1975), Alexandria's DASH (est. 1984), Fairfax County's Connector (est. 1985), Arlington County's ART Bus (est. 1998), and PRTC's OmniRide (est. 1995). In addition, several suburban jurisdictions provide commuter services during rush hour that offer limited, express bus service into the District. In 1997, the WMATA Board appointed Regional Mobility Panel determined that WMATA should plan and operate regional bus service with coordination from all local jurisdictions similar to the provision of Metrorail service. Once these recommendations were approved in 1998, regional bus service and non-regional bus service were planned differently. Regional service is determined by the WMATA board and subsidies are calculated based upon density weighted population, revenue hours by jurisdiction, revenue miles by jurisdictions, and ridership by jurisdiction of residence. Subsidies for non-regional bus service equal to the marginal cost of operating each route minus the revenue of that route are paid directly by the jurisdiction which requested service.

5.2.3.5 Silver Line, DC Circulator, 8 Car Trains

The 103-mile Metro Rail System was completed in 2001. In 2002, the WMATA Board approved extending Metro Rail 23 miles to service Dulles International Airport. The first phase of the "Silver Line," serving Tysons Corner and Reston, opened in 2014. In 2004, the systems only infill station, New York Ave-Florida Ave-Gallaudet University, officially opened while a month later the Largo Town Center and Morgan Boulevard stations opened marking the first expansion of the initial system. In 2005, the DC Circulator, an intra-city bus network aimed at providing frequent circulation service between major destinations, launched through collaboration between WMATA, DC Surface Transit, and the District Department of Transportation. This system now has a fleet of 67 buses with over 130 stops.

5.2.3.6 Funding & Planning

WMATA is primarily funded through state and local contributions from WMATA Compact members, although the source of funding between states varies greatly. In Maryland, funding contributions to WMATA come entirely from state coffers through the Maryland Transportation Trust Fund while contributions from Virginia come directly from local jurisdictions and are supplemented by state funds. For the FY 2015 budget, state and local contributes to Metrorail and Metrobus operations by the District of Columbia accounted for 39.22% while Maryland contributed 34.26% and Virginia contributes 26.52%. The lack of dedicated funding, rising labor costs and maintenance costs for WMATA and the reliance on

annual state contributions has led to budget conflicts and the growth of more cost-effective and locally-responsive bus service by individual jurisdictions. The majority of capital funding comes from federal formula grants and competitive grants. In FY 2015, 49.41% of capital funding originated from the federal government, 38.49% originated from state and local funding sources, and the remaining 12.11% originated from financing, Metro 2025 investment, and other sources.

The major long-range transportation planning actors in the D.C. Metropolitan area are the Northern Virginia Transportation Commission (NVTC), Northern Virginia Transportation Authority (NVTA), and the National Region Capital Transportation Planning Board (TPB). The NVTC manages state assistance, SmarTrip Card revenues, federal funding on behalf of member jurisdictions, and a 2.1% Virginia gas tax which helps fund WMATA. In addition to acting as a financial manager, NVTC also provides a forum for member jurisdictions to reach consensus on key transit issues and negotiates directly with WMATA.

The NVTA has the authority to raise taxes on member jurisdictions as authorized by Virginia state legislation (HB 2313). These taxes can pay for regional roadways and regional transit projects with the requirement that 70 percent be spent regionally while 30 percent must be spent on projects benefiting the local jurisdiction where the tax was raised. Issues arise, for example, as buses purchased with this funding must stay within Virginia or the local jurisdictions where taxes originated from. With the NVTA's focus on long-range transportation planning, it plays a similar transit-planning role as a Metropolitan Planning Organization although it technically is not a MPO. The official MPO for the area is the TPB. The TPB plays a prominent role in convening jurisdictions from Maryland, Virginia, and Washington, D.C. to build consensus regarding regional capital investments. However, the TPB does not directly control funding. Instead, the three DOTs control federal and state funds. This limits the TPB from playing a larger role beyond compiling long-range projects submitted by member jurisdictions.

5.2.3.7 Passes and Fares

The Metro System was one of the first adopter of farecards in the U.S. During the first year of operation, the system used exact change fareboxes which were replaced in 1977 with automatic fare collection systems and paper farecards. In 1995, a new vending system and smart farecard known as Go Card debuted in the Metro System. This payment system allowed for the purchase of passes and multiple fare cards. Four years later in 1999, WMATA made the purchase of fares and passes available online while also launching a contactless smart farecard known as SmarTrip. This coincided with a simplification of Metrobus prices to include free transfers between buses, a \$0.25 transfer from Metro Rail, and the introduction of all day passes. Despite these simplifications, SmarTrip technology was not be available on all buses until 2004. In 2001, NVTC led an effort to pilot the use of SmarTrip cards on Northern Virginia buses which was later implemented system wide. VRE, MARC, and MTA offer Transit Link Cards which provide unlimited Metrorail, Metrobus, commuter bus, and commuter rail service via paper farecards and SmarTrip cards on a monthly basis. For VRE and MARC, the cost of a Transit Link Card is the cost of a monthly pass plus an additional \$111. There were several fare increases during the 2000s including in 2003, 2004, and 2008. The increase in 2008 included Metrobus discounts for using SmarTrip cards. In 2009, paper transfers on Metrobus were discontinued and transfer times for individual tickets were extended from two hours to three hours. A \$1 surcharge per trip for using paper farecards was also added although Metro plans to completely eliminate paper farecards by 2016.

5.2.3.8 Customer Service

The region’s first computerized fare calculator launched in 1985 and schedules for all providers were available electronically by 2003. The WMATA Trip Planner provides multiple trip itineraries complete with directions, fare costs, and rail alerts. WMATA also offers a savings calculator, mobile alerts, and provides real time arrival information for buses and trains. Arlington County Commuter Services, the largest commuter service organization in the country, plays a key role in trip planning as it conducts transit outreach and operates commuter stores where fares, passes, maps, and schedules for all modes are available. As previously mentioned, the SmarTrip card works on all buses in the region and the Metro system helping to create seamless experience. VRE Mobile allows passengers to purchase tickets and passes using a smart phone. WMATA is experimenting with a new payment technology which would allow smart phones and contactless credit cards to be used.

5.3 Comparison of Recent Trends in Public Transport Demand, Supply, Finance and Ticketing between 1990 and 2012¹⁷

5.3.1 Trend in Public Transport Demand 1991 to 2010

Tables 14a and 14b present trends in public transport demand in the San Francisco Bay Area and Washington National Capital Region between 1991 and 2010 in terms of total passenger trips per year and passenger trips per capita. While ridership has increased in both US regions, the Washington National Capital Region experienced much greater growth. Annual ridership in the Washington National Capital Region increased by over 69 million trips (+26%) while ridership in the San Francisco Bay Area increased by less than 3 million (+1%). Despite the greater growth in terms of total ridership in the Washington National Capital Region, public transport trips per capita per year actually decreased by 7 trips since 1991. An increase of 1.2 million residents in the Washington National Capital Region from 1990 – 2010 (+36.4%) may explain the declining per capita ridership. Alternatively, population in San Francisco Bay Area declined by 348,000 residents from 1990 – 2010 (-9.6%) and corresponded with a 12% growth in annual per capita ridership.

Region	1991	1995	2000	2005	2010	Change '91-'10
Washington, DC	268	262	270	327	337	1.26
San Francisco, CA	293	275	297	291	296	1.01

Table 14a. Trend in Public Transportation Passengers per Year, 1991 -2012 (in million)¹⁸

¹⁷ Demographia. 2014. *Urban Areas in the United States: 1950 to 2010 Principal Urban Areas in Metropolitan Areas Over 1,000,000 Population in 2010*. Belleville, IL.

U.S. Census Bureau. 2002. *Qualifying Urban Areas for Census 2000; Notice*. Suitland, MD.

U.S. Department of Transportation, Federal Transit Administration. 2014. *National Transit Database*. Charlottesville, VA.

¹⁸ Unlinked passenger trips have been converted to linked passenger trips by multiplying by a factor of 0.7 as suggested in Polzin & Chu, 2003

Region	1991	2000	2010	Change '91-'10
Washington, DC	80	69	73	0.92
San Francisco, CA	81	99	90	1.12

Table 14b. Trend in Public Transportation Passengers per Person per Year, 1990 -2014
(Source: own calculations by the authors based on data collected from the National Transit Database and US Census Bureau)

5.3.2 Trend in Public Transport Supply 1990 to 2012

5.3.2.1 Trend in Supply by Mode 1990 to 2012

Both seat kilometers of service by mode and total network kilometers by mode provide more detailed information on the supply of transport offered in each US region. Table 15a and 15b show the available supply indicators for subway, regional rail, tramway, and bus service. Table 15a shows that seat kilometers of service have grown in each region. Seat kilometers of subway service in the Washington National Capital Region (+87%) and San Francisco Bay Area (+44%) reflect system growth as well as service upgrades such as running eight car trains instead of six car trains. Regional rail service has also grown in the Washington National Capital Region (+45%) and the San Francisco Bay Area (+41%). While there is currently no existing tramway service in the Washington National Capital Region, service has increased 40% in the San Francisco Bay Area. Finally, bus service has increased only slightly in the San Francisco Bay Area (+1%) while service has quadrupled in the Washington National Capital Region reflecting the increase in locally provided bus service.

Region	1993	2000	2012	Change '93-'12
Washington, D.C.	4,294	5,644	8,027	1.87
San Francisco	4,716	6,311	6,801	1.44

Trend in Public Transportation Seat Kilometers of Subway Service per Year, 1993 -2012 (in million)

Region	1993	2000	2012	Change '93-'12
Washington, D.C.	1,804	1,995	2,618	1.45
San Francisco	806	968	1,135	1.41

Trend in Public Transportation Seat Kilometers of Regional Rail Service per Year, 1993 - 2012 (in million)

Region	1993	2000	2012	Change '93-'12
Washington, D.C.	n.a.	n.a.	n.a.	n.a.
San Francisco	2,623	2,636	3,682	1.40

Trend in Public Transportation Seat Kilometers of Trolley Service per Year, 1993 -2012 (in million).

Region	1993	2000	2012	Change '93-'12
Washington, D.C.	13,780	27,547	56,354	4.09
San Francisco	26,702	31,896	26,837	1.01

Trend in Public Transportation Seat Kilometers of Bus Service per Year, 1993 -2012 (in million)

Table 15a. Trend in Seat Kilometers of Public Transport Service by Mode, 1993-2012
(Source: own calculations by the authors based on data collected from the National Transit Database)

Table 15b presents the total length of each network by mode. The total length of subway track has increased by 45 km (+36%) in the Washington National Capital Region and by 54 km (+47%) in the San Francisco Bay Area. The regional rail network grew 22 km (+7%) in the Washington National Capital Region and 178 km (+236%) in the San Francisco Bay Area due to a tripling of track from 1992 to 1993 when the Peninsula Corridor Joint Powers Board purchased 178 km of track from the Southern Pacific Transportation Company. Again, there is currently no tramway in the Washington National Capital Region but the total kilometers of track in the San Francisco Bay Area grew 42 km (+89%). Finally, the bus network has grown by only 299 km (8%) in the San Francisco Bay Area but has grown by 3,127 kilometers (+106%) in the Washington National Capital Region.

Region	1991	2000	2012	Change '91-'12
Washington, D.C.	126	156	170	1.36
San Francisco, CA	114	153	168	1.47

Trend in Kilometers of Subway Network per Year, 1991 -2012 (in million)

Region	1991	2000	2012	Change '91-'12
Washington, D.C.	300	300	322	1.07
San Francisco, CA	75	266	254	3.36

Trend in Kilometers of Regional Rail Network per Year, 1991 -2012 (in million)

Region	1991	2000	2012	Change '91-'12
Washington, D.C.	n.a.	n.a.	n.a.	n.a.
San Francisco, CA	47	63	89	1.89

Trend in Kilometers of Tramway Network per Year, 1991 -2012 (in million)

Region	1991	2000	2012	Change '91-'12
Washington, D.C.	2,958	4,382	6,085	2.06
San Francisco, CA	3,005	3,347	3,233	1.08

Trend in Kilometers of Bus Network per Year, 1991 -2012 (in million)

Table 15b. Trend in Route Kilometers of Public Transport Service by Mode, 1991-2012
(Source: own calculations by the authors based on data collected from the National Transit Database)

5.3.3 Trend in Public Transport Revenue from 2002 to 2012

Table 16a and 16b below present revenue data for the Washington National Capital Region and San Francisco Bay Area. The National Transit Database began collecting revenue data in 2002, so data prior to this are unavailable. Since 2002, total revenue has increased \$328 million in the Washington National Capital Region (+70%) and \$279 million in the San Francisco Bay Area (+61%). With the exception of a brief decline from 2002 to 2003, revenues have increased annually since 2002 in both US regions. Table 16b shows that revenues per passenger have increased by \$0.80 in the Washington National Capital Region (+51%) and by \$0.93 in San Francisco (+63%).

Region	2002	2005	2010	2012	Change '02-'12
Washington, D.C.	\$470.33	\$519.03	\$668.68	\$799.13	1.70
San Francisco, CA	\$455.04	\$460.29	\$660.94	\$734.01	1.61

Table 16a. Trend in Revenue (in million US Dollars), 2002 -2012

Region	2002	2005	2010	2012	Change '02-'12
Washington, D.C.	\$1.57	\$1.61	\$2.02	\$2.36	1.51
San Francisco, CA	\$1.49	\$1.58	\$2.23	\$2.42	1.63

Table 16b. Trend in Revenue per Passenger, 2002 -2012 (Linked Trips)¹⁹ (Source: own calculations by the authors based on data collected from the National Transit Database)

5.3.4 Trend in Public Transport Expenses from 1991 to 2012

Table 17 below lists the total operating expenses for each region. Operating expenses have increased by \$1.14 billion in the Washington National Capital Region (+194%) and by \$1.1 billion in the San Francisco Bay Area (+177%) from 1991 to 2012. Operating expenses increased in every year since 1991 except for a decrease of \$14.1 million from 2010 to 2011 in the San Francisco Bay Area and a decrease of \$39.3 million from 1996 to 1997 in the Washington National Capital Region. From 1991 to 2012, operating expenses increased over \$100 million annually three times for each region.

Region	1991	1995	2000	2005	2010	2012	Change '91-'12
Washington, D.C.	\$588	\$706	\$807	\$1,187	\$1,632	\$1,730	2.94
San Francisco, CA	\$625	\$777	\$1,045	\$1,337	\$1,668	\$1,727	2.77

Table 17. Trend in Operating Expenses (in million US Dollars), 1991 -2012 (Source: own calculations by the authors based on data collected from the National Transit Database)

5.3.5 Trend in Public Transport Farebox Recovery Ratio from 2002 to 2012

Table 18 lists the farebox recovery ratio (total farebox revenue divided by total operating expenses) for each region. The farebox recovery ratio has decreased by 8% in the Washington National Capital Region and increased by 13% in the San Francisco Bay Area Region. However, the farebox recovery ratio is currently lower in the San Francisco Bay Area Region and reached a minimum in 2003 (.31) and a maximum in 2012 (.42). The Washington National Capital Region reached a minimum in 2007 (.39) and a maximum in 2002 (.50).

Region	2002	2005	2010	2012	Change '02-'12
Washington, D.C.	0.50	0.44	0.41	0.46	0.92
San Francisco, CA	0.38	0.34	0.40	0.42	1.13

Table 18. Trend in Farebox Recovery Ratio, 2002 -2012 (Source: own calculations by the authors based on data collected from the National Transit Database)

¹⁹ Unlinked passenger trips have been converted to linked passenger trips by multiplying by a factor of 0.7 as suggested in Polzin & Chu, 2003.

5.4 Summary of US Case Studies

Several similarities are apparent between the Bay Area and National Capital regions in terms of regional transit coordination, investment trends, and customer service:

First, the regional rail systems in both regions were created at roughly the same time in the mid-1960s in response to the financial decline of private transit operators. Federal investment comprised a significant portion of the funds used to build the regional rail systems in both. Many of the local private operators became public providers through the 1980s in order to provide continued bus service. Today, both BART and WMATA Metrorail face significant maintenance needs and core capacity constraints that are creating new impetus for improved regional coordination to address public safety, service and performance.

Second, public transit funding is split between different government levels (federal, state, local) but regional coordination requirements are largely limited to only the federal portion of funding. Further, these requirements are focused on metropolitan long-range transportation planning to support capital investments. Transit operations and customer experience are left largely to local transit agencies to determine.

Third, farebox revenue is not sufficient to meet operating needs so transit operators are heavily reliant upon government funding sources. While regional transit agencies exist in both case studies that are funded through a mix of state, local and federal funds the majority of local transit operators are dependent upon local government subsidy. This reliance on local funding inhibits regional coordination or consolidation in that many of have specific requirements limiting what can be funded (i.e. type of transit service, or geography of the service area) and how funding can be used (i.e. capital or operations). Federal transit funding does not go through local jurisdictions but directly to agencies.

Fourth, transit operators determine funding needs and priorities which are then incorporated into regional long-range transportation plans. The new federal requirements for enhanced transit safety, asset management and performance measurement are creating important new venues for regional collaboration across governments and between transit providers.

Fifth, fare coordination is evolving but limited. In the Bay Area, the MTC has played a critical role in advancing fare coordination through the Clipper Card. In the National Capital Region, WMATA's early innovation with fare coordination now creates a backbone for coordination across bus and other transit providers. Electronic farecard technology is the primary customer service tool used by transit operators. In both regions, transit providers are providing data that is being used by private developers to create new mobile apps and online services to support a more seamless travel experience.

Sixth, in both case study regions there are many government agencies involved with regional planning and transportation including agencies such as MTC and ABAG in the Bay Area, and MWCOG, NVTC, WTSC and others in the National Capital Region. This redundancy at the regional level further challenges coordination with planning, revenue and capital investment authorities unevenly distributed across these agencies.

6 Overall Conclusions and Lessons

Many differences are apparent between the US and European case studies detailed in this report ranging from how transit service is planned, funded, and provided to the role of regional agencies in coordination of fares, service, and capital investment needs. Individual lessons from the European and US case studies are provided in sections 3.5 and 5.4 above. Overall, US case

study systems have smaller transit coverage, less frequent service, and much lower total and per capita demand than seen in European systems. Farebox recovery ratios are lower in the US systems reflecting higher ridership levels and other system efficiencies in the European case studies. At the same time, however, there are interesting similarities including the myriad of providers, governmental agencies, and funding sources involved in both European and US examples. Further, in all countries funding from federal government is important, even though it is not the dominant funder. Other key similarities and differences observed across the case studies can be organized by funding structures, planning structures, marketing and branding:

6.1 Funding Structures

Funding of European and American case study transit systems include the interaction of federal, state, and local levels of governments. In the 1960s transit ridership was declining in both European and American cities and governments stepped in to reform urban transit systems that were struggling financially.

In the United States, the federal transit program was established and cities took over private transit companies or amalgamated them into regional transit authorities. Today, funding for transit operations in urban areas primarily comes from local revenues. Federal funds are generally only available for capital investments either for new service, vehicles and facilities, or to improve the state of good repair. Local funding is critical, but reinforces parochialism and makes regional coordination of service, fares, and marketing a challenge. A potential limitation for US systems may be that the majority of federal transit funding flows directly to transit agencies and not through local or regional governments. This may reduce the willingness of agencies to innovate or take risks. The European experience suggests there may be benefits from moving towards a model where local government assumes this risk and guarantees revenues, but requires agencies to collaborate.

Public transport systems in the European case studies have a longer history of local public ownership. In the European case studies, in general, states and local governments fund public transport operations. Federal governments provide operating funds for regional rail services directly or to the states. Federal, state, and local governments fund capital investments. In stark contrast to the US, federal governments in Germany, Austria, and Switzerland have a longer history of providing regional rail service—typically running on tracks provided by federal governments for (federal) intercity rail. In some case study regions the federal government has also funded and operated separate regional S-Bahn services. Federal governments also provide funds for (significant) public transport capital investments (such as the Zurich or Munich's S-Bahn). Austria's federal government helped fund Vienna's U-Bahn and was an important stakeholder in the country's first VB in the Vienna region. Moreover, the Austrian federal government provides funding for regional coordination and lost fare revenue for transit agencies that join VBs. Federal ownership and funding for regional rail and S-Bahn can also be problematic for regional coordination, as seen in the case of Germany's first VB in Hamburg, where German railways was initially unwilling to participate. Similarly, there have been issues with Vienna's S-Bahn, owned by the Austrian federal government, in terms of modernizing vehicles, upgrading service and even integrating U-Bahn and S-Bahn maps.

6.2 Planning Structures

In general, regional public transport organizations in both Europe and America are small and have specific planning authorities and areas of focus. The MTC in the Bay Area is an

exception to this rule as it has fiscal authorities associated with transportation and tolling revenues. In the United States, regional agencies play an important planning function and MPOs are authorized through federal legislation to conduct long-range transport planning and develop an annual metropolitan transportation investment program. At the same time, however, the two American case study regions both had numerous other regional entities that were simultaneously involved in transportation funding and planning. In the US, regional collaboration is most dominantly focused on capital planning through the MPO process, whereas planning coordination on transit service and operation funding needs is much more limited and largely the domain of individual transit providers.

Most VBs in the European case studies have small staff and a specific set of responsibilities related to transit coordination. In the European case studies, local and state governments were key to regional coordination of public transport. The two oldest VBs, in Hamburg and Munich, were initially founded as associations of owners of public transport providers, but in the 1990s both VBs were reformed to transfer leadership to local jurisdictions that fund public transport operation and coordinate capital investments. The jurisdictions' collaboration in VBs requires public transport agencies to work together. Jurisdictions outline their desired levels of public transport service and coordination, as well as a budget. Public transport agencies and jurisdictions then collaborate to finalize public transport service for the region within the given budget. The power of local and state jurisdictions to require regional coordination is important in creating VBs—as is the local jurisdictions' ability to potentially absorb revenue losses of individual public transport agencies that join VBs.

6.3 Champions that Promote Coordination

In most European case studies a government entity served as champion for the creation of the VB. In Hamburg, the City of Hamburg agreed to pay for operating deficits of German Federal Railways' S-Bahn and even guaranteed farebox revenues for bus operators joining the VB from neighboring states. In Austria the federal government participated financially in the creation of the Vienna VB. Today Austria's government provides federal funds for regional coordination and lost farebox revenue due to regional collaboration. Zurich state covered initial farebox revenue losses for small bus operators. In all cases, public transport agencies alone would not have participated in the VBs. It was pressure by governments combined with funding guarantees that enticed transit providers to participate. Left to their own devices many public transport agencies may have focused on their own revenues and even viewed other providers as competitors rather than potential collaborators.

In the two US case studies, the role of the MPO in coordinating regional transit capital needs and connecting transit to the broader transportation system through long-range planning is critical to the transit expansion that has occurred in both regions. In the Washington Capital Region sub-regional agencies such as NVTC have also emerged to play a critical role in championing collaboration – both formal and informal. While US systems are coordinating on fare collection, capital investments, and data sharing they fall behind their European counterparts on revenue sharing, steeply discounted monthly and annual tickets, unified branding, integration of public transport service, and timetable coordination. Given the significant growth in ridership and farebox recovery seen in the European case studies, it appears that coordination itself—especially on the elements that strongly influence the customer experience—may help transit be seen as a viable option compared to commuting by automobile.

6.4 Marketing, branding, and service provision with customer in mind in European cities

All European case studies show a clear desire of VBs to compete with the car. Munich's slogan 'one ticket, one timetable, one network' displays the idea of an easy to use, convenient, and customer oriented public transport system. This approach includes an entire gamut of activities including branding of vehicles and innovative marketing campaigns. A key part of this 'competition' with the automobile are steeply discounted annual and monthly tickets—often with a multitude of options for different groups, such as student tickets, employer sponsored tickets, senior or off-peak tickets, or special tickets for the unemployed. Once such a monthly or annual ticket is bought marginal cost of individual public transport trips are 0—similar to a driver's perception when getting into a car—which was paid for, insured, registered, and fill-up with gas prior to the seemingly free car trip. In addition VB's coordinate timetables to guarantee connections and minimize wait times—reducing the uncertainty about public transport trip duration and transfers.

Coordinated fare collection in the US is challenged given the myriad of revenue sources and service requirements. This undermines the ability to share revenues or coordinate transit service, especially among transit agencies who receive funding directly. The US case studies examined, and most transit agencies in the country, do not offer special discounted fares beyond reduced fares for seniors, or offer annual passes. Some regions including San Francisco are starting to explore special fares or reduced ticketing for low-income riders including youth, but this experience is limited. Marketing and branding budgets for transit agencies are limited. In Arlington, VA a combination of local, state and federal funding is used to more broadly market the benefits of transit and support commuter programs.

6.5 Lessons: How to Promote Regional Coordination

Regions in both European and US case studies have the shared goal to increase ridership and revenues. However European examples have been more successful. The US has tried to achieve increased ridership through increased capital investment and expanded service. The European examples also invested heavily in new infrastructure, but the success in growing ridership and revenues appears to also be strongly influenced by their increased focus on intentional regional coordination through VBs and greater attention to the quality of the customer experience including ticketing, guaranteed connections, and branding of services.

Fare coordination requires a regional agency with authority and capacity to bring together different providers. In the European examples this role is played by local jurisdictions through the VB, whereas in the US examples the MPO plays this role, albeit in a more limited role than seen internationally.

The MPO process provides an important starting point in US for improved transit coordination. The US Department of Transportation is encouraging MPOs to play a more active role in facilitating transit coordination through the planning process, but also in terms of data sharing. The MPO structure can provide a critical venue for considering these issues as it brings together both technical expertise and involvement by a large number of regional stakeholders including elected officials, transit riders and transportation providers.

In addition, European VB's have received help from the much higher cost of driving in Europe. Even if US public transport would provide a level of service similar to the European VBs in this analysis, low gasoline prices, ample and often free car parking, as well as large

supplies of roadway capacity make it more difficult for public transport in the US to compete with the car.

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